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Metabolic Profiles in Abdominal Obesity and Generalized Obesity in College Students

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Abstract

Introduction: *Obesity can be defined as an excess of body fat. Obesity is generally classified as generalized obesity (GO) and abdominal obesity (AO). Abdominal fat distribution, particularly intra-abdominal fat, is a greater risk factor than peripheral fat distribution. Obesity is a known risk factor for metabolic syndrome in adults. Metabolic syndrome includes a group of cardiovascular disease risk factors namely impaired carbohydrate metabolism, dyslipidemia and hypertension.*

Methods: *A total of 98 college students (aged 17-25years) were included in the study. Waist Circumference (WC), Height, weight was measured and their BMI was calculated. An overnight fasting venous blood sample was drawn for lipid profile. Abdominal obesity was defined as WC =≥90cm in male, ≥80cm in female and generalized obesity was defined as BMI ≥ 25 kg/m2 for both genders.*

Results: *The prevalence of generalized obesity was 36% while the prevalence of abdominal obesity was 58% among the college students. Obesity measured either as WC or BMI is associated with altered metabolic profiles.*

Conclusions: *It can be concluded from our study that abdominal obesity is more common than generalized obesity. Abdominal obesity is the predictor of cardiometabolic risks.*

Keywords – *Central Obesity, Generalized Obesity, Waist Circumference, Body Mass Index (BMI), Metabolic Profiles.*

Introduction

According to WHO, Obesity is one of the most common and the most neglected, public health problems in both developed and developing countries.[1] The underlying disease is the undesirable positive energy balance and weight gain. However, obese individuals differ not only in the amount of excess fat that they store but also in the regional distribution of that fat within the body. The distribution of fat induced by weight gain affects the risks associated with obesity, and the kinds of disease that result. The prevalence of overweight and obesity has been rapidly increasing in countries of the South Asian region, with adverse consequences on health.[2,3] Obesity can be defined as an excess of body fat. A surrogate marker for body fat content is the body mass index (BMI), which is determined by weight (kilograms) divided by height squared (square meters). Overweight was defined as a BMI ≥23 kg/m2 but <25 kg/m2 for both genders (based on the World Health Organization Asia Pacific Guidelines and also based on Consensus Statement for Diagnosis of Obesity, Abdominal Obesity and the Metabolic Syndrome for Asian Indians and Recommendations for Physical Activity, Medical and Surgical Management[4,5]) with or without abdominal obesity (AO)[11].

Generalized obesity (GO) was defined as a BMI ≥ 25 kg/m2 for both genders (based on the World Health Organization Asia Pacific Guidelines) with or without abdominal obesity (AO)[11].

Abdominal obesity (AO) was defined as a waist circumference (WC) ≥ 90 cm for men and ≥ 80 cm for women with or without GO[12].

Obesity is a significant risk factor for cardiovascular disease (CVD). Cardiovascular morbidity and mortality of obesity are associated with classic risk factors, namely dyslipidemia, hypertension, and impaired glucose metabolism. These risk factors, known as the predictors of future CVD, make part of what is known as the metabolic syndrome.[6] Central distribution of body fat; particularly intra-abdominal fat is more a risk factor for obesity-related ill health than peripheral distribution. [1] Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) more correctly measure the fat distribution but their high cost and radiation hazards prevent their use in large-scale epidemiological studies, clinical study and self assessment.[7] Waist Circumference (WC) and Waist-Hip Ratio (WHpR) can be used to assess the risk associated with intra-abdominal fat. Internationally accepted cut off points for abdominal obesity are >102 cm for men and >88 cm for women[8] (National Cholesterol Education Program, 2002). Many studies[9,10] have questioned the sensitivity of these cut-off points in identifying cardiovascular risk in Indian subjects and have proposed lower cut off points for Indians.

The risk associated with fat distribution varies in different populations. Some populations (like Indians) are susceptible to obesity-related disorders even at lower levels of obesity, than the global standards. Therefore, WHO recommends to develop population specific cut-off points for anthropometric variables to assess the risk associated with obesity. Dyslipidemia commonly observed in obese patients may be due to altered cholesterol metabolism. Obese patients present with elevated cholesterol synthesis compared with normal-weight individuals.[13]

The aim of the present study was to compare the metabolic profiles in obese and non-obese students according to their WC and BMI.

Material and Methods

The data collected from the 98 college going-students (aged 17-25years) were divided into obese and non-obese categories according to the WC and BMI cut-offs separately. Generalized obesity (GO) was defined as a BMI ≥ 25 kg/m2 for both genders (based on the World Health Organization Asia Pacific Guidelines) with or without abdominal obesity (AO). Waist Circumference (WC), Height, weight were measured and BMI was calculated. Abdominal obesity was defined as WC =≥90cm in male, ≥80cm in the female. Waist-Hip Ratio (WHpR) was calculated as WC divided by HC (WC/HC). Waist-Height Ratio (WHtR) was calculated as WC divided by Height. Subjects were examined by Physician in the Department of Medicine, Sharda Hospital, Greater Noida, UP, India. This study was conducted in the Department of Biochemistry, School of Medical Sciences & Research, Sharda University, Knowledge Park-III, Greater Noida and the Department of Biochemistry, Santosh University, Ghaziabad. Subjects were excluded if there was no consent for participation in the study, BMI <18, history of any disease or under any kind of treatment or under any medication. The study protocol and the

Informed Consent Form (ICF) were reviewed and approved by Institutional Ethics Committee.

Anthropometric Profile

Body weight and height were measured with the subject barefoot and wearing light clothing. BMI was calculated as weight in kilograms over height in meters squared. Waist circumference was measured at the midpoint between the lower limit of the rib cage and upper border of the iliac crest. Blood pressure was recorded in a sitting position of the right arm to the nearest 2 mmHg using mercury sphygmomanometer. Two readings were taken 5 min apart and the mean was taken as the blood pressure.

Biochemical Estimations

Venous blood was drawn from each individual after an overnight fast of ≥12 h for estimation of metabolic variables. Fasting blood sugar, Serum lipids i.e total cholesterol (TC), triglycerides (TGs), high density lipoprotein (HDL-C) were estimated by commercially available kit manufactured by Accurex Biomedical Pvt Ltd by using a Star 21 Plus Semiautomatic Biochemistry Analyzer (Rapid Diagnostics group of Companies). Values of low density lipoprotein (LDL-C) were estimated using standard formula (LDL-C= TC - (HDL-C + TGs/5) and very low density lipoprotein (VLDL-C) as TGs/5 provided TG was <400 mg/dl.

Statistical Analysis

Descriptive statistics such mean and standard deviation (SD) of anthropometric and biochemical measures was calculated by using unpaired *t*- test to compare the significance of the difference in the metabolic profiles in the two groups. The mean difference was significant at P <0.05 level. All analyses were carried out using GraphPad Prism 6 software.

Result

Table 1: Clinical and biochemical data of the study population based on waist circumference.

	Nonobese, n=41		Obese, n=57		p-VALUE
PARAMETERS	Mean	Std. Deviation	Mean	Std. Deviation	
AGE (year)	19.12	2.11	18.86	1.68	.496*
HEIGHT (meter)	1.68	0.10	1.64	0.12	.110*
WEIGHT (kg)	64.00	6.81	71.37	12.74	.001**
HIP CIRCUMFERENCE (cm)	92.88	5.17	104.28	6.68	.000**
WHpR	0.85	0.06	0.89	0.06	.002**
WAIST CIRCUMFERENCE (cm)	79.32	4.87	93.30	7.01	.000**
WHtR	0.47	0.03	0.56	0.05	.000**
SYSTOLIC BP (mm Hg)	118.00	7.24	120.42	6.54	.087*
DIASTOLIC BP (mm Hg)	78.78	4.29	79.81	4.63	.267*
FASTING BLOOD SUGAR (mg/dl)	82.17	7.19	84.88	10.36	.153*
TOTAL CHOLESTEROL (mg/dl)	170.54	24.38	177.04	24.16	.194*
HDL- C (mg/dl)	42.83	9.11	41.33	10.28	.458*
LDL- C (mg/dl)	107.20	27.83	112.35	27.91	.369*
VLDL- C (mg/dl)	20.51	4.27	23.56	6.60	.011**
TRIGLYCERIDES (mg/dl)	102.66	21.57	118.07	32.85	.010**
TOTAL CHOLESTEROL/HDL-C	4.18	1.17	4.57	1.39	.150*
TGs/HDL-C	2.50	0.79	3.07	1.23	.011**
LDL-C/HDL-C	2.68	1.07	2.96	1.22	.240*

Variables represented in mean ± SD, and unpaired t-test applied. WHpR; waist to hip ratio, WHtR; waist to height ratio.
*= Nonsignificant, **= significant

Table 2: Clinical and biochemical data of the study population based on Body Mass Index.

	Nonobese, n=63		Obese, n=35		P-VALUE
PARAMETERS	Mean	Std. Deviation	Mean	Std. Deviation	
AGE (year)	18.95	1.86	19.00	1.91	.905*
HEIGHT (meter)	1.68	0.11	1.62	0.10	.011**
WEIGHT (kg)	64.49	8.87	75.11	11.91	.000**
HIP CIRCUMFERENCE (cm)	96.54	7.23	104.86	7.42	.000**
WHpR	0.87	0.06	0.90	0.07	.004**
WAIST CIRCUMFERENCE (cm)	83.43	7.19	94.69	8.23	.000**
WHtR	0.49	0.04	0.58	0.052	.000**
SYSTOLIC BP (mm Hg)	117.83	6.83	122.26	6.2	.002**
DIASTOLIC BP (mm Hg)	78.33	4.84	81.26	3.07	.002**
FASTING BLOOD SUGAR (mg/dl)	82.51	8.10	85.97	10.73	.075*
TOTAL CHOLESTEROL (mg/dl)	167.44	22.59	186.69	22.68	.000**
HDL- C (mg/dl)	44.17	9.75	37.97	8.61	.002**
LDL- C (mg/dl)	103.11	25.62	122.94	27.48	.001**
VLDL- C (mg/dl)	20.19	4.37	26.06	6.5	.000**
TRIGLYCERIDES (mg/dl)	101.10	21.77	130.57	32.42	.000**
TOTAL CHOLESTEROL/HDL-C	3.97	1.04	5.19	1.39	.000**
TGs/HDL-C	2.4	0.74	3.61	1.22	.000**
LDL-C/HDL-C	2.49	0.95	3.47	1.25	.000**

Variables represented in mean ± SD, and unpaired t-test applied. WHpR; waist to hip ratio, WHtR; waist to height ratio.
*= Nonsignificant, **= significant

The data collected from the 98 college going students were divided into obese and non-obese categories according to the WC and BMI cut-offs separately and was analyzed for any statistically significant difference in the metabolic profiles between two groups.

The prevalence of generalized obesity was 36% while the prevalence of abdominal obesity was 58% among the college students. The mean value of the fasting blood sugar, blood pressure, lipid profile variables in the obese and non-obese according to their waist circumference cut-offs are shown in the table: 1. The obese subjects were found to be increased in fasting blood sugar, systolic & diastolic blood pressure, TC, TC/HDL-C, LDL-C/HDL-C and LDL-C and low HDL-C than non-obese subjects, but the difference was significant for TGs, TGs/HDL-C and VLDL-C (P< 0.01). Similarly, hip circumference (HC), WHpR, WHtR was significantly increased in obese students (P< 0.01).

The mean value of the fasting blood sugar, blood pressure, lipid profile variables in the obese and non-obese subjects according to their body mass index cut offs are shown in the table: 2. The obese subjects were found to be increased in fasting blood sugar than non-obese subjects, but the difference was significant for systolic & diastolic blood pressure, TC, TC/HDL-C, LDL-C/HDL-C, LDL-C, TGs, TGs/HDL-C, VLDL-C, and low HDL-C (P< 0.01). Similarly hip circumference (HC), waist circumference (WC), WHpR, and WHtR was significantly increased in obese students (P< 0.01).

Discussion

In our study, we found that the prevalence rates of generalized obesity was 36% while the prevalence of abdominal obesity was 58% among the college students. Asian Indians tend to develop abdominal obesity rather than generalized obesity. Studies had reported that Asian Indians have a greater predisposition to abdominal obesity and accumulation of visceral fat and this has been termed as "Asian Indian phenotype[14,15]. This prevalence was relatively low with the study conducted in urban north India (New Delhi), the overall prevalence of generalized obesity was 50.1 %, while that of abdominal obesity was 68.9 %[16]. Whereas comparable with the another study conducted in the adult population of urban Delhi and rural Ballabgarh (Haryana state), revealed that overweight was widely prevalent in the urban population (men: 35.1, women: 47.6%) compared to the rural population (men: 7.7%, women: 11.3%)[17]. In countries like India, the rise in obesity prevalence could be attributed to the increasing urbanization, use of mechanized transport, increasing availability of processed and fast foods, increased television viewing, adoption of less physically active lifestyles and consumption of more "energy-dense, nutrient-poor" diets.[18-20] People of South Asian (Bangladeshi, Indian and Pakistani) descent living in urban societies have a higher prevalence of many of the complications of obesity than other ethnic groups. These complications are associated with the abdominal fat distribution that is markedly higher for a given level of BMI than in Europeans.[1] Lipid abnormalities noted in the present study reveal hypertriglyceridemia to be the most common lipid abnormality by measuring BMI as well as WC. Our study showed significantly increased levels of TGs, VLDL-C, TGs/HDL-C (all $p<0.01$) in obese compared to non-obese. The CAD risk increases to eightfold with low HDL, 12-fold with high LDL-C, 16-fold with diabetes and 25-fold with TC/HDL-C ratio.[21] The relation between WC and clinical outcome is consistently strong for diabetes risk, coronary heart diseases, and all-cause and selected cause-specific mortality rates, and WC is a stronger predictor of cardiometabolic risks than is BMI.[22] In Chinese adults, the best anthropometric measurements to screen for metabolic syndrome is WC, since it was better associated with metabolic risk factors than BMI, WHpR, and WHtR[23]. A tendency to gain fat in the abdominal area, as opposed to the hip, buttock, and limb areas, is linked to a rise in fatty acids in the blood, which is thought to lead to insulin resistance, high blood pressure, abdominal blood lipids, and eventually diabetes. Asian Indians tend to develop abdominal obesity rather than generalized obesity. Lipid mobilization from the fat depots and release of free fatty acids is mainly regulated by catecholamines and insulin. Catecholamines regulate lipolysis in human adipocytes by the action of stimulatory β and inhibitory α2 receptors. Insulin has an inhibitory effect on lipolysis. Central fat depots show higher density and sensitivity to stimulatory β receptors, while lower density and sensitivity to inhibitory α2 receptors. These are also less sensitive to the anti-lipolytic effect of insulin. Thus all these factors combined together may explain the altered lipid profile level in individuals with abdominal obesity. According to available data in Asia, the WHO expert consultation concluded that Asians generally have a higher percentage of body fat than white people of the same age, sex, and BMI. Also, the proportion of Asian people with risk factors for type 2 diabetes and cardiovascular disease is substantial even below the existing WHO BMI cut-off point of 25 kg/m^2. So, current WHO cut-off points do not provide an adequate basis for taking action on risks related to over-weight and obesity in many populations in Asia.

In the present study, higher BMI was significant and has been widely used as an indicator of total adiposity; its limitations are clearly recognized by its dependence on race (Asians having large percentages of body fat at low BMI values), and age. As compared to BMI, WC has been used as surrogates of body fat centralization. This fact demonstrates the importance of early interventions for control and treatment of these risk factors for prevention of the cardiovascular complications in these patients.

Conclusion

Our study showed that the prevalence of obesity (generalized and abdominal) was higher in college students. However, the prevalence of abdominal obesity was much higher than the generalized obesity. Obesity measured either as WC or BMI is associated with altered metabolic profiles.

The prevention and reduction of overweight and obesity depend ultimately on individual lifestyle changes, and further research on motivations for behavior change would be important in combating the obesity epidemic.

Conflicts of interest: None.

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