



## **Nutritional Status of Adolescent Girls in Corporation Schools in India: Still the Goal is Far Ahead**

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### **Authors' contributions**

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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### **ABSTRACT**

Adolescence is a vulnerable period for the incidence of malnutrition, as rapid growth takes place in this phase of life. Malnutrition, especially among adolescent girls, adversely affects future generations and indirectly impedes national productivity. Maternal malnutrition also contributes significantly to maternal mortality. It is required to be reduced to 70 per lac live births in 2030 from 167 per lac live births in 2013 to achieve sustainable development goals. The other crucial sustainable development goal is improvement in nutritional status in all phases of life. In the present study, we assessed the healthy situation by Body mass index and Haemoglobin estimation of adolescent girls incorporation school located at Pimpri, Pune, India. Most of the girls belonged to lower-middle to middle socioeconomic status. 67.9% of AGs under study were malnourished, while 8.6% were overweight. Only 3.5% of them had Haemoglobin in the normal range, 1% had severe, 65% of adolescent girls understudy had moderate anemia, and the rest had mild anemia. Results of the study show that India is still far away from attaining Sustainable development goals regarding the nutrition of adolescent girls and will have to take great efforts by existing program evaluation, modification, and strict implementation.

*Keywords: Adolescence; malnutrition; haemoglobin; nutrition; modification; evaluation.*

## 1. INTRODUCTION

Adolescence, 10-19 years of age, is a transient phase of life. Worldwide, Adolescents comprise roughly 16% of the total population, while they comprise 20% of India's population. This phase of life is characterized by rapid growth and essential physiological, psychological, and social changes. About 45% growth of the skeleton takes place in this phase of life. Also, there is an expansion of blood volume and muscle mass. Hence, nutrient needs are the greatest macro and micronutrient deficient diets superadded with increased demand make adolescents vulnerable for under-nutrition and anemia, especially nutritional anemia in the form of iron deficiency anemia [1]. These can severely limit their growth spurts. Among Adolescent girls (AGs), it also affects their reproductive life and future generations [2].

In South-Esat-Asia, maternal under-nutrition and anemia, since childhood and adolescence, exist among more than fifty percent of all pregnant women. Pregnant adolescents are more prone to adverse outcomes, and they often receive less care. It contributes significantly to intrauterine growth retardation, [3] premature deaths, infant, child& under-five mortality, and off-springs of under-nourished mothers have a lifetime risk of malnutrition and related disorders. Thus, malnutrition among AGs fuels the vicious cycle of intergenerational under-nutrition, poverty, and chronic diseases are discussed. Suppose adolescence is considered the last opportunity to catch up on growth lag and prioritize nutrition needs and interventions. In that case, it will significantly impact economic development by making healthy, productive youth. It will also prepare them for healthy reproductive life and prevent the onset of nutrition-related chronic diseases in their adult life and future generations.

Millennium Development Goal (MDG) of India targeted to improve maternal health by decreasing maternal mortality. An outstanding achievement shows all interventions are under RCH, maternal mortality reduced by more than 40% between 1990 to 2015, 437 in 1990 to 167 per lac live births in 2013, [4] but was short of the 75% target but. Still, it was too higher as the majority of these maternal deaths are preventable. Sustainable Development Goals (SDG) targets to reduce the global maternal mortality ratio to 70 per lac live births by 2030.

One of the important SDGs is improving nutritional status, ensuring healthy life to populations, and promoting well-being in all phases of life. Nutrition has a multidirectional relationship with many developmental goals. <sup>4</sup> Hence, now onwards, SDG has a target that by 2030 there should be an end of all forms of malnutrition. All countries should achieve internationally agreed targets on stunting and wasting in under-five children by 2025. Hence, they must address and act on the nutritional needs of AGs, pregnant and lactating women [5].

The nutrition situation is still alarming, particularly in South East Asia, where malnutrition is widely prevalent despite economic development and the deceleration of poverty. Because of the number of undernourished people in this region, SEAR countries must raise the nutritional status of the populations to meet SDG goals. The malnutrition cases of girls are overcome by breaking the intergenerational cycle of malnutrition [6]. In this scenario, the need for an hour is to strengthen the role of women and AGs by improving their nutritional and socioeconomic status.

RMNCH+A strategy is based on Continuum of Care, adapted under RCH with a particular component for adolescent health, including teenage nutrition. Many initiatives by Governmental agencies and Non-governmental agencies are directed to combat micro-nutrient and macro-nutrient deficiencies among AGs in India, like day meals at schools, iron-folic acid supplementation, [7] Rashtriya Bal SwasthyaKaryakram (RBSK), etc. The present study was designed to assess the nutritional status of school-going AGs. It is necessary to periodically determine the impact of all ongoing nutritional interventions to identify pitfalls and provisions for improvements at the regional level.

## 2. MATERIALS AND METHODS

A school-based cross-sectional study was carried out from August to October 2013 among AGs studying in 7<sup>th</sup> to 9<sup>th</sup> standards in Pimpri-Chinchwad Municipal Corporation (PCMC) schools in Pimpri, Pune Maharashtra, India. The study was approved by the Institutional Ethical Committee of D Y Patil Medical College, Pimpri, Pune [8]. Permissions were sought from the Education Officer and Medical Officer of Health, PCMC.

The sample size was calculated, taking the anticipated prevalence of under-nutrition as 50% and allowable error of 4.5%. At 95% CI, it came out to be 248, a 10% non-response rate was added, and it was fixed to enroll 262 girls [9].

A list of Corporation schools was obtained from PCMC. Three schools were randomly selected from the list for the study purpose. Permission from principals of all three schools was also taken before initiating the study [10].

A list of all divisions of 7<sup>th</sup> to 9<sup>th</sup> standards for all three schools was prepared, and four divisions were selected randomly from each school. Girls who were absent on the day of the visit to the school, girls who were unwilling to participate in the study were excluded. It was also decided to exclude girls with known other hematological abnormalities like Thalassemia and sickle cell disease, but no girl in our sample size had any disorders [11]. Informed consent from parents & Verbal consent from girls was taken before inclusion in the study [12].

All three schools received and distributed Iron & folic acid (IFA) tablets under the National nutritional anemia prophylaxis program (NNAPP) 2 years back. The midday meal program was in operation at all three schools.

Trained public health professionals administered pretested semi-structured questionnaires to get the study group's socio-demographic, personal, and dietary information. Standing height was recorded by measuring tape pasted on the wall. Weight was recorded using portable dial weighing scales accurate to 100 g. Hemoglobin(Hb) estimation was done by trained personnel by Sahli's method. Investigators' bias was minimized as the investigator administering questionnaire & performing Hb was different [13]. The person administering the questionnaire remained the same throughout the study. Similarly, the weighing scale & measuring tape used for measurements in the study remained the same. Laboratory person estimating the Hb of the study subjects remained the same throughout the study. Anemia among study subjects was also graded as per WHO cut-offs of Hb for grades of anemia as: Normal:  $\geq 12$  gm/dl, Mild: 10-12 gm/dl, Moderate: 7-10 gm/dl, Severe: Upto 7 gm/dl. The overall nutritional status of study subjects was assessed as per BMI cut-offs by WHO for India/ Asia as Underweight  $< 18.5$  kg/m<sup>2</sup>, Normal range: 18.5 – 22.99, and Overweight:  $\geq 23$ .

Data were entered in a Microsoft Excel spreadsheet, imported to SPSS 15.0 spreadsheet for further analysis. Frequencies and proportions were enlisted, appropriate tests of significance and correlation were applied wherever necessary.

### 3. RESULTS

252 AGs were recruited. All were from lower-middle to lower SES. As shown in Table 1, the Mean average of AGs recruited in the study was 13.46 ( $\pm 1.179$ ) years with minimum and maximum years as 11 & 16. The majority (81.7%) of study subjects were from the 8<sup>th</sup> standard. Table 1 also depicts the quantitative aspect of observed nutritional characteristics.

#### 3.1 Overall Nutritional Status

It was measured in the form of Body Mass Index (BMI). As shown in Fig. 1, Mean BMI 17.83 ( $\pm 2.92$ ) kg/m<sup>2</sup> with minimum & maximum BMI of 12.04 kg/m<sup>2</sup> & 26.92 kg/m<sup>2</sup> respectively. As shown in Fig. 2, 67.9% of AGs under study were undernourished & only 23.5% were well-nourished, while 8.6% were overweight.

As shown in Fig. 3, the percentage of under nutrition decreased from 11-15 years of aging. In 16 years age group, we had only one AG, and she was undernourished.

BMI had Positive correlation with Age in years ( $r=0.514$ ,  $p<0.001$ ), Score for intake & liking of pulses ( $r=0.339$ ,  $p=.002$ ), Score for intake & liking of non-veg items ( $r=0.250$ ,  $p= 0.041$ ).

#### 3.2 Haemoglobin and Related Observations

Mean Hb was 9.9 ( $\pm 1.272$ ) gm% with minimum & maximum of 6.5 gm% and 14.0 gm% respectively.

As shown in Fig. 2, only 3.5% of them had Hb in the normal range, and others had mild to severe anemia. The majority, 65% of AGs under study, had moderate anemia while 1% had severe anemia.

90.6% of girls got IFA tablets two years back. 81.4% had it regularly while 18.6% did not for various reasons like Nausea &/ or vomiting, thrown away, felt sleepy, got it at home & forgot to consume, or lost. 25.4% consumed IFA tab within 15 minutes of lunch, which can affect iron

absorption. The proportion of study subjects who attained menarche was increased as age increased per standard, from 50% in 7<sup>th</sup> to 96.4% in 9<sup>th</sup> standard.

### 3.3 Other Observations

The majority (79.5%) consumed some fast food on 2-5 days of a week, in the recess of the schools. Use to purchase from outside of the school. Spent mean of Rs 22.67 (5-100) per week. 11.6% consumed fast foods on all six days of a week. They were significantly more to have under-nutrition ( $p=0.04$ ).

The mid-day meals scheme was in function at all three schools. But, as shown in Table 1, only 34.7% consumed it on all six days, 54.6% consumed it on 1-3 days. They gave various reasons like Parents don't allow o finish it, Mid-day meal is tasteless or unhygienic, or they don't like it at all.

## 4. DISCUSSION

There was functional IFA supplementation under National Nutritional Anemia Prophylaxis Program (NNAPP) and a Mid-day meal program at selected schools. Despite that, an enormous proportion of AGs understudy had under-nutrition and anemia.

The NFHS-4 reported a reduced prevalence of underweight (BMI <18.5 kg/m<sup>2</sup>) AGs in the age group of 11-19 years that is 42% from 46.8% in NFHS-3 [14]. In our study, 67.9% AGs were found to be underweight. As per reports of other studies, 40-90% of AGs in India are under-nourished.

The culture of early marriages in India forces such underweight AGs to bear children at an early age. It increases the burden of maternal and infant mortality and the proportion of malnourished children at all ages more vulnerable to the disease malnutrition cycle.

Schools are essential points of contact for AGs to identify and correct nutritional deficiencies. Mid Day meal scheme has been in operation since 1961 to supply at least one-third calorie requirement of school children now covers adolescents. Only 34.6% AGs under study used to consume mid-day meals given at the school on all six days a week. Others told various reasons for not consuming mid-day meals provided in the school: they don't like it, parents

don't allow it, it was tasteless or unhygienic. Fears & mis-concepts regarding mid-day meals should be needed to be removed from the minds of parents and students by all possible means.

Our study found a significant proportion of AGs with mild & moderate anemia, 35.5% & 65%, while only 3.5% of them were non-anemic. Various studies from rural and urban India report Iron deficiency prevalence among AGs to be 22-92%.

Iron supplementation is recognized as the most successful and effective micronutrient supplementation [15]. A comprehensive program of iron supplementation and deworming in north-western Viet Nam among women of reproductive aging resulted in a 48% decrease in anemia among women in the reproductive age group within 12 months. But, in India, despite IFA supplementation to all vulnerable age groups, the prevalence of anemia is on the increase as 56% population in the 15-49 year age group affected is reported in NFHS-3. In comparison, it was 53% in NFHS2. Between 2005–2016, IDA in India decreased by only 3.5 percentage for this age group of women.

Similarly, during this period, IDA increased in eight states out of 27. Delhi, Haryana, Himachal Pradesh, Kerala, Meghalaya, Tamil Nadu, Punjab, and Uttar Pradesh. Out of these, Kerala and few other states have the highest Human Development Index but have failed to reduce the burden of IDA.

IDA is the hidden cause of high maternal mortality in India. Apart from being the leading cause of 19% maternal deaths, it aggravates maternal deaths due to hemorrhage, sepsis, and toxemia. The risk of maternal death is three times higher if the mother is in the age group of 15-19 years, and it is still higher, nearly five times, in those younger than 15 years compared to women more than 20 years ago. As NFHS 4 reported, 15% of girls of 15-19 years aging were already married & 16-19% of total pregnancies were teenage pregnancies [13] Thus, effective programs to combat anemia among AGs are of utmost importance.

Effective implementation of iron supplementation under various strategies and programs in India remains a challenging task. All AGs in our study got IFA tablets and tablets for deworming a long time ago, two years back. We identified logistic

constraints of supplies of IFA tablets which needed to be rectified urgently. The majority of girls used to have IFA tablets as per norms of NNAPP of supervised consumption. About 18.6% of girls gave various reasons for non-consumption as they had Nausea or vomiting after having IFA tablets; they have thrown them away as they felt sleepy OR got it at home & forgot to consume or lost.

A combined effort at the community level, including school teachers, parents, adolescents themselves, and community health workers, can strengthen IFA intervention and its uptake. Various interventions like Dietary diversification, food fortification, food supplementation, and not the least, improvement of health services are required to reduce the burden of anemia as well as under-nutrition among AGs in India.

Nutritional iron deficiency was inevitable in our study as all AGs were from lower-middle to lower Socio-economic status, and iron deficiency arises due to inadequate intake or excessive losses of iron because of menstruation. Poor bioavailability of dietary or supplemented iron is also a significant cause of IDA. 25.4% AGs in the study consumed the IFA tab within 15 minutes of lunch which affects iron absorption by reducing bio-availability. They should be educated about increasing the bio-availability of iron from consumed IFA tablets or iron-rich food items.

As depicted in the results, BMI positively correlated with the Score of intake & liking of pulses and the Score for information & preference of non-veg items. Nutrition education needs to be intensified among AGs by inclusion in the school curriculum with a practical approach. Intensified Nutritional Educational using all possible Audio-visual aids can be initiated to improve adolescents' nutrition behaviors. It will prove as an investment in adult health.

Adolescents, curious and showing interest in the surrounding, are open to new ideas, Various motivational activities like quiz, competition for iron-rich recipes for AGs, their mothers, prize distribution for the girls passing from under-nutrition to BMI within normal range, attaining highest rise in Hb in the specified time, etc. can be arranged during Nutrition week, Annual day functions, etc.

Nutritional counseling sessions may be in mass for behavior change communication to remove personal dislikes for healthy foods, spend money wisely, discourage fast food consumption, the importance of mid-day meals, healthy dietary habits, etc., school health services. Workshops for mothers regarding cost-effective nutritious diets & nutrition education sessions arranged preferably at the time of parents' meetings or another get-together at school may significantly impact their nutritional knowledge, attitude, and practices, which will be beneficial to improve the nutritional status of the entire family.

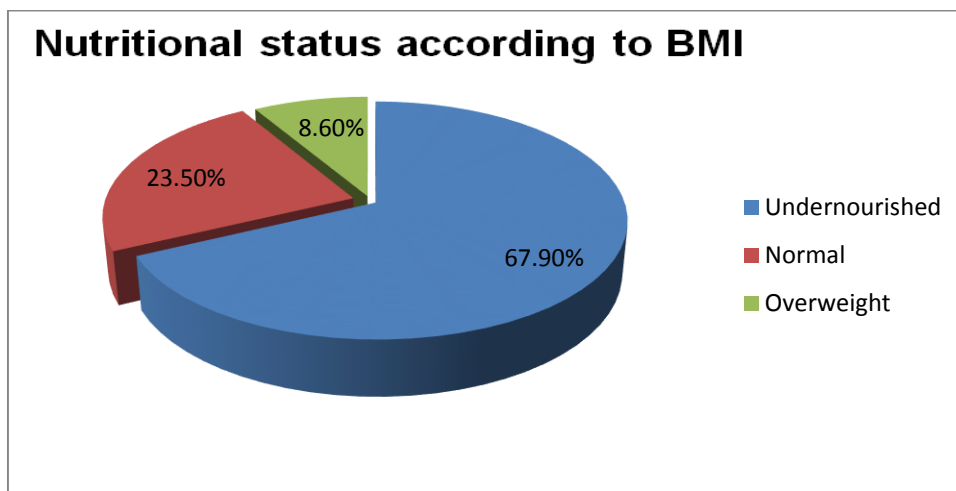


Fig. 1. Nutritional Status According to BMI

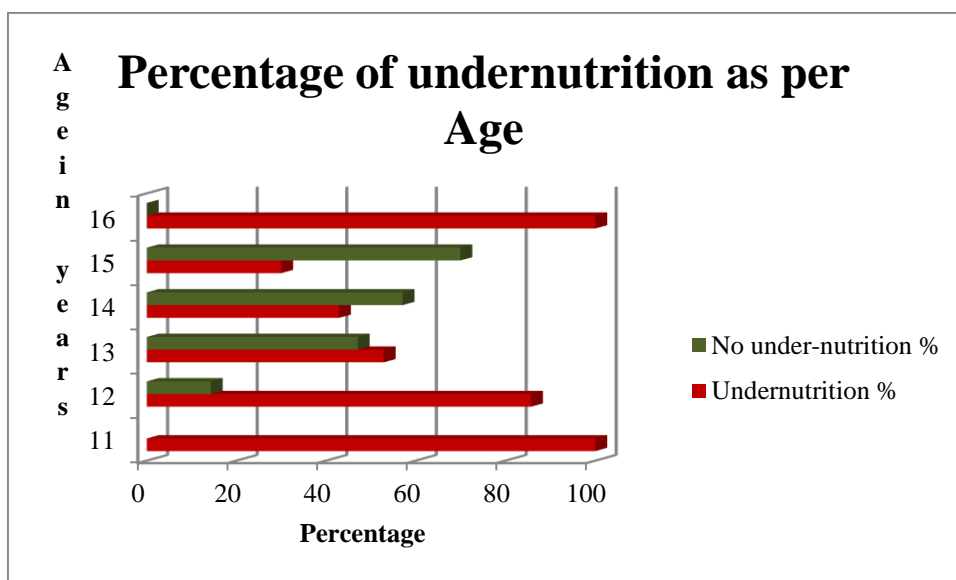


Fig. 2. Percentage of undernutrition as per age

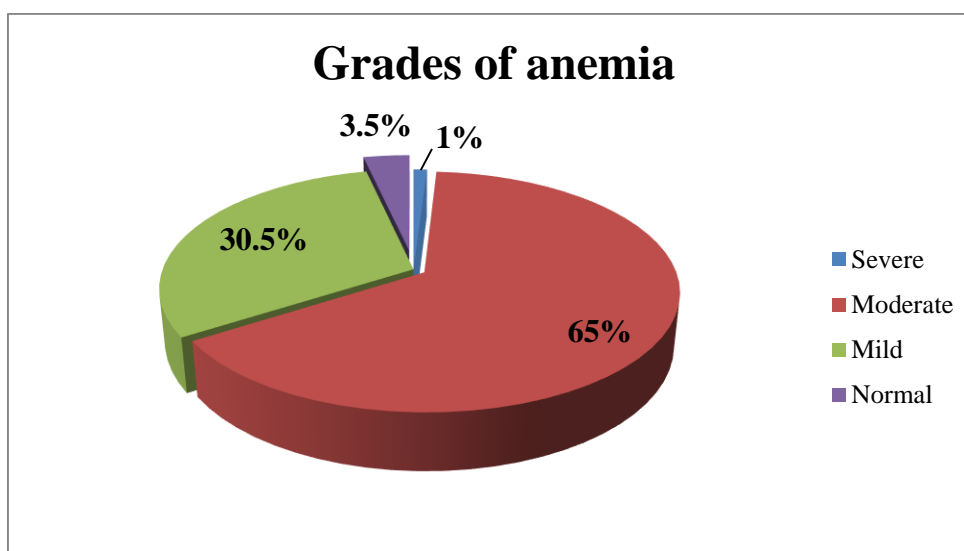


Fig. 3. Grades of anemia

Table 1. Age and nutritional parameters of AGs under study

Parameter	Mean	SD	Minimum	Maximum
Age in years	13.46	± 1.179	11	16
BMI in kg/m <sup>2</sup>	17.83	± 2.92	12.04	26.92
Hb in gm%	9.9	± 1.272	6.5	14.0

Fast food Consumption was found as a routine for 11.6% of girls. Surprisingly, they were significantly more under-nutrition ( $p=0.04$ ) as fast food consumption may be in little quantity to satisfy hunger, making them deficient in macro and micronutrients. Another majority (79.5%) had it on 2-5 days a week. All the girls were from

lower-middle to lower SES and spent about Rs 22.67 per week on fast food items. There were many undesired factors to probe and act in this regard as to why student girls were allowed to go out of the school during school timings and purchase it, how fast food vendors permitted nearby school premises, were parents and

school teachers gave unspoken permission or they did not know it at all.

## 5. CONCLUSION

We could not investigate other causes of anemia, but the commonest anemia among AGs is nutritional, and that too is Iron deficiency anemia. Similarly, gender bias, family practices regarding cooking and food intake and knowledge, attitude & rules of the family, especially mothers regarding iron-rich food, can profoundly impact anemia and overall nutritional status of AGs, which needs different study design to elaborate. The study population of AGs represents only that in corporation schools in Pimpri, Pune; hence generalisability of the study can't be assured. Early diagnosis and management of under-nutrition and severe to moderate anemia also play a crucial role in preventing morbidities and devastating reproductive outcomes in the future. It should be followed by appropriate management with referral activities. In our study, girls with severe & moderate anemia were referred to tertiary hospitals surveying further treatment. Because of the enormous magnitude of under-nutrition & iron deficiency anemia in AGs under study, we conclude that existing nutritional programs and strategies need to be modified at the earliest for beneficiaries' effective implementation and utilization.

At the same time, mid-day meals are needed to be richer in macro & micronutrients with improved taste prepared with utmost hygienic care. Supplementation or fortification of IFA tablets with Vitamin C needs to be considered to increase its bioavailability.

## CONSENT

Informed consent from parents & Verbal consent from girls was taken before inclusion in the study.

## ETHICAL APPROVAL

Ethical Approval was taken from the Institutional Ethical Committee of D Y Patil Medical College, Pimpri, and Pune.

## DISCLAIMER

The products used for this research are commonly and predominantly used in our research area and country. There is no conflict of interest between the authors and producers of the products because we do not intend to use

these products as an avenue for litigation but the advancement of knowledge. Also, the research was not funded by the producing company instead, the personal efforts of the authors financed it.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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