

## Original Research Article

# Body composition and prevalence of overweight and obesity and its determinants among adolescents in Manipur, North-Eastern India: a cross-sectional study

Joymati Oinam<sup>1</sup>, Joy Singh Akoijam<sup>2\*</sup>, Ningthemba Yumnam<sup>2</sup>,  
L. Suresh Roy<sup>3</sup>, Tripti Khanna<sup>4</sup>

<sup>1</sup>Department of Community Medicine, Jawaharlal Nehru Institute of Medical Sciences, Imphal, Manipur, India

<sup>2</sup>Department of Physical Medicine and Rehabilitation, <sup>3</sup>Department of Physiology, Regional Institute of Medical Sciences, Imphal, Manipur, India

<sup>4</sup>Scientist F, Indian Council of Medical Research, New Delhi, India

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### \*Correspondence:

Dr. Joy Singh Akoijam,

E-mail: joyakoijam2@yahoo.com

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## ABSTRACT

**Background:** Childhood obesity is emerging as one of the serious public health problems. It has become one of the significant risk factors associated with a cluster of non-communicable diseases which causes an enormous socioeconomic and public health burden. Therefore, the objective of this study was to assess the body fat % and prevalence of overweight and obesity among adolescent in Manipur and to identify factors which may contribute to overweight.

**Methods:** A cross-sectional study was conducted among 12,410 students studying in class VIII-XII in four districts of Manipur from 2007-2009. A self-administered questionnaire method was used. BMI and Body composition were determined using the TANITA Body Composition Analyzer. Overweight/ obesity were classified by using WHO classification. Analysis done using SPSSv20 and mean (SD), percentages and Chi-square test were used. A p-value <0.05 was considered as statistically significant.

**Results:** The overall mean fat % was 19.4±6.1 and girls have higher fat% than boys. Overall prevalence of overweight and obesity were 6.4% and 1.2% respectively. Obesity prevalence was more among girls than boys (1.6% vs 1.0%). Statistically significant association was found between obesity with family history of overweight, private schooling, playing games, mode of transport to school, sleeping hours, being vegetarian and watching television.

**Conclusions:** Though the prevalence of overweight and obesity as compared to other parts of India is low, the increasing trend is a definite cause of concern. Therefore, there is a need for primary prevention targeted among children and adolescents regarding adoption of healthy life styles.

**Keywords:** Adolescent, Body composition, Obesity, Overweight, Prevalence

## INTRODUCTION

Overweight and obesity are among the most prevalent nutritional problems in developed and developing

countries and is one of today's most neglected public health problems.<sup>1</sup> Childhood obesity is emerging as a potential public health issue and the worldwide prevalence of childhood obesity increased from 4.2% in

1990 to 6.7% in 2010. This trend is expected to reach 9.1% globally by 2020.<sup>2</sup> The increasing prevalence of overweight, obesity and its consequences prompted the World health organization to designate obesity as a global epidemic.<sup>3</sup> Worldwide, 3.4 million deaths and 3.8% of global DALYs are attributed to overweight or obesity.<sup>4</sup> Childhood obesity is not an immediate lethal disease by itself, but has become a significant risk factors associated with a cluster of non-communicable diseases especially cardiovascular diseases (CVDs) in adulthood as overweight or obese children tend to become obese adults.<sup>5</sup> As obesity is an independent and modifiable risk factor for CVDs, medical professionals, policy makers, parents and other important stakeholders should try to address the childhood overweight and obesity to avert CVD in adulthood. In India, many studies have shown that the prevalence of overweight and obesity among adolescents vary between 1.6-34.1% and 0.8-33.6% respectively.<sup>6-15</sup> Prevalence varies within the country may be because of differences in the lifestyle mainly in dietary pattern, emergence and acceptance of unhealthy lifestyles, physical activity, rapid unplanned urbanization and deterioration of environment.<sup>16</sup> Few data are available on prevalence of obesity from the northeastern India. In a study conducted in 2010 amongst adolescents in an urban area of Imphal district, Manipur reported a low prevalence of overweight and obesity as 6.1% and 0.7% respectively.<sup>11</sup> However, the prevalence of overweight and obesity has increased at an alarming rate.<sup>17</sup> Therefore, there is an urgent need to know the burden of this problem in other areas, including both urban and rural areas of Manipur and also very limited studies mentioned about the body composition especially body fat % distribution among adolescent. Therefore, the objective of this study was to assess the body fat % and prevalence of overweight and obesity among adolescent in Manipur and to identify factors which may contribute to overweight.

## METHODS

A cross-sectional study was conducted for two years from 2007-2009 among schools' students in four districts including both urban and rural areas of Manipur namely Imphal East, Imphal West, Bishnupur and Thoubal districts. Manipur is one of the seven states of the north-eastern India having nine districts in total. According to 2001 census report, there were 237,167 adolescents in the age range of 10-19 years in these four districts. Study population comprises of all the students from class VIII - XII studying in the selected schools.

### Exclusion criteria

- Students who were absent on the day of data collection, with bony deformity that will hinder in taking anthropometric measurements, with loose motion or with chronic systemic disease, on medication with steroids/anti-psychotics and those who don't give assent were excluded.

### Sample size calculation

It was calculated based on the formula:  $4PQ/e^2$ , where, prevalence rate of obesity was 11% with 5% relative allowable error at 5% significance level.<sup>14</sup> A sample of 12407 which was rounded to 12410, was obtained. A representative sample for each of the 4 districts was calculated using PPS.

**Table 1: District-wise population size of 10-19 years age group.**

Districts	Population 10-19 years*	Sample size (PPS)#
Bishnupur	45621	1824
Thoubal	8122	3249
Imphal east	89283	3572
Imphal west	94141	3765
		Total= 12410

\*Based on 2001 census report published by the Govt of Manipur, #Probability proportionate to size.

### Sampling method

Stratified two-stage cluster sampling with probability proportionate to size was used to select a representative sample. For this study, clusters identified were institutions providing class VIII -XII educations in these four districts. Details of schools and students enrolled in each school were collected from council of higher secondary education, Manipur. Government aided schools were considered as government schools. The schools were first stratified into government and private schools and then students from each school were stratified based on their gender and standard. Students were selected by simple random sampling based on their class roll number.

### Survey tools

- A pre-designed and pre-tested semi-structured questionnaire was used which consists of two sections namely, socio-demographic profile and anthropometry measurements.
- An anthropometric rod to measure height which is recordable up to the nearest 0.5cm
- Digital weighing machine was used to measure weight up to a minimum of 10gm
- Body composition analyzer machine (Tanita-300 BF, made in USA) to measure body composition- fat %, fat mass (FM) and body mass index (BMI)
- Skinfold calliper for validation of the recordings of the Tanita machine
- N.B. Anthropometric rod, skinfold calliper (Ozaki Mfg. Ltd, Japan)

Study variables such as gender, age, weight, height, BMI and fat % were considered. Associated lifestyle factors

like food habit, physical activity and leisure time activities were also considered.

**Data collection**

A prior written consent for the study was taken from the school authority and from the parents for their children’s participation and date of visits were prepared as per convenience of the school administration. Data collection was performed taking care not to disturb the routine classes. The school authorities were requested to adjust the physical education classes as the first class on the day of the study so that surveyors get one more hour in continuity. A self-administered questionnaire method was used. Data collection was done in all the districts throughout the study period depending on the availability of dates from various schools under study.

An interactive session with the students regarding adopting healthy lifestyle was also carried out on the same day after data collection. Three anthropometric assessments were taken by the surveyor while participants wore light clothing and were barefoot: height, weight and fat %. Height was measured when the participant was made to stand still, upright and barefoot, using a calibrated vertical bar with a horizontal headboard and was recorded to the nearest 0.5 cm. Weight was measured by making the participants stand bare feet with minimum clothing on the machine, measurements were taken up to a minimum of 10 gm. A minimum of 2 measurements were taken for each student and average was recorded. Regarding body composition measurement, after recording the height (in cm) and age (in year) of the students in the body composition analyser, the students were made to stand on the footpads of the instrument barefoot with minimum clothing. The readings inclusive of all parameters were available in the form of a printout.

**Working definition of obesity and overweight<sup>18</sup>**

The classification of BMI (overweight and obesity in children) was done based on WHO guidelines-between 85<sup>th</sup>-95<sup>th</sup> percentile as overweight and above 95<sup>th</sup> percentile as obese as follows.

**Table 2: Classification of BMI.**

Average BMI for age	Boys		Girls	
Percentile	85 <sup>th</sup>	95 <sup>th</sup>	85 <sup>th</sup>	95 <sup>th</sup>
13-15 years	23.3	27.2	22.6	26.0
16-17 years	25.0	29.2	24.6	27.8

**Reliability of the tanita machine**

This machine has been used by many investigators including the surveyors for measuring fat % and fat mass in this study. A high correlation was observed between

the percentage fat estimates by bioimpedance analysis (BIA) and dual x-ray absorptiometry (DEXA) indicating that the leg to leg BIA system provides comparable estimates with DEXA body composition estimates in children as reported in a study conducted by Sung RYT.<sup>19</sup> Fat mass and fat free mass measured by TANITA machine and calculations from measurements of skinfold callipers were found to be highly correlated (r=0.87) in a PhD thesis work conducted on elite sportspersons in Manipur.

**Statistical analysis**

Data were entered in Microsoft excel and analyzed using IBM SPSS21 (Statistical package for social sciences) for windows (SPSS Inc. Chicago IL, USA). To ensure the accuracy and quality of data entry, 5% of total data were randomly selected and rechecked manually by another author involved in the study and it was repeated until no errors were found. Descriptive statistics like mean, proportion, percentage, percentiles etc. were employed. Inferential statistics such as Chi- square test was used to test the level of significance. For all statistical tests, two-tailed p-values less than 0.05 were considered statistically significant.

Ethical approval was obtained from the Institutional Ethics Committee, Regional Institute of Medical Sciences (RIMS), Imphal, Manipur. A detailed verbal explanation of the purpose of the study as well as the procedures to be followed, including collection of anthropometric measurements, was given to the participants and assent were taken before the start of data collection.

**RESULTS**

Out of the total 12410 students, 57.6% of the students were boys (n=7149).

**Table 3: Socio-demographic profile of the students.**

Characteristics	Number (%)
Age (Mean±SD)	14.29±1.4 years
Gender	Boys 7149 (57.6)
	Girls 5261(42.4)
Standard	VIII-X 8595 (69.3)
	XI-XII 3815 (30.7)
Type of school	Government 2733 (22)
	Private 9677 (78)
Family income/month (Rs)	Below 10000 6733 (54.3)
	10000-19999 3856 (31.1)
	20000-29000 512 (4.1)
	30000-39000 298 (2.4)
	≥40000 201(1.6)

Majority of students belonged to the high school standard (69.3 %, n=8595) and from private schools (78%, n=9677). Family income of 54.3% (n=6733) students was below Rs. 10000/months (Table 3). The

mean fat % was 19.4±6.1 (range 6.8 to 51.3) among adolescents with a minimum recorded fat % of 6.8 and maximum of 51 (Table 4). The mean fat % ranged from 15.5 to 17.3 for boys and 21.8 to 24.1 for girls.

The maximum fat % range was 38.4 to 47.6 for boys and 45.4 to 51.3 for girls (Table 5).

**Table 4: District-wise distribution of body composition-fat % profile among adolescent.**

District	Number	Minimum	Maximum	Mean	SD
District 1	3765	7.3	47.0	19.4	5.9
District 2	3572	6.8	49.1	19.7	6.2
District 3	3249	11.4	32.6	19.2	2.3
District 4	1824	7.4	51.3	19.3	6.0
All Districts	12410	6.8	51.3	19.4	6.1

**Table 5: District and gender-wise distribution of fat % among adolescent.**

District	Gender	Minimum	Maximum	Mean	SD
District 1	Boys	7.3	45.4	17.3	4.8
	Girls	8.4	47.0	24.1	5.4
District 2	Boys	6.8	42.9	16.6	5.3
	Girls	8.6	49.1	23.0	5.4
District 3	Boys	7.6	38.4	15.5	4.4
	Girls	9.1	45.4	23.5	5.2
District 4	Boys	7.4	47.6	16.9	7.4
	Girls	7.7	51.3	21.8	5.7

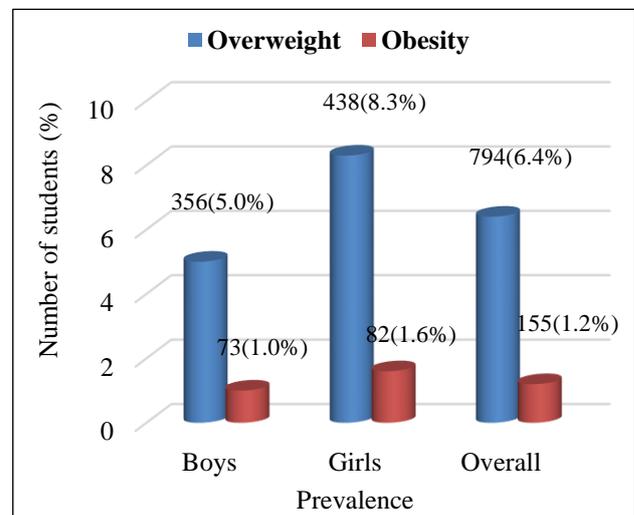
**Table 6: District wise prevalence of overweight and obesity among adolescent.**

District	Overweight (%)			Obesity		
	Boys	Girls	B+G	Boys	Girls	B+G
District 1	5.2	8.4	6.2	1.3	1.7	1.4
District 2	6.5	7.3	6.9	1.3	1.7	1.5
District 3	2.8	7.9	5.1	0.5	0.7	0.6
District 4	5.7	11.1	8.3	0.9	2.5	1.7

Prevalence of overweight (8.3%) and obesity (1.7%) was recorded highest in district 4 and district 2 recorded lowest for both overweight (5.1%) and obesity (0.6%).

For boys, district 2 showed highest number of overweight (6.5%, n=118) and obesity (1.3%, n=23). For girls, district 4 recorded highest number of overweight (11.1 %, n=97) and obesity (2.5%, n=22) (Table 6). Overall 6.4% was found to be overweight and 1.2% was found obese. Prevalence of overweight was 5.0% among boys and 8.3% among girls. Similarly, obesity was higher among girls (1.65%) when compared with 1.0% among boys.

Statistically significant association was found between obesity with playing games, mode of transport to school, sleeping hours, watching TV, vegetarian diets, family history of overweight/obesity and private schooling (Table 7).



**Figure 1: Overall prevalence of overweight and obesity in Manipur.**

**DISCUSSION**

Different school-based data on overweight and obesity in India shows a prevalence of 1.6-27.7% and 1.2-12.4% respectively among adolescents.<sup>6-15</sup> In Northeastern India, the prevalence of overweight and obesity are 1.9-6.1% and 0.4-0.8% respectively.<sup>7-11</sup>

**Table 7: Association between socio-demographic parameters and obesity among adolescents.**

Parameters	Obesity N (%)	P-value
>999	679 (6.6)	0.105
<500	19 (5.0)	
Playing indoor/outdoor games	Yes	200(5.3) 4570(92.9)
	No	349(7.1) 3555(94.6)
Mode of transport to school	By vehicle/rickshaw/sitting on bicycle others	379(7.2) 4881(92.8)
	On foot/bicycle	415(5.8) 6735(94.2)
Sleeping hours/day	≥8 hours	108(5.2) 1967(92.8)
	<8 hours	231(7.1) 3002(92.8)
Reading hours/day	>4 hours/day	118(7.1) 1541(92.9)
	4 hours or less	676(6.3) 10075(93.7)
Snacking while watching TV	Regular	97(14.2) 587(85.8)
	Occasional	383(5.4) 6743(94.6)
	Never	314(6.8) 4286(93.2)
TV hours/day	>4 hours	80(13.5) 512(86.5)
	<2 hours	560(5.7) 9251(94.3)
Dietary habits	Vegetarians	70(8.6) 745(91.4)
	Non vegetarians	101(5.8) 1647(94.2)
Intake of green leafy vegetables	Almost daily	362(7.1) 4753(92.9)
	Rarely	35(4.7) 703(95.3)
Family history of overweight/obesity (parents)	Yes	67(11.3) 527(88.7)
	No	727(6.2) 11089(93.8)
Type of school	Private	695(7.2) 8982(92.8)
	Government	99(3.6) 2634(96.4)

In the present study, the prevalence of overweight and obesity was found to be 6.4% and 1.2% respectively in Manipur. Present study finding is higher as compared to the previous studies conducted in different states of northeastern India, which shows that there is increasing trend of childhood overweight and obesity among Manipuri adolescents over the years.

As compared to mainland, lower prevalence is observed in northeastern India. The large range in the reported prevalence of overweight and obesity could be due to regional differences, sample size, non-uniformity in the criteria used to classify socio economic status, different age range, gender of the adolescent studied, differences in the lifestyle, mainly in the dietary patterns, physical activity, and urbanization.

In the present study, prevalence of overweight/obesity was more in private school as compared to government school. Similar findings were observed in other studies carried out in different part of the country.<sup>12,20-24</sup> This finding gives indirectly that students studying in private schools belong to higher socioeconomic strata as compared to those children studying in government schools because mostly people belonging to higher socioeconomic strata can afford private schooling of their children. Therefore, it shows that high socio-economic

status plays a major role in the contributing factor of overweight and obesity.

Adolescents indulge in sedentary activities like watching TV, sitting in front of computers and video games resulting in higher risk of overweight and obesity.<sup>8</sup> Similar findings were observed in present study. However, one finding which was noted in present study is that obesity was found to be statistically associated with vegetarian diets when compared to those who eat fish/egg/meat almost daily (8.6% vs 5.8%). Similarly, significant association was found between eating green leafy vegetables almost daily when compared with who rarely eat green leafy vegetable (7.1% vs 4.7%). This could be explained when the energy intake from whatever the sources (mostly vegetarian diet) is much more than that is being utilised leading to energy imbalances and also vegetarian diet usually consumed more of dairy products such as ghee or butter in their daily dietary pattern. Another reason could be due to the fact that those who were overweight and obese had already modified their eating behaviors, eating more of vegetables than meat in the recent times, and the students were answering the modified behaviors.

Higher prevalence of obesity among girls was observed as compared to boys (1.6% vs 1.0%) in the present.

Similar findings were reported in various studies conducted by Sidhu et al, (6.31% vs 4.95%), Meharda B et al, (12.6% vs 8.6%), Kumar S et al, (8.82% vs 4.42%).<sup>12,13,15</sup> This difference may be due to that during puberty, females have tendency to accumulate more fat and is a well-known fact that weight gain during puberty is physiological so puberty girls are more likely to overweight as compare to boys.

In the present study, significant association was found between overweight and obesity and family history of overweight and obesity. Our finding is comparable to other studies conducted at Kerala and Mysore city.<sup>24,25</sup> It may be explained due to genetic factors, dietary pattern and life style practices which is usually share among the members in the family. In the present study, significant association was found between overweight/obesity among those who sleeps less than 8 hours per day (7.1%). Similar findings were observed other studies conducted in Udaipur city and Nagpur.<sup>12,26</sup> The present study shows that body fat% is higher in girls as compared to boys. Similar findings are also reported by other studies.<sup>27,28</sup> This could be because during puberty, females have tendency to accumulate more fat, differences in body fat determined genetically or the level of physical activity engaged between the boys and girls.

## CONCLUSION

This study highlighted a mean fat % of 19.4±6.1 and overall prevalence of overweight and obesity among adolescents as 6.4% and 1.2% respectively in Manipur. Though the prevalence of overweight and obesity as compared to other parts of India is low, the increasing trend is a definite cause of concern before the prevalence of obesity becomes alarming in this part of country.

## Recommendations

Need to focus on primordial and primary prevention regarding effective health promotion measures such as strategies aiming at reduction of sedentary lifestyles, increase of physical activity, adoption of healthy dietary habits and inclusion of topics regarding NCDs and its risk factors in school curriculum may be fruitful in long run in preventing childhood overweight and obesity. Since adolescent obesity has been given lots of importance in view of the higher association of obesity in later life, diabetes and hypertension, further research should be conducted to do similar surveys to find out prevalence of adolescent hypertension and diabetes in Manipur.

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