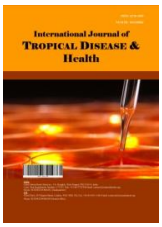

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Assessment of the Nutritional Status and Determinants of Malnutrition among School Going Adolescents in the Rural Field Practice Area of the Medical College, Hassan, Karnataka

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Authors' contributions

Both the authors have equally contributed to conception and design, literature search, acquisition of data, analysis and interpretation of data, drafting the article and revising the manuscript critically for important intellectual content. Both authors read and approved the final manuscript.

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ABSTRACT

Background and Objectives: Adolescence which is the transitional period between childhood and adulthood is often the neglected phase as the adolescents are often regarded as relatively healthy with the focus being given for children and women. Addressing the nutritional needs of adolescents could be an important step in curbing malnutrition among them. With the rising epidemic of Non-communicable diseases, it is equally important to address both the issues of under-nutrition and over-nutrition. Hence this study was undertaken to assess the nutritional status and associated risk factors of malnutrition among the school going adolescents from 5th to 12th standard in the rural field practice area of Hassan Institute of Medical Sciences (HIMS), Hassan.

Methods: A cross-sectional study was conducted among the school going adolescents attending the government and private schools of the rural field practice area of the medical college from January 2017 to June 2018. The sample size of 830 was divided between the three areas under

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rural field practice area as per sample size proportional to population. BMI was measured and WHO reference charts 2007 for BMI was used to categorize the nutritional status of the adolescents.

Results: The prevalence of malnutrition among the school going adolescents was found to be 44.1% of which the prevalence of thinness and severe thinness was 15.8% and 21.3% respectively and that of overweight and obesity was 5.8% and 1.2% respectively. On logistic regression, male gender, government school, lower socio-economic status, deworming status and open-air defecation were identified as significant risk factors for undernutrition and female gender, private school, upper socio-economic status, low levels of physical activity, excess television watching, consuming junk foods, breakfast skipping, inadequate sleeping hours were identified as significant risk factors for over nutrition.

Conclusion: The prevalence of malnutrition among the school going adolescents was found to be 44.1% in our study. Gender, type of school in which they study, socio-economic status and life style behaviours were found to be significant risk factors for malnutrition. There is a need for health education programmes, regular monitoring and effective policies to promote healthy eating and lifestyle changes among adolescents to curb the burden of malnutrition.

Keywords: Adolescence; malnutrition; thinness; obesity; school going adolescents; nutritional status; body mass index.

1. INTRODUCTION

Adolescence which is a transitional period between childhood and adulthood, provides an opportunity to prepare for a healthy productive and reproductive life, and to prevent the onset of nutrition-related chronic diseases in adult life. WHO identifies adolescence as the period from 10 to19 years of age. Adolescence is commonly regarded as a relatively healthy period of the life cycle as they are less vulnerable to infection and being in transition, adolescents may no longer benefit from the attention and care that usually go to children, and they may not get the protections associated with adulthood either [1]. Addressing the nutritional needs of adolescents could be an important step towards breaking the vicious cycle of intergenerational malnutrition, chronic diseases and poverty [2].

Malnutrition denotes impairment of health arising either from deficiency or excess or imbalance of nutrients in the body. It is the end result of multiple overlapping and interacting factors – physical, biological, social and cultural environment, and economic [3] that adolescents are exposed to under-nutrition, micronutrient malnutrition as well as obesity. Their lifestyle and eating behaviours, along with underlying psychosocial factors, are particularly important threats to adequate nutrition [1].

In the South East Asia Region, while a large number of adolescents suffer from chronic under-nutrition, those belonging to the affluent segments of society may suffer from obesity. Both conditions however, compromise adolescents' general health and performance [4].

In India, currently there is more emphasis on micronutrient deficiencies with respect to iron, vitamin A and iodine deficiency disorders that continue to be major nutritional problems. On the other hand, obesity is increasing in most of high income countries, in developing countries undergoing nutrition transition and even in poor countries. Adolescents are exposed to high calorie, high fat foods that are readily available, heavily advertised and are delicious; along with lack of exercise leads to psychosocial problems, increased cardiovascular risk factors, abnormal glucose metabolism, hepatic gastrointestinal disturbance, sleep apnoea and orthopaedic condition [5].

Very little attention has been paid to adolescents' nutrition in research as well as in programming for adolescent health. When adolescents are well nourished, they can make optimum use of their skills, opportunities and energies today, and become healthy and responsible adults. To accomplish such a task, and in order to break the intergenerational cycle of malnutrition, a special focus for overcoming adolescent malnutrition is needed [4].

Studies available for adolescent malnutrition in the rural areas are comparatively scant and the literature being available focuses more on girls than boys. This signifies the need of the hour to assess the nutritional status among both

adolescent boys and girls between the age group of 10-19 years in the rural area. With this in mind, the present study was undertaken to assess the nutritional status of the adolescents.

1.1 Objectives

To estimate the prevalence of malnutrition and to determine the risk factors among the school going adolescents from 5th to 12th standard in the rural field practice area of Hassan Institute of Medical Sciences (HIMS), Hassan .

2. MATERIALS AND METHODS

This cross-sectional study was conducted among the school going adolescents from 5th to 12th standard attending Government and Private schools in the rural field practice area of HIMS, Hassan during the period of January 2017 to June 2018. The three Primary Health Centres that come under the rural field practice area of HIMS, Hassan are Bhuvanahalli, Shantigrama and Salagame. The school going adolescents from 5th to 12th standard residing in these three areas were included for collecting data.

2.1 Sampling

Sample Size: Sample size was estimated using the formula $n=Z^2pq/d^2$

where, p = prevalence of adolescent obesity taken as 32.7 % (According to study conducted in rural Goa by Banerjee S et al. [6])

z = 1.96 (considering 95% confidence level)
d = relative precision of 10%= 10% of 32.7= 3.27
n = 790 school going adolescents

To compensate for sample attrition, 5% (5% of 790) is added to the calculated sample size to get final sample size of 830.

Inclusion Criteria: Both boys and girls in the age group 10-19 years attending the Government and Private schools in Bhuvanahalli, Shantigrama and Salagame and students who were willing to participate in the study were included.

Exclusion Criteria: Students who had any chronic illness, who had been taken bed rest for more than 15 days during last 6 months due to any sickness, who were not present on the day of the interview.

Sampling Procedure: Ethical clearance was obtained from Institutional Ethical Committee. The 830 subjects fulfilling the inclusion criteria were divided among the 3 Primary Health Centres as per sample size proportional to population. Bhuvanahalli had a population of 14,280; Shantigrama had 12,934 and Salagame had 27,800 for the year 2017. Considering 21% of total population is being constituted by Adolescents in India [7], Bhuvanahalli, Shantigrama and Salagame had an expected adolescent population of 2998, 2716 and 5838 respectively. Hence as per Sample size proportional to population, 216 adolescents were selected from Bhuvanahalli, 195 adolescents from Shantigrama and 419 from Salagame. Among the schools present in those 3 areas, 2 Government and 2 Private schools were selected randomly keeping in view the operational feasibility. Then the number of adolescents selected from each study area were divided among the Government and Private schools equally. Written informed consent from the Schools' principals was obtained. Students and their parents were informed of the activities to be conducted. As the information being collected was part of a routine school health programme, no parent refused participation of their child. Adolescents were asked for their assent for each activity. The students were then selected from each class as per the availability of the students till required sample is reached. A brief explanation about the questionnaire and the motive of the interview was explained to the students and after that data was collected from them.

The study included:

1. A structured questionnaire: A pre-designed, pre-tested, structured questionnaire was used which included data on demographic factors like religion, community, type of family, family size, per capita income, literacy and occupation of their parents, about nutritional habits, lifestyle behaviours, physical activity, sleeping behaviour etc.
2. Anthropometric Measurements: The weight and height of each student was measured. The height was measured on a stadiometer to the nearest 0.1 cm and weight measured to the nearest 0.1 kg by standard weighing machine calibrated periodically. BMI was calculated and assessed using the WHO Growth reference gender specific chart 2007 and

categorized into normal, thin, severely thin, overweight and obese [8].

2.2 Analysis of Data

The data collected was entered in Microsoft Excel and analyzed using SPSS version 20. Statistical methods: Descriptive statistical analysis was used in this study. Association of each of the categorical variable with nutritional status was assessed with the Chi-square test. The variables that were significantly associated with malnutrition were simultaneously subjected to the multiple logistic regression model to determine the significant independent risk factor of malnutrition. Significance is assessed at 5% level of significance.

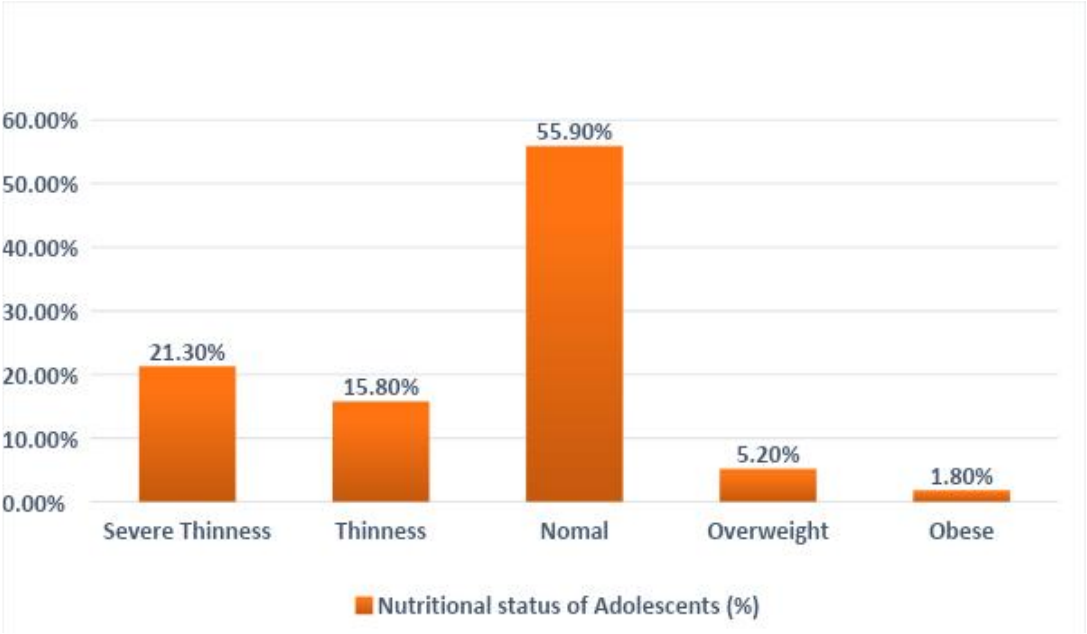
3. RESULTS

Out of the 830 school going adolescents, 640 (77.1%) were in their early adolescent period (10 to 14 years) and 190 (22.9%) were in their late adolescence (15 to 19 years). 429 (51.7%) were males and 401 (48.3%) were females. Majority of the study subjects belonged to Hinduism (96.3%) followed by Christianity (1.9%) and Islam (1.8%). Majority of the study participants were from nuclear family (86.1%), 7.7% were from joint family and 6.2% of them were from three generation family. 16.4 % of the study subjects belonged to Upper class, 17.3 % belonged to Upper Middle class, 30.4%, 26.1% and 9.8% belonged to Middle, Lower Middle and Lower classes respectively according to modified B G Prasad's classification [9].

Graph 1 shows that prevalence of Malnutrition among school going adolescents was 44.1%; and that of Under-nutrition and over-nutrition was found to be 37.1% and 7.0% respectively.

Table 2 shows the association between the socio-demographic factors and malnutrition of the adolescents. Age, gender, type of school in which they study and socio-economic status (SES) of the adolescents were significantly associated with their nutritional status with p value <0.05. All these significant factors along with the other risk factors were run through a logistic regression model to determine the significant predictors of malnutrition.

The Univariate Logistic Regression model for under-nutrition revealed that age of the adolescent, gender, type of school in which they are studying, socio-economic status, religion, mothers' education and occupation, deworming status and open air defecation were significantly associated with under-nutrition (p <0.05). These significant factors were adjusted to get adjusted odds ratio using Multinomial logistic regression analysis. (Table 1).



Graph 1. Proportion of malnutrition among school going adolescents (n= 830)

Table 1. Socio-demographic correlates of malnutrition among school going adolescents (n=830)

Demographic profile	Normal	Thinness and Severe thinness	Overweight and obese	p value
Age				
10-14 years	375 (58.6)	218 (34.1)	47 (7.3)	0.004*
15-19 years	89 (46.8)	90 (47.4)	11 (5.8)	
Gender				
Male	216 (50.3)	186 (43.4)	27 (6.3)	0.001*
Female	370 (92.3)	122 (30.4)	31 (7.7)	
School				
Government	224 (54.0)	164 (39.5)	27 (6.5)	0.002*
Private	240 (57.8)	144 (34.7)	31 (7.5)	
Socio-Economic status				
Upper	84 (61.8)	45 (16.2)	7 (16.9)	0.013*
Middle	345 (56.3)	222 (36.2)	46 (7.5)	
Lower	35 (43.2)	41 (50.6)	5 (5.1)	
Type of family				
Nuclear	396 (55.4)	275 (38.5)	44 (6.1)	0.080
Joint	39 (60.9)	18 (28.1)	7 (10.9)	
Three generation	29 (56.9)	15 (29.4)	7 (13.7)	
Religion				0.814
Hindu	449 (56.2)	299 (28.7)	51 (7.1)	
Non- Hindus	19 (61.2)	5 (16. 1)	7 22.6)	

*Note: Figures in parenthesis indicate percentages, *p value<0.05 = significant*

Table 2. Association of under-nutrition with significant socio-demographic and risk factors using multinomial logistic regression

S.No	Variables	Variable Category	Adjusted Odds ratio	95% Confidence Interval for Adjusted OR	p value
	Age		1.192	1.037-1.370	0.014*
1.	Age	Late adolescence	1.892	1.530-2.955	0.001*
		Early adolescence	1		
2.	Gender	Male	2.080	1.445-2.996	0.000*
		Female	1	.	
3.	School	Government	1.439	1.021-2.030	0.038*
		Private	1		
4.	SES	Lower	2.922	1.484-5.752	0.002*
		Middle	1.260	0.755-2.103	0.377
		Upper	1		
5.	Mother's Education	Illiterate	1.216	0.380 -3.887	0.741
		Schooling	1.262	0.400- 3.980	0.691
		Degree	1		
6.	Mother's Occupation	Housewife	0.840	0.516–1.368	0.483
		Working mother			
7.	Availability to clean water	Yes	1.664	0.462- 1.925	0.097
		No	1		
8.	Open Air Defecation	Yes	1.526	1.296-3.350	0.020*
		No	1		
9.	Deworming done	No	1.972	1.324 -2.914	0.048*
		Yes	1		

** Significant predictors of undernutrition after adjusting for confounders*

After adjusting to find out the independent significant risk factors of undernutrition, the test shows, for every one-unit increase in the age, the odds of being undernourished increases by 1.192 times (OR= 1.192, 95% CI 1.037-1.370). Adolescents in their late adolescence had 1.892 times (OR= 1.892, 95% CI 1.530-2.955) more odds of developing undernutrition when compared with early adolescents. Males adolescents have more odds of developing undernutrition by 2.08 times (OR= 2.080, 95% CI 1.445-2.996) when compared with the female adolescents. Adolescents of government schools have 1.439 times (OR= 1.439, 95% CI 1.021-2.030) more odds of developing undernutrition when compared with private school adolescents. Those adolescents in the lower SES have 2.922 times (OR= 2.922, 95% CI 1.484-5.752) more odds of developing undernutrition when compared with those belonging to upper SES. Those adolescents who have did not have accessibility to toilets and practiced open air defecation have more odds of developing undernutrition when compared with those who have accessibility to toilet by 1.526 times (OR= 1.526, 95% CI 1.296-3.350). The adolescents for whom deworming was not done biannually were at more risk of developing under-nutrition by 1.972 times (OR= 1.972, 95% CI 1.324-2.914).

The Univariate Logistic Regression model for over-nutrition revealed that age, gender, school to which the students belong, socio-economic status, food intake frequency (consumption of vegetables, fruits, chocolates, biscuits, junk), physical activity, hours of watching television, duration of sleep at night, pattern of breakfast skipping were significantly associated with over-nutrition ($p < 0.05$). These significant factors were adjusted to get adjusted odds ratio using Multinomial logistic regression analysis (Table 3).

After adjusting to find out the independent significant risk factors of over-nutrition, the test shows adolescents in their early adolescence had 1.514 times (OR= 1.514, 95% CI 1.006-2.034) more odds of developing over-nutrition when compared with late adolescents. Those adolescents in the upper SES have 3.5 times (OR= 3.499, 95% CI 2.769-15.926) higher odds of developing overweight and obesity when compared with those belonging to lower SES. Those adolescents who have never consumed vegetables in the past week have more odds of developing overweight and obesity by 1.086 times (OR= 1.086, 95% CI 1.010- 1.459) when compared with those who consume vegetables daily. Those adolescents who consume chocolates more than once daily have more odds of developing overweight and obesity by 8.356 times (OR= 8.356, 95% CI 1.672- 41.768) when compared with those who have never consumed chocolates at all in the past week. Similarly, who consume oil fried items like vadda, bajji more than once in the past week have more odds of developing overweight and obesity by 2.733 times (OR= 2.733, 95% CI 1.003 – 7.446). The adolescents who do not play any day in the past week have 8.654 times (OR= 8.654, 95% CI 2.420 – 52.741) more odds of developing overweight and obesity when compared with those who play daily in the form of sports, exercise, household chores etc. The adolescents who watch television for more than 4 hours/day have 1.498 times (OR= 1.498, 95% CI 1.112-3.152) more odds of developing overweight and obesity when compared with those who watch less than 2 hours. The adolescents who sleep inadequately or more than 9 hours have more odds of developing overweight and obesity by 1.214 times (OR= 1.214, 95% CI 1.078 – 1.585) when compared with those who sleep adequately for 8-9 hours. The adolescents who skip breakfast daily or intermittently have more odds of developing overweight and obesity by 2.130 times (OR= 2.130, 95% CI 1.976 – 4.649) when compared with those who never skip breakfast.

4. DISCUSSION

A study of adolescent boys and girls attending the government and private schools in the rural field practice area of Hassan Institute of Medical Sciences, Karnataka on a sample, consisting of 830 adolescents was conducted to assess the burden of Malnutrition – Undernutrition and Over-nutrition. A number of studies have concentrated either underweight or overweight and very few studies have concentrated on both the aspects of Malnutrition. Our study focuses on both the facets of malnutrition.

In this study, the prevalence of malnutrition-undernutrition and overnutrition was found to be 44.1% which is relatively less compared with the study done by Deshmukh PR et al. [10] in rural Wardha (56%) and much lesser when compared with the study done by Palaniappan S et al. [11] and Syamala AP et al. [12] in Thiruvallur district and in selected five districts of Tamilnadu respectively that showed a prevalence of 66.8% and 82.5% respectively. And also when compared with the studies done in district of

Table 3. Association of over-nutrition with significant socio-demographic and risk factors using multinomial logistic regression

S.No	Variables	Variable Category	Adjusted Odds ratio	95% Confidence Interval for Adjusted OR	p value
	Age		**1.082**	**0.795- 1.473**	**0.615**
1.	Age	Early adolescence	1.514	1.006 – 2.034	0.001*
		Late adolescence	1		
2.	Gender	Male	0.581	0.285-1.182	0.134
		Female	1		
3.	School	Government	.943	0.474-1.875	0.867
		Private	1		
4.	SES	Upper	3.499	2.769-15.926	0.017*
		Middle	3.873	1.270-11.808	0.105
		Lower	1		
5.	**Food Intake pattern**				
	Vegetables	Never in the past week	1.086	1.018-1.406	0.002*
		Once or more than once in the past week	1.160	1.021-1.222	0.089
		Once Daily	0.066	0.010-1.459	0.077
		More than once daily	1		
	Fruits	More than once daily	1.041	0.362-2.990	0.941
		Once Daily	0.527	0.190- 1.461	0.218
		Once or more than once in the past week	0.963	0.328 – 2.824	0.945
		Never in the past week	1		
	Biscuits	More than once daily	0.284	0.088-0.918	0.135
		Once Daily	0.296	0.101-0.863	0.126
		Once or more than once in the past week	0.405	0.112-1.464	0.168
		Never in the past week	1		
	Chocolates	More than once daily	8.356	1.672-41.768	0.010*
		Once Daily	3.939	0.845-18.363	0.081
		Once or more than once in the past week	2.915	0.614-13.837	0.178
		Never in the past week	1		
	Junk	More than once daily	1.205	0.438-3.310	0.718

S.No	Variables	Variable Category	Adjusted Odds ratio	95% Confidence Interval for Adjusted OR	p value
		Once Daily	0.885	0.253-3.098	0.848
		Once or more than once in the past week	2.733	1.003-7.446	0.049*
		Never in the past week	1		
6.	Playing outside days/week	None	8.654	2.420-52.741	0.019*
		Weekly 5 times	13.184	2.109-82.410	0.006*
		Weekly <5 times	11.409	1.839-70.790	0.159
		Daily	1		
7.	TV watching/day	>4 hours	1.498	1.112-3.152	0.011*
		2-4 hours	1.839	1.359-2.961	0.007*
		<2 hours	1		
8.	Hours of sleep during night	< 8 hours	1.852	1.384-2.893	.0490
		>9 hours	1.214	1.078-1.585	.003*
		8-9 hours	1		
9.	Skipping breakfast/ week	Daily	2.130	1.976-4.649	0.047*
		Intermediate	2.216	1.004-4.893	0.049*
		Never	1		

** Significant predictors of over-nutrition after adjusting for confounders*

Karnataka by Kamath R et al. [13] in Bellary (33.5%) and by Abraham RR et al. [14] in Bangalore (31.5%), our study showed an increased prevalence of malnutrition (44.1%). Another study by Singh MS et al. [15] in Manipur showed a prevalence of 31.9%.

This variation in the prevalence of malnutrition between different studies has been explained to be due to cultural differences, different measurement tools like WHO BMI reference charts, IAP classification of nutritional status, CDC guidelines 2000, International Obesity Task Force, etc., different methods, and different appraisal standards. Other reasons may be due to socio-demographic factors and risk factors associated with the nutritional status of the adolescents.

In our study, the prevalence of undernutrition was found to be more among boys (43.4%) when compared with girls (30.4%). This is similar to other studies that showed an increased prevalence of undernutrition among boys when compared with girls [6,13,14,16,17]. And also, the prevalence of overweight and obesity was found to be more among the girls (7.7%) when compared with boys (6.3) which is similar to the studies conducted across the country [13,14,15,18,19,20] and in contrary to few studies that shows a higher prevalence of overweight and obesity among boys when compared to girls [19,21].

Gender differences in malnutrition can be summed as follows: compared with boys, girls have greater fat mass and distinctive fat distribution; and they are more susceptible to family and environmental factors that lead to obesity; and also they are less sensitive to insulin and leptin, then they are predicted to have increased energy intake coupled with decreased energy expenditure, based on the biological properties of this hormone. These factors would, in turn, lead to increased fat mass and higher circulating levels of leptin [22].

In our study, students in late adolescence were observed to be at highest risk of undernutrition (47.4%) significantly more as compared to early adolescents (34.1%) which is contrary to the study done by Palaniappan S. [11], Dambhare DG et al. [16] and Bose K et al. [17] which showed that early adolescents are at higher risk of under-nutrition due to various stress factors, increasing demand and inadequate intake of nutrients. Pubertal spurt leads to greater nutritional requirements among adolescents, but psychosocial and emotional problems too, may exert significant influence on their nutritional status [11]. This variation in our study needs to be further probed to find out if the risk of undernutrition remains the same throughout the adolescence without distinction between early and late. But early adolescents were observed to be at highest risk of over-nutrition (7.3%) significantly more as compared to late adolescents (5.8%). In a study by Dietz WH, 10% of the adult obesity developed during early adolescence in males whereas in females this proportion was found to be 30% [23].

In our study, the prevalence of undernutrition was found to be more among students who did their schooling in Government school (39.5%) when compared with those in Private schools (34.7%) and the prevalence of over-nutrition was found to be more among students who did their schooling in Private school (7.5%) when compared with those in Government schools (6.5%). This is similar to the studies done in Gujarat, Chennai and New Delhi [18,24,25]. This discrepancy may be attributed to, people with better affordability tend to put their children in private schools than in the government schools.

In our study, the students belonging to Lower SES (50.6%) were more undernourished than those belonging to Upper SES (16.2%) and the students belonging to Upper SES (16.9 %) were more overweight and obese than those belonging to Lower SES (5.1%). This is similar to the studies done by Syamala AP et al. [12], Gupta DK et al. [25], Kotian MS et al. [26], Gaiki et al. [27]. In economically poor households, lower income of the family leads to decreased buying capacity which affects the nutritional status of the adolescents. More affordability, better living conditions, urbanization may be the reasons for higher prevalence of over-nutrition among upper SES [14].

In this study, study subjects belonging to nuclear family (38.5%) were thin and severely thin followed by adolescents belonging to three generation family (29.4%) and joint family (28.1%). 13.7% of students belonging to three generation family were overweight and obese followed by joint (11%) and nuclear family (6.1%). This is contrary to the study done by Bose K et al. [17] that showed that those belonging to joint family were more undernourished when compared with those belonging to nuclear family because of sharing of the food between the family members.

In this study, those adolescents who practiced open air defecation have more odds of developing undernutrition by 1.526 times and adolescents for whom deworming was not done biannually were at more risk of developing under-nutrition by 1.972 times. This signifies the importance of biannual deworming and the risk of hookworm infestation among adolescents.

In our study, adolescents who had indulged in daily consumption of chocolates and oil fried items, and those who lack physical activity in the form of sports, exercise, household chores etc and who watch television more than 4 hours/day are more in the risk of developing overweight and obesity when compared with their counterparts. The increased prevalence of over-nutrition can be attributed to increasing accessibility and affordability of both junk foods and modes of motorized transportation resulting in an increased consumption of energy-dense foods coupled with decreased physical activity, television watching while eating. This is similar to the study done by Kotian MS et al. [26] that showed the prevalence of overweight was higher among the adolescents who had physical activity of less than one hour/day, watched television ≥ 4 hours/day, and ate chocolates daily. Also similar to the study by Goyal JP et al. [21] that showed that important determinants of overweight and obesity were low levels of physical activity, watching television or playing computer games, and consuming junk foods, snacks and carbonated drinks and similar to the studies done by Jain S et al.[19], Gupta DK et al. [25], Laxmaiah A et al. [28], Vohra R et al. [29].

Missing breakfast has adverse effects on cognition, particularly the speed of information retrieval in working memory [30]. Research suggests infrequent or never breakfast consumers are at higher risk of being overweight and obese [31]. In our study, the adolescents who skip breakfast daily or intermittently have more odds of developing overweight and obesity by 2.130 times when compared with those who never skip breakfast. This is similar to the study done by Chitra U et al. [30] in Andhra Pradesh, Arora M et al. [31] in New Delhi and Croezen S et al. [32].

Recent studies conducted in various parts of the world indicate that sleep has evolved as a significant determinant of body composition. These studies indicate that lack of adequate sleep predisposes the children to overweight and obesity [33]. The prevalence of overweight and obesity were less among those students who slept adequately at night between 8 to 9 hours when compared with those who slept inadequately or slept overtly and a statistically significant association was seen between duration of sleep hours and overweight and obesity in our study. This is similar to the study done by Wasim A Shaikh et al. [33] that showed that inadequate sleep duration increases adiposity among Indian adolescents and also similar to the study done by Yu Y et al. [34] but in contrast to the study done by Calamaro CJ et al. [35] that showed shortened sleep duration does not predict obesity in adolescents. Further research is hence needed to further explore the association between duration of sleep hours and adiposity.

5. CONCLUSION

Our study highlights the double burden of underweight and overweight among the adolescents attending the government and private schools in the rural field practice area of Hassan Institute of Medical Sciences. The prevalence of malnutrition was found to be 44.1% among the school going adolescents. As malnutrition constitutes both undernutrition and over-nutrition, this study reveals the prevalence of Undernutrition to be 37.1% and that of over-nutrition to be 7.0%. Male gender, government school, lower socio-economic status, deworming status and open-air defecation were identified as significant risk factors for undernutrition and female gender, private school, upper socio-economic status, low levels of physical activity, excess television watching, consuming junk foods, breakfast skipping, inadequate sleeping hours were identified as significant risk factors for overnutrition. Findings of the study were shared with students and those who were underweight and overweight were provided nutritional counselling.

6. RECOMMENDATIONS

To reduce both forms of malnutrition, it is essential to create awareness among the students and their families and also among the school teachers regarding the ill-effects of malnutrition. A periodical and regular health check-up of the adolescents must be carried out by the school administration taking help of the medical officers and field level workers who work in the primary health centres. National Deworming days to be observed biannually without fail as our study also reveals increased

prevalence of undernutrition among students who did not receive deworming tablets. Students should be encouraged to participate in household activities and regular physical exercise that could help in lowering the prevalence of overweight and obesity. Compulsory hours of sports and games in schools should be emphasized. The Government of India's National Program on Prevention and Control of Diabetes, Cardiovascular Disease, and Stroke should have a school component that would focus on addressing the non-communicable diseases. Promotion of daily breakfast consumption should be advised to students as our study reveals and also supports the literature that says regular breakfast consumption is negatively associated with overweight and obesity. Hence time can be allotted in schools like a short break in the morning to allow students to consume breakfast that they can carry from home. This study shows that night sleep duration less than eight hours or more than 9 hours significantly affects the body composition of the adolescents and predisposes them to the risk of overweight and obesity. Hence students are to be advised on the importance of adequate sleep at night.

7. LIMITATIONS OF THE STUDY

Being a Cross-sectional study, the credibility to deduce a cause-effect association is reduced. Only rural children were included in the study with no representation from urban areas. Hence the generalizability of the results is affected. Self-reported data was relied upon, which has the chance of recall bias. WHO growth reference charts for 5 to 19 years are not specific for Indian Adolescents yet they are widely used in various studies. Other measures like waist circumference and waist-to-hip ratio were not measured as ethnicity-specific cutoffs in Asian Indian adolescents are not available unlike western countries. There was no representation from class 11^{th} and 12^{th} standard as there were no pre-university colleges in the study setting.

CONSENT

Written informed consent from the schools' principals was obtained. Adolescents were asked for their assent for each activity.

ETHICAL APPROVAL

Institutional ethical committee approval was obtained for the study.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. World Health Organization. Nutrition in adolescence – Issues and challenges for the health sector; 2005.
2. World Health Organization. Adolescent Nutrition: A Review of the Situation in Selected South-East Asian Countries. New Delhi: Regional Office South-East Asia. 2006;1-96.
3. Beegum MR. Prevalence of malnutrition among adolescent girls: A case study in Kalliyoor Panchayat, Thiruvananthapuram. Unpublished Article. 2001;35.
4. World Health Organization. Improvement of Nutritional Status of Adolescents. Rep Regional Meet. 2002;1-31.
5. Anand D, Anuradha RK. Malnutrition Status of Adolescent Girls in India: A Need for the Hour. International J Science Res. 2016;5(3):642-6.
6. Banerjee S, Dias A, Shinkre R, Patel V. Under-nutrition among adolescents: A survey in five secondary schools in rural Goa. The National Medical Journal of India. 2011;24(1):8.
7. NHM Components: RMNCH+A: Adolescent Health (RKSK). Background. Available:http://nhm.gov.in/nrhm-components/rmnch-a/adolescent-healthrksk/ rksk.background.html/ [Accessed on 8^{th} November, 2019]
8. World Health Organization: Growth reference 5-19 years. Available:http://www.who.int/growthref/who2007_bmi_for_age/en/ [Accessed on 8^{th} November, 2019]
9. Pandey VK, Aggarwal P, Kakkar R. Modified BG Prasad's Socio-economic Classification-2018: The need of an update in the present scenario. Indian J Community Health. 2018;30(1):82-4.

10. Deshmukh PR, Gupta SS, Bharambe MS, Dongre AR, Maliye C, Kaur S, et al. Nutritional status of adolescents in rural Wardha. The Indian Journal of Pediatrics. 2006;73(2):139-41.
11. Palaniappan S. A Cross-sectional Study on the Prevalence of Thinness based on the Body Mass Index among the children in VI to VIII Standards in a Government school in Minjur, Thiruvallur District, Tamil Nadu 2011. University Journal of Medicine and Medical Specialties. 2017;3(4).
12. Syamala AP, Jaganathan D. Health status of adolescents in selected districts of Tamil Nadu. Int J Health Sciences Res. 2012; 2(7):54-62.
13. Kamath R, Jakkula RP, Kumar S. Nutritional status assessment of school children in Bellary district, Karnataka. Journal of Dr. NTR University of Health Sciences. 2015;4(1):13.
14. Abraham RR, Anand AK. A study on nutritional status and its determinants in adolescents aged 11 to 17 years, from selected schools in Bangalore, India. National Journal of Research in Community Medicine. 2017;6(3):213-6.
15. Singh MS, Devi RK. Nutritional status among the urban Meitei children and adolescents of Manipur, Northeast India. Journal of Anthropology; 2013.
16. Dambhare DG, Bharambe MS, Mehendale AM, Garg BS. Nutritional status and morbidity among school going adolescents in Wardha, a Peri-Urban area. Online Journal of Health and Allied Sciences. 2010;9(2).
17. Bose K, Bisai S, Chakraborty J, Datta N, Banerjee P. Extreme levels of underweight and stunting among pre-adolescent children of low socioeconomic class from Madhyamgram and Barasat, West Bengal, India. Collegium Antropologicum. 2008; 32(1):73-7.
18. Sonya J, Ranjani H, Priya M, Unnikrishnan RA, Anjana RM, Mohan VI. Prevalence of overweight and obesity among school children and adolescents in Chennai. Indian Pediatrics. 2014;51(7):544-9.
19. Jain S, Pant B, Chopra H, Tiwari R. Obesity among adolescents of affluent public schools in Meerut. Indian Journal of Public Health. 2010;54(3):158.
20. Ornelas IJ, Perreira KM, Ayala GX. Parental influences on adolescent physical activity: A longitudinal study. International Journal of Behavioral Nutrition and Physical Activity. 2007;4(1):3.
21. Goyal JP, Kumar N, Parmar I, Shah VB, Patel B. Determinants of overweight and obesity in affluent adolescent in Surat City, South Gujarat region, India. Indian Journal of Community Medicine. 2011;36(4):296.
22. Wisniewski AB, Chernausek SD. Gender in childhood obesity: Family environment, hormones, and genes. Gender Medicine. 2009;6:76-85.
23. Dietz WH. Periods of risk in childhood for the development of adult obesity – what do we need to learn? The Journal of Nutrition. 1997;127(9):1884S6S.
24. Thekdi K, Kartha G, Nagar SS. Assessment of nutritional and health status of the school students of 5^{th} to 9^{th} standard (11 to 15 years age group) of Surendranagar district, Gujarat state, India. Pathology. 2011;25(10):35.
25. Gupta DK, Shah P, Misra A, Bharadwaj S, Gulati S, Gupta N, et al. Secular trends in prevalence of overweight and obesity from 2006 to 2009 in urban Asian Indian adolescents aged 14-17 years. PloS One. 2011;6(2):e17221.
26. Kotian MS, Kumar G, Kotian SS. Prevalence and determinants of overweight and obesity among adolescent school children of South Karnataka, India. Indian journal of community medicine: official publication of Indian Association of Preventive and Social Medicine. 2010; 35(1):176.
27. Gaiki VW. Nutritional status of adolescent girls from selected rural area of a district from central India. Innovative Journal of Medical and Health Science. 2014;4(2):90-2.
28. Laxmaiah A, Nagalla B, Vijayaraghavan K, Nair M. Factors Affecting Prevalence of Overweight Among 12-to 17-year old Urban Adolescents in Hyderabad, India. Obesity. 2007;15(6):1384-90.
29. Vohra R, Bhardwaj P, Srivastava JP, Srivastava S, Vohra A. Overweight and obesity among school-going children of Lucknow city. Journal of Family and Community Medicine. 2011;18(2):59.
30. Chitra U, Reddy CR. The role of breakfast in nutrient intake of urban school children. Public health nutrition. 2007;10(1):55-8.
31. Arora M, Nazar GP, Gupta VK, Perry CL, Reddy KS, Stigler MH. Association of

breakfast intake with obesity, dietary and physical activity behaviour among urban school-aged adolescents in Delhi, India: results of a cross-sectional study. BMC Public Health. 2012;12(1):881.

32. Croezen S, Visscher TL, Ter-Bogt NC, Veling ML, Haveman-Nies A. Skipping breakfast, alcohol consumption and physical inactivity as risk factors for overweight and obesity in adolescents: results of the E-MOVO project. European Journal of Clinical Nutrition. 2009;63(3): 405.

33. Shaikh WA, Patel M, Singh SK. Sleep Deprivation Predisposes Gujarati Indian Adolescents to Obesity. Indian Journal of Community Medicine. 2009; 34(3):192-94.

34. Yu Y, Lu BS, Wang B, Wang H, Yang J, Li Z, et al. Short sleep duration and adiposity in Chinese adolescents. Sleep. 2007; 30(12):1688-97.

35. Calamaro CJ, Park S, Mason TB, Marcus CL, Weaver TE, Pack A, et al. Shortened sleep duration does not predict obesity in adolescents. Journal of Sleep Research. 2010;19(4):559-66.

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