# **Original Research Article**

DOI: http://dx.doi.org/10.18203/2349-3291.ijcp20194709

# Survey of obesity among school children in rural Kerala, India

## Robin Joseph Abraham<sup>1</sup>, Priyadarsini C. Pillai<sup>2\*</sup>

<sup>1</sup>Department of Paediatrics, <sup>2</sup>Department of Emergency Medicine, Al Azhar Medical College and Super Specialty Hospital, Ezhalloor P O, Thodupuzha, Kerala, India

Received: 16 July 2019 Revised: 21 September 2019 Accepted: 03 October 2019

\*Correspondence: Dr Priyadarsini C. Pillai,

E-mail: dharsinipillai@gmail.com

**Copyright:** © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

## **ABSTRACT**

**Background:** Childhood obesity is a risk factor for subsequent development of diabetes mellitus, hypertension etc. Rural children show lower levels of obesity and higher rates of malnutrion. Objectives: Study seeks to access the prevalence of obesity and overweight among higher secondary students in rural Kerala).

**Methods:** 1577 students were selected from schools picked randomly in and around vadavukode block in Ernakulam district, Kerala, of which 761 from private and 816 from government and aided school. Their height, weight and BMI was recorded and plotted in WHO growth charts to assess stunting, wasting, overweight and obesity.

**Results:** No difference was found among the government and private schools. The finding from the data tally with the results from other parts of rural India with overweight and obese children (around 10%). The study found 44% children were found to be undernourished. Malnutrition was noted in both private and public schools possible highlighting knowledge deficit on Nutrition may be the cause of malnutrition. Only 47% students were in the normal range.

**Conclusions:** Rural Kerala is afflicted with a serious problem of undernutrition and lower levels of obesity. There was striking prelidiction for obesity was noted among stunted children in the study highlighting the complex nature of the nutrition problem in India where malnutrition and obesity coexist and cause double burden of diseases. The solution is to encourage the message of healthy living, equally to the over nourished and the undernourished, where balanced diet and exercise as a way of life is encouraged.

Keywords: Balanced diet, Growth, Malnutrition, Obesity, School children, Wasting

## INTRODUCTION

Obesity is an important pediatric public health problem associated with risk of complications in childhood and increased morbidity and mortality throughout adult life. The prevalence of childhood obesity has increased, and the prevention and treatment of obesity has emerged as an important focus of pediatric research and clinical care. Obesity is a global public health problem, affecting countries like India too where it coexist alongside

problems of malnutrition sparing only dramatically poor regions with chronic food scarcity such as sub-Saharan Africa and Haiti. As of 2005, more than 1.6 billion persons ≥15 yr old are overweight or obese (WHO).

In USA, 30% of adults are obese, and an additional 35% of adults are overweight. In USA children have shown an increase of 300% in the prevalence of obesity over 40 years. The National Health and Nutrition Examination Survey (NHANES) IV, 1999-2002, 31% children over 2 years were found to be overweight or obese and 16% of

children and adolescents 6-19 years were in the obese range. Children's risk varies by socioeconomic status, race, maternal education level, and gender.

In a recent study by Reddy, et al., more than 28% of adult males and 47% of adult females in urban Delhi were overweight by WHO standards. In the same study the corresponding figures for overweight in Haryana rural area were 7% in males and 9% in females. Conversely, as many as 38% of males and 36% of females in the rural area were actually 'underweight' by BMI standards. Other studies from India also document such 'urban, rural divide'.<sup>2</sup>

Urban studies from India show evidence of difference between the rich and the poor in Urban areas. Ramachandran, et al. studied children from six schools in Chennai, two each from high, middle and lower income groups.<sup>3</sup> The prevalence of overweight (including obese) adolescents ranged from 22% in better off schools to 4.5% in lower income group schools. In a Delhi school with tuition fees more than Rs. 2,500 per month, the prevalence of overweight was 31%, of which 7.5% were frankly obese.<sup>4</sup>

Parental obesity correlates with a higher risk for obesity in their children. Prenatal factors including weight gain during pregnancy, high birth weight, and gestational diabetes are associated with increased risk for later obesity. Paradoxically, intrauterine growth restriction with early infant catch-up growth is associated with the development of central adiposity and cardiovascular risk.

Childhood Obesity is important, as it is one of the predictors of adult obesity. Obesity has been shown to increase susceptibility to diabetes mellitus, hypertension, myocardial infarction, stroke etc. Pediatrics is traditionally seen as a preventative specialty and thus pediatricians have a role in prevention of obesity through interventions during childhood. If messages of healthy eating and exercise is inculcated in childhood it may go a long way in establishing healthy behavior in adulthood, which will surely make a dent in reducing the epidemic non-communicable diseases like diabetes, hypertension, etc. There is thus an urgent need to focus on childhood obesity as a preventive strategy.

## **METHODS**

This was a school-based, cross-sectional study carried out over a period of four months, from January to April 2011. The sample size was estimated for infinite population by using the formula 4pq/d² 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 1300- 1500. Thus, 1500 subjects were selected for this study. For the selection of schools, a list of all schools was obtained from the school authorities of the district education office. First, four schools were selected by a simple random technique. Statistical analysis was done using Chi-square test to assess the significance of association between

anthropometric data and age and gender. SPSS version 16 was used for statistical analysis.

The subjects were students of the age 10-15 years. The students were from a rural block of Ernakulum district, central Kerala. The study is descriptive type of cross sectional study.

#### Data collection

Weight was recorded with minimal clothing/school uniform with students standing without any support and without shoes using a SECA balance (electronic spring scale) to an accuracy of 0.5 kg. Height was recorded using the standard anthropometric rod from National Institute of Nutrition, Hyderabad, to an accuracy of 0.1 cm. Each student is made to stand on a flat surface after removal of shoes with the feet parallel and with the heels, buttocks, shoulders and the back of the head touching the upright rod. The head of the student is positioned so that it held the head comfortably erect, with the lower border of the orbit of the eye in the same horizontal plane as the external canal of the ear with the arms loosely by the side. The head piece of the measuring device was then gently lowered, crushing the hair and making contact with the top of the head to record the height.

Weight and height was used to calculate the BMI and polled on the WHO graph (see Appendix) and the data was recorded as to between which major percentile line the student's data belonged.

For example: If a student of age 11 had wt of 29.5 kg and ht of 1.44 m, then BMI is 14.2 and the student was between 50-85th percentile for height for age graph of WHO and BMI for age was below 3rd percentile. All the students in the study were thus categorized.

The categories were defined as below

BMI for age(percentile): Child's BMI was plotted against the age and were grouped by the position between the major percentile lines namely 3, 15,50,85,97. Children were divided based on what group they were in, as given below. (See appendix for graphs)

>85 percentile to 97 percentile : over weight

>97 percentile : obese >=15 to <85 : Normal

<15 percentile to 3<sup>rd</sup> percentile mild underweight

<3<sup>rd</sup> percentile : severe under nutrition

Height for age (percentile): Child's height was plotted against the age and were grouped by the position between the major percentile lines namely 3, 15,50,85,97. Children were divided based on what group they were in, as given below.

>85 percentile to 97 percentile : tall for age

>97 percentile : very tall for age

>=15 to < 85 : Normal

<15 percentile to 3rd percentile: Mild stunting

< 3 rd percentile: severe stunting

BMI for Age (Z score): Child's BMI was plotted against the age and were grouped by the position between the major Z score lines namely +1, +2,0,-1, -2. Children were divided based on what group they were in, as given below.

>+2 Obese

+1 - +2 : Overweight -1 to +1 : Normal

-1 to -2 : mild undernutrition <-2 severe undernutrition

Height for age (Z score): Child's BMI was plotted against the age and were grouped by the position between the major Z score lines namely +1, +2,0,-1, -2. Children were divided based on what group they were in, as given below.

> +2 very tall for age +1 - +2 : tall for age -1 to +1 : Normal -1 to -2 : mild stunting <-2 severe stunting

#### Inclusion criteria

All students from age 10-15.

## Exclusion criteria

- Those below 10 and above 15 were excluded.
- Students who were absent during the conduct of the survey
- Those who were advised bed rest for more than 15 days during the last 6 months
- Those students who had any chronic diseases.
- Limitation of the study

The main limitation of the study is that schools are sampled from a small area in and around vadavkode block in Ernakulam district, Kerala.

## **RESULTS**

Four Schools were surveyed, and 1577 students were checked for height and weight. Of these 765 were female and 812 were males.

Table 1: Table shows the percentage of children who were severely stunted, mildly stunted and normal children along with tall for age children.

|        |        |                 | Height/Age PER  | C      |        |                 |                      | _       |
|--------|--------|-----------------|-----------------|--------|--------|-----------------|----------------------|---------|
|        |        |                 | Severe stunting | Mild   | Normal | Tall for<br>age | Very tall<br>for age | Total   |
|        | E1-    | Count           | 71              | 188    | 459    | 41              | 6                    | 765     |
| Candan | Female | % within gender | 9.30%           | 24.60% | 60.00% | 5.40%           | 0.80%                | 100.00% |
| Gender | M-1-   | Count           | 82              | 165    | 502    | 48              | 15                   | 812     |
|        | Male   | % within gender | 10.10%          | 20.30% | 61.80% | 5.90%           | 1.80%                | 100.00% |
| T-4-1  |        | Count           | 153             | 353    | 961    | 89              | 21                   | 1577    |
| Total  |        | % within Gender | 9.70%           | 22.40% | 60.90% | 5.60%           | 1.30%                | 100.00% |

Around 61% of total children were found to be normal and around 32% were found to be stunted, while 7% were

found to be tall for age. The distribution across the genders were similar. 35% girls were found to be stunted in contrast to 31% boys but is statistically insignificant.

Table 2: Table shows the percentage and number of male and female children who were obese, overweight, normal and undernourished children.

|        |        |                 | BMI/Age Percentile     |        |        |             |       | Total   |
|--------|--------|-----------------|------------------------|--------|--------|-------------|-------|---------|
|        |        |                 | Severe under nutrition | Mild   | Normal | Over weight | Obese |         |
|        | Female | Count           | 147                    | 160    | 396    | 47          | 15    | 765     |
| G 1    | гешае  | % within gender | 19.20%                 | 20.90% | 51.80% | 6.10%       | 2.00% | 100.00% |
| Gender | Male   | Count           | 201                    | 169    | 349    | 69          | 24    | 812     |
|        |        | % within gender | 24.80%                 | 20.80% | 43.00% | 8.50%       | 3.00% | 100.00% |
| Total  |        | Count           | 348                    | 329    | 745    | 116         | 39    | 1577    |
| Total  |        | % Total         | 22.10%                 | 20.90% | 47.20% | 7.40%       | 2.50% | 100.00% |

The number of obese and overweight children were found to be around 10% of which 7.4% were overweight and 2.5% were obese. A large percentage of children (42%)

where found to be thin or undernourished. It was that half of the undernourished children were severely undernourished (22%) Around 11.5% of boys were overweight/obese in comparison to 8% of girls.

Table 3: Table shows the percentage of children who were severely stunted, mildly stunted and normal children in private and government aided schools.

|             |                 |                           |                    | Height/Age PERC |        |              |                   |         |  |  |
|-------------|-----------------|---------------------------|--------------------|-----------------|--------|--------------|-------------------|---------|--|--|
|             |                 |                           | Severe<br>stunting | Mild            | Normal | Tall for age | Very tall for age | Total   |  |  |
| TD 6        | Private         | Count                     | 34                 | 147             | 521    | 52           | 7                 | 761     |  |  |
| Type of     | riivate         | % within type of school N | 4.50%              | 19.30%          | 68.50% | 6.80%        | 0.90%             | 100.00% |  |  |
| school<br>N | Aided/<br>Govt. | Count                     | 119                | 206             | 440    | 37           | 14                | 816     |  |  |
| 11          |                 | % within type of school N | 14.60%             | 25.20%          | 53.90% | 4.50%        | 1.70%             | 100.00% |  |  |
| Total       |                 | Count                     | 153                | 353             | 961    | 89           | 21                | 1577    |  |  |
| Total       |                 | % within type of school N | 9.70%              | 22.40%          | 60.90% | 5.60%        | 1.30%             | 100.00% |  |  |

It was found that 9.7% showed severe stunting while 22% showed moderate stunting while around 6% were tall for age. Stunting was found to be higher in government schools

in comparison to private schools. Severe stunting was around three times higher in government schools (14.6% vs 4.5%). Mild stunting rates were higher in government compared to private schools. (25.2% vs 19.3%).

Table 4: Table shows the percentage of children who were obese, overweight, normal and undernourished children who studied in Private or government schools.

|            |               |                           | BMI/Age Perc           | entile |        |                |       |         |
|------------|---------------|---------------------------|------------------------|--------|--------|----------------|-------|---------|
|            |               |                           | Severe under nutrition | Mild   | Normal | over<br>weight | Obese | Total   |
| Type       | Private Co    | Count                     | 172                    | 153    | 355    | 59             | 22    | 761     |
| Type<br>of |               | % within type of school N | 22.60%                 | 20.10% | 46.60% | 7.80%          | 2.90% | 100.00% |
| school     | school Aided/ | Count                     | 176                    | 176    | 390    | 57             | 17    | 816     |
| N          | Govt.         | % within type of school N | 21.60%                 | 21.60% | 47.80% | 7.00%          | 2.10% | 100.00% |
| T-4-1      |               | Count                     | 348                    | 329    | 745    | 116            | 39    | 1577    |
| Total      |               | % within type of school N | 22.10%                 | 20.90% | 47.20% | 7.40%          | 2.50% | 100.00% |

Table 6: Table shows the percentage of children who were severely stunted, mildly stunted and normal children along with tall for age children. It shows data based on WHO z score chart for height for age (both male and female).

| Height Age New  | Frequency | Percent |                   |
|-----------------|-----------|---------|-------------------|
| 1.00 Below -2   | 219       | 13.89   | severe stunting   |
| 2.00 -1 to -2   | 427       | 27.08   | mild stunting     |
| 3.00 -1 to +1   | 850       | 53.90   | Normal            |
| 4.00 +2 & above | 12        | 0.76    | Very tall for age |
| 5.00 +1 to +2   | 69        | 4.38    | Tall for Age      |
| Total           | 1577      | 100.00  |                   |

There was not much difference in the rates of overweight and obesity among Private and government school. Private had 7.8% while government had 7% overweight children. 2.9% and 2.1% of children in private and

government schools were obese respectively. The rates of severe and mild undernutrition were also similar. 22.6% and 21.6% children in Private and government schools had severe undernutrition respectively. 20.1% and 21.6%

children were having mild under nutrition in private and government schools respectively.

As per the WHO z-score growth charts 13.9% children had severe stunting and 27% had mild stunting.

## **DISCUSSION**

The finding from the data tally with the results from other parts of rural India with overweight and obese children around 10% of the total sample. Around 44% children were found to be undernourished. Only 47% students were in the normal range. This highlights the growing problem of increasing obesity and malnutrition in the rural areas combining together to form twin burden of malnutrition in a country like India. Of the 44% undernourished children 22% percent of the total were found to be severely undernourished. 7.4% of the children were found to be overweight and 2.5% were found to be obese. Not much variation was found in the male and the female data of undernutrition and overnutrition. Severe stunting was seen in 9.7% of the students and 22.4% showed mild stunting. Stunting is a marker for chronic malnutrition. Z score chart recorded finding with 27% showing mild stunting and 14% had severe stunting(Ref Table 1 and 2 ). As per the Z score charts 47% showed undernutrition with 27% children showing mild undernutrion and 22% showing severe undernutrition. (Ref Table 2 ) Severe stunting was thrice as much in govt and aided schools compared to private schools (14.6% vs 4.5%). Mild stunting was slightly more in Government/Aided schools than in Private schools. (25.2% vs 19.3%). (Ref Table 3 ) BMI for age percentiles were more or less evenly distributed in both Private and Govt/Aided schools. Overweight and obesity levels were only marginally more in private schools (7.8% vs 7% and 2.9% vs 2.1%) with statistically little significance. (Table 4) Of the 116 children found to be overweight 28 (24%) had stunting. Of the 39 children shown to be obese 6 (15%) had stunting.( Refer table no 5 )This is significant as it is shown that stunted children when taking high calorie diet are more prone to obesity and increased central obesity. This is consistent with many surveys showing higher chance of obesity among stunted children.<sup>5-8</sup> Stunting has not shown to increase obesity in adulthood but raises the chance of central obesity<sup>9</sup> which is significant due to the association of central obesity with metabolic syndrome of dyslipidemia, hyperinsulinism etc. All stunted children who are overweight must be screened for endocrine disorders like hypothyroidism.

Anthropometric surveys are labour intensive but low cost method of monitoring the health status of our children. Schools have sufficient staff to conduct once a year anthropometric survey. The unique problem of India shows that there is a growing trend towards obesity alongside with persistence of undernutrition as a problem. This can result in confusion of messages when given to the public. There is a need to streamline health message in a way that does not confuse. It is imperative that all students should get the message of healthy eating and

exercise alike. The goal should be good health rather than ideal weight.

There have been numerous school health programmes to prevent obesity which are useful lessons in the Indian context. In Singapore a national healthy lifestyle programme called 'Trim and Fit' was initiated to reduce the rates of obesity but had only modest success. Obesity decreased from 16% to 14% only. The growing body of evidence suggests that inclusion of parents along with children has higher rates of reduction of obesity in comparison to child centric strategies. Authors of a cocharane review 10 concluded that three out of four long tern studies showed no difference in overweight with combined dietary and physical activity intervention. Fourth study reported improvement following intervention. One long term study which focused on physical activity alone resulted in slight gain in reduction of overweight compared to other intervention group. School based interventions are most effective when whole school is involved including cafeterias, PE classes, lunch and recess activities, classroom teaching, with home and community involvement.

Experimental intervention done in Israel with obese children between 6-11 years was conducted only parents attended group sessions and control group had only children attending. Parent only group showed better results in reduction of weight of over-weight children. This emphasizes the importance of involving parents in addressing obesity and related issues in children.

We can see that only a comprehensive approach involving family, school staff, community elders, leaders, state government, healthy commercial practices would result in change of behavior to healthy living. As we see that malnutrition is more common in the rural area, we have to aware of the looming obesity epidemic starting the urban areas. Malnutrition results in stunting and low birth weight which results in higher rates of obesity and metabolic syndromes as shown in numerous studies.

It is imperative in the Indian context to have regular monitoring of weight, height and BMI. Even though it is labour intensive, it is very cost effective for a country like India. Emphasis should be on participation of parents, community leaders, for the nutrition intervention to be effective. Considering the diabetes epidemic in India it is imperative that healthy lifestyle with healthy eating and exercise should be emphasized.

## **CONCLUSION**

Rural Kerala is afflicted with a serious problem of undernutrition and lower levels of obesity. There was striking predictions for obesity was noted among stunted children in the study highlighting the complex nature of the nutrition problem in India where malnutrition and obesity coexist and cause double burden of diseases. The solution is to encourage the message of healthy living, equally to the

over nourished and the undernourished, where balanced diet and exercise as a way of life is encouraged.

#### Recommendations

- All schools should have mandatory anthropometric surveys every year
- School teacher must be given training on how to use WHO growth charts. Teachers should be trained to refer children to health care system if child is severely malnourished, obese or has crossed the centiles compared to previous year
- Parents should be contacted every year for health feedback and emphasis of eating more fruits and vegetables and the importance of exercise must be stressed. This is should be for all the students parents. Malnourished children must all have the same message. Emphasis on high calorie food in malnourished children is counterproductive as they tend to have more central obesity. Thus micronutrient rich diet is best for all children irrespective of their nutrition status.
- Emphasis on sports should be given in all school curriculum. Adolescence is the period when physical activity comes down the most. Those adolescence who are motivated to active at this age have more chance of remaining active as adults.
- Health education using multimedia like videos have been most effective in causing behavior change.
  Emphasis should be on showing the ill effects of sedentary lifestyle and high calorie diet. Alcoholism, smoking and other lifestyle vices can also be targeted in the video campaigns.

Funding: No funding sources Conflict of interest: None declared

Ethical approval: The study was approved by the

Institutional Ethics Committee

## **REFERENCES**

- 1. Reddy KS, Prabhakaran D, Shah P, Shah B. Differences in body mass index and waist: hip ratios in North Indian rural and urban populations. Obesity Reviews. 2002 Aug;3(3):197-202.
- 2. Chadha SL, Gopinath N, Shekhawat S. Urban-rural differences in the prevalence of coronary heart disease and its risk factors in Delhi. Bulletin World Health Organization. 1997;75(1):31.

- Ramachandran A, Snehalatha C, Vinitha R, Thayyil M, Kumar CS, Sheeba L, et al. Prevalence of overweight in urban Indian adolescent school children. Diabetes res clin pract. 2002 Sep 1;57(3):185-90.
- 4. Kapil U, Singh P, Pathak P, Dwivedi SN, Bhasin S. Prevalence of obesity amongst affluent adolescent school children in Delhi. Indian Pediatrics. 2002 May 1;39(5):449-52.
- 5. Popkin BM, Richards MK, Montiero CA. Stunting is associated with overweight in children of four nations that are undergoing the nutrition transition. J Nutr. 1996 Dec 1;126(12):3009-16.
- Florêncio TM, da Silva Ferreira H, de França AP, Cavalcante JC, Sawaya AL. Obesity and undernutrition in a very-low-income population in the city of Maceio, northeastern Brazil. Br J Nutr. 2001 Aug;86(2):277-83.
- 7. 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. Obes Res. 1995 Sep;3(S2):107s-15s.
- 8. Steyn K, Bourne L, Jooste P, Fourie JM, Rossouw K, Lombard C. Anthropometric profile of a black population of the Cape Peninsula in South Africa. East Afr Med J. 1998 Jan;75(1):35-40.
- 9. Schroeder DG, Martorell R, Flores R. Infant and child growth and fatness and fat distribution in Guatemalan adults. American Journal of epidemiology. 1999 Jan 15;149(2):177-85.
- 10. Summerbell CD, Ashton V, Campbell KJ, Edmunds L, Kelly S, Waters E. Interventions for treating obesity in children. Cochrane database of systematic reviews. 2003(3).
- Golan M, Fainaru M, Weizman A. Role of behaviour modification in the treatment of childhood obesity with the parents as the exclusive agents of change. Inter J Obesity. 1998 Dec;22(12):1217.
- 12. Golan M, Weizman A, Apter A, Fainaru M. Parents as the exclusive agents of change in the treatment of childhood obesity. Am J Clin Nutr. 1998 Jun 1;67(6):1130-5.

Cite this article as: Abraham RJ, Pillai PC. Survey of obesity among school children in rural Kerala, India. Int J Contemp Pediatr 2019;6:2413-8.