

# Prevalence of Malnutrition and its Associated Sociodemographic and Clinical Factors among Adolescents in Selected Schools of Urban Puducherry, India

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## Abstract

**Background:** In India, adolescents constitute 21% of the total population. Majority of boys and girls in developing countries enter adolescence as undernourished, making them more vulnerable to several diseases. **Objective:** Among adolescents in selected schools of urban Puducherry, we determined the prevalence of malnutrition and also assessed the sociodemographic and clinical factors associated with undernutrition. **Materials and Methods:** A cross-sectional analytical study was conducted among adolescents (10–18 years) in selected public schools of Urban Puducherry. Data were collected using semi-structured and pre-tested questionnaires. The data collection period was between September and October 2019. Malnutrition was assessed by the World Health Organisation recommended Height-for-age and body mass index-for-age cut-offs using AnthroPlus software. **Results:** A total of 144 (28.9%) boys and 355 (71.1%) girls were included in the study ( $N = 499$ ). The prevalence of malnutrition was 46.8% (95% confidence interval [CI]: 42.5–51.3). The prevalence of undernutrition was 33.3% (Stunting [21.6%] and Thinness [15%]). The prevalence of overweight and obesity were 10.2% and 5.8%, respectively. Male gender was found to be an independent risk factor of undernutrition (annual percentage rate = 1.4; 95% CI: 1.0–1.9); and known risk factors such as socio-economic status, parental education were not significantly associated with undernutrition. **Conclusions:** One in every two school-going adolescents was malnourished. Despite the high prevalence of undernourishment, over nourishment was also commonly observed. Educating parents and students about growth monitoring and dietary habits might help in bringing down the burden of malnutrition.

**Keywords:** Adolescent, malnutrition, obesity, overweight, schools, undernutrition

## INTRODUCTION

Adolescence is a period of transition between childhood to adulthood and occupies a very pivotal role in human life.<sup>[1]</sup> In a developing country like India, adolescents (10–19 years) constitute around 21% of the whole population.<sup>[2]</sup> Usually, in this phase, the requirement for the macro and micronutrients increases, thereby leading to malnutrition.<sup>[3]</sup> Majority of the mortality and morbidity occurring in adolescents are mainly due to preventable causes.<sup>[4,5]</sup>

According to the World Health Organisation (WHO), the term ‘malnutrition’ refers to ‘A deficiency, imbalance or excesses in a person’s intake of energy and/or nutrients’.<sup>[6]</sup> As per Sustainable development goals, India has set a target of

eliminating all forms of malnutrition by 2030.<sup>[7]</sup> Meanwhile, WHO elimination of malnutrition is defined as ‘Reduction to zero incidences of all form of malnutrition in a defined geographic area’.<sup>[8]</sup>

The high rate of malnutrition among adolescent girls not only affects their present life but, is also associated with their future health problems related to pregnancy and low birth weight babies.<sup>[9]</sup> The intergenerational cycle plays an important role in the prevalence of malnutrition among adolescents.<sup>[10]</sup>

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According to the National Family Health Survey (NFHS)-3, the proportion of thinness among adolescent girls and boys was 47% and 58%, respectively. NFHS-3 also reported that 2.7% of girls and 31.7% of boys were overweight.<sup>[11]</sup> According to the Comprehensive National Nutrition Survey conducted in India, (CNNS 2016–18) the prevalence of stunting, thinness and overweight among adolescents was 26.4%, 24.1% and 4.1%, respectively.<sup>[12]</sup>

In India, there are many barriers that influence adolescent health. In 2014, Rashtriya Kishor Swasthya Karyakram (RKSK) was started with an objective to provide continuous care for adolescents and meet their developmental needs. To enhance nutritional support to adolescents, the Mid-day meal scheme, a centrally sponsored scheme, has been extended to cover adolescents in 2007.<sup>[11]</sup> Schools have always been an efficient platform for early detection and prevention of health issues among adolescents.<sup>[13]</sup> The government of India has started a new initiative Rashtriya Bal Swasthya Karyakram (RBSK) to address the health issues among children from birth to 18 years encompassing the spectrum of 4Ds-Deficiencies, Disease, Development Delays and Disability.<sup>[14]</sup> In 2018, the National nutrition mission, also known as POSHAN Abhiyan, was launched which mainly focus on undernutrition, stunting and low birth weight babies among young child, women and adolescent girls.<sup>[12]</sup>

Although efforts have been taken through various national programs to address malnutrition among adolescents in the past two decades, still a number of challenges are faced in addressing the same and malnutrition has continued to be a common health problem among adolescents. Hence, the objective of our study was to find the prevalence of malnutrition among the school-going adolescents in selected schools of urban Puducherry and also to assess the socio-demographic and clinical factors associated with undernutrition.

## MATERIALS AND METHODS

A school-based cross-sectional analytical study was carried out among adolescents studying in all the eligible government schools present in the service area of the urban health and training centre of a tertiary medical college. In the service area, there are four government schools that provide education to the 6<sup>th</sup> to 12<sup>th</sup> class and one private nursery school. All government schools that are giving education to students from 6<sup>th</sup> to 12<sup>th</sup> class were included in our study. The health center provided health services to 4 wards (Kurusukuppam, Vazhaikkulam, Vaithikuppam and Chinnayapuram) comprising 13 anganwadis functioning under it. The centre runs Adolescent friendly health clinic weekly on every Saturday as per RKSK guidelines. Iron-folic Acid supplementation is given to adolescents studying in selected schools through the WIFS program<sup>[15]</sup> and are also covered under the RBSK programme.

Assuming 95% confidence level (CI), 4% absolute precision and the proportion of undernutrition and overnutrition among the school-going adolescents as 19.8% and 16.9%, respectively,

based on a previous study,<sup>[11]</sup> the sample size was calculated to be 382 and 338, respectively, using OpenEpi v. 3.03. This research involved evaluating a routine package of services as prescribed in the program. We enrolled all the students present during the day of the visit to the school (499) from all the four existing government schools present in the area. The sample size required was more than two-thirds of the total children enrolled; we thus preferred to include them all.

The study protocol was reviewed and approved by Institutional Ethics Committee for observational studies, JIPMER (JIP/IEC/2019/296 on July 26, 2019). Written permission was obtained from the Directorate of school education, Puducherry, the head of the institution and parents. Verbal assent was taken from the students aged 10–12 years and written assent was obtained from the school students aged 13–18 years, after briefing them about the study. Before obtaining permission, a copy of the questionnaire and study protocol was shared with the school authorities.

Separate questionnaires were administered to both students and parents. A semi-structured and pretested questionnaire which was self-administered, except for certain clinical parameters like height and weight was used for data collection. Almost 93% of parents could self administer the questionnaire and the information was collected on socio-demographic characteristics of the adolescent's family, i.e. parent's education, occupation, monthly income, and source of drinking water. Those parents who were not able to fill the questionnaire (around 17%), their information were obtained from school records through the student's class teachers. Data were collected from the students in their respective classes during school hours. The questionnaire included sociodemographic characteristics, dietary habits, personal hygiene, physical activity and details of vitamin deficiencies (adopted from RBSK questionnaire). Self-reported morbidities were collected for the past 1 month. Clinical assessment was performed by a team of researchers and Master in public health postgraduate students for nutrition status, vitamin deficiencies, oral health and skin conditions.

For anthropometric measurement standard procedure was followed. Height was recorded using a validated stadiometer with a precision of 0.1 cm. Weight was measured using a validated digital weighing machine with a precision of 0.1 kg. Nutrition status was assessed using WHO body mass index (BMI)-for-age and Height-for-age growth charts. The Z scores for BMI-for-age and height-for-age were plotted using WHO AnthroPlus software which uses WHO Reference 2007 for children aged 5–19 years.<sup>[1,16,17]</sup>

### Study variables

**Stunting**-According to WHO standards adolescents with height for age z-score below-2 standard deviation (SD) of the median of a reference standard, below-3 SD is severe stunting.

**Thinness**-According to WHO standards adolescents with BMI for age z-score below-2 SD of the median of a reference standard, below-3SD is severe thinness.

Overweight and obesity-According to WHO standards adolescents with BMI for age z-score more than 1 SD of the median of a reference standard, more than 2 SD is obesity.

Undernutrition-Either stunting and thinness or both.

Malnutrition-Undernutrition and/or, overweight and/or obesity.

Data was entered in EpiData Manager Software (version 4.6.0.0, The EpiData Association, Odense Denmark) and analysis was done using SPSS (version 22, IBM Corp, Armonk, NY, USA) and OpenEpi (2008 Andrew G. Dean and Kevin M. Sullivan, Atlanta, GA, USA).<sup>[16]</sup> Continuous variables were summarised as mean (SD) or median (interquartile range) based on the distribution of the data. The categorical variables were summarised as frequency and proportion. The prevalence of malnutrition was reported as proportions with 95% confidence interval (CI). Association between sociodemographic factors and clinical factors with undernutrition was assessed using Chi-square test and prevalence ratio with 95% CI. Multivariable (logistic binomial regression analysis) was done to adjust for confounders taking variables with  $P < 0.20$  into the model.

## RESULTS

Of the total 550 students enrolled in the four selected schools, 499 students were included in the study. The remaining 51 students could not be contacted despite two visits and hence were excluded from the study.

Table 1 show that 59.9% of the study participants belonged to the age group of 15–18 years and a majority of them were females (71.1%). The mean age of the adolescents was 14.7 (SD 1.9). About 51% of the mothers of the study participants were employed, whereas 91% of the participant's fathers were engaged in some occupation. More than three-fourth of the participant's belonged to the lower socioeconomic class. Majority of the adolescents (95.6) were taking nonvegetarian diet and 72.1% used tap water for drinking. More than half of the adolescents (58.9%) were not engaged in regular physical activity. About 454 (91%) adolescents washed their hands before having meal and 491 (98.4%) adolescents washed their hands after defecation.

The distribution of nutritional-related morbidities (assessed using RBSK guidelines) among the school-going adolescents is depicted in Table 2. About one-fourth of the adolescents had dental caries. About 34.3% of the participants had palmar pallor. Of the total, 99 (19.8%) reported of suffering from some illness in the last month, the most common being fever (11.8%).

The prevalence of malnutrition (undernutrition and overnutrition) among the study participants was 46.8% (95% CI 42.5–51.3) [Table 3].

As shown in Figure 1, the proportion of adolescents with thinness or severe thinness was found to be 15% by using the WHO BMI-for-age growth chart. The proportion of children

**Table 1: Socio-demographic and other characteristics of adolescents in selected schools of urban Puducherry (n=499)**

Characteristics	Frequency (%)
Age (years)	
Early adolescence (10-11)	42 (8.4)
Adolescence (12-14)	158 (31.7)
Late adolescence (15-18)	299 (59.9)
Gender	
Male	144 (28.9)
Female	355 (71.1)
Religion	
Hindu	379 (76.0)
Christian	117 (23.4)
Muslim	3 (0.6)
Class of education	
Upper primary (6-8)	110 (22.0)
Secondary (9-10)	134 (26.9)
Higher secondary (11-12)	255 (51.1)
Type of family	
Nuclear	458 (91.8)
Joint	41 (8.2)
Number of family members	
≤4	265 (53.1)
5-6	193 (38.7)
≥7	41 (8.2)
Father's education (n=483) <sup>§</sup>	
Nonformal	43 (8.9)
Primary and upper primary (1-8)	108 (22.4)
Secondary (9-10)	221 (45.8)
Higher secondary and above (≥11)	111 (23.0)
Mother's education (n=486) <sup>§</sup>	
Nonformal	38 (7.8)
Primary and upper primary (1-8)	129 (26.5)
Secondary (9-10)	207 (42.6)
Higher secondary and above (≥11)	112 (23.1)
Father's occupation (n=470)	
Unemployed	14 (3.0)
Self-employed/farmer	160 (34.0)
Daily waged	229 (48.7)
Monthly waged	67 (14.3)
Mother's occupation (n=487)	
Self-employed/farmer	115 (23.7)
Dailywaged	91 (18.7)
Monthly waged	50 (10.3)
Homemaker/housewife	231 (47.4)
Socio-economicclass (n=496)*	
Lower class	406 (81.9)
Middleclass	47 (9.5)
Upperclass	43 (8.7)
Physical activity <sup>#</sup>	
No	294 (58.9)
Yes	205 (41.1)
Dietary intake	
Nonvegetarian	477 (95.6)
Vegetarian	22 (4.4)

\*Socioeconomic classification,<sup>[1]</sup> #Physical activity classified according to WHO adolescents guidelines, <sup>§</sup>Indian standard classification of education. WHO: World Health Organisation

**Table 2: Clinical profile of adolescents in selected schools of urban Puducherry (n=499)**

Characteristics	Frequency (%)
Nutritional deficiencies	
Palmar pallor	171 (34.3)
Cracked lips	53 (10.6)
Oral ulcers and h/o oral ulcers	35 (7.0)
Angular cheilitis	1 (0.2)
Dental condition	
Visible stains/plaque	255 (51.1)
Caries	123 (24.6)
Swollen/bleeding gums	87 (17.4)
Skin infections	3 (0.6)
Morbidity in the last month	99 (19.8)

**Table 3: Nutrition status among the adolescents in selected schools of urban Puducherry (n=499)**

Nutrition status	Frequency, n (%)	95% CI
As per WHO height-for-age growth chart*		
Severe stunting	17 (3.4)	2.1-5.3
Stunting	91 (18.2)	15.0-21.8
Normal	391 (78.4)	74.6-81.8
As per WHO BMI-for-age growth chart*		
Severe thinness	23 (4.6)	3.0-6.7
Thinness	52 (10.4)	8.0-13.3
Normal	344 (69.0)	64.8-72.9
Overweight	51 (10.2)	7.8-13.1
Obesity	29 (5.8)	4.0-8.1

\*WHO growth chart reference 2007.<sup>[17]</sup> WHO: World Health Organisation, CI: Confidence interval, BMI: Body mass index

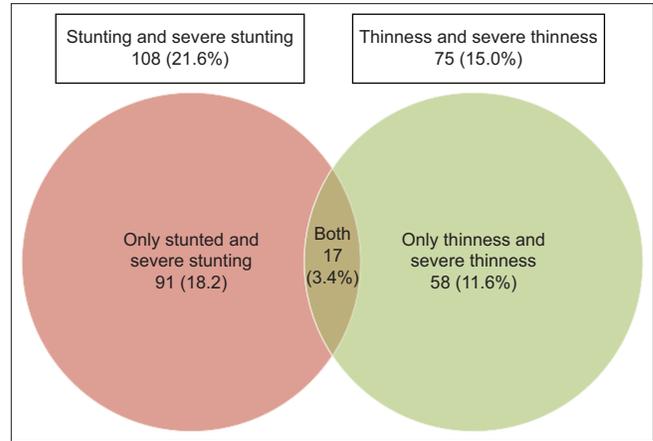
with stunting or severe stunting was found to be 21.6%, using the Height-for-age growth chart. The prevalence of undernutrition (either stunting, thinness or both) using two growth charts was found to be (166 out of 499) was found to be 33.3% (95% CI 29.3–37.5).

Among the undernourished adolescents, as shown in Figure 1, almost 17 (3.4%) suffered from both stunting and thinness.

On bivariate analysis, factors such as gender and mother’s education were found to be significantly associated with undernutrition as shown in Table 4. While in multivariable logistic regression analysis, only gender, i.e., Males had 1.4 (1.0–1.9) times more risk of having undernutrition as compared to females and was found to be statistically significant with *P* value of 0.04.

## DISCUSSION

The overall prevalence of malnutrition in this study was found to be 46.8% (95% CI 42.5–51.3) while the prevalence of undernutrition, stunting and thinness were found to be 33.3% (95% CI 29.27–37.51), 18.2% (95% CI 15.03–21.81) and 10.4% (95% CI 7.96–13.34) respectively; similar results were reported by Selvaraj *et al.* in a study conducted in semi-urban



**Figure 1: Distribution of undernourished adolescents identified using World Health Organisation growth charts among adolescents in selected schools of urban Puducherry (n = 499)**

area of Chennai, where they found the prevalence of stunting and thinness to be 19.2% and 13% respectively.<sup>[1]</sup> In our study, the overall prevalence of overweight and obesity was found to be 16% (95% CI 12.9–19.6) which was in line with the findings of a similar study from the same study setting<sup>[18]</sup> but in contrast to the studies from Northern India.<sup>[4]</sup> Likewise, the proportion of thinness among the adolescents in this study was less compared to the study carried out by Rashmi *et al.*, among school-going students (34%) in Bangalore.<sup>[19]</sup> This disparity could be due to differences in the study setting and differences in the availability and accessibility of health care services. Compared to a study from Africa,<sup>[20]</sup> our study had a better undernutrition status among the adolescents, while it was poorer than the estimates from the neighboring country Nepal.<sup>[21]</sup> This disparity might be due to differences in health-care systems, dietary habits and cultural variations among the study participants. Moreover, students reading in public schools in our study setting were mostly from lower socio-economic status families.

Around one-fourth of the adolescents in the present study had dental caries, palmer pallor (34.3%) and history of worm infestation (8%). Similar findings were observed in studies conducted in Puducherry.<sup>[13,22,23]</sup> In contrary to our findings, a higher prevalence was found in a study conducted in West Bengal.<sup>[24]</sup> Regular screening camps for children through outreach activities by the health centre, health education activities in school and the availability of better health facilities in Puducherry might have contributed to lower morbidities among the participants in the current study.

In our study, the male gender was found to be an independent risk factor associated with undernutrition, in contrast to usual expectation; but this finding was similar to the results of another study from West Bengal.<sup>[24]</sup> According to CNNS (2016–2018), 29.4% of boys and 18.9% of girls aged between 10 and 19 years were undernourished.<sup>[12]</sup> In the present study, children of the nonworking mother showed better nutritional status than working mothers but was not statistically significant. Similar findings were observed in a study by Srivastava *et al.*<sup>[25]</sup>

**Table 4: Association of socio-demographic factors and clinical factors with Under-nutrition among the adolescents in selected schools of urban Puducherry (n=499)**

Characteristics	Total (n=499)	Undernourished frequency (n=166), n (%)	Unadjusted prevalence ratio (95% CI)	Adjusted prevalence ratio (95% CI)	P
Age (years)					
Early adolescence (10-11)	42	10 (23.8)	1	-	-
Adolescence (12-14)	158	62 (39.2)	1.64 (0.92-2.92)	1.73 (0.94-3.18)	0.08
Late adolescence (15-18)	299	94 (31.4)	1.34 (0.74-2.32)	1.66 (0.90-3.07)	0.10
Gender					
Male	144	59 (40.9)	1.35 (1.05-1.74)	1.36 (1.01-1.83)	0.04
Female	355	107 (30.1)	1	-	-
Religion					
Hindu	379	130 (34.3)	1.14 (0.84-1.56)	-	-
Christian	117	35 (29.9)	1	-	-
Muslim	3	1 (33.33)	1.11 (0.21-5.65)	-	-
Number of family members					
≤4	265	80 (30.2)	1	-	-
5-7	193	68 (35.2)	1.16 (0.89-1.52)	-	-
≥8	41	18 (43.9)	1.45 (0.98-2.15)	-	-
Father's education (n=483)					
Illiterate	43	9 (21.0)	1	-	-
Primary	108	42 (38.9)	1.85 (0.99-3.47)	1.57 (0.82-2.96)	0.17
Secondary	221	70 (31.7)	1.51 (0.82-2.79)	1.30 (0.70-2.42)	0.42
Higher secondary and above	111	41 (36.9)	1.76 (0.94-3.37)	1.39 (0.72-2.68)	0.33
Mother's education (n=486)					
Illiterate	38	8 (21.1)	1	-	-
Primary	129	44 (34.1)	1.62 (0.83-3.13)	1.48 (0.70-3.10)	0.31
Secondary	207	67 (32.4)	1.53 (0.80-2.93)	1.49 (0.71-3.10)	0.29
Higher secondary and above	112	47 (42.0)	1.99 (1.03-3.83)	1.97 (0.93-4.17)	0.08
Fathers occupation (n=470)					
Unemployed	14	6 (42.9)	1.36 (0.67-2.75)	-	-
Self-employed/farmer	160	59 (36.9)	1.17 (0.78-1.77)	-	-
Daily waged	229	73 (31.9)	1.01 (0.64-1.52)	-	-
Monthly waged	67	21 (31.3)	1	-	-
Mother's occupation (n=487)					
Self-employed/farmer	115	41 (35.7)	1.11 (0.82-1.52)	-	-
Daily waged	91	30 (33)	1.03 (0.72-1.46)	-	-
Monthly waged	50	20 (40)	1.25 (0.85-1.85)	-	-
Homemaker/housewife	231	73 (31.9)	1	-	-
Socio-economic class (n=496)					
Lower class	406	139 (34.2)	1.14 (0.73-1.81)	1.14 (0.72-1.78)	0.58
Middle class	47	14 (29.8)	1	-	-
Upper class	43	13 (30.2)	1.01 (0.54-1.91)	0.90 (0.48-1.68)	0.74
H/o of skipping breakfast in last week					
No	236	77 (32.6)	1	-	-
Yes	263	89 (33.8)	1.15 (0.90-1.47)	-	-
H/o worm in stool					
No	459	150 (32.7)	1	-	-
Yes	40	16 (40)	1.22 (0.82-1.83)	-	-
Anemia status (n=458)					
Nonanemic	171	52 (30.4)	1	-	-
Anemic	287	108 (37.6)	1.24 (0.94-1.62)	-	-
Dental caries					
No	376	118 (31.4)	1	-	-
Yes	123	48 (39.0)	1.24 (0.95-1.62)	-	-

CI: Confidence interval, H/o: History of

The study had certain strengths; we included all the adolescents from all the existing government schools present in the area to estimate the burden of malnutrition. Standard WHO growth charts were used to assess the nutritional status among adolescents. Questions from RBSK guidelines were selected for assessing nutritional deficiencies and other common co-morbidities.

We had a few limitations in our study like being a study conducted among government schools in our study setting alone; the findings of the present study may not be generalisable to adolescents from private schools or to other study settings. Recall bias and social desirability bias while administering the questionnaire may not be completely eliminated. Assessment of self-reported co-morbidities might have been subjected to reporting bias. Almost 17% of the parents were not having formal education enough to self-administer the questionnaire. Due to practical difficulty in meeting the parents for an interview, data regarding these children were collected from school records. Despite this care has been taken to record the latest and authentic data to reduce any bias.

## CONCLUSION

One in every two adolescents was malnourished and one-third of adolescents were undernourished. One fourth of the adolescents had dental caries. Adolescent males need to be given special focus to tackle undernutrition among them as they are usually missed in routine interventions. Inclusion of advices related to healthy diet and healthy lifestyle needs to be given focused attention in the school curriculum. Periodic growth monitoring of school going students needs to be emphasised for the early identification of malnutrition.

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## Conflicts of interest

There are no conflicts of interest.

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