International Journal of Contemporary Pediatrics
*Mukhopadhyay S et al. Int J Contemp Pediatr. 2017 Mar;4(2):370-373*
http://www.ijpediatrics.com
pISSN 2349-3283 | eISSN 2349-3291

DOI: http://dx.doi.org/10.18203/2349-3291.ijcp20170525

**Original Research Article**

# School based screening tools for childhood obesity: a comparison of TSFT, WHR and BMI

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**Received:** 30 January 2017
**Revised:** 07 February 2017
**Accepted:** 08 February 2017

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## ABSTRACT

**Background:** Obesity is an emerging health problem in children and adolescents. Various screening tools are there for assessment of nutritional status and this study was done to compare various methods to screen for obesity and overweight in adolescents that can be used during school health check-up.
**Methods:** This study was conducted in the urban schools of Vadodara city. 609 students were included in the study.
**Results:** Maximum students were in the age group of 16-18 year of which 57.9% were males and 42.03 % females. By using BMI, 4.1% students were found to be obese and 12.8% overweight. 10% students had WHR above the cut-off levels. In 11.3% TSFT was above 90$^{th}$ centile.
**Conclusions:** Comparison between the three parameters done using ANNOVA, shows that TSFT is better than BMI in detecting Obesity.

**Keywords:** Adolescents, BMI, Obesity, Over-weight, TSFT, Vadodara city, WHR

## INTRODUCTION

Obesity is an emerging health problem in children and adolescents. Obesity is defined as a condition of abnormal or excessive fat accumulation in adipose tissues to the extent that health may be impaired.[1] International obesity task force (IOTF) classifies overweight as children with BMI value between 85th to 95th percentile for a specific age and sex. Similarly obesity is defined as children with a BMI value above 95$^{th}$ percentile for a specific age and sex.[2]

Ten percent of children, or at least 155 million youngsters worldwide, are overweight or obese. In India we are facing dual epidemic of under nutrition and over nutrition. Prevalence of obesity in India ranges from 6% - 8%. Tendency for overweight is more. In a study by Ramchandran et al in Chennai city, the prevalence of overweight (including obese) adolescents ranged from 22% in better off schools to 4.5% in lower income group schools.[3] In urban Delhi 31% were found to be overweight and 7.5% obese. In Pune 24% overweight.[1,4]

***Methods for measuring body composition***[2]

- Underwater weighing (hydro-densitometry)
- Magnetic resonance imaging (MRI)
- Computerized tomography (CT)
- Dual-Energy X-ray Absorptiometry (DEXA)
- Bioelectrical impedance analysis (BIA)
- Air-displacement plethysmography.

***Indirect methods for estimating body composition***

- Weight and weight-for-height
- Body mass index (BMI)
- Waist circumference and waist-to-hip ratio (WHR)
- Skin-fold thickness.

The indirect methods stated above are easy to assess and these measurements can be incorporated in annual school checkups. Standard cut offs are available for these so deciding who is affected and who is not, is not difficult.

BMI is significantly associated with relative fatness in childhood and adolescence, and is the most convenient way of measuring relative adiposity.[2] BMI varies with age and gender. It typically rises during the first months after birth, falls after the first year and rises again around the sixth year of life: this second rise is sometimes referred to as 'the adiposity rebound'. A given value of BMI therefore needs to be evaluated against age- and gender-specific reference values.

Several countries, including France, the UK, Singapore, Sweden, Denmark and the Netherlands, have developed their own BMI-for-age gender-specific reference charts using local data. The advantage of using BMI-for-age charts is that a child can be described as being above or below certain centile lines (for example the 85th or 90th centile), which can be useful in a clinical setting. Data, however, are usually derived from a single reference population, and classifying an individual as overweight or obese assumes that the individual is comparable to that reference population. Furthermore, clinicians may wrongly interpret the centiles as representing an ideal population, when the figures may in fact come from a reference population with a high prevalence of obesity, such as the USA NCHS data. CDC along with NCHS developed BMI percentile charts in the year 2000 for boys and girls in the age group of 2-18 years.[5]

A WHO expert consultation addressed the debate about interpretation of recommended body-mass index (BMI) cut-off points for determining overweight and obesity in Asian populations, and considered whether population-specific cut-off points for BMI are necessary.[6] They reviewed scientific evidence that suggests that Asian populations have different associations between BMI, percentage of body fat, and health risks than do European populations. The consultation concluded that the proportion of Asian people with a high risk of type 2 diabetes and cardiovascular disease is substantial at BMIs lower than the existing WHO cut-off point for overweight (25 $kg/m^2$). However, available data do not necessarily indicate a clear BMI cut-off point for all Asians for overweight or obesity.

Aggarwal et al, has developed BMI percentile charts for Indian population considering that although the world's children app-ear to follow a similar growth pattern, still there are variations due to ethnic, geographical, and regional factors giving different rates of maturation and adult stature.[7] The final height of differ-ren ethnic groups is different, even accounting for secular trends. Thus for assessment, a national representative sample of population data are ideal as growth standards.

Waist circumference is an indirect measure of central adiposity. Central adiposity is strongly correlated with risk for cardiovascular disease in adults and an adverse lipid profile and hyperinsulinaemia in children. Waist and hip circumferences are easy to measure with simple, low-cost equipment, have low observer error, offer good reliability, validity and low measurement error.[2]

The World Health Organization (WHO) expert consultation on waist circumference and waist–hip ratio was held in Geneva, Switzerland on December 2008, and it decided cut-offs for waist hip ratio and waist circumference.[8]

The committee further concluded that though universal cut-off points for BMI, waist circumference are not appropriate for use worldwide, given ethnic and population specific differences in disease risk, however there may be general consistency in the cut-off points of WHR for predicting cardiovascular diseases risk .

Lobstein T, et al in a review of publications for the IASO International Obesity Task Force concluded that skin-fold thickness uses simple equipment and offers only a moderate respondent burden, and has the potential to determine total body fat and regional fat distribution.[5] However, skin-fold thickness varies with age, sex and race, and the equations relating skin-fold thickness at several sites to total body fat need to be validated for each population. Measurement requires training and intra and inter-observer reliability is poor. In very obese individuals the measurement of triceps skin-fold or other skin-fold thicknesses may not be possible. The relationship with metabolic problems is unclear.

To determine which of the 3 methods i.e. BMI, waist hip ratio (WHR) and triceps skin fold thickness (TSFT) is better and easy to screen for obesity in school health checkups, this study was conducted in schools of Vadodara city, Gujarat, India.

## METHODS

Cross sectional study was conducted in the urban schools of Vadodara city, Gujarat, India among the students of class 8th to $12^{th}$ std. Schools were selected randomly from the list of secondary and senior secondary schools of Vadodara city. All the children belonging to either gender in the age group of 13 - 18 years who were apparently healthy were included in the study.

Simple random sampling was done on 609 study sample.

### *Inclusion criteria*

All children of either gender of 13-18 years who were free from any chronic illness were included in the study.

***Exclusion criteria***

Child having any chronic illnesses. Rheumatic heart disease, hereditary anaemia, endocrine disorders, etc, were excluded from the study.

Written consent was taken from appropriate authority before inclusion into the study. Each student underwent a complete physical examination, anthropometry including weight, height, waist circumference, hip circumference, Triceps skin fold thickness. Then BMI and waist hip ratio indices were calculated.

All subjects with BMI ≥ 85 percentile for age and sex was defined as overweight and ≥ 95 percentile as obese. All subjects with mean TSFT ≥ 90 percentile for age and sex were considered obese.

The percentile chart of TSFT by WHO based on the Health Examination Survey and NHANES, 1991 was used.[9] WHR >0.90 in males and WHR > 0.85 in females were classified as having abdominal obesity. ANNOVA was used to see which out of the three (BMI, WHR, TSFT) is better in detecting obesity.

## RESULTS

609 students were included in the study. Maximum number of students were in 16 year age group (138) followed by 15 year (120), 18 year (100), 17 year (91), 13 year (89) and finally 71 students in 13 year age group of which 57.9% were males and 42.03 % females. By using BMI, 4.1% students were found to be obese and 12.8% overweight. 10% students had WHR above the cut-off levels. In 11.3% TSFT was above 90$^{th}$ centile.

In this study, overweight was more common in boys (7.2%) as compared to girls (5.5%) while obesity prevalence was comparable in both (1.9% and 2.1% in boys and girls respectively). Maximum students with overweight and obesity were in the 18 year age group with prevalence increasing beyond 15 years of age.

**Table 1: BMI distribution.**

| BMI | Frequency | Percentage |
|---|---|---|
| Less than 85 p | 506 | 83.1 |
| Between 85-95 p | 78 | 12.8 |
| More than 95 p | 25 | 4.1 |
| **Total** | **609** | **100.0** |

**Table 2: Waist - hip ratio distribution: 10% out of total had waist hip ratio above the respective cut offs.**

| WHR | Frequency | Percentage |
|---|---|---|
| Non-significant | 547 | 89.8 |
| Significant | 62 | 10.2 |
| **Total** | **609** | **100.0** |

**Table 3: TSFT distribution: in 11.3% students TSFT was above the 90$^{th}$ centile for age and sex.**

| TSFT | Frequency | Percentage |
|---|---|---|
| Non-significant | 540 | 88.7 |
| Significant | 69 | 11.3 |
| **Total** | **609** | **100.0** |

**Table 4: Percentage of children with obesity as detected by different methods.**

| BMI | 4.1% |
|---|---|
| WHR | 10.2% |
| TSFT | 11.3% |

**Table 5: Gender distribution of overweight and obesity (on the basis of BMI).**

| Overweight | 78 |
|---|---|
| Male | 44 (7.2%) |
| Female | 34 (5.5%) |
| Obese | 25 |
| Male | 12 (1.9%) |
| Female | 13 (2.1%) |

## DISCUSSION

The prevalence of obesity in the present study was 4.1 % and that of overweight 12.8%. Comparison between the three parameters done using ANNOVA shows that TSFT is better than BMI in detecting obesity.

Similar difference was seen in the study by Mozaffer et al BMI is not considered a good measure of obesity in Asians as they have different body stature, with relatively low BMI and a central obesity, thus needing separate cut-off values.[10,11] BMI is a measure of body weight, and therefore doesn't make allowances for increased weight due to muscular development.

In a study by Mehru N et al it was found that BMI cannot give accurate assessment of body composition or body fat.[11] Skinfold thickness measurements are better predictors for body fat in both boys and girls which do not correlates with age.

The prevalence of obesity in the present study was 4.1% and that of overweight 12.8%. In this study, overweight was more common in boys (7.2%) as compared to girls (5.5%) while obesity prevalence was comparable in both (1.9% and 2.1% in boys and girls respectively). In a study by Ramesh et al in Ahmedabad, India age-adjusted prevalence of overweight was found to be 14.3% among boys and 9.2% among girls whereas the prevalence of obesity was 2.9% in boys and 1.5% in girls.[12] This could be attributed to the overall sex ratio in Gujarat which is inclined towards males and the fact that boys are usually more pampered in Indian household than the girls.

Maximum students with overweight and obesity were in the 18 year age group with prevalence increasing beyond 15 years of age. This is probably because this is the age in which children are not much dependent on their parents, they get to spend money on their own without parental supervision, are highly influenced by advertising media, they like to experiment and last but not the least peer pressure. Also this is the time when students have to appear for board examinations and other competitive exams, and they spend hours together studying. So they don't have enough of physical activity and end up being overweight or obese. This corroborates well with the study by Chhatwal J et al.[13]

## CONCLUSION

Obesity can lead to many long-term health problems so all efforts should be made to screen for overweight and obesity in childhood and adolescence and incorporate measures to control it.

In the present study TSFT was found to be better in detecting obesity than WHR and BMI. TSFT needs special equipment and trained personnel while BMI and WHR needs to be measured accurately. School health personnel can be trained in either of these.

TSFT, WHR and BMI all are easy to do and calculate, standards are available for comparison. Though each has its own advantages and disadvantages either can be incorporated in school health check-up routine.

*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:** Mukhopadhyay S, Bhattacharjee P, Joshi P. School based screening tools for childhood obesity: a comparison of TSFT, WHR and BMI. Int J Contemp Pediatr 2017;4:370-3.