

## Comparison of CDC, WHO and IOTF growth references in relation to overweight and obesity in college adolescents of North Karnataka, India

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**Abstract:** *Background and Objective:* obesity has become a serious public health concern and is a key risk factor for the chronic and non-communicable disease. The objective of the study is to compare the various growth references in relation to overweight and obesity. *Material & Methods:* Weights and heights were measured on 330 adolescents and Body Mass Index (BMI) calculated. The prevalence of overweight and obesity was determined and statistical comparisons conducted among the three growth references; Centres for Disease Control (CDC), World Health Organization (WHO) and International Obesity Task Force (IOTF). *Results:* CDC and IOTF produced almost similar estimates of the prevalence of overweight, 9.1% versus 10.9% while WHO reported a higher prevalence 12.7%. In our study CDC and WHO classified twice as many as obese adolescents as compared to IOTF. There was a variable level of agreement between the references. *Conclusions:* The WHO reported a much higher prevalence of obesity compared to the other references. The prevalence of adolescent's obesity is dependent on the growth reference used.

**Keywords:** Adolescent, Body Mass Index (BMI), Obesity, Overweight, Growth references.

### Introduction

In both developed and developing countries obesity has become a serious public health concern and is a key risk factor for the chronic and non-communicable disease [1-2]. There is a negative impact of obesity on physical, mental and social functions in children. Child obese in childhood remains obese in their adulthood with various possible risks of adult mortality and morbidity [3]. By giving the importance of growth in early life and childhood we can prevent risk to future disease. It is vital to precisely monitor childhood growth and determine whether it is adequate or not [4].

The most common method for assessing weight status and health risk in children is sex specific body mass index (kg/m<sup>2</sup>) or BMI. There are various sets of growth references but among them three are commonly used to assess a child's weight status and health risk. These are cut-off points published by the US Centre for Disease Control and Prevention (CDC), the International Obesity Task Force (IOTF) and those published by the World Health Organization (WHO) [5]. An important step towards planning the strategy

for effective intervention is accurate estimation of magnitude of problem [6]. Inconsistent prevalence estimates of childhood overweight and obesity based on variant growth references pose a challenge in defining the burden of childhood obesity at a population level. Recommendations are inconsistent on which references to use. Hence, this study is carried out to study prevalence and compare the various growth references in relation to overweight and obesity by using kappa statistics.

### Material and Methods

This cross-sectional study was conducted in the two pre-university college of Belgaum city, Karnataka from January-September 2013. Adolescents (10-19) years who gave the assent were included in the study. Adolescents having the chronic diseases and who were on the medication to reduce the weight were excluded. sample size was calculated by taking prevalence(p) of 29% [7] and allowable error (d) 5% by using formula  $N = \frac{4pq}{d^2}$  (q=1-p) the sample size was calculated to be 329 and rounded off to 330.

The Pre-University Colleges (PUC) colleges were clustered in the North and south zones. Hence, one PUC was selected by Simple Random Sampling (Lottery Method), from each zone. Required member of adolescents were enrolled in the study. Data was collected by using pre designed and pre tested questionnaire. Standard Weighing machine and measurement tape were used to measure weight and height respectively.

Based on Centers for Disease Control and Prevention (CDC)-2000 growth charts for children and adolescents aged 2-20 years i.e. BMI for age and sex percentile growth curves adolescent with a BMI-for-age between 85<sup>th</sup> to 95<sup>th</sup> percentiles were considered “overweight” and above 95<sup>th</sup> percentile as “Obesity” and < 5<sup>th</sup> percentile as “Underweight”.

Based on World Health Organization (WHO)-2007 growth charts for children and adolescents aged 5-19 years i.e. BMI for age and sex percentile growth curves adolescent with a BMI-for-age between 85<sup>th</sup> to 97<sup>th</sup> percentiles were considered “overweight” and above 95<sup>th</sup> percentile as “Obesity” and < 5<sup>th</sup> percentile as “Underweight”.

Based on International Obesity Task Force (IOTF) standard obesity is defined as BMI >30, Overweight as BMI >25, Normal as BMI=18.5-25 and Underweight as BMI<18.5.

Ethical clearance from Institutional Ethics Committee (IEC) of KLEU, J.N. Medical College was obtained. Consent from respective college authority and assent was taken from all respondents before data collection. Data entry and analysis was made by using Statistical Package for Social Science (SPSS) software (Version 20.0). Mean, percentage, chi-square and kappa statistics are applied.

**Results**

In this study 152 (46.1%) were boys and 178 (53.9%) were girls with a male to female sex ratio being 0.85:1 and with a mean age of 16.9 years. Among them majority belonged to age 17 years (61.5%, Male=49.3% and Female=50.7%). Data on 330 college adolescents aged 15 to 18 years of age were analyzed. The anthropometric measures and its characteristics are presented in Table no.1.

|                          | <b>Total (330)</b> | <b>Boys (152)</b> | <b>Girls (178)</b> |
|--------------------------|--------------------|-------------------|--------------------|
| Age (years)              | 16.95±0.65         | 17.02±0.60        | 16.88±0.69         |
| Height (cms)             | 160.97±8.60        | 166.72±7.76       | 156.06±5.77        |
| Weight (kg)              | 53.58±11.99        | 56.93±11.78       | 50.71±11.44        |
| BMI (Kg/m <sup>2</sup> ) | 20.61±4.26         | 20.38±3.91        | 16.88±0.69         |

The prevalence of overweight/ obesity was estimated by using CDC, WHO and IOTF cut-off criteria according to sex. WHO classification had the higher prevalence of overweight (12.7%) and for obesity (4.2%) as compared to the categories in CDC classification (9.1% and 5.2% respectively) and IOTF classification (10.9% and 2.7% respectively). Overweight (12.9%) and obesity (4.5%) prevalence in girls were higher when using WHO cut-off point compared to CDC (9% and 5.1% respectively) and IOTF (11.2% and 2.8% respectively). CDC presented lower prevalence of overweight and IOTF presented lower prevalence of obesity as compared to other. (Table no 2 and 3).

|      | <b>Total (%)</b> | <b>Boys (%)</b> | <b>Girls (%)</b> |
|------|------------------|-----------------|------------------|
| CDC  | 9.1              | 9.2             | 9.0              |
| WHO  | 12.7             | 12.5            | 12.9             |
| IOTF | 10.9             | 10.5            | 11.2             |

|      | <b>Total (%)</b> | <b>Boys (%)</b> | <b>Girls (%)</b> |
|------|------------------|-----------------|------------------|
| CDC  | 5.2              | 5.3             | 5.1              |
| WHO  | 4.2              | 3.9             | 4.5              |
| IOTF | 2.7              | 2.6             | 2.8              |

The agreement between different cut-off is presented in Table no. 4. A substantial agreement was observed between WHO and CDC

(Kappa=0.75) and between CDC and IOTF (Kappa=0.62) and moderate agreement between WHO and IOTF (kappa=0.52).

| <b>Table-4: Comparison of agreement for categorizing weight categories between<br/>1) CDC and WHO 2) IOTF and WHO and 3) CDC and IOTF</b> |              |                     |               |                   |              |
|---|--------------|---------------------|---------------|-------------------|--------------|
|   |              | <b>Under weight</b> | <b>Normal</b> | <b>Overweight</b> | <b>Obese</b> |
| <b>1. WHO</b>   |              |                     |               |                   |              |
| <b>CDC</b>  | Under weight | 39                  | 22            | 0                 | 0            |
|   | Normal       | 0                   | 212           | 10                | 0            |
|   | Overweight   | 1                   | 0             | 27                | 2            |
|   | Obese        | 0                   | 0             | 5                 | 12           |
| % agreement: 87.9%, kappa statistic: .75, p < .001  |              |                     |               |                   |              |
| <b>2. WHO</b>   |              |                     |               |                   |              |
| <b>IOTF</b>   | Under weight | 40                  | 77            | 0                 | 0            |
|   | Normal       | 0                   | 157           | 11                | 0            |
|   | Overweight   | 0                   | 0             | 31                | 5            |
|   | Obese        | 0                   | 0             | 0                 | 9            |
| % agreement: 71.8%, kappa statistic: .52, p < .001  |              |                     |               |                   |              |
| <b>3. IOTF</b>  |              |                     |               |                   |              |
| <b>CDC</b>  | Under weight | 61                  | 0             | 0                 | 0            |
|   | Normal       | 55                  | 164           | 3                 | 0            |
|   | Overweight   | 1                   | 4             | 24                | 1            |
|   | Obese        | 0                   | 0             | 9                 | 8            |
| % agreement: 77.9%, kappa statistic: .62, p < .001  |              |                     |               |                   |              |

### Discussion

The prevalence of adolescents overweight or obesity in college adolescents ranges from (13-16%), according to various growth references used. Due to the excess weight short and long term physical health risks for adolescents include hypertension, hyperinsulinemia, glucose intolerance, type II diabetes, dyslipidemia, increased risk of early cardiac disease and psychosocial difficulties. Adolescent's obesity is a significant public health concern and its appropriate classification is crucial in determining the burden of the health problem [5].

There are widely used three classification systems for ages 5 to 18 years which were developed with different objectives. WHO was developed using only NCHS 1977 to have a "non-obese sample with expected heights" and to obtain an equivalent of the healthy population used to

develop the growth charts for children less than 5 years old [8]. From the surveys conducted in six countries with the objective of obtaining an international reference, IOTF come into existence [9]; and CDC used five U.S. national nutrition and health surveys conducted between 1963 and 1994 with the objective of developing a reference for the U.S. population [10].

It is obvious that various references with different objectives and sources of reference populations would yield differences in prevalence estimation of overweight and obesity. In the developing countries no such a gold standard references has been developed yet for generalization but different studies conducted in India use one among the three internationally used references. So, the variance in the prevalence estimate has been observed.

This study conducted to assess the prevalence of overweight/obesity by using the CDC, WHO and IOTF standard among adolescents of North Karnataka, India. It was observed that prevalence of overweight was found to be high by WHO (12.7%) followed by IOTF (10.9%) and CDC (9.1%) as well as obesity was marked high by CDC (5.2%) followed by WHO (4.2%) and IOTF (2.7%). The study reported that the WHO system of classification yield highest prevalence of overweight/obesity combined than that of IOTF and CDC system of classification. WHO yields the highest prevalence estimate of overweight and obesity because its reference population is intended to be a non-obese sample. The similar finding was observed in the studies conducted in India, Canada, Colombia, Brazil, and Belgium [5, 11-13, 7].

The study conducted in Hongkong revealed overweight/obesity classified by CDC was greater as compared to IOTF which was comparable to our study. In our study CDC and WHO classified twice as many as obese adolescents as compared to IOTF which is comparable to the study conducted in Hongkong [5].

In our study, a substantial agreement was observed between WHO and CDC (Kappa=0.75) and study conducted in Canada showed kappa=0.84 for the same. In our study the % agreement between CDC and IOTF (Kappa=0.62), which is similar to study in India (kappa=0.69) and Canada (kappa=0.64) [5]. A study conducted in Canada and Brazil assessed

the % agreement by kappa showed similar value i.e. 0.71 between WHO and IOTF which was in contrast to our study (kappa=0.52) [5, 13].

### Conclusion

The WHO reported a much higher prevalence of obesity as compared to the other references. The prevalence of adolescent's obesity is dependent on the growth references used. One problem with references is always the question on the golden standard. Moreover the fact that the comparison with the IOTF and the CDC and the WHO reference give different prevalence estimates proves that these references represent populations between them. Perhaps in this case, it will be more appropriate to develop and use a local reference, in particular for BMI for age, where body distribution of fat might be more genetically determined in the developing country like India. Hence, there is requirement of cohort study and many more systematic review and meta-analysis for development of golden standard in developing country like India.

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