

First Generation Learners and Lifestyle Correlates of Anaemic spectrum among Adolescent Girls in Madurai, Tamil Nadu, India: A Sustainable Development Approach

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Abstract- Millions of individuals annually are affected by anaemia due to nutritional deficiency. In particular, adolescent girls experience rapid physiological changes that necessitate specific nutritional requirements. When the needs of the body are ignored, anaemia may ensue, leading to diminished concentration and reduced physical and mental capacity, which can subsequently impact educational attainment and future maternal health. Several studies have reported that nutrient deficiencies, parental education and income as separate determinants of anaemia, isolating biological parameters from others especially in first generation learners creating a gap by overlooking how these factors directly shape the diet and nutritional intake which ultimately leads to micronutrient deficiency in adolescent girls. This study presents an integrated perspective that links all three aspects, and studies the prevalence of anaemia among adolescent girls residing in rural and semi-urban Madurai, Tamil Nadu, India. The primary data was collected from 423 adolescent girls aged 17 to 19, the outcome variable was anaemia, and the explanatory variable were age, BMI, haemoglobin count, parental education, mother's occupation, household income, siblings, locality, disease history, market distance or shop distance, and family type. Descriptive statistics was used to obtain preliminary results, and independent sample t-test was used to obtain the significance between two different groups. Among the adolescent girls 17.5 % were normal ($Hb \geq 12.0$ g/dL), 32.4 % were mildly anaemic (11.0 – 11.9 g/dL), majority of 44.7 % were moderately anaemic (8.0 – 10.9 g/dL), and 5.4 % come under severely anaemic category (< 8.0 g/dL). Among the variable, girls who have regular healthy diet with fruits and vegetables are less prone to anaemia compared to those have not consumed. This change in diet is influenced by parental education and household income, which showed statistically significant results. The potential reasons for poor nutrient intake in our study are attributed to low parental education as it affects nutritional choices and dietary intake, the income level of the parents acts as an economic barrier which directly impacts the access to nutrient rich food which is important to tackle anaemia.

Keywords- Anaemia, Adolescent, Micronutrient, Education.

I. Introduction

The world's most common public health problem is anaemia. 43% of children, 38% of pregnant women and 29% women in reproductive age are affected by anaemia globally. The factors that are most important causes of anaemia include nutrition, infection, chronic disease and genetic disorders (Stevens et al., 2013). Across the globe almost 2

billion people are affected by anaemia, and among this population half of them are affected by iron deficiency anaemia (Sharma et al., 2022). Abu-Baker et al., (2021) has also noted that the effects of anaemia also affect the production of neurotransmitters that are chemical messenger at the synapse, delaying brain development or developmental delay, children learn slower than expected which impacts cognitive processing in adolescents.

Certain cultures and societal aspects, psychological elements and perceptions about healthy diet also tend to influence the food choices of people, which is complex. The knowledge about food and nutrition, which gives the ability for the individual to use the nutrition information to make healthy food choices lacks in adolescents and paves way for the prevalence of anaemia (Kant et al., 2019). Consuming ultra processed foods, fast foods, carbonated drinks and refined foods, where the shift prioritizes quick meals that is driven by globalization and convenience have replaced traditional foods like vegetables and fruits that are important sources of iron and other important micronutrients and negatively impacts societal well-being (Amarnath et al., 2021).

These fast foods and processed foods are devoid of important nutrients and they provide only empty calories. Majority of the adolescents lean towards western diet, which has high energy, high fat especially saturated and trans fats, high sugar, refined carbohydrates, and high levels of sodium, these foods items have established stronger relationship with anaemia when compared to other traditional foods (Zárate et al., 2019).

One out of three people are malnourished in South Asian countries. Malnourishment includes both under and over nutrition, this is due to diet poor in nutrition, lack of affordable nutrition, substandard healthcare, and socio-economic conditions of the individual, low economic development, poverty and inequalities which affects vulnerable girls in the society (Bharati et al., 2019). In India, despite numerous governmental initiatives and the implementation of national and state-level programs such as Anaemia Mukh Bharat which is aimed at improving adolescent nutrition through educational institutions that provides supplementation and tracking, the prevalence of anaemia persists. Socio-economic and lifestyle factors which includes dietary patterns, educational and financial background and accessibility to food resources play a critical role in determining the health of the individuals.

This present study aims to assess the anaemia prevalence and its association with various socio-economic factors and lifestyle choices among the adolescent girls in Madurai region of Tamil Nadu, India.

II. Materials and Methods

A cross-sectional study was conducted among the 423 adolescent girls aged 17 to 19 in Madurai district, Tamil Nadu, India. Data were collected using semi structured questionnaire which covers socio-economic (Locality, Family type, Parental education, Household income, siblings), lifestyle factors (dietary pattern, distance to shops) and health variables (Disease history). Regular dietary habits and irregular diet were categorized based on frequency and regular consumption of balanced meals and vegetable intake. Anthropometric assessment includes height (cm), weight (Kg) was

measured using standard procedures. Body Mass Index (BMI) was calculated and categorized as underweight, normal, overweight and obese according to BMI classification for adolescents.

Haemoglobin Estimation

Haemoglobin concentration was measured using Sahli's method. Anaemia was classified according to WHO criteria for adolescent girls as follows:

Normal ≥ 12.0 g/dL

Mild Anaemia 10.0 – 11.9 g/dL

Moderate Anaemia 7.0 – 9.9 g/dL

Severe Anaemia < 7.0 g/dL

Statistics

Data were analysed using SPSS version 20. Mean haemoglobin levels were expressed as mean $\pm$ standard deviation (SD), comparison of mean haemoglobin between groups was performed using independent sample t test, p-value < 0.05 was considered statistically significant.

II. Results and Discussion

Table 1. Socio-demographic and Nutritional profile of study participants

Variable	Frequency (N)	Total Percentage (%)
BMI group		
Underweight	97	22.9
Normal	260	61.5
Overweight	53	12.5
Obese	13	3.1
Healthy diet		
Regular	235	50.4
Irregular	188	49.6
First generation learner		
yes	44.7	46.8
No	55.3	53.2
Income		
$>1,20,000$	394	93.1
$<1,20,000$	29	6.9
Siblings		
Yes	330	78
No	93	22
Locality		
Rural	111	26.2
Urban	312	73.8
Disease History		
Affected	306	72.3
Not affected	117	27.7
Shop distance		
$<1\text{Km}$	206	48.7
$>1\text{Km}$	217	51.3

Family type		
Nuclear	352	83.2
Joint	71	16.8
Mother occupation		
Working	117	27.7
Home maker	306	72.3

423 adolescent girls from Madurai, Tamil Nadu were included for the study. Table 1. Shows BMI of 61.5% were normal, 22.9% were underweight, 12.5% were overweight and 3.1% were obese. 50.4% of participants reported following healthy diet and 49.6% were following irregular dietary habits. The annual income of majority of families was below Rupees. 1,20,000. Majority of participants had siblings (78%) and were in nuclear family (83.2%). A small proportion of girls resided in rural area (26.2%). 48.7% had access to shop within 1 Km radius of their house. Most mothers were homemakers (72.3%) and 72.3% reported disease of history.

Table 2. Distribution of Anaemia prevalence among adolescent girls by lifestyle variables

Variable	Normal (%)	Mild (%)	Moderate (%)	Severe (%)
BMI group				
Underweight	3.3	7.8	10.6	1.2
Normal	10.9	19.6	27.4	3.5
Overweight	1.9	4.3	5.7	0.7
Obese	1.4	0.7	0.9	0
Healthy diet				
Regular	12.1	20.1	17	1.2
Irregular	5.4	12.3	27.7	4.3
First generation learner				
Yes	5	16.1	22.5	3.3
No	12.5	16.3	22.2	2.1
Income				
>1,20,000	15.6	30.3	41.8	5.4
<1,20,000	1.9	2.1	2.8	0
Siblings				
Yes	13.2	27.4	34	3.3
No	4.3	5	10.6	2.1
Locality				
Rural	17	35	52	7
Urban	57	102	137	16
Disease History				
Affected	14.9	21.5	32.4	3.5
Not affected	2.6	10.9	12.3	1.9
Shop distance				
<1Km	8.3	16.5	21.3	2.6
>1Km	9.2	15.8	23.4	2.8
Family type				
Nuclear	13.9	27.9	36.2	5.2
Joint	3.5	4.5	8.5	0.2

Mother occupation				
Working	5.4	8.5	11.8	1.9
Home maker	12.1	23.9	32.9	3.5

Table 2. depicts distribution of anaemia severity among adolescent girls. Large proportion of girls belong to moderately anaemic, with higher percentage in normal and underweight BMI. Irregular dietary pattern showed higher proportions of moderate and severe anaemia compared to regular diet. Among the first-generation learners a comparable proportion of girls come under moderately anaemic. Urban residents show higher percentage of severe category. Moderate anaemia was more frequent among adolescents from nuclear families and among those whose mothers were homemakers.

Table 3. Comparison of Haemoglobin Values across study variables

Variable	N	Mean $\pm$ SD	t-value	p-value
Healthy diet				
Regular	213	10.47 $\pm$ 1.68	6.28	0.001
Irregular	210	9.4 $\pm$ 1.61		
First generation learner				
yes	198	9.6 $\pm$ 1.64	-3.41	0.001
No	225	10.23 $\pm$ 1.75		
Income				
>1,20,000	394	9.91 $\pm$ 1.7	-2.425	0.016
<1,20,000	29	10.71 $\pm$ 1.8		
Siblings				
Yes	330	9.9 $\pm$ 1.68	0.533	0.595
No	93	9.8 $\pm$ 1.86		
Locality				
Rural	111	9.8 $\pm$ 1.67	-1.11	0.267
Urban	312	10.02 $\pm$ 1.73		
Disease History				
Affected	306	10.04 $\pm$ 1.7	1.437	0.151
Not affected	117	9.7 $\pm$ 1.54		
Shop distance				
<1Km	206	9.94 $\pm$ 1.69	-0.33	0.739
>1Km	217	9.99 $\pm$ 1.75		
Family type				
Nuclear	352	9.94 $\pm$ 1.7	-0.789	0.43
Joint	71	10.11 $\pm$ 1.72		
Mother occupation				
Working	117	10.0 $\pm$ 1.81	0.229	0.221
Home maker	306	9.96 $\pm$ 1.69		

The comparison of mean haemoglobin levels across the selected lifestyle and socio-economic variables are depicted in Table 3. Adolescents consuming a regular healthy diet have significant higher mean haemoglobin than those who do not. Significance was

higher in the case of first-generation learners and anaemia. The families with household income less than Rupees 1,20,000 have a significant difference in mean haemoglobin compared to those who have higher income.

In recent years, nutritional issues have significantly escalated, becoming a major public health concern influenced by both environmental and individual factors. Previous research has demonstrated a clear correlation between unhealthy dietary practices and the prevalence of anaemia, particularly among adolescent girls. The consumption of foods high in energy, fat, and sugars is strongly associated with anaemia (Zárate-Ortiz et al., 2019). Iron deficiency, hemoglobinopathies, vitamin A deficiency, and zinc deficiency are critical predictors of anaemia (Scott et al., 2022). A study by Hariyanato et al., (2022) has also supported this correlation. Reports indicate that 88% of adolescents exhibit poor eating habits, often favoring fast foods. Among adolescent girls from lower socio-economic backgrounds, there is a significant association with the prevalence of anaemia, particularly when their mothers are educated and employed where the mother could provide better diets, better diets.

The study further identified that a reduction in the consumption of eggs, milk, and leafy vegetables, which are important sources of protein, is correlated with anaemia as it lacks essential nutrients like iron, Vitamin B12 and folate (Batoool et al., 2017). The intake of fast food and the adoption of improper dietary habits, characterized by energy-dense and nutrient-poor foods, result in a deficiency of essential micronutrients such as vitamin C, which is crucial for the absorption of non-heme iron. These foods also contain phytates- found in refined carbohydrates like noodles, calcium -, competes with iron during absorption, and polyphenol inhibitors that are present in tea, coffee and certain spices, and these factors impede the bioavailability of iron.

Hidden hunger which means lack of micronutrients also hugely impacts anaemia. Additionally, the intake of foods high in fat, sugar, and ultra-processed ingredients has been linked to low grade systemic inflammation, which stimulates the liver's production of hepcidin, a regulatory hormone that inhibits the absorption of iron and it released from the liver and macrophages. Elevated levels of hepcidin consequently lead to iron deficiency as it stores iron in the liver (Jalambo et al., 2018; Paramastri et al., 2021).

Adolescents often exhibit a deficiency in nutritional knowledge, which adversely affects their propensity to read food labels- interpretation barriers, leading to the consumption of foods lacking nutritional value. There is also “knowledge practice gap” which is because of many economic factors. Body Mass Index (BMI) serves as a practical indicator, providing an indirect measure of body fat. The prevalence of obesity has escalated into a significant global issue, with individuals frequently consuming nutrient-poor foods high in sugars for immediate energy. This study found no correlation between BMI and anaemia (Koca and Arkan, 2020).

The education level of parents is crucial, as they are the primary providers for their children. Parents with higher educational attainment possess greater nutritional literacy concerning nutrition and health, and they are more likely to offer low-energy-dense foods to their children (Galvan et al., 2018). Ronta et al. (2016) reported that children who dine with their families tend to consume healthier foods, whereas those who rely on parental choices consume whatever is provided, even if it is unhealthy. Consequently, parental education is a significant factor in ensuring children receive

nutritious foods. Skipping breakfast and the consumption of fast foods and nutritionally deficient foods have been identified as significant contributors to anaemia, resulting in decreased hemoglobin and red blood cell levels (Sonay et al., 2017; Akan, 2018).

A reduction in hemoglobin and red blood cells is associated with an increase in white blood cells and C-reactive protein, an inflammation marker (Paramastri et al., 2017). According to Hariyanto et al. (2022), a substantial 88% of adolescents exhibit improper dietary patterns, often opting for fast food due to its availability and quick preparation. Sari et al. (2022) observed that adolescents with anaemia are also at risk of experiencing anaemia during pregnancy, which can adversely affect pregnancy, childbirth, and result in stunted birth. Nutritional intake is the most critical factor in anaemia, manifesting as either nutritional deficiencies, such as iron deficiency, or nutritional excesses, leading to a double burden of malnutrition (Oekarjo et al., 2018).

Health outcomes rely heavily on socio-economic status on the family. There is a strong correlation between lower socio-economic status and prevalence of anaemia. Lower house hold income directly contributes to poverty, inadequate nutrition, limited healthcare access and reduced dietary diversity (Gore et al., 2023). Nutritional literacy and supplements to the adolescent girls from this background is lacking. Efforts must be taken to address this issue by considering socio-economic status into account. They play between education, socio-economic background and fast foods shows the complicated nature of the issue. Policy interventions with holistic approach that could address the disparities would help to achieve the benefits.

IV. Conclusion

This study has revealed that there is a significant relationship between nutrition, education of parents, household income and anaemia. Efforts must be undertaken to address this issue by considering socio-economic status. The interplay between education, socio-economic background, and fast-food consumption illustrates the complexity of the matter. Policy interventions adopting a holistic approach to address these disparities could facilitate the realization of benefits.

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The study questionnaire is given below

Identification details

- a. Name
- b. Age
- c. Locality - Urban/Rural

Socio-demographic characters

- d. Type of family - Nuclear/Joint
- e. Annual family income-Less than 1,20,000/Greater than 1,20,000
- f. Siblings-Yes/No
- g. First Generation Learner - Yes/No
- h. Mother's Occupation - Homemaker/Working

- i. Distance to nearest food shop/market - less than 1 Km/greater than 1 Km

Diet and Disease history

j. Do you consume fruits and vegetables every day - Yes/No

k. History of any illness in the past 6 months - Yes/No

If yes, specify _____

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