Original article

Classification of body mass index and waist circumference based on cut-offs for Asian Indians: can it be gender specific predictor of cardiovascular risk among young adults?

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Abstract

Introduction: Obesity has been reported to be an independent risk factor for development of cardiovascular disease. Studies in Indian population have reported that lower BMI among Indians is associated with an increased risk of CVD.

Aims: To classify BMI based on cut-offs for defining obesity in Asian Indians and to assess gender specific predictor of cardiovascular risk among Indian young adults if any.

Methods: 224 healthy student volunteers of age 19 ± 2 years were recruited for study. Weight, height was measured and volunteers were divided into groups based on BMI cut-offs under WHO guidelines and that for Asian Indians. Anthropometric parameters (WC, HC, WHR), FBG, complete lipid profile and BP parameters were measured to assess cardiovascular risk.

Results: We observed that under WHO classification 150 subjects had normal BMI, 47 subjects were overweight and 20 in obese category. Under BMI cut-offs for Asian Indians, number of subjects under overweight category remained same but number of obese individual increased to 70, whereas those under normal category reduced to 100. Among those 50 subjects, who had normal BMI when classified under WHO classification (23 males, 27 females) height, weight, WC, HC was significantly higher in males (p=0.001). Males had significantly higher SBP (p=0.001), DBP (p=0.02), heart rate (p=0.001). TC and VLDL were significantly higher in males (p=0.001 for both). Significant negative correlation of BMI and HDL (p=0.02) was observed in males. Significant positive correlation exists between BMI and LDL (p=0.05), TC (p= 0.01), FBG (p=0.01), SBP (p=0.03), DBP (p=0.02) in females.

Conclusions: Using region specific guidelines to classify obesity increases the prevalence of obesity among young adults thus escalating the risk of CVD. Also, gender specific categorization leads to early prediction of CVD risk among either gender.

Keywords: Body Mass Index, Cardiovascular disease, Gender difference

Introduction

Obesity is an emerging health problem worldwide, including the developing countries.[1,2] Almost 30-65% of adult urban Indians is either overweight or obese or has abdominal obesity.[1,3] Obesity is associated with numerous cardiovascular disease (CVD) risk factors [4] and it is estimated that 20-25% of South Asians have metabolic syndrome.[5] Simple anthropometric measurements that are used as an index of obesity and is known to have more practical values both in clinical practice and for large scale epidemiological studies.[6]

The current definitions of overweight [Body mass index (BMI kg/ meters^2)> 25] and central adiposity [waist circumference (WC) > 94 cm for men and > 80 cm for women] as recommended by World Health Organisation (WHO) are based on data from Western populations and are not appropriate for Indian populations.[4]

In response to these findings, the Western Pacific regional office of the WHO, the International Association for the Study of Obesity (IASO), and the International Obesity Task Force (IOTF) collaborated in the creation of new recommendations for BMI and WC cut-offs among Asian populations.[4]. It is estimated that if Asian Indian BMI cut-off is used, an additional 10-15% of Indian population would be labelled overweight/ obese much earlier and would require appropriate management.[1] Hence, several reports from Asian populations suggested the need to follow population-specific cut offs for BMI.[7,8]

Moreover, cardiovascular risk factors start early in childhood, track through young age and manifest during middle age which calls for health promotion, mainly targeted at youth.[9] This study aims to evaluate the cardiovascular risk based on classification of BMI and WC based on WHO guidelines and that for Asian Indians among young adults.

Methods

The present study is a cross sectional study. A total of two twenty four student volunteers (males=119, females=105) between 18-22 years were enrolled in the study. Those who had history of any cardiovascular illness, bronchial asthma**,** history of use of medications were excluded from the study. The study has been approved by the Institute ethics committee and written informed consent was obtained from all study participants. They were divided into groups based on the BMI cut-offs under WHO guidelines and that of Asian Indian criteria.

Participants were asked to avoid caffeinated beverages, vigorous work for about 30 minutes on the day of study.

Anthropometric measurements: Weight, height and minimum WC and maximum hip circumference (HC) were measured using standard techniques.[10] Height of subjects were measured using a stadiometer with a fixed vertical backboard and an adjustable head piece to the nearest of 0.1 cm and weight was measured using a standard weighing scale to the nearest of 0.1 kg. WC and HC were measured with an inelastic tape to a nearest of 0.1 cm. WC was measured above the level of iliac crest at the end of normal expiration. HC was measured at maximum extension of the buttocks. Waist hip ratio was then calculated. BMI was calculated as weight in kilograms divided by height in meters squared.

Blood pressure measurement: Blood pressure (BP) was measured using a mercury sphygmomanometer after the subject had rested for 5 min, in the sitting position, using an appropriate cuff size. Three BP measurements were taken with cuff completely evacuated and recovery allowed between readings and average of it was used.

Metabolic profiles: An overnight fasting blood sample (5 ml) was collected from all the subjects for determination of fasting blood glucose (FBG) and serum lipid profile by enzymatic method. Very low density lipoprotein (VLDL) was calculated using the formula,VLDL= TG /5. Low density lipoprotein (LDL) was calculated using Freidewald's formula.[11] LDL= TC – (HDL + TG/5). All the metabolic profiles were estimated in mg/ dl.

Statistical analysis: The volunteers were divided into two groups based on classifications of BMI as per WHO guidelines and that for Asian Indians. Among those 50 subjects (23 males, 27 females), who had normal BMI when classified under WHO classification but were either categorized as overweight or obese under cut-offs for Asian Indians, comparisons of means between the two genders was done using unpaired t-test.

Correlation between BMI and cardiovascular risk parameters were studied using Pearson's correlation test. 'P' values ≤ 0.05 was considered as statistically significant.

Results

Table: 1. Classification of BMI based on WHO classification and Asian Indian classification (n=224)

	WHO classification	Asian Indian classification
Underweight	7	7
Normal	150	100
Overweight	47	47
Obese	20	70

Table: 2. Gender difference in overweight and obese category when classified based on WHO and Asian Indian classification

	WHO classification			Asian Indian classification		
	MALES	FEMALES	TOTAL	MALES	FEMALES	TOTAL
Overweight	26	21	47	23	24	47
Obese	14	6	20	44	26	70

Table: 3. Gender difference in anthropometric parameters of individuals who fall under obese and overweight category when classified under Asian Indian classification, but categorized as normal as per WHO guidelines

Variables	Males (n=23)	Females (n=27)
Height (meters)	1.70 ± 0.06* †	1.5 ± 0.01
Weight (kg)	70 ± 8* †	56 ± 10
BMI (Kg/m^2)	24 ± 3	25 ± 4
WC(cm)	80 ± 12* †	72 ± 14
HC (cm)	98 ± 10*	95 ± 12

BMI: Body mass index; WC: Waist circumference, HC: Hip circumference

*significantly higher compared with females †p<0.01

Table: 4. Gender difference in blood pressure parameters of individuals who fall under obese and overweight category when classified under Asian Indian classification, but categorized as normal as per WHO guidelines

Variables	Males (n=23)	Females (n=27)
Systolic BP (mm Hg)	130 ± 10*†	120 ± 10
Diastolic BP (mm Hg)	80 ± 9*	70 ± 6
Heart rate	76 ± 4*†	70 ± 6

*significantly higher compared with females , †p<0.01

Table: 5. Gender difference in FBG and lipid profile parameters of individuals who fall under obese and overweight category when classified under Asian Indian classification, but categorized as normal as per WHO guidelines

Variables (mg/dl)	Males (n=23)	Females (n=27)
Fasting blood glucose	80 ± 10	80 ± 11
Total cholesterol	170 ± 25*†	155 ± 20
Triglycerides	90 ± 37	88 ± 64
HDL cholesterol	54 ± 4	57 ± 4
LDL cholesterol	96 ± 26	95 ± 30
VLDL cholesterol	20 ± 7*†	12 ± 4
TC/HDL	3.14 ± 0.79*	2.71± 0.69

*significantly higher compared with females

†p<0.01

Table: 6. Correlation of BMI with biochemical parameters, blood pressure parameters

Correlation of BMI with	Males (r value)	Females (r value)
HDL cholesterol	-0.20*	
LDL cholesterol		0.25*
Total cholesterol		0.34†
Fasting blood glucose		0.34†
Systolic BP (mm Hg)		0.28*
Diastolic BP (mm Hg)		0.31*

*p<0.05

†p<0.01

Table: 7. Correlation of WC with biochemical parameters, blood pressure parameters

Correlation of WC with	Males (r value)	Females (r value)
VLDL cholesterol	0.25*	
Diastolic BP (mm Hg)		0.36†

*p<0.05

†p<0.01

The present study is a cross sectional study among 224 age matched (19 ± 2) subjects (119 males, 105 females)

Table 1 shows classification of BMI based on WHO classification and Asian Indian classification. It was found that, when classified according to WHO classification, 7 were underweight, 150 were under normal category, 47 were overweight and 20 were classified as obese. When classified based on Asian Indian guidelines, 7 were underweight, 100 were under normal category, 47 were overweight and 70 were classified as obese.

Table 2 shows gender difference in overweight and obese category when classified based on WHO and Asian Indian classification

Table 3 shows gender difference in anthropometric parameters of individuals who fall under obese and overweight category when classified under Asian Indian classification, but categorized as normal as per WHO guidelines. Males had higher weight and height when compared with females and it was statistically significant (P=0.001 for both).WC and HC was also significantly higher in males (P=0.001, P=0.04 respectively).

Table 4 shows gender difference in blood pressure parameters of individuals who fall under obese and overweight category when classified under Asian Indian classification, but categorized as normal as per WHO guidelines. Males had significantly higher SBP (P=0.001), DBP (P=0.02), Herat rate (P=0.001) when compared with females. No significant difference was observed in pulse pressure, rate pressure product among either gender.

Table 5 shows gender difference in FBG and lipid profile parameters of individuals who fall under obese and overweight category when classified under Asian Indian classification, but categorized as normal as per WHO guidelines. TC and VLDL was found to be significantly higher in males as compared to females (P=0.001 for both). No significant difference observed for FBG, TG, HDL, LDL, TC/HDL between either gender.

Table 6 shows correlation of BMI with biochemical parameters, blood pressure parameters. Significant negative correlation of BMI and HDL (p=0.02) was observed in males. Significant positive correlation exists between BMI and LDL (p=0.05), TC (p= 0.01), FBG (p=0.01), SBP (p=0.03), DBP (p=0.02) in females.

Table 7 shows correlation of WC with biochemical parameters, blood pressure parameters. A significant correlation of WC with VLDL was observed in males (P=0.01). Also, there exists significant correlation of WC with DBP among females (P=0.001).

Discussion

Obesity has emerged as a major non-communicable disorder associated with many metabolic diseases in both developed and developing countries. Obesity and obesity related co-morbidities are becoming an epidemic disease in Asian countries like India. Although obesity has a genetic aetiology, the major precipitating factor is environmental, mostly related to sedentary lifestyle and causing conservation of energy as body fat.

Because of variations in body proportions, BMI may not correspond to the same body fat in different populations. Asian Indians exhibit unique features of obesity; excess body fat, abdominal adiposity, increased subcutaneous fat, increased intra-abdominal fat and deposition of fat in ectopic sites like liver, muscle. Insulin resistance is noted among Asian Indians at normal BMI levels.[1] This thin-fat phenotype (muscle thin but body fat) is associated with increased risk of diabetes mellitus, subclinical atherosclerosis and hence South Asian ethnicity itself is an independent predictor of CVD.[12,13] Hence proposed cut-offs for defining overweight and obesity are not appropriate for Asian Indians as they are at risk of developing obesity related co-morbidities at lower levels of BMI and WC.

When we classified the study groups based on cut offs for Asian Indians and that of WHO guidelines we found that number of individuals in normal category reduced to 100 from 150 as per WHO guidelines. Also number of obese individuals increased to 70 individuals according to Asian Indian guidelines from 20 as per WHO guidelines. This shows that at a lower BMI there is CVD risk among these individuals. That is BMI cut-off for overweight and obese as defined by the WHO may not adequately reflect the actual overweight or obese status. Studies in Hong Kong and Singapore [14,15] showed that risk for CVD or diabetes is high at lower BMI. Data from China indicate that the prevalence of hypertension, diabetes, dyslipidaemia and clustering of risk factors with higher BMI, was below the current cut-off point for overweight (25 kg/m^2).[16] However, these studies were in older group of population, where in present study is mainly in young adults who are productive groups of community.

When individuals who were classified as normal under WHO guidelines but, overweight and/or obese under Asian Indian guidelines were assessed for cardiovascular risk factors, anthropometric parameters like WC, HC were higher in males. WC and HC are indices of central obesity.[17,18] and a higher values shows the presence of central obesity in this group and in par with study by Bertsias et al. [19], who reported central obesity among men. Central obesity is known to be an independent risk factor for CVD. [20] Also, males had significantly higher SBP, DBP, heart rate in present study. Harshfield et al. reported that after onset of puberty, boys have higher BP than do age matched girls [21], which may be attributed to hormone testosterone [22]. When lipid profile parameters were compared between groups males had a higher TC, VLDL. Similar findings were observed in study by Bertsias et al. [19] Owing to the presence of hormone oestrogen, normally HDL cholesterol levels will be higher in females [23]. In contrast to above statement, present study did not show any gender difference in HDL levels. Also, no significant difference was observed in any other lipid profile parameters across gender in present study. Similar findings were observed in study by Habib et al.[23], only difference is that this study was on elderly subjects while our group of study were young adults.

Also, in those individuals who were characterized as normal based on WHO guidelines, BMI positively correlated with SBP, DBP, LDL, TC and FBG among females but not in males. A positive correlation between BMI and SBP was reported in overweight individuals in a study by Ravishankar et al. [24] The relationship between BMI and BP indices has been well established and has a potential role in development of hypertension.[25] It has also been observed that a 10 kilogram increase in body weight has been associated with 3 mm Hg higher SBP and 2.3 mm Hg higher DBP. [26] As body mass increases, the demand for nutrient supply also increases, which increases the sympathetic activity and increases the risk of development of hypertension.[27]

Conclusion

Owing to the fact of childhood roots of adult obesity, which track through young age and manifest with CVD related co-morbidities during middle age assessment of young adults for CVD risk factors is of particular importance. This would allow prompt identification of persons at risk for development of clinical CVD later in life. There is an urgent need to evolve methods of primary prevention in these populations to save the community from the burden of CVD and its sequelae. This can be done by early diagnosis by following ethnicity specific guidelines for BMI, WC cut-offs and also, maintenance of ideal BMI by lifestyle modifications helps to delay or postpone the onset of CVD.

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