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Praveen G
Associate Professor, Department of Community Medicine, Hassan Institute of Medical Sciences, Hassan, Karnataka, India

Subhashini KJ
Postgraduate, Department of Community Medicine, Hassan Institute of Medical Sciences, Hassan, Karnataka, India

Corresponding Author:
Subhashini KJ
Postgraduate, Department of Community Medicine, Hassan Institute of Medical Sciences, Hassan, Karnataka, India

Assessment of magnitude and determinants of overweight and obesity among school going adolescents of rural field practice area of the medical college, Hassan, Karnataka

Praveen G and Subhashini KJ

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Abstract
Background & Objectives: The epidemic of adolescent obesity is a substantial health burden worldwide and its impact is being observed in developing countries as well. Obesity has major implications towards increasing prevalence of non-communicable diseases. Hence this study was undertaken to estimate the prevalence of overweight and obesity and to determine its determinants among school going adolescents in the rural field practice area of the medical college, Hassan, Karnataka.
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. The sample size of 830 was divided between the three areas under 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 overweight and obesity was found to be 5.8% and 1.2% respectively. 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 associated with higher prevalence of overweight and obesity.
Conclusion: 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 over-nutrition so that adolescents do not become victims of chronic non-communicable diseases.

Keywords: Adolescence, overweight, obesity, school going adolescents, body mass index, risk factors

1. Introduction
The epidemic of obesity among children and adolescents is a potential health burden worldwide and its impact is being observed in developing countries as well [1]. In most developing countries, adolescents are often neglected because adolescence is 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 [2]. The prevalence of overweight and obesity varies between 10 and 30% across various regions of the country. Prevalence varies within the country because of differences in the lifestyle, mainly in the dietary patterns, and physical activity [3] Overweight adolescents have double chances to become obese adult than normal children. More than 60% of overweight children have at least one additional risk factor for cardiovascular disease and more than 20% obese children have two or more risk factors [4].
Rising prevalence of obesity in India may be attributed to various factors, like sedentary life-style, unhealthy food habits, cultural practices and increasing affluence of middle class population [1, 4] Obesity is increasing in most of high income countries, in developing countries undergoing nutritional transition and even in poor countries. Adolescents are exposed to high calorie, high fat foods that are readily available, heavily advertised and delicious and lack of exercise. Skipping meals at home and consuming junk foods also contribute to overweight [5] In addition to this urbanization and industrialization are the main culprits for the increase in the prevalence of childhood obesity [3].

Obesity related symptoms in children and adolescents include multiple co-morbidities such as type 2 diabetes mellitus, cardiovascular diseases, hypertension, dyslipidemia, polycystic ovarian disease and the metabolic syndrome, psychosocial problems, abnormal glucose metabolism, hepatic gastrointestinal disturbance, sleep apnoea, and orthopaedic condition [1, 5, 6, 7]. Most importantly, childhood obesity has been associated with higher risk of morbidity and mortality in adult life [1].

Extensive literature is being available in studying about overweight and obesity among urban affluent adolescents but little attention has been paid to assess overweight and obesity among adolescents in rural areas. And due to Nutritional transition, there is a shift in the occurrence of obesity to rural areas also.

1.1. Objectives

To estimate the prevalence of overweight and obesity and its determinants 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 Sample Size: Sample size was estimated using the formula $n=Z^2pq/d^2$

Where, p = prevalence of adolescent obesity taken as 17.4% (According to study conducted in Bellary district, Karnataka by Kamath R *et al.*) [8]

z = 1.96 (considering 95% confidence level)

d = relative precision of 15%= 15% of 17.4 = 2.61

The sample size was adjusted for sample attrition and was estimated to be 830

2.2 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.

2.3 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.

2.4 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, 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.

2.4.1 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 behavior etc.
2. **Anthropometric Measurements:** The weight and height of each student was measured and BMI was calculated and assessed using the WHO Growth reference gender specific chart 2007 [9].

2.5 Analysis of data

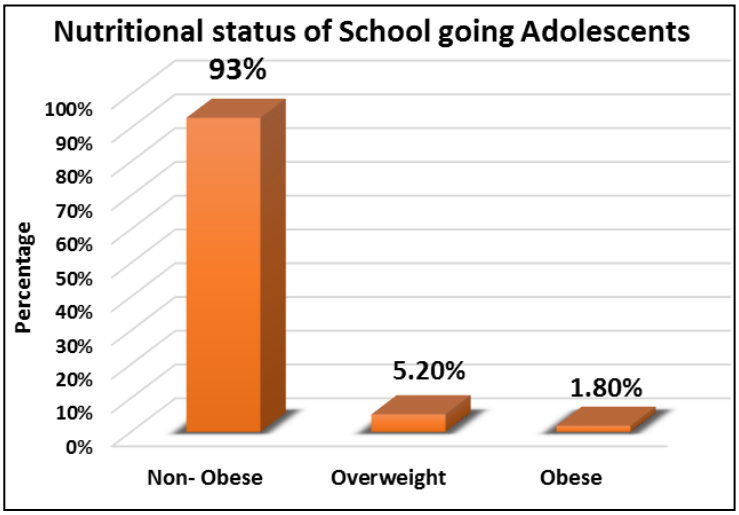
The data collected was entered in Microsoft Excel and analysed using SPSS (Statistical Package for Social Sciences) Software version 20.

2.6 Statistical methods

Descriptive statistical analysis was used in this study. Association of each of the categorical variable with overweight and obesity was assessed with the Chi‾ square test. The variables that were significantly associated with over-nutrition 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 [10].



Graph 1: Prevalence of overweight and obesity among school going adolescents (n=830)

Graph 1 shows the proportion of overweight and obesity among school going adolescents and prevalence of overweight was greater than obesity.

Table 1: Socio-demographic correlates of Overweight and Obesity among School going adolescents (n=830)

Demographic profile	Non-obese	Overweight and obese	p value
Age			
10-14 years	593 (92.7)	47 (7.3)	0.046*
15-19 years	179 (94.2)	11 (5.8)	
Gender			
Male	402 (93.7)	27 (6.3)	0.042*
Female	370 (92.3)	31 (7.7)	
School			
Government	388 (93.5)	27 (6.5)	0.029*
Private	384 (92.5)	31 (7.5)	
SES			
Upper	211 (93.8)	14 (6.2)	0.017*
Middle	226 (89.7)	26 (10.3)	
Lower	335 (94.9)	18 (5.1)	
Type of family			
Nuclear	671 (93.8)	44 (6.1)	0.057
Joint	57 (89.1)	7 (11.0)	
Three generation	44 (86.3)	8 (13.7)	
Religion			
Hindu	748 (92.8)	58 (7.1)	0.814
Non- Hindus	24 (100)	0 (0)	
Mother Education			
Illiterate	316(94.0)	20 (6.0)	0.531
Schooling	440 (92.4)	36 (7.6)	
Degree	12 (66.7)	6 (33.3)	
Father Education			
Illiterate	265 (92.7)	21 (7.3)	0.673
Schooling	476 (93.0)	36 (7.1)	
Degree	26 (81.3)	6 (18.7)	

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

Table 1 shows the association between the socio-demographic factors and overweight and obesity of the adolescents. Age, gender, type of school in which they study and socio-economic status of the adolescents were significantly associated with overweight and obesity 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 overweight and obesity .

Table 2: Association of overnutrition 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
		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.

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 estimate the burden of overweight and obesity which remains as a potential health problem in the recent times making the path for all chronic non-communicable diseases.

In our study, the prevalence of overweight and obesity was found to be 7.0 % which corresponds to the prevalence of overweight and obesity in Bangalore schools by Abraham RR *et al.* [11] and in Thiruvallur schools of Tamilnadu by Palaniappan S [12] that shows a prevalence of 8.6% and 9.05% respectively. In our study the prevalence of overweight was found to be 5.2% which is almost similar to the study done by Goyal JP *et al*. [6] in Gujarat and Vohra R *et al*. [7] in Lucknow that shows a prevalence of 6.6% and 4.9% respectively. The prevalence of obesity was found to be 1.8% which is much lesser compared with other studies done across the country by Kotian *et al*., Jain S *et al*., Goyal JP *et al*., Kamath R *et al*. that showed a prevalence ranging between 4.8 to 13.9% [3, 4, 6, 8].

This variation in the prevalence of overweight and obesity 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.

And also, the prevalence of overweight was found to be more among the girls (6.2%) when compared with boys (4.2%) which is similar to the studies conducted across the country [3, 4, 8, 11, 13]. And contrary to the studies which showed boys are more overweight than the girls [1, 12]. The prevalence of obesity in our study was found to be more among boys (2.1%) when compared with girls (1.5%) which is similar to the studies done in Mangalore, Gujarat and Meerut [3, 4, 6]. Overall the prevalence of over-nutrition was more among girls (7.7%) when compared with boys (6.3%) in our study.

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. In contrast to girls, boys are more physically active; receive more benefit from physical activity; have lower leptin levels and hence decreased energy intake and are protected from the obesity-genesis effects of some gene variants (eg, FTO gene- Fat mass and obesity associated protein) [14].

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% [15].

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 [1, 16, 17]. 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 Upper and Middle SES (5.1%) were more overweight and obese than those belonging to Lower SES (1.9%). This is similar to the studies done by Gupta DK *et al.* [1] Kotian MS *et al.* [3] Gaiki *et al.* [18] Syamala AP *et al.* [19] More affordability, better living conditions, urbanization may be the reasons for higher prevalence of over-nutrition among upper SES. [11]

In our study, those adolescents who consume chocolates daily have more risk of developing overweight and obesity by 8.356 times 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 risk of developing overweight and obesity by 2.733 times. The adolescents who play outside daily have 8.654 times less risk of developing overweight and obesity when compared with those who do not have any physical activity in the form of sports, exercise, household chores etc. 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.* [3] that showed the prevalence of overweight was higher among the adolescents who had physical activity of < one hour/day, watched television ≥ 4 hours/day, and ate chocolates daily. Also similar to the study by Goyal JP *et al.* [6] 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 Gupta DK *et al.* [1], Jain S *et al.* [4], Vohra R *et al.* [7], and Laxmaiah A *et al.* [20]

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. Literature suggests an inverse relationship between breakfast skipping and occurrence of overweight and obesity. Similar associations were also seen in studies done by Arora M *et al.* [21] in New Delhi and Chitra U *et al.* [22] in Andhra Pradesh.

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. 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.* [23] that showed that inadequate sleep duration increases adiposity among Indian adolescents and also similar to the study done by Yu Y *et al.* [24] but in contrast to the study done by Calamaro CJ *et al.* [25] 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

This study reveals the prevalence of over-nutrition to be 7.0%. Findings of the study were shared with students and those who were overweight were provided nutritional counselling. Age, gender, socio-economic status, type of school, low levels of physical activity, consuming junk foods, breakfast skipping and inadequate sleep hours were significantly associated with overweight and obesity among adolescents.

5.1. Recommendations

A periodical and regular health check-up of the adolescents must be carried out by the school administration. Participation in household activities and regular physical exercise could help in lowering the prevalence of overweight and obesity. Compulsory hours of sports and games in schools to be emphasized. Government should take appropriate measure regarding control of food-related advertisement shown on television. There is an urgent need to educate the student community on the aspects of healthy food habits and desired lifestyles to prevent overweight/ obesity and its associated ill effects.

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