

## Nutritional Status of Adolescent School Girls of Uttarakhand

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**ABSTRACT** India has the highest number of adolescents in the world (20.9%). Nutritional intake of girls is on the decline with serious health implications. The study was conducted in two districts of Uttarakhand to determine the prevalence of malnutrition among adolescent girls in the context of socioeconomic factors. The objective was to assess the nutritional status, deficiency symptoms, and socioeconomic background of girls aged 12-15 years (n=300). The results revealed that three percent of the subjects were severely undernourished, 11.67 percent were moderately undernourished, twenty-one percent were stunted and 21.33 percent were thin. No significant association was found between BMI and variables such as age, family type, family income, food habits and meal pattern. Significant clinical symptoms were pale conjunctiva (24.33%), mottled teeth (23.33%), cavities in teeth (21.33%) and spongy bleeding gums (18.67%). Mean energy intake and several micronutrients were lower than recommended values.

### INTRODUCTION

Adolescence represents one of the critical transitions in a person's lifespan and is characterized by a tremendous pace in growth. The transitional phase (10-19 years) between commencements of puberty to adulthood is termed as adolescence (WHO 1986). According to the State of World's Children Report of 2011, out of 1.20 billion of total adolescents in the world, India is the largest contributor with 243 million adolescents (Parasuraman et al. 2009). According to the Census of India Report 2011, 20.9 percent of population in India comprises of adolescents. The Report of Third Repeat Survey of NNMB 2011-2012 shows that the nutrient intake of adolescents has declined considerably from 1996-1997 to 2011-2012. The extent of decline was 294 Kcal of energy, 5.6 g of protein and 144 mg of calcium. The overall mean intake of cereals and millets among girls decreased from 396g in 1996-1997 to 324g in 2011-2012. A large proportion of adolescents were consuming less than fifty percent of RDA of vitamins and minerals such as vitamin A, riboflavin, vitamin C, dietary folate, iron and calcium. Poor nutritional status during adolescence is an important determinant of health outcomes. Short stature in adolescents resulting from chronic under nutrition is associated with reduced lean body mass and deficiencies in muscular strength and working

capacity and reproductive efficiency (Deshmukh et al. 2006; Baliga et al. 2017). Anemia has been reported to be a major micronutrient deficiency among adolescent girls across the country. The prevalence of anemia was seen to be above eighty percent in various states of India (Giuseppina 2000; NIPCCD 2008). Recently, Dhuppar et al. (2017) reported prevalence of anemia to be 40.7 percent in adolescent girls from Raipur district, Chhattisgarh, and Upadhye and Upadhye (2017) concluded it to be ninety percent in an urban school of Nagpur. Researches show that under nutrition and menstrual problems particularly dysmenorrhea and premenstrual syndrome (PMS) are common among adolescent girls (Jyoti et al. 2012; Thakre et al. 2012; Yerpude et al. 2013). Various studies conducted in India highlight the high prevalence of stunting, thinness and micronutrient deficiencies among adolescents (UNICEF 2013). De (2016) pointed out that adolescents have increased nutritional needs due to several reasons, including their high requirements for growth spurt coupled with intense anabolism, their eating patterns, and their susceptibility to environmental influences. Haider (2006) asserted that in adolescents, chronic undernutrition delays normal maturation and is an important and widespread problem with multiple adverse health outcomes. Twenty-five to fifty percent of final adult ideal weight is gained during adolescence. Stunting among adoles-

cents is of great concern, as a short woman tends to have a small pelvis, and therefore, is more likely to have obstructed labor during childbirth. Thinness may limit school achievements and work productivity. Stigler et al. (2011) reported that obesity is also emerging as a common health issue among adolescents of the country. Bharthi et al. (2017) pointed out the fact that health and nutritional status of adolescent girls presently may have great impact on the quality of next generation. Given this background the study was undertaken to establish the health and nutritional status of adolescent girls of Uttarakhand.

### Objectives

The present study aimed to:

1. Explore the nutritional status of adolescent girls of Uttarakhand.
2. Investigate the association between BMI and various socioeconomic factors in the lives of adolescent girls.
3. Determine the prevalence of nutritional deficiency symptoms among adolescent girls.

## METHODOLOGY

### Study Design

In this study a cross-sectional design was employed by the researchers to assess the nutritional status of adolescent girls in two districts of Uttarakhand state.

### Study Setting

The study was conducted in rural schools of Udham Singh Nagar and Nainital districts of Uttarakhand, India. According to MSME Report of 1999, Udham Singh Nagar district falls in the Tarai region of Uttarakhand and its geographical coordinates are 29° 3' 0" north and 79° 31' 0" east. It covers a total land area of 2542 square kilometers. According to the 2011 Udham Singh Nagar District: Census Report, the total population in this region is 1,648,902 and 64.42 percent of the population lives in rural areas (15, 16). Bussa (2016) in a report stated that Nainital district situated in the Kumaon division is located approximately between 80°14' and 78°80' east longitude and 29°00' and 29° 05' north latitude.

As stated in Nainital District: Census 2011 it covers a total area of 4,251 square kilometers and has a total population of 954,605 of which 61.06 percent of the people live in rural areas. The present study was a cross-sectional investigation of the health status of adolescent girls. The study was conducted in three government schools of two districts. Govt. Girls Madhyamik School, Nagla and Govt. Girls Madhyamik School, Shanti Puri were the two schools located in Udham Singh Nagar district. The third school selected for the study was Govt. Girls Madhyamik School, Halduchaur located in Nainital district.

### Population and Sampling

Adolescent girls aged 12-15 years were selected for the study. All girls in the specified age range were included in the study. The single population proportion formula was used to determine sample size with ninety-five percent confidence level, five percent margin of error, design effect of 1.5 and five percent non-response rate. Thus, a sample of adolescent girls aged 12-15 years (n= 300) from three schools was selected for the study.

### Instrument and Data Collection Approach

A structured questionnaire that included questions about socio-demographic features was developed for the study. Data was collected between July and December 2015. Dietary intake was assessed through a 3-day 24-hour dietary recall method. Presence of nutritional deficiencies in the study samples was identified through clinical examination. Clinical symptoms such as lack of luster hair, thinness, sparseness, straightness, dys-pigmentation, flag sign, and easy pluck ability were noted. Eyes were checked for pale conjunctiva, bitot's spot, conjunctival xerosis, corneal xerosis, and keratomalacia. Presence of angular stomatitis, angular scars and cheilosis in lips, scarlet and raw tongue, magenta tongue and atropic papillae in tongue were noted. Teeth and mouth were checked for mottled enamel, cavity and spongy, bleeding gums. Thyroid and paratid enlargement was noted. Skin was checked for any signs of xerosis, follicular hyperkeratosis, Type-1 and Type-2 petechiae, pellagrous dermatosis and flaky paint dermatosis. Finally, nails were assessed for koilonychia.

The height of adolescent girls were measured to the nearest 0.1 centimeter using a calibrated ruler fixed to the wall as the child stood barefoot with the heels, back and head touching the wall and the head held in Frankfurt plane. A thin, wooden scale was placed above the head perpendicular to the ruler and parallel to the ground. Weight was measured to the nearest 0.1 kilogram using a portable weighing machine, which was standardized regularly by calibrating it to zero before each measurement, the girl being barefoot, emptied her pockets while standing on the weighing machine.

Body Mass Index (BMI) was computed using the standard equation:

$$\text{BMI (kg/m}^2\text{)} = \text{Weight (kg)/Height (m}^2\text{)}$$

For anthropometric indicators, WHO expert committee recommendations for adolescents were followed. The cutoff values for stunting was the <3 percentile of the National Center for Health Statistics (NCHS) standards and thinness was the <5 percentile of NCHS standards (WHO 1995). Data was analyzed and expressed in percentages. Associations were examined using chi square test. Mean BMI of sample population were calculated with relating confidence intervals. Prevalence of stunting and thinness was calculated based upon NCHS standards and were expressed in percentages. Statistically significant association of various socioeconomic parameters with BMI was computed. The socioeconomic parameters were age, family type, family income, food habits and meal pattern.

Prevalence of clinical symptoms of nutritional deficiencies has been presented as percent prevalence in the in the study samples.

The daily dietary intake of adolescent girls was assessed and compared with the RDA for that age group. Confidence intervals were computed at the ninety-five percent level and statistical significance was established at five percent.

### **Ethical Consideration**

Ethical approval was obtained from the University Ethical Committee for Human Research, G. B. Pant University of Agriculture and Technology, Pant Nagar, U. S. Nagar, Uttarakhand. Informed consent of participants was obtained after the study and its objectives were explained to them.

### **Data Analysis**

All the questionnaires returned were coded and data was entered on a Microsoft Excel

spreadsheet. The Statistical Package for Social Sciences (SPSS) version 22 was used to analyze the data. Processed data was presented using frequency distribution tables. Analysis involved simple statistics and correlations. Statistical significance was set at  $p < 0.05$ .

## **RESULTS**

### **Demographics**

A total of 300 girls participated in the present study. Table 1 represents the prevalence of stunting and thinness and its age wise distribution among the sample population. Stunting as defined by height for age <3<sup>rd</sup> percentile was present in overall twenty-one percent of the adolescent girls of whom 19.38 percent belonged to the 13-year age group, 19.56 percent were 14 years of age and 25.24 percent were 15 years old. Girls in the 15 years age group showed highest prevalence of stunting (25.24%). Thinness as defined by a BMI for age <5<sup>th</sup> percentile was reported in total 21.33 percent of adolescent girls. 14.28 percent of 12-year-old girls were thin. The prevalence of thinness was the highest among 13-year-old girls (27.55%). The BMI of study participants is also indicated in Table 1, which was calculated using the manual of Dietary Guidelines for Indians given by NIN (National Institute of Nutrition 2011). A total of three percent of adolescent girls were found to severely under-nourished. 11.67 percent were moderately undernourished and nine percent were overweight. 76.33 percent were found have normal BMI.

### **Association of BMI with Selected Variables**

Table 2 represents the association of BMI with different socioeconomic parameters. BMI of adolescent girls is a potent health indicator. No association was observed between BMI of adolescent girls and their age.

Further, Table 2 represents the association between BMI and family type. No significant dependence is observed. Family type was found to be independent of BMI. Association between BMI of adolescent girls and their food habit, and meal pattern is further depicted in Table 2. No significant dependency is observed between BMI and both factors, that is, food habit and meal pattern. Both factors, that is, food habit and meal pattern were found to be independent of BMI of adolescent girls.

**Table 1: Prevalence of stunting, thinness and BMI among adolescent girls**

% of girls in each age group	Age %	Stunting (Height for age < 3 <sup>rd</sup> percentile) %		Thinness (BMI for age < 5 <sup>th</sup> percentile) %						
		Mean $\pm$ SD	Confidence interval	Moderate under-nutrition	Obesity					
		n	%	n	%					
12	2.33	0		14,286						
13	32.67	19,388		27,551						
14	30.67	19,565		20,652						
15	34.33	25,243		16,505						
Total	100.00	21,00		21,333						
BMI(kg/m <sup>2</sup> )	18.379 $\pm$ 3.174	18,019-	18,738	11.67	229	76.33	27	9	0	0
MUAC(cm)	21.683 $\pm$ 2.545	21,395-	21,971	0.07	276	92	0	0	0	0

Severe under-nutrition= <-3 SD, Moderate under-nutrition= -3 SD to -2 SD, Normal= -1 SD to +1 SD, Overweight= +2 SD to +3 SD, Obesity= > 3 SD, SD= Standard Deviation, Confidence limit= 95%

**Table 2: Association of BMI with different variables**

Association between-	Factors	n	S. Un. (n)	M. Un. (n)	N. (n)	O.W. (n)	$\chi^2_{cal}$	$\chi^2_{tab}$	Level of significance (P)	Degree of freedom (df)
<i>Age</i>										
BMI of adolescent girls and their age	12	7	0	1	5	1	8.98	16.91	0.05	9
	13	98	6	12	74	6				
	14	92	2	13	66	11				
	15	103	1	9	84	9				
Total	300									
<i>Family Type</i>										
BMI of adolescent girls and family type	Nuclear	231	5	27	177	22	3.92	12.59	0.05	6
	Joint	64	4	7	48	5				
	Extended	5	0	1	4	0				
Total	300									
<i>Food Habit</i>										
BMI of adolescent girls and their food habit	Vegetarian	74	4	6	55	9	9.07	12.592	0.05	6
	Non-vegetarian	132	3	18	96	15				
	Ovatarian	94	2	11	78	3				
Total	300									
<i>Meal Pattern</i>										
BMI of adolescent girls and meal pattern	1 Time	35	1	5	26	3	1.12	16.91	0.05	9
	2 Time	4	0	0	4	0				
	3 Time	261	8	30	199	24				
	4 Time	0	0	0	0	0				
Total	300									

n- number, S. Un.- Severe Under nutrition, M. Un.- Moderate Under nutrition, N- Normal, O.W.- Over weight

### Prevalence of Clinical Symptoms

Table 3 shows the clinical symptoms of nutritional deficiencies found among the adolescent girls. The pale conjunctiva in eyes was the most common (24.33%) clinical symptom. Next was presence of mottled enamel and cavities in teeth (23.33%). 21.33 percent of adolescent girls were reported to have thin hair and 14.675 percent of the girls lack luster in their hair or had sparse hair. 18.67 percent girls had spongy and bleeding gums. Only 3.33 percent were reported to have angular scars on lips.

**Table 3: Prevalence of clinical symptoms among adolescent girls**

<i>Clinical symptoms</i>		<i>Symptom present %</i>
<i>Hairs</i>	Lack of luster and sparse	14.67
	Thinness	21.33
	Straightness	0.67
	Dys-pigmentation	3.33
	Flag sign	2.33
<i>Eyes</i>	Easy pluck ability	13.67
	Pale conjunctiva	24.33
<i>Lips</i>	Bitot's spot	0.67
	Angular stomatitis	0.33
	Angular scars	3.33
	Cheilosis	0.33
	Magenta tongue	0.33
<i>Teeth</i>	Atropic papillae	0.67
	Mottled enamel, cavity	23.33
<i>Gum</i>	Spongy, bleeding gums	18.67
<i>Glands</i>	Thyroid enlargement	0.33
	Flaky paint dermatosis	2.33

### Dietary Intake in Comparison with RDA

Table 4 shows the dietary intake of subjects. It is observed that the daily dietary intake of adolescent girls was insufficient when compared with RDA. Intake of all nutrients listed in the table was below the recommended level except for vitamin C, thiamine and riboflavin. Micronutrient deficiencies appear to be a serious nutritional problem among the subjects.

### DISCUSSION

In the present study, 3 and 11.67 percent of adolescent girls aged between 12-15 years were found to severely and moderately undernourished, respectively. In a cross-sectional study by NNMB conducted in 1996-1997 published in 2002 including data from rural areas of 9 states of India the prevalence of under nutrition on an average was reported to be 39.5 percent, whereas its prevalence varied from 35.7 to 45.3 percent according to different age groups between 12-15 years, which is less than reported in the present study. In their diet and nutritional survey of rural adolescents in India, Venkaiah et al. (2002) reported that the prevalence of underweight among adolescent girls is 39.5 percent. A study by Mukhopadhyay et al. (2005) revealed the prevalence of under nutrition among adolescent girls to be 30.61 percent. A similar study by Shaw and Prashant (2009) conducted on adolescent girls from an urban slum in South India

**Table 4: Comparison of daily average nutrient intake with RDA**

<i>Nutrients</i>	<i>Average intake per day</i>	<i>RDA (Revised RDA for Indians by NIN- 2010)</i>	<i>Difference</i>	<i>% Deficiency</i>
Energy	1306.35	2330	-1023.65	43.93
Carbohydrate	213.28	699	-485.72	69.49
Protein	40.12	51.9	-11.78	22.70
Fat	29.14	40	-10.86	27.15
Calcium	317.33	800	-482.67	60.33
Iron	16.32	27	-10.68	39.56
Zinc	6.80	11	-4.20	38.18
Vitamin C	143.37	40	+103.37	-
̑-carotene	1100.58	4800	-3699.42	77.07
Retinol	0.06	600	-599.94	99.99
Thiamine	5.81	1.2	+4.61	-
Riboflavin	2.21	1.4	+0.81	-
Niacin	12.03	14	-1.97	14.07
Folic acid	92.79	150	-57.21	38.14



in 2009 showcased the prevalence of under nutrition to be 42.6 percent. In the study, "Nutritional Status of Schoolgoing Adolescents in a Rural Block of Darjeeling, West Bengal" by Biswas et al. (2011) forty percent of the adolescents were reported to be undernourished and severe malnutrition was found in twenty-nine percent of girls. Dhingra (2011) reported that the prevalence of under nutrition was maximum among the adolescent Gujjar girls of Jammu, that is, 8.1 percent. The highest prevalence of malnourishment was found among girls of 13 years of age, which is similar to the present study. In a study conducted by Yerpude (2013) in South India on schoolgoing adolescents in urban area of south India, 37.76 percent girls were found to be underweight. In a recent study by De (2017), only 64.2 percent rural adolescent girls were in the normal BMI range, whereas in the present study this percentage was 76.33. Another study by Bharthi et al. (2017) showcased the mean BMI of adolescent girls to be  $15.52 \pm 2.75$ , which was less as compared to mean BMI of girls in the present study that is  $18.379 \pm 3.174$ .

When the adolescent girls of the study area were evaluated on the basis of stunting and thinness the percentage observed was twenty-one percent. In the study done by Vashist et al. (2009), stunting (height for age) was reported to be 12.7 percent and thinness (BMI for age) was 15.1 percent. These values are lower than those found in this study. In a study conducted in urban slums of south India by Mukhopadhyay (2005) the prevalence of stunting was reported to be forty-seven percent, which is much higher than the prevalence of stunting found in the present study. In another study of south Indian schoolgoing adolescents by Yerpude et al. (2013), 33.33 percent were found to be stunted. Recently, Dharmalingam et al. (2017) reported 48.1 percent stunting in adolescent girls aged between 10-19 years in Pondicherry, which was quite high as compared to the present study. In another recent study conducted by Pal et al. (2017) in West Bengal the prevalence of stunting and thinness among adolescent girls aged 10-17 years was observed to be 58.36 and 50.89 percent. A study in 2006 conducted by Deshmukh et al. (2006) to determine nutritional status of adolescents in rural Wardha the prevalence of thinness was observed to be 53.8 percent, which is very high as compared to the present study. Vashist et al. (2009) reported that the prev-

alence of thinness among adolescents in rural and urban Rohtak, Haryana in 2009 was 15.1 percent. Mukhopadhyay et al. (2005) stated prevalence of thinness to be 20. Six percent in a study on adolescent girls of south India, which is similar to prevalence of thinness found in present study. Prevalence of thinness was found highest at the age of 13 years that is similar to present study. In a study by conducted by Baliga et al. (2017) in Belgaum, Karnataka among 400 adolescent girls of 10-19 years, sixty-two percent was observed to be thin, which is quite high when compared to the present study.

14.67 percent adolescent girls of Uttarakhand had lusterless and sparse hair, 21.33 percent had thin hair, 3.33 percent and 13.67 percent girls showed dys-pigmentation and easy pluck ability, respectively. 24.33 percent girls had pale conjunctiva and only 0.67 percent were reported to have Bitot's spot. 3.33 percent girls had angular scars on their lips. 23.33 percent of subjects had mottled enamel or cavities in teeth and 18.67 percent were found to have spongy and bleeding gums. 2.33 percent of total subjects were reported to have flaky paint dermatosis of the skin. In a study conducted in 2003 by Choudhary et al. the prevalence of Bitot's spots were reported in 3.33 percent subjects and 13.33 percent were found to have dental caries, which is more than the prevalence found in the present study. Kishore et al. (2010) conducted a study in Dehradun, which is in the state of Uttarakhand, and found that thirty-one percent schoolgoing adolescents had dental caries, which is comparable to the present study. In a study conducted in south India in 2013 by Yerpude et al. (2013) on schoolgoing adolescents, the prevalence of dental caries was stated to be 36.11 percent. In the present study, the mean energy intake was found to be 1306.35kcal, that is, 56.07 percent of daily intake as per RDA. Average protein consumption is 40.12 grams per day that is 77.30 percent of RDA prescribed for adolescents, which is approximately 22.75 less than RDA. In a study conducted by Sharma et al. in 2005 it was reported that the protein intake on an average was thirty percent less than that recommended by Indian Council of Medical Research (ICMR), which is comparable to the present study. The mean calorie intake for 301 adolescent girls was  $1155.9 + 522.7$  Kcal, which is only fifty-six percent of recommended daily calorie intake, which is very similar to the present study. Iron consumption

is 60.44 percent of RDA. Percentage of retinol,  $\beta$ -carotene and folic acid is also very less in diet, that is, less than one percent, less than thirty percent and less than sixty-five percent of RDA, respectively. In a report given by NNMB it was reported that more than 2/3 of adolescents were consuming less than seventy percent of RDA for vitamin A and riboflavin, that is, the intakes of micronutrients such as vitamin A and riboflavin were woefully inadequate (NNMB 2002).

The study shows that 88.33 percent adolescent girls consumed more than one meal per day. In a recent study conducted in 2015 by Hedge it was reported that most of the participants (91.6%) consumed at least one meal. Recent study conducted by Khandelwal et al. (2017) in Shimla district concluded that the adolescent girls aged 13-15 years had percentage deficit for calorie, iron, zinc and calcium intake as 47.7, 61.5, 53.6, and 43.6 percent respectively, as compared to RDA.

The study has tried to identify factors that may have a significant association with the nutritional status of the adolescent girls of Uttarakhand. Associations of BMI with age, family type (nuclear or joint), food habits and meal pattern were found to be insignificant. According to a NNMB report, association of BMI with type of family was found to be non-significant but significant association was found between BMI and family income (NNMB 2002). In a recent study by Kankana (2017) it was found that socioeconomic status affects living standards and nutritional intake of adolescent girls.

### CONCLUSION

It may be concluded from the study that the nutritional status of adolescent girls of Uttarakhand is a matter of concern. The prevalence of under nutrition is higher on the basis of stunting and thinness as compared to adolescents in many other parts of the country. Similarly, food intake of the respondents is below the required level. The diet of the girls has been found to be severely deficient in all nutrients barring vitamin C, B1 and B2. This is likely to have serious health implications when the girls transit into motherhood later in life. Puberty influences the health of individuals, which means that that special attention needs to be given to the girls in this period of life. Further longitudinal studies

will help develop a framework for building a female robust population for the state.

### RECOMMENDATIONS

On the basis of the findings of the study it is recommended that national policies for early detection of under nutrition, stunting and wasting among young adolescent girls need to be framed. Strategies to address issues of hidden hunger need to be taken up in order to insure that the future generations are healthy and can give their full potential to the development of the nation. Social media may be effectively employed to disseminate and encourage young girls to seek health information pertaining to above discussed health issues.

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