International Journal of Contemporary Pediatrics
*Prashanth SV et al. Int J Contemp Pediatr. 2017 May;4(3):706-712*
http://www.ijpediatrics.com
pISSN 2349-3283 | eISSN 2349-3291

DOI: http://dx.doi.org/10.18203/2349-3291.ijcp20170897

**Original Research Article**

# Obesity: changing outlook of Indian adolescent children: emerging and worrying trend

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**Received:** 13 February 2017
**Accepted:** 21 February 2017

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## ABSTRACT

**Background:** Obesity, a key risk factor for the chronic and non-communicable disease, has become a serious public health concern in both developed and developing countries. WHO has designated obesity as global epidemic. In 2014, 41 million children under the age of 5 years were found to be overweight or obese. Most of the world's population lives in countries where overweight and obesity kills more people than underweight. Objectives of the study were to know the prevalence of obesity and factors associated with obesity in rural and urban part of India.
**Methods:** This cross-sectional study was conducted in three high schools of rural and urban part of Davangere district, central Karnataka, India with a sample of 918 adolescent school children. Pre-designed questionnaire was used to elicit the required information. Height and weight was measured. Body mass index was calculated.
**Results:** The prevalence of overweight and obesity was observed to be 10.1% and 0.5% respectively. In rural part the prevalence was 7.1% and in urban area it is 12.6%. Overweight/obesity was significantly associated with family history of overweight/obesity, dietary habit, eating junk foods, sedentary life styles including watching television, lack of physical exercise and not participating in outdoor games.
**Conclusions:** Overweight and obesity thought to be disease of developed and affluent nation. But in changing trends, countries like India especially rural areas, it's alarming to see such results. Adopting the healthy lifestyles, food habits and regular exercise can reduce the risk of becoming overweight and obese.

**Keywords:** Activity of children, BMI, Childhood obesity, High school children, Influencing factors, Prevalence, Parental obesity, Rural and urban, Snacking habit

## INTRODUCTION

Think "malnutrition" and possibly the images that come to mind are the one associated with poverty and under nutrition. However as today, with ever improving standards of living, other spectrum of malnutrition namely, overweight and obesity are posing a growing threat to the world health.

Obesity is derived from Latin word 'OBESUS' means pump or having eaten oneself fat. Invariably obesity is a product of imbalance between energy intake and energy spent. Today childhood obesity is a matter of concern to the whole world. WHO has designated obesity as global epidemic. As per the recent data worldwide obesity has more than doubled since 1980. In 2014, more than 1.9 billion adults, 18 years and older were overweight. Of these over 600 million were obese. That comes to 39% of adults worldwide are either overweight or obese. 41 million children under the age of 5 were overweight or obese in 2014.[1,2]

The problem of childhood obesity is quite high in rich and affluent countries. But things are changing now, where obesity is on the rise in developing nations and it's a worrying trend. In Africa, the number of children who

are overweight and obese has nearly doubled from 5.4 million in 1990 to 10.6 million in 2014.[1] Nearly half of the children under 5 years who were overweight and obese in 2014 lived in Asia. Consequently it has high potential for the problem of childhood obesity. Scientists have shown that 50-80% of obese children will continue as obese adults.[3,4]

There are many studies which show that overweight and obesity are very much prevalent in urban population. But very few studies were undertaken to assess this global epidemic in rural population. With all these background our study was undertaken in rural and urban schools of Davangere, a small city in central Karnataka, India.

## METHODS

The study was a cross-sectional randomized epidemiological study among high school students of 8th, 9th, and 10th standard in rural and urban areas of Davangere, Karnataka, India, in the year 2015-2016.

Children having chronic illness, endocrinal problems, physical and mental defects etc., children aged below 12 year and above 16 years and children hailing from outside Karnataka, were excluded from the study. The consent was taken from the head of the institute before their inclusion in the study. Present study was approved by ethical committee of S.S. Institute of Medical Sciences, Davangere, Karnataka, India.

In the present study 3 schools each selected from rural urban part of Davangere by convenient sampling. These schools were sub categorized into 3 types of schools (Govt., Aided and Unaided) proportion to the population size of the students. The sample size was estimated for infinite population by using the formula $4pq/d^2$ where prevalence was taken as 10%.

The required precision of the estimate [d] was set at 20%. Using the above mentioned formula, the sample size was estimated to be 900. A total number of 918 school children aged 12 to 16 years had participated in this study. Out of them, 507 were from urban and 411 were from rural area. In the urban area, 148 were boys and 359 were girls, and from the rural area, 296 were boys and 115 were girls (Table 1).

The body weight was measured without shoes using a measuring scale and height to the nearest centimetre was taken. Trained investigators collected data on various modalities such as age, sex, height, weight, school type, school working hours, school physical activity, physical activity outside the school which includes playing hours and domestic work, diet preference, availability of pocket money, family history including literacy levels, occupation, history of family obesity, and socio-economic status.

Physical activity included mode of transportation to the school, PE classes in the school, participation in sports, extra hours spent on sports outside school hours. Physical activity was recorded with the help of school curriculum and questionnaire specially designed for them. Diet preferences includes normal Indian home cooked food for that area and eating cakes biscuits, chocolates, chips or other junk foods.

Body mass index (BMI) was calculated as weight (in kilograms) divided by height (in meter square). Healthy children have a BMI percentile ranging between 5$^{th}$ percentile to 85$^{th}$ percentile. The children whose weight were more than 85$^{th}$ to less than the 95$^{th}$ percentile were considered as overweight and obese who were equal to or greater than the 95$^{th}$ percentile.

The prevalence of childhood obesity was compared between urban and rural areas and expressed in percentage (%).

### *Statistical analysis*

The data present in the electronic format was abstracted from the Microsoft excel database which was imported into SPSS statistical software 10 and analyzed using different statistical methods. Descriptive data presented as mean, standard deviation and percentage. The association between outcome and factors was studied by using Chi square test. The p-value of 0.005 or less was considered as statistically significant.

## RESULTS

As per the study design, out of 6 schools, three each were from rural and urban areas. The schools were sub divided into government, aided and private schools, one each from rural and urban areas, age and sex distribution (Table 1).

In the rural schools out of 411 students, 139(33.8%) were from government school, 87 (21.2%) from aided school and 185 (45%) were from private school (Table 2). In the urban schools out of 507 students, 122 (24.1%) were from government school, 219 (43.2%) from aided school and 166 (32.7%) were from private school.

Out of 918 children 93 were overweight/ obese, with a total prevalence of 10.1%. Among these, 64 (12.6%) children in urban schools and 29 (7.1%) in rural schools were found to be overweight/ obese. In boys prevalence of overweight was 7.43% and obesity 0.22% in boys, similarly 11.6% and 0.85% in girls.

Prevalence of overweight and obesity in rural schools at the age group of 13 years is 11.1%, at 14$^{th}$ year 48.1%, at 15th year 37% and at 16$^{th}$ year it is 3.7% with the overall prevalence of 7.1%.

Prevalence of overweight and obesity in urban schools at the age group of 13 years is 21.3%, at 14th year 32.8%, at 15th year 39.3%, and at 16th year it is 6.6% with the overall prevalence of 12.6%. The striking feature in this study is that, the prevalence was found to be more in the age group of 14 and 15 years. Interestingly it was equal in both rural and urban schools.

Prevalence of overweight and obesity in rural government school children is 7.9%, in aided schools 6.9% and in private school 6.5%. Prevalence of overweight and obesity in urban government school children is 21.3%, in aided schools 8.7% and in private school 11.4%. In the present study, the p value was significant (<0.05).

**Table 1: Distribution according to the type of school.**

| Type of School | Area | | Total |
|---|---|---|---|
| | Rural | Urban | |
| Government | 139 | 122 | 261 |
| | 33.8% | 24.1% | 28.4% |
| Aided | 87 | 219 | 306 |
| | 21.2% | 43.2% | 33.3% |
| Private | 185 | 166 | 351 |
| | 45.0% | 32.7% | 38.2% |
| **Total** | **411** | **507** | **918** |
| | **100.0%** | **100.0%** | **100.0%** |

**Table 2: Comparison of overweight/obesity between rural and urban with the type of school.**

| Area | BMI status | Type of school | | | Total | p-value |
|---|---|---|---|---|---|---|
| | | Government | Aided | Private | | |
| Rural | Non-obese | 128 | 81 | 173 | 382 | 0.882 |
| | | 92.1% | 93.1% | 93.5% | 92.9% | |
| | Overweight/obesity | 11 | 6 | 12 | 29 | |
| | | 7.9% | 6.9% | 6.5% | 7.1% | |
| **Total** | **139** | **87** | **185** | **411** | | |
| | **100.0%** | **100.0%** | **100.0%** | **100.0%** | | |
| Urban | Non-obese | 96 | 200 | 147 | 443 | 0.003 |
| | | 78.7% | 91.3% | 88.6% | 87.4% | |
| | Overweight/obesity | 26 | 19 | 19 | 64 | |
| | | 21.3% | 8.7% | 11.4% | 12.6% | |
| **Total** | **122** | **219** | **166** | **507** | | |
| | **100.0%** | **100.0%** | **100.0%** | **100.0%** | | |
| **Total** | Non-obese | 224 | 281 | 320 | 825 | 0.036 |
| | | 85.8% | 91.8% | 91.2% | 89.9% | |
| | Overweight/obesity | 37 | 25 | 31 | 93 | |
| | | 14.2% | 8.2% | 8.8% | 10.1% | |
| | **Total** | **261** | **306** | **351** | **918** | |
| | | **100.0%** | **100.0%** | **100.0%** | **100.0%** | |

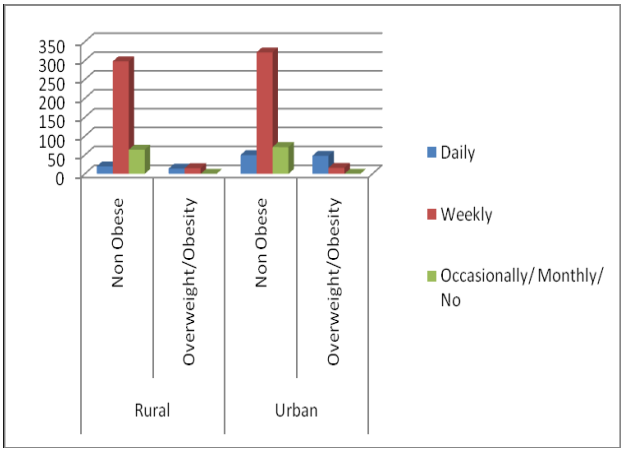


**Figure 1: Association with snacking habit.**

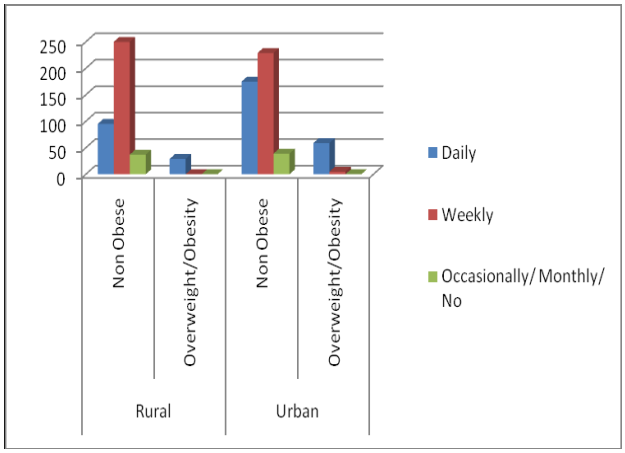


**Figure 2: Association with fatty food intake.**

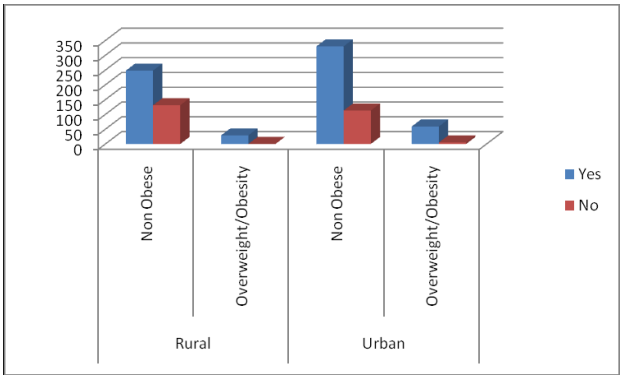


**Figure 3: Association with pocket money.**

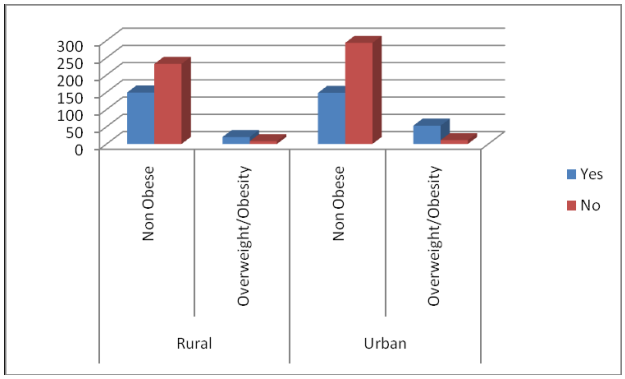


**Figure 4: Association with parental obesity.**

**Table 3: Association between physical activity and overweight/obesity.**

| Area | BMI status | Outdoor games | | Total | p-value |
|---|---|---|---|---|---|
| | | Yes | No | | |
| Rural | Non-obese | 369 | 13 | 382 | 0.000 |
| | | 95.1% | 56.5% | 92.9% | |
| | Overweight/obesity | 19 | 10 | 29 | |
| | | 4.9% | 43.5% | 7.1% | |
| | **Total** | **388** | **23** | **411** | |
| | | **100.0%** | **100.0%** | **100.0%** | |
| Urban | Non-obese | 296 | 147 | 443 | 0.000 |
| | | 99.3% | 70.3% | 87.4% | |
| | Overweight/obesity | 2 | 62 | 64 | |
| | | 7% | 29.7% | 12.6% | |
| | **Total** | **298** | **209** | **507** | |
| | | **100.0%** | **100.0%** | **100.0%** | |
| **Total** | Non-obese | 665 | 160 | 825 | 0.000 |
| | | 96.9% | 69.0% | 89.9% | |
| | Overweight/obesity | 21 | 72 | 93 | |
| | | 3.1% | 31.0% | 10.1% | |
| | **Total** | **686** | **232** | **918** | |
| | | **100.0%** | **100.0%** | **100.0%** | |

**Table 4: Association between mode of transportation and overweight/obesity.**

| Area | BMI status | Transportation | | Total | p-value |
|---|---|---|---|---|---|
| | | Vehicle | Walk/Cycle | | |
| Rural | Non-obese | 38 | 344 | 382 | **0.000** |
| | | 76.0% | 95.3% | 92.9% | |
| | Overweight/obesity | 12 | 17 | 29 | |
| | | 24.0% | 4.7% | 7.1% | |
| | **Total** | **50** | **361** | **411** | |
| | | **100.0%** | **100.0%** | **100.0%** | |
| Urban | Non-obese | 167 | 276 | 443 | **0.000** |
| | | 73.6% | 98.6% | 87.4% | |
| | Overweight/obesity | 60 | 4 | 64 | |
| | | 26.4% | 1.4% | 12.6% | |
| | **Total** | **227** | **280** | **507** | |
| | | **100.0%** | **100.0%** | **100.0%** | |
| **Total** | Non-obese | 205 | 620 | 825 | **0.000** |
| | | 74.0% | 96.7% | 89.9% | |
| | Overweight/obesity | 72 | 21 | 93 | |
| | | 26.0% | 3.3% | 10.1% | |
| | **Total** | **277** | **641** | **918** | |

**Table 5: Association between sedentary activity and overweight/obesity.**

| Area | TV viewing | | | | Total |
|---|---|---|---|---|---|
| | BMI status | 2 hours and above | 1 hour | No. | |
| Rural | Non-obese | 49 | 327 | 6 | 382 |
| | | 63.6% | 99.7% | 100.0% | 92.9% |
| | Overweight/obesity | 28 | 1 | 0 | 29 |
| | | 36.4% | 0.3% | 0.0% | 7.1% |
| | **Total** | **77** | **328** | **6** | **411** |
| | | **100.0%** | **100.0%** | **100.0%** | **100.0%** |
| Urban | Non-obese | 188 | 255 | | 443 |
| | | 74.6% | 100.0% | | 87.4% |
| | Overweight/obesity | 64 | 0 | | 64 |
| | | 25.4% | 0.0% | | 12.6% |
| | **Total** | **252** | **255** | | **507** |
| | | **100.0%** | **100.0%** | | **100.0%** |
| **Total** | Non-obese | 237 | 582 | 6 | 825 |
| | | 72.0% | 99.8% | 100.0% | 89.9% |
| | Overweight/obesity | 92 | 1 | 0 | 93 |
| | | 28.0% | 0.2% | 0.0% | 10.1% |
| | **Total** | **329** | **583** | **6** | **918** |
| | | **100.0%** | **100.0%** | **100.0%** | **100.0%** |

## DISCUSSION

In India, studies have been carried out to study the overweight/obesity in school children and majority of them have been carried out in metropolitan cities in high income schools. Studies from rural areas mainly emphasize on underweight and data on overweight and obesity are not available. There are very few comparative studies undertaken between urban and rural children with respect to obesity.

In our study, three different schools were selected randomly from rural and urban areas of Davangere, Karnataka, India, which is a small city, situated 260 kilometers away from Bangalore metropolitan. Here the subjects were from middle to low income families.

In the physical activity/outdoor games section as depicted in Table 3, among overweight and obese children, 1/3 rd (34 %) in rural schools and almost all (97%) in urban schools were found to be not involved or spending less than 2hr/day in any kind of vigorous or non-vigorous physical activity. Similar observation was also found in a recent study conducted in Kuwait.[5] Furthermore in our study, total prevalence of overweight and obesity among all children who were using vehicle as mode of transportation (Table 4). 77.5 % which was similar to a study conducted in elementary schools of Mexico City.[6]

Table 5 shows the sedentary activity, almost all the children (92 out of 93) who are overweight and obese were found to be spending at least ≥2 hours per day in watching TV/ playing computer games/ using mobile phones. This trend was observed equally in urban as well as rural children.

A study by Rosiek A et al on effects of Television on Obesity revealed that commercials on TV which promote unhealthy eating habits along with the amount of time spent, has got negative impact on child's health.[7-9]

Type of food consumed played a part in the incidence of Obesity. Among obese children 2/3 rd of children were eating Non-vegetarian. In both, vegetarians and non-vegetarians, children were consuming less of fiber rich foods and fruits were eaten occasionally. Similar results were observed by Y Ramachandran in Kerala.[10]

In the obese children, snacking habit was found to be very predominant. Most of the children, both in rural and urban areas, were consuming high calorie foods either daily or weekly basis. Worrying trend was found in rural parts, where the availability of fast was easily available and children found to consume them on regular basis.

Interestingly, multiple factors influenced children towards these food items. Namely, most of these children were given pocket money and children used this money on eating high calorie food rather than on curricular activities.

Similar results to our study were noticed by Shatabdi G et al.[11] Parental history of obesity is present in 73(78.5%) out of 93 overweight and obese children. Whitaker et al, and in the Indian set up, Sidhu et al, Monga S and Singh

M et al reported that risk of increasing childhood obesity has direct relationship with parental obesity.[12-15]

All these findings were similar to the several studies conducted in India as well as worldwide. Very glaringly most of these studies were conducted in urban areas. There are few studies which compared urban and rural children and results are similar to our studies except for the prevalence of obesity found to be increasing in our study.[16,17]

## CONCLUSION

During the year 2016 prevalence of overweight and obesity is 10.1% in high school children of rural and urban population of Davangere city. In rural schools the prevalence was 7.1 % as compared to 12.6 % in urban schools. This is a worrying emerging trend. Prevalence of overweight and obesity is more in girls (11.6%) than boys (7.4%). Education of parents and family income has direct relationship on childhood obesity. Parental obesity had a definite influence of obesity of children. Lack of physical activity predisposes to the risk of overweight and obesity.

Increase in duration of sedentary activity precipitates obesity of children. Increase in the frequency of snacks intakes like chocolates, sweets, ice creams, bakery products and other fast foods was commonly seen in obese children than in non-obese children. The practice of giving pocket money is a contributing factor. Environmental factors definitely play a role in the prevalence.

### *Recommendations*

- With the background of higher prevalence of obesity in school children formulation and implementation of intervention (short and long term) measures focusing mainly on increasing the activity of children, drawing them away from high energy foods and providing psychological support is recommended.
- At least 30 minutes of cumulative moderate physical activity every day, with children of all ages an additional 20 minutes of vigorous physical activity 3 times a week is recommended.
- Restrict TV viewing, video games and use of computers to a total of less than 2 hours/day.
- At the school student level physical education must be compulsorily integrated into school and college curriculum.
- At a government community level increase playground facilities and safe play area for children, and provide safe and level pedestrian path for the public to walk.
- Consider taxation on fatty food or alternatively reduce taxation promote production of fresh food and vegetables.
- Knowledge regarding healthy life style and healthy food habit should be inculcated to the school children through curriculum and teachers should be trained.
- Necessary measures to be taken to educate the public, (mainly mothers and children) to build healthy future generation by creating awareness to combat childhood obesity.

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

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**Cite this article as:** Prashanth SV, Latha GS, Babu VDV, Gururaj S. Obesity: changing outlook of Indian adolescent children: emerging and worrying trend. Int J Contemp Pediatr 2017;4:706-12.