

## ORIGINAL RESEARCH

# A study on the relation of obesity and overweight with physical activity, food and environment in children

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### ABSTRACT

Globally, in 2010 the number of overweight children under age of 5 is estimated to be over 42 million. Close to 35 million of these are living in developing countries. In developed countries like United States of America, the incidence is 35% in boys and 35.9% in girls. Similarly in UK it is 21.8% and 26.1% in boys and girls respectively. Examination was done in the school premises under the supervision of a senior staff. For taking anthropometric measurements non stretchable measuring tapes and electronic weighing machines (calibrated to +/- 100 grams accuracy) were used. Weight was recorded in kilograms with minimal clothing on, without shoes. The zero error was corrected before each measurement. Our study shows that prevalence of obesity and overweight among the subjects belonging to upper and lower socioeconomic classes were 18.89% and 12.60% respectively. In our study it was found that obesity/overweight was found to be significantly higher in children who consume junk food more than 7 times a week compared to those who consume less than 7 times a week.

**Key words:** Obesity and overweight, physical activity, children

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### INTRODUCTION

*Obesity* (from the Latin word '*obesitas*', which means "stout, fat, or plump") is defined as abnormal or excessive fat accumulation that may impair health. It results from a prolonged net energy balance. i.e. energy consumed has been greater than the energy expended <sup>[1]</sup>.

Ideally the diagnosis of obesity should be on direct demonstration of increased amount of body fat. As methods for measuring body fat are cumbersome and expensive several anthropometric parameters are used as markers of obesity. These are body weight, weight for height, body mass index, skin fold thickness and waist to hip ratio. Each method has its own advantages and disadvantages <sup>[2]</sup>.

Globally, in 2010 the number of overweight children under age of 5 is estimated to be over 42 million. Close to 35 million of these are living in developing countries. In developed countries like United States of America, the incidence is 35% in boys and 35.9% in girls. Similarly in UK it is 21.8% and 26.1% in boys and girls respectively. In the Middle East, highest incidence is seen in UAE where one in five children is having either overweight/obesity. In a recent review

from developed countries, prevalence of overweight youth was >15% in North America (Canada, Mexico and USA) and European countries (Germany, Italy) and 5-15% in France and Sweden. In China, overweight children account for 4.5 and 5.9% of boys and girls respectively. Among African countries, prevalence is between 10-20% in South Africa and Nigeria. In developing countries like Brazil (23.1 & 21.1%) and Chile (28.6 & 27.1%) also prevalence is very high <sup>[3]</sup>.

Aetiopathogenesis of childhood obesity is multifactorial interactions between genetic, neuroendocrine, metabolic, psychological, environmental and socio-cultural factors are clearly evident in childhood obesity <sup>[4]</sup>.

Environmental factors that influence eating behaviors and physical activity influence the development of obesity. Today's child lives in an obesogenic food environment that readily provides calorie dense food. Failure to lose weight despite low calorie intake is often due to misreporting of food intake and physical activity. Physical activity in children has declined over last few years and the life style has become sedentary. Indoor entertainment like television,

computer and videogames are becoming popular. Academic pressure too contributes to sedentary life style [5].

Complications of pediatric obesity occur during childhood and adolescence and persist into adulthood. An important reason to prevent and treat pediatric obesity is the increased risk for morbidity and mortality later in life. The Harvard Growth Study found that boys who were overweight during adolescence were twice as likely to die from cardiovascular disease as those who had normal weight. More immediate comorbidities include type 2 diabetes, hypertension, hyperlipidemia, and nonalcoholic fatty liver disease [6].

**Methodology**

- **Study design:**Cross-sectional randomized epidemiological study.
- **Study population:** Children aged between 6 years to 12 years.

**Inclusion criteria**

- Children who are residents of Shimoga.
- Age ranging from 6 to 12 yrs.

**Exclusion criteria**

- Children suffering from disease related overweight.

**Sample size**

- 500 school going children of ages between 6 to 12 years.
- No randomization/blinding/intervention was done in the study.

**Follow up**

None

**Data collection methods**

- Sample collection was done from 3 government and 2 private schools.Each school authority was approached and the intention of the study was explained.
- Informed consent was taken from the principal of the school and the parents.

**Data collection was done by**

Questionnaires  
Personal interviews  
Physical examination.

- 2 visits were made to each school. On the first visit questionnaires were distributed among the children. Data regarding parents and family were collected through the questionnaires. Children were assigned to different socioeconomic strata according to Modified Kuppaswamy Scale. Level I and II were considered as upper socioeconomic status whereas level III, IV and V were considered as lower socioeconomic status. Data regarding diet and physical activity were also collected.
- On the second visit, anthropometric, general physical examination and systemic examination of the children who brought appropriately filled questionnaires were done.
- Examination was done in the school premises under the supervision of a senior staff. For taking anthropometric measurements non stretchable measuring tapes and electronic weighing machines (calibrated to +/- 100 grams accuracy) were used.
- Weight was recorded in kilograms with minimal clothing on, without shoes. The zero error was corrected before each measurement.
- Height was obtained as the individual was asked to stand on the horizontal platform with heels together stretching upward to the fullest extent with arms hanging on the sides and heel and buttocks touching against the wall. The height was measured in centimeter scale using a measuring tape. The head was aligned so that the lower rim of the orbit and the auditory canal were in a horizontal plane (Frankfurt plane).
- BMI was calculated by the formula  $\text{weight (kg)/height (mt)}^2$ .
- CDC growth charts for BMI (published May 2000; modified 10/16/00) and WHO growth charts (published in 2007) for age and sex were used as reference standards. Children with body mass index (BMI) above 95th percentile were considered as obese, those between 85th and 95th percentile as overweight, and those with BMI below the 5th percentile will be considered as underweight according to CDC growth standards and children with BMI Z score above 1 were considered overweight and those with Z score above 2 were considered as obese according to WHO growth standards.

**Results**

**Table 1: Prevalence of Obesity and Overweight and Religion**

Religion	Hindu	Muslim	Christian	Total	P value
Obese/Overweight	70(16.9%)	9(12.16%)	0(0%)	79	0.1854
Non Obese	344(83.09%)	65(87.83%)	12(100%)	421	
Total	414	74	12	500	

Table 1 shows that 16.9% of Hindu children were obese/overweight, 12.16% of Muslim children were overweight/obese and none of the Christian children were obese/overweight. No statistical significant difference was found among Hindus Muslims and Christians. P value was > 0.05

**Table 2: Prevalence of Obesity and Overweight and Family Size**

Family Size	≤4	>4	Total	P value
Obese/Overweight	50(15.57%)	29(16.20%)	79	0.8984
Non Obese	271(84.42%)	150(83.79%)	421	
Total	321	179	500	

Table 2 shows that there was no significant difference between prevalence of obesity and overweight among children belonging to family size of 4 members or less and those belonging to family size of more than 4 members.

**Table 3: Prevalence of Obesity and Overweight and Socioeconomic Status**

School	Upper	Lower	Total	P value
Obese/Overweight	48 (18.89%)	31 (12.60%)	79	0.0655
Non Obese	206 (81.10%)	215 (87.39%)	421	
Total	254	246	500	

Table 3 shows that prevalence of obesity and overweight among the subjects belonging to upper and lower socioeconomic classes were 18.89% and 12.60% respectively. These values were not found to be statistically significant. P value was 0.0655.

**Table 4: Prevalence of Obesity and Overweight and Diet**

Diet	Veg	Non Veg	Total	P value
Obese/Overweight	22(44%)	57(13.31%)	79	0.0007
Non Obese	50(69.44%)	371(86.68%)	421	
Total	72	428	500	

Obesity/Overweight was found to be significantly higher in vegetarians than non-vegetarians. P value is < 0.05.

**Table 5: Prevalence of Obesity and Overweight and Junk Food**

Junk Food	≤ 7times/week	>7times a week	Total	P value
Obese/Overweight	21(9.25%)	58(21.24%)	79	0.0003
Non Obese	206(90.74%)	215(78.75%)	421	
Total	227	273	500	

Table 5 shows that obesity/Overweight was found to be significantly higher in children who consume junk food more than 7 times a week compared to those who consume less than 7 times a week. P value is < 0.05.

**Table 6: Prevalence of Obesity and Overweight and Cold Drinks**

Cold Drinks	≤ 2 per day	>2 per day	Total	P Value
Obese/Overweight	44(12.08%)	35(25.73%)	79	0.0005
Non Obese	320(87.91%)	101(74.26%)	421	
Total	364	136	500	

Table 6 shows that obesity/overweight was found to be significantly higher in children who consumed > 2 cold drinks per week compared to those who consumed ≤ 2 cold drinks per week. P value is < 0.05.

**Table 7: Prevalence of Obesity and Overweight and Outdoor Activity**

Outdoor Activity	No/occasional	≥1hour per day	Total	P Value
Obese/Overweight	28 (40.57%)	51 (11.8%)	79	<0.0001
Non Obese	41 (59.42%)	380 (88.16%)	431	
Total	69	431	500	

Table 7 shows that obesity/overweight is significantly high in children who have no/occasional outdoor activity compared to children who have outdoor activity of 1 hour or more per day. P value was < 0.05.

**Table 8: Prevalence of Obesity and Overweight and Computer/Mobile/Videogames /Television Watching**

Computer/Mobile/Videogames /Television Watching	<= 2hour per day	>2hour per day	Total	P value
Obese/Overweight	31(11.31%)	48(21.23%)	79	0.003
Non Obese	243(88.68%)	178(78.76%)	421	
Total	274	226	500	

Obesity/Overweight was found to be significantly higher in children who spend more than 2 hours in watching Computer/ Mobile/ Videogames /Television per day compared to those who watch less than or equal to 2 hours per day. P value is < 0.05.

**Table 9: Prevalence of Obesity and Overweight and Mode of Transport**

Mode of Transport	Walking/Cycling	Car/Bus	Total	P Value
Obese/Overweight	53(14.97%)	26(17.80%)	79	0.4219
Non Obese	301(85.02%)	120(82.91%)	421	
Total	354	146	500	

Table 9 shows that there is no significant association between prevalence of obesity and overweight and mode of transport to school in children. P value is > 0.05.

This discrepancy can be explained by the following reasons:

- Our study has a limitation of small sample size.
- The criteria for defining socioeconomic status were different. e.g. Shabana Tharkar *et al.* defined upper socioeconomic status as the children studying in private school and lower socioeconomic status as the children studying in government school. Alice T Cherian *et al.* classified socioeconomic status as Upper, Middle and Lower Income group. In our study socioeconomic status was defined by modified Kuppaswamy scale as upper socioeconomic status (I and II) and lower socioeconomic status (III, IV, V).

### Discussion

Our study shows that prevalence of obesity and overweight among the subjects belonging to upper and lower socioeconomic classes were 18.89% and 12.60% respectively. These values were not found to be statistically significant. Our results are in contrast to those of earlier studies done by Shabana Tharkar *et al.*, Subhash B Thakrey *et al.*, Dr. Nazeem I. Siddiqui *et al.*, Alice T Cherian *et al.* and Soniya V. Ashtekar *et al.* who found that obesity/overweight was significantly higher in upper socioeconomic status.

**Table 10: Comparison of SES**

Author	Age group	Prevalence of Obesity and overweight
Shabana Tharkar <i>et al.</i> 2009 (Chennai) <sup>[7]</sup>	8-15 years	Significantly higher in Upper socioeconomic status
Subhash B Thakrey <i>et al.</i> 2011(Nagpur City) <sup>[8]</sup>	5-16 years	Significantly higher in Upper socioeconomic status
Dr. Nazeem I. Siddiqui <i>et al.</i> 2012(Indore) <sup>[9]</sup>	7-14 years	Significantly higher in Upper socioeconomic status
Alice T Cherian <i>et al.</i> 2012(Kerela) <sup>[10]</sup>	6-15 years	Significantly higher in Upper income group
Soniya V. Ashtekar <i>et al.</i> 2014 (Latur) <sup>[11]</sup>	9-14 years	Significantly higher in Upper socioeconomic status
Present Study 2023 (Shimoga)	6-12 years	No association

In our study we found that obesity/overweight was significantly higher in vegetarians than non-vegetarians. Our result is in contrast with those of other studies done in Nagpur and Latur by Subhash B Thakrey *et al.* and Soniya V. Ashtekar *et al.* respectively who found significantly high obesity in

non-vegetarians. This can be explained by the fact that the people of North east India are mostly non-vegetarians and the vegetarian population is mostly migrated from North India like Marwaris who belong to higher socioeconomic status.

**Table 11: Comparison of diet**

Author	Age group	Prevalence of Obesity and overweight
Subhash B Thakrey <i>et al.</i> 2011(Nagpur City) <sup>[12]</sup>	5-16 years	Significantly higher in non-vegetarians
Soniya V. Ashtekar <i>et al.</i> 2014 (Latur) <sup>[13]</sup>	9-14 years	Significantly higher in non-vegetarians
Present Study 2023 (Shimoga)	6-12 years	Significantly higher in vegetarians

In our study it was found that obesity/overweight was found to be significantly higher in children who consume junk food more than 7 times a week compared to those who consume less than 7 times a week. Our results are similar to that of studies of

Subhash B Thakrey *et al.*, Poonam Marwah *et al.*, Bansal AK *et al.* and Soniya V. Ashtekar *et al.* who also found that daily/regular intake of junk food was significantly associated with obesity/overweight <sup>[14]</sup>.

**Table 12: Prevalence of Obesity and Overweight and Junk Food**

Author	Age group	Prevalence of Obesity and overweight
Subhash B Thakrey <i>et al.</i> 2011(Nagpur City)	5-16 years	Regular/Frequent intake of junk food significantly associated
Poonam Marwah <i>et al.</i> 2012 (Patiala, Punjab)	9-10 years	Daily consumption of junk food is significantly associated
Bansal A K <i>et al.</i> 2013 (Jaipur)	Class 5 <sup>th</sup> and above	Junk food > once a day significantly associated
Soniya V. Ashtekar <i>et al.</i> 2014 (Latur)	9-14 years	Significantly higher in non-vegetarians
Present Study 2023 (Shimoga)	6-12 years	Junk food > 7 times a week significantly associated

In our studies we found that obesity/overweight was significantly higher in children who consume cold drinks 2 per week compared to those who consume less than or equal to per week. Our results are

comparable with that of Subhash B Thakrey *et al.* and Bansal A K *et al.* who also found that regular or >= 3 a week consumption of cold drinks is associated with increased risk of developing obesity/overweight.<sup>12,13,14</sup>

**Table 13: Prevalence of Obesity and Overweight and Cold Drinks**

Author	Age group	Prevalence of Obesity and overweight
Subhash B Thakrey <i>et al.</i> 2011(Nagpur City)	5-16 years	Regular consumption not significantly associated
Bansal A K <i>et al.</i> 2013 (Jaipur)	Class 5 <sup>th</sup> and above	Cold drinks >= 3 per week is significantly associated
Present Study 2023 (Shimoga)	6-12 years	Cold drinks >2 per week is significantly associated

Our study shows that obesity/overweight was significantly high in children who have no/occasional outdoor activity compared to children who have outdoor activity of 1 hour or more per day. Y. S.

Saraswathi *et al.*, Subhash B Thakrey *et al.*, Bansal AK *et al.* and Soniya V. Ashtekar *et al.* also found similar results in their studies<sup>[11-14]</sup>.

**Table 14: Prevalence of Obesity and Overweight and Outdoor Activity:**

Author	Age group	Prevalence of Obesity and overweight
Y. S. Saraswathi <i>et al.</i> 2011(Mysore)	13-17 years	< 20 hours a week significantly associated
Subhash B Thakrey <i>et al.</i> 2011(Nagpur City)	5-16 years	No outdoor games significantly associated
Bansal A K <i>et al.</i> 2013 (Jaipur)	Class 5 <sup>th</sup> and above	Weekly/no outdoor games significantly associated
Soniya V. Ashtekar <i>et al.</i> 2014 (Latur)	9-14 years	< 30 minutes a day significantly associated
Present Study 2023 (Shimoga)	6-12 years	No/Occasional outdoor games significantly associated

Obesity/Overweight was found to be significantly higher in children who spend more than 2 hours in watching Computer/ Mobile/ Videogames /Television per day compared to those who watch less than or equal to 2 hours per day in our study. Our results are comparable to those of studies done by Y. S.

Saraswathi *et al.*, Subhash B Thakrey *et al.*, Bansal A K *et al.* and Soniya V. Ashtekar *et al.* who also found obesity and overweight to be significantly higher in children who spent their time in sedentary activities like Computer/TV watching<sup>[11-14]</sup>.

**Table 15: Prevalence of Obesity and Overweight and Computer/Mobile/Videogames /Television Watching**

Author	Age group	Prevalence of Obesity and overweight
Y. S. Saraswathi <i>et al.</i> 2011(Mysore)	13-17 years	Television viewing > 20 hours/ week significantly associated
Subhash B Thakrey <i>et al.</i> 2011(Nagpur City)	5-16 years	TV watching > 60 mins /day significantly associated
Bansal A K <i>et al.</i> 2013 (Jaipur)	Class 5 <sup>th</sup> and above	TV/Computer watching > 1 hour /day significantly associated
Soniya V. Ashtekar <i>et al.</i> 2014 (Latur)	9-14 years	TV/Computer watching > 2 hours /day significantly associated
Present Study 2023 (Shimoga)	6-12 years	Computer/Mobile/Videogames /TV Watching >> 2 hours /day significantly associated

In our study we found no significant association between prevalence of obesity and mode of transport

to school in children whereas earlier studies done by Subhash B Thakrey *et al.*, Bansal A K *et al.* and

Soniya V. Ashtekar *et al.* shows that obesity use bus/car/motor vehicle [12, 13, 14]. /overweight was significantly higher in children who

**Table 16: Prevalence of Obesity and Overweight and Mode of Transport**

Author	Age group	Prevalence of Obesity and overweight
Subhash B Thakrey <i>et al.</i> 2011(Nagpur City)	5-16 years	Significantly high in those using motor vehicle as a mode of transport
Bansal A K <i>et al.</i> 2013 (Jaipur)	Class 5 <sup>th</sup> and above	Significantly high in those using bus/car as a mode of transport
Soniya V. Ashtekar <i>et al.</i> 2014 (Latur)	9-14 years	Significantly high in those using motor vehicle as a mode of transport
Present Study 2023 (Shimoga)	6-12 years	No association

### Conclusion

- This study shows no correlation between socioeconomic status of children and that prevalence of obesity/overweight. It is in contrast with many studies which show that higher socioeconomic status is significantly associated with obesity/overweight.
- The prevalence of obesity/overweight was found to be significantly higher in children who were vegetarians and who consumed junk food more than 7 times a week and cold drinks more than twice a week in this study.
- In this study it was found that obesity/overweight was significantly higher in children who spend more than 2 hours a day in watching television/computer/mobile/videogames and have no/occasional outdoor activities. However no significant correlation was found with mode of transport to school.

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