International Journal of Contemporary Pediatrics
Vedavathy S et al. Int J Contemp Pediatr. 2016 May;3(2):568-574
http://www.ijpediatrics.com
pISSN 2349-3283 | eISSN 2349-3291
DOI: http://dx.doi.org/10.18203/2349-3291.ijcp20161040

Research Article

Prevalence of obesity and its risk factors in school going adolescents of urban Bangalore, India

Vedavathy S.*, Ganesh Kamath, Sangamesh

Department of Pediatrics, Indira Gandhi Institute of Child Health, Bangalore, Karnataka, India

Received: 04 February 2016
Revised: 04 February 2016
Accepted: 16 March 2016

***Correspondence:**
Dr. Vedavathy S.,
E-mail: vedavathys@gmail.com

ABSTRACT

Background: Obesity, one of the most widespread and major problems affecting children and adolescents is of global nutritional concern. In last two decades, the prevalence of obesity has doubled in children and tripled in adolescents in United States of America. There is not enough data on the prevalence of obesity in adolescents in urban Bangalore. Hence the present study aims to fulfil this urgent requirement. Aims & objectives of the study were to study the prevalence of obesity and its risk factors in school going adolescents of urban Bangalore.
Methods: Observational study conducted in adolescents between the ages 11 to 19 years from the schools around Indira Gandhi Institute of Child Health, Bangalore.
Results: The maximum number of adolescents in the present study belonged to the 14 years age group. Majority of the adolescents studied had a birth weight of 2.5 to 3.5 kg. 6.7% of the total adolescents had history of sleep disturbance. There was family history of hypertension in 19.4%, diabetes mellitus in 8.7%, obesity in 9.9% and cardiovascular diseases in 1.1% of the adolescents. The prevalence of obesity was 5.9%.
Conclusions: The overall prevalence of obesity is 5.9%, 4.2% girls and 6.9% boys are obese. Obese children were more likely to belong to higher socioeconomic strata; more obese children had mixed diet. Family histories of hypertension, obesity and diabetes mellitus were significant risk factors. Sleep disturbance was associated with obesity.

Keywords: Adolescent obesity, Body mass index, Family history, Sleep disturbances

INTRODUCTION

Obesity, one of the most widespread and major problems affecting children and adolescents is of global nutritional concern. An increased prevalence is found in many countries where the major nutritional disorder previously was malnutrition.[1] Increase in prevalence of childhood obesity is associated with potential medical complications of obesity noted in adolescence and especially in adulthood, like hypertension, coronary artery disease, cerebrovascular accidents, diabetes mellitus type 2, dyslipidemia, gall stones, premature joint destruction and many others.[2,3]

In last two decades, the prevalence of obesity has doubled in children and tripled in adolescents in United States of America. The increase in childhood and adolescent obesity has resulted in increase in over weight and obesity in adults.[4] This has a profound public health consequence as 80% of overweight children become overweight adults. In addition, obesity has a negative impact on self-esteem of children and adolescents, which may have significant implications for long-term happiness and success in life. Finally, directed sessions that emphasize healthy eating and exercise habits for children and their families may have lasting effects on life style of this children.[5]

Evaluation of obesity in childhood is important for several reasons. Firstly, it offers the best hope for preventing disease progression with its associated morbidities in adulthood. Secondly, genetic and hormonal causes of obesity are rare; they do warrant consideration in obese children.

Children above 97th percentile of BMI for age are potential candidates for evaluation, as they are likely to have mutations in the known obesity genes. Obesity due to gene mutations is more likely if other family members are also obese.[6] Identifying these patients and families will help in early intervention so that child will not become as an obese adult.[7]

BMI correlates with markers of secondary complications of obesity, including current blood pressure, blood lipids and with long-term mortality.[8] BMI cannot differentiate an obese individual from a muscular one. It also cannot locate the site of fat e.g. people with central obesity may have normal BMIs.[9] In spite of several limitations, BMI as of now appears to be the most practical way of measuring and comparing obesity for clinical and epidemiological purpose.

There is not enough data on the prevalence of obesity in adolescents in urban Bangalore. Hence the present study aims to fulfil this urgent requirement.

The aim and objectives of the study was to study the prevalence of obesity and its risk factors in school going adolescents of urban Bangalore, India.

METHODS

The Observational study was carried out during December 2008 to November 2009 in Bangalore with school going adolescents between the ages 11 to 19 years from the schools around Indira Gandhi Institute of Child Health, Bangalore, India.

Sample size

Presuming the prevalence of obesity to be 6% (as found in a study done in South India by Vedavati Subramanyam et al), Sample size was calculated by using a formula:

$n=4pq/d^2$

Sample size obtained = 550-2000

Method of collection of data

Inclusion criteria

Students between 11 to 19 years of age, studying in schools around Indira Gandhi Institute of Child Health, Bangalore.

Methodology

Before initiating the study, permission for carrying out the work was obtained from the Principals of the selected high schools. The study was conducted for 1 year from December 2008 to November 2009.

As far as possible, the free time/physical activity periods were used for this study so that the routine classes were unaffected. Prior consent from the teachers and students were obtained.

The students were given a pre-designed structured questionnaire which consisted of questions to be answered by the student. The questionnaire was explained o the students beforehand. It included demographic description, annual income, dietetic history and physical activity.

Socioeconomic status was assessed by using modified Kuppuswamy's classification.

Measurements

Height

It was measured barefoot, to the nearest of 0.1 cm using a standard calibrated bar. The student stood straight with heels, buttocks and back touching the vertical limb of the instrument and stretching upward to the fullest extent with arms hanging on the sides. The head was aligned so that the lower rim of the orbit and the auditory canal were in the horizontal plane (Frankfurt place). Mild upward pressure was exerted on the mastoid region bilaterally.

Weight

It was measured without any footwear with minimal clothing (school uniforms) to the nearest of 0.1 kg using a standard portable weighing machine and the scale was zeroed before each session and weight was recorded in kilograms.

WHO expert group defines obesity as a condition of abnormal or excessive fat accumulation in adipose tissue to the extent that health may be impaired.[10]

WHO has recommended BMI >85th-95th percentile for age and gender as cut off point for overweight and BMI >95th percentile for age and gender for obesity, while BMI < 85th percentile are considered as normal.[10,11]

The BMI was then calculated. Children with BMI >95th percentile for age and gender as per the Aggarwal charts for Indian children were classified as obese.

Statistical methods

Descriptive statistical analysis has been carried out in the present study. Results on continuous measurements are

presented on Mean ± SD (Min-Max) and results on categorical measurements are presented in Number (%). Significance is assessed at 5 % level of significance. Student t test (two tailed, independent) has been used to find the significance of study parameters on continuous scale between two groups (Male and Female). Chi-square test/2x2, 2x4 Fisher exact test has been used to find the significance of incidence of obesity in relation to study characteristics. Odds ratio has been computed to find the strength of relationship between the incidence of obesity and study characteristics. 95% confidence interval has been used in the present study.

Chi-Square test

$$\chi^2 = \frac{\sum (Oi - Ei)^2}{Ei}$$

Where, OI = observed frequency
Ei is Expected frequency

Fisher exact test

Table 1:

	Class1	Class2	Total
Sample 1	A	B	a+b
Sample 2	C	D	c+d
Total	a+c	b+d	n

2x2; Fisher Exact Test statistic =

$$\sum p = \frac{(a+b)!(c+d)!(a+c)!(b+d)!}{n!} \frac{1}{\sum a!b!c!d!}$$

Student t test (Two tailed, independent)

$$t = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sqrt{s^2(1/n1 + 1/n2)}}$$

Where,

$$s^2 = \frac{(n1-1)\sum_{i=1}^{n1}(x1 - \bar{x}1)^2 + (n2-1)\sum_{i-1}^{n2}(x2 - \bar{x}2)^2}{n1 + n2 - 2}$$

1. 95% Confidence Interval

P ± 1.96* SE (P), Where SE (P) is the Standard error of proportion = P*Q/√n

2. Significant figures

+ Suggestive significance (P value: 0.05<P<0.10)

* Moderately significant (P value: 0.01<P ≤ 0.05)

** Strongly significant (P value: P≤0.01)

Statistical software

The Statistical software namely SPSS 15.0, Stata 8.0, MedCalc 9.0.1 and Systat 11.0 were used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables etc**.**

RESULTS

Study Design: An Observational study consisting of 748 children is undertaken to study the prevalence of obesity

The maximum number of adolescents in the present study belonged to the 14 years age group.38.2% adolescents belong to 14 years age group. Males constituted 62.2% of the subjects studied. And females constituted 37.8% of the study group. The majority of the adolescents studied had a birth weight of 2.5 to 3.5 kg (Table 2).

Table 2: Association of age and gender with obesity.

Characteristics	Total	Obesity		p value (Stage I)
		No	%	
Age in years				
12 years	19	0	0.0	-
13 years	140	10	7.1	0.546
14 years	286	10	3.5	0.085+
15 years	204	19	9.3	0.039*
16 years	91	5	5.5	0.871
17years	8	0	0.0	-
Gender				
Male	465	32	6.9	0.361
Female	283	12	4.2	0.225
Birth weight				
1.50-2.50	132	8	6.1	0.922
2.50-3.50	535	28	5.2	0.492
>3.50	75	8	10.7	0.069+
Unknown	6	8	6.1	0.922
Total	748			

6.7% of the total adolescents had history of sleep disturbance. There was family history of hypertension in 19.4%, diabetes mellitus in 8.7%, obesity in 9.9% and cardiovascular diseases in 1.1% of the total adolescents studied.

More number of adolescents had a mixed diet pattern.

Majority of the adolescents in the present study belonged to lower middle class group (Table 3).

Table 3: Characteristics and their association with obesity.

Characteristics	Total	Male		Female		Obesity		P value
		No	%	No	%	No	%	
H/o sleep disturbance								
Absent	673	431	92.7	242	85.5	25	3.7	0.087
Present	50	29	6.2	21	7.4	14	28	<0.001**
Not known	25	5	1.1	20	7.1	5	20	0.037*
Diet								
Vegetarian	230	151	32.5	79	27.9	7	3.1	0.278
Non vegetarian	518	314	67.5	204	72.1	20	3.9	0.278
Socio-economic status								
1. Upper class	15	15	100	0	0.0	0	0.0	-
2. Upper middle class	198	161	81.3	22	11.1	19	9.6	0.028*
3. Lower middle class	365	355	97.3	3	0.8	16	4.4	0.223
4. Upper lower	170	163	95.9	2	1.2	9	5.1	0.653
5. Lower						0	0.0	-
Family history								
Hypertension	145	93	20.0	52	18.4	16	11.03	0.003**
Diabetes mellitus	65	36	7.7	29	10.2	7	10.7	0.090+
Obesity	74	50	10.8	24	8.4	17	22.97	<0.001**
Cardiovascular disease	8	7	1.5	1	0.4	1	12.5	0.386
Total	748							

The mean age in years of males was 14.27 and females were 14.39 (Figure 1).

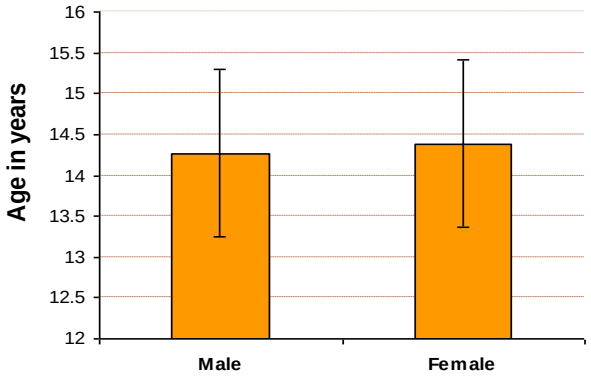

Figure 1: Mean and standard deviation of age in males and females.

The mean birth weight of males was 2.74 kg and females were 2.87kg (Figure 2).

The mean weight of males was 44.64kg and females were 45.46kg (Figure 3).

The mean height of males was 157.29cm and of females was 154.06 cm (Figure 4).

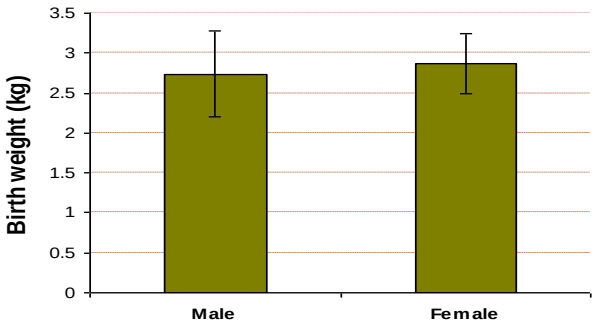

Figure 2: Mean and standard deviation of birth weight in males and females.

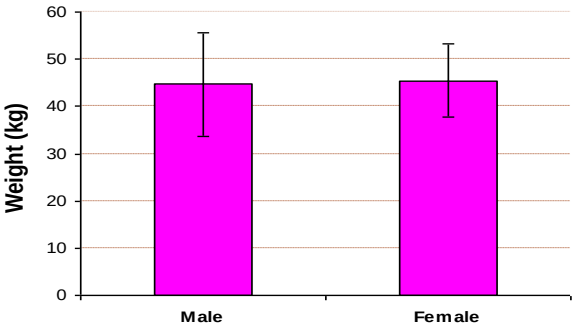

Figure 3: Mean and standard deviation of weight in males and females.

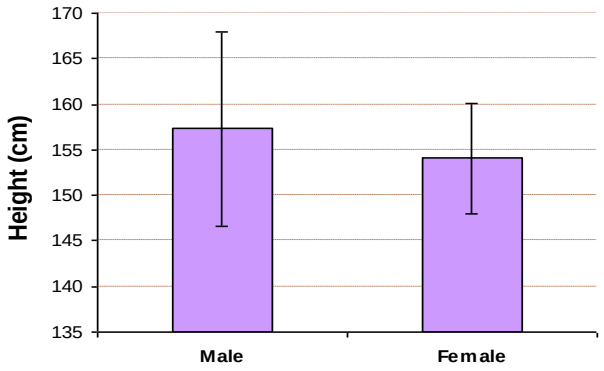

Figure 4: Mean and standard deviation of height in males and females.

The mean BMI of males was 17.58 and of females was 19.06 (Table 4 & Figure 5).

Table 4: Mean and standard deviation of age, birth weight, weight, height and BMI according to gender.

Study parameters	Male	Female	Total	P value
Age in years	14.27± 1.02	14.39± 1.03	14.31± 1.02	0.103
Birth weight (kg)	2.74± 0.53	2.87± 0.37	2.79± 0.47	0.001**
Weight (kg)	44.64± 11.05	45.46± 7.73	44.95± 9.93	0.283
Height (cm)	157.29± 10.71	154.06± 6.03	156.08± 9.36	<0.001**
BMI (kg/m^2)	17.58± 4.00	19.06± 2.89	18.14± 3.69	<0.001**

Prevalence of Obesity.

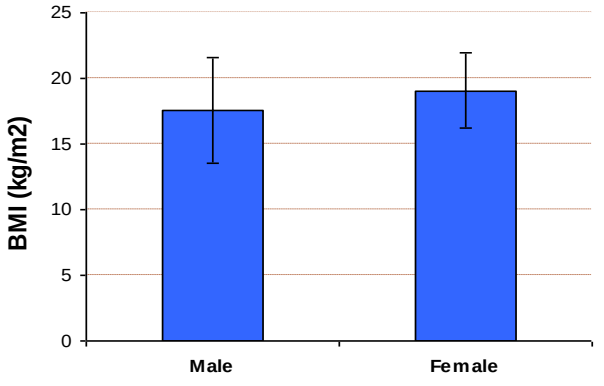

Figure 5: Mean and standard deviation of BMI in males and females.

The highest prevalence of obesity was in the 15 year age group.

The prevalence of obesity in males was 6.9% and in females was 4.2% with an overall prevalence of 5.9%. Males were more obese when compared to females in the present study.

Majority of obese adolescents belonged to upper middle class socioeconomic status.

Sleep disturbance was more prevalent in obese adolescents. Sleep disturbances is 10.08 times more likely more obese children with P<0.001** (Figure 6).

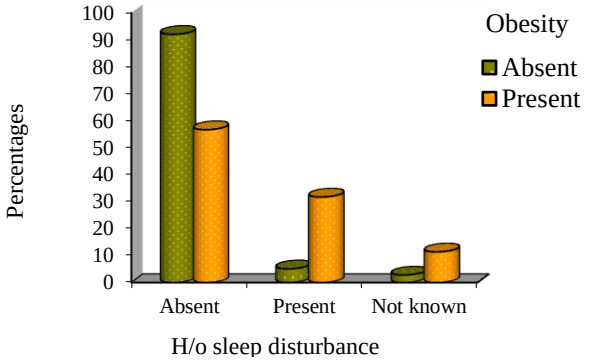

Figure 6: Sleep disturbances in normal and obese adolescents.

There was a statistically significant correlation between family history of obesity, hypertension, diabetes mellitus and incidence of obesity in adolescents (Figure 7).

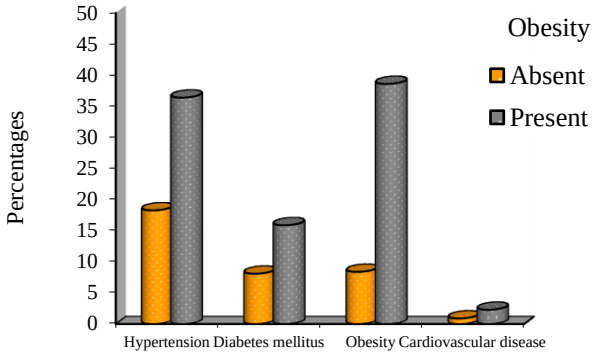

Figure 7: Family histories of hypertension, obesity, DM and cardiovascular diseases in adolescents with obesity and normal children.

Obesity was more prevalent in adolescents with mixed diet pattern.

More obese adolescents had a birth weight of more than 3.5kg.

DISCUSSION

The present study showed that the prevalence of obesity is 4.2% in girls as compared to 6.9% in boys, with overall prevalence of 5.9%.

Table 5 shows a similar finding reported from various parts of India.

Table 5: Prevalence of obesity in different studies.

Sr. No	Study	Place of study	Year	Prevalence of obesity
1	Kapil et al[12] N=870	Delhi, Delhi	2002	7.4%
2	Sidhu et al[14] N=870	Amritsar, punjab	2005	5.9%
3	Vedavati et al[15] N=707	Chennai, Tamil Nadu	1981	5.94%
4	Vedavati et al[15] N=610	Chennai, Tamil Nadu	1998	6.23%
5	Present study N=748	Bangalore, Karnataka	2009	7.2%

The higher prevalence of obesity in boys could be possibly due to larger number of boys in the present study (62.2%boys as compared to 37.8% girls).

Kapil, et al too reported that boys from Delhi schools are more obese as compared to girls (8.3% vs 5.5%).[12]

However, Sawaya, et al from Brazil, found girls to be more obese than boys (8.7% vs 6.4%).[13]

The majority of children included in the present study had birth weight of 2.5 to 3.5 kg. The highest prevalence of obesity was found in children in the birth weight group of >3.5kg.

This finding is in contrast to the Barker's Hypothesis.

However, Demosthenes, et al from Athens found that excess birth weight was one of the significant predictors of obesity in Greek children.[16]

Sleep disturbance is 10.08 times more likely in obese children, which was similar to the heartfelt study.

Gupta NK et al, in the Heartfelt study, found that obese adolescents experienced less sleep than non-obese adolescents (P <0.001).[17] For each hour of lost sleep, the odds of obesity increased by 80%. Daytime physical activity diminished by 3% for every hour increase in sleep disturbance. Inadequate and poor sleep quality in adolescents may be important factors to consider in the prevention of childhood obesity, they concluded.

The majority of children in the present study had a mixed diet. Incidence of obesity is positively related to mixed diet pattern.

The majority of children belonged to lower middle class. But most of the obese children belonged to upper middle class socioeconomic status.

Ramachandran et al, studied children from six schools in Chennai, two from each high, middle and lower income groups.[18] The prevalence of overweight (including obese) adolescents ranged from 22% in better of school to 4.5% in lower income group schools. Among adults, a negative relationship between socioeconomic status (SES) (e.g., parental income, parental education, occupation status) and being overweight or obese has been well established, however, the relationship appears weaker and less consistent in children.[19-21] A number of studies find that SES is negatively associated with children being overweight or obese.[22]

There was a statistically significant prevalence of hypertension, obesity and diabetes mellitus in the families of children with obesity.

Results from a Brazilian study by Marilda et al, showed that having parents with high BMI values is a risk factor for obesity in adolescents.[23] Although family aggregation of obesity certainly has a genetic component, it has also been demonstrated that a child or adolescent is at risk of becoming obese simply by living with other obese persons, independent of the existence or not of biological relationships among them.

CONCLUSION

The overall prevalence of obesity is 5.9%, 4.2% girls and 6.9% boys are obese.

Obese children were more likely to belong to higher socioeconomic strata; obese children were more likely to have a mixed diet.

There was a statistically significant prevalence of hypertension, obesity and diabetes mellitus in the families of children with obesity. Sleep disturbance is 10.08 times more likely in obese children.

Recommendations were;

1. Identification of at risk child for adiposity related morbidity- The rapid increase in prevalence of obesity demonstrates the potent effects of environment on adiposity implying that obesity may be more treatable via lifestyle changes, such as increased physical activity and decreased caloric intake.[17-19] Any child, regardless of body weight, with a history of obesity, diabetes mellitus, hypertension, or cardiovascular disease in relatives should be monitored for obesity.
2. A complete physical examination should be performed with special attention to the possibility of adiposity related morbidity.

Limitations of the present study were;

1. There were more males as compared to females in this study. The study group was not representative of the general population. Hence the results cannot be extrapolated to the general population.
2. History of recent illnesses which might have resulted in weight loss during the study period was not taken.
3. Skin fold thickness was not used to assess prevalence of obesity.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Styne DM. Childhood and adolescent obesity prevalence and significance. PCNA. 2001;48(5):823-54.
2. Must A, Jacques PF, Dallal GE, Bafema CJ, Dietz WH. Long term morbidity and mortality of overweight adolescents: a follow up of Harvard Growth study of 1922-1935. NEJM. 1992;327:1350-55.
3. Hill Jo and Trowbridge FL(Ed). Symposium on the causes and health consequence of obesity in children and adolescents. Pediatrics. 1998;101:S497-574.
4. Deitz WH. Overweight in childhood and adolescence. NEJM. 2004;350:855-7.
5. Rebecca M. Evaluation and treatment of childhood obesity. American Family Physicians. 1999;59(4):861-71.
6. Fisher JA, Birch LL. Fat preferences and fat consumption of 3-5 year old children related to parenteral obesity.J Am Deit Assoc. 1995;95:759-64.
7. Jahns L, Siega-Riz A, Popkin B. The increasing prevalence of snacking among U.S. children from 1977 to 1996. J Pediatr. 2001;138:493-6.
8. Troiano RP, Flegal KM. Overweight Children and Adolescents. Description, Epidemology and Demographics. Peadiatrics. 1998;101(3):497-504.
9. Styne DM. Childhood and adolescent obesity. PCNA. 2001;48:823-7.
10. Physical status: The use and interpretation of Anthropometry- Report of a WHO expert committee, Geneva World Health organisation. 1995;263-308.
11. Agarwal KN, Saxena A, Bansal AK, Agarwal DK. Physical growth Assessment in Adolescence. Ind Pediatr. 2001;38:1217:35.
12. Kapil U, Singh P. Prevalence of obesity amongst affluent adolescent school children in Delhi. Ind Pediatrics. 2002;39:449-52.
13. Sawaya AL, Dallal G, Solymos G, de Sousa MH, Ventura ML, Roberts SB, et al. Obesity and Malnutrition in a Shantytown Population in the City of São Paulo, Brazil. Obesity Research. 1995;3:107s-115s.
14. Sidhu S, Marwah G, Prabhjot. Prevalence of overweight and obesity among the affluent adolescent school children of Amritsar, Punjab. Coll Antropol. 2005;29(1):53-5.
15. Subramanyam V, Jayashree R, Mohd Rafi. Prevalence of overweight and obesity in Affluent Adolescent Girls in Chennai in 1981 and 1988. Ind Ped. 2003;40:332-36.
16. Physical Activity, Nutrition and Allergies in Children Examined in Athens (PANACEA) study. Demosthenes B. Panagiotakos, Pediatrics International. 2008;50(4); 563-8.
17. Gupta NK. The Heartfelt Study, American Journal of Human Biology. 2002;14(6):762-768.
18. Dwyer JT, Tona EJ, Yang M. Prevalence of marked overweight and obesity in a multiethnic pediatric population findings from child and adolescent trial for cardiovascular health (CATCH). J Am Diet Assoc. 2000;100:1149-56.
19. Sobal J, Stunkard AJ. Socioeconomic status and obesity: A review of the literature. Psychological Bulletin. 1989;105:260-75.
20. Strauss RS, Knight J. Influence of the home environment on the development of obesity in children. Pediatrics. 1999;101(6).
21. Hyattsville, Berkowitz RI, Stunkard AJ. National Center for Health Statistics. Health, United States with socioeconomic status and health chartbook. Development of childhood obesity. In Wadden, & Stunkard (ed). Handbook of obesity treatment. 1998:515-31.
22. Sobal J, Stunkard AJ, (1989), Strauss RS, Knight J. (1999). Influence of the home environment on the development of obesity in children. Pediatrics, 101 (6); National Center for Health Statistics (1998). Health, United States with socioeconomic status and health chartbook. Hyattsville, MD.; Berkowitz, R.I. & Stunkard, A.J. (2002). Development of childhood obesity. In Wadden, & Stunkard (ed). Handbook of obesity treatment; pp. 515-531.
23. Neutzling MB. Risk factors of obesity among Brazilian adolescents. Public Health Nutrition. 2007;6(8):743-9.

Cite this article as: Vedavathy S, Kamath G, Sangamesh. Prevalence of obesity and its risk factors in school going adolescents of urban Bangalore, India. Int J Contemp Pediatr 2016;3:568-74.