Global Journal of Pharmacology 6 (1): 08-11, 2012
ISSN 1992-0075

Correlation of Blood Sugar with Waist Circumference and Body Mass Index in an Indian Population

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Abstract: The objective of the study was to assess the correlation of blood sugar with waist circumference and body mass index in an Indian population. 204 patients were examined for Body Mass Index (BMI), waist circumference,Waist: Hip ratio and fasting blood sugar. The study showed a positive statistically significant correlation between fasting blood glucose and BMI ($p<0.001$) and Waist circumference ($p<0.001$). 30% of overweight patients and 25% of obese patients were diabetic. High BMI, Waist circumference, Waist: Hip can be taken as predictors of type 2 diabetes.

Key words: Obesity · Incidence · Type 2 Diabetes · BMI · Waist Circumference

INTRODUCTION

Indians are highly susceptible to diabetes and cardiovascular disease with modest over weight, central obesity, and decrease in physical activity. There has been a rapid increase in the prevalence of diabetes and cardiovascular disease in India, in association with rapid changes in diet and life style. In adults the prevalence of diabetes is 2-3 folds greater in urban than in rural population. In the past two decades the prevalence of diabetes has almost doubled in rural areas of India and has increased threefold in urban areas. National surveys conducted during the past 15 years in 10 states of India showed that there has been a marked decrease in under nutrition and significant increase in the prevalence of overweight and obesity, more specifically among the urban populations of India [1-4]. The greater prevalence of diabetes, cardiovascular risk, insulin sensitivity, glucose intolerance and coronary mortality observed among people of Indian origin in developed countries has been explained as being caused by central obesity and an insulin resistance syndrome resulting from genetic predisposition [3-10]. This study was designed to assess the incidence of overweight and obesity in Indian subjects and to assess the correlation of fasting blood sugar with BMI and waist circumference.

The currently recommended cut-offs of BMI recommended by World Health Organization include 18.5 - 24.9 kg/m^2 for normal, 25.0 - 29.9 kg/m^2 for overweight and >30 kg/m^2 for obesity. The Health Ministry, India has reduced the diagnostic cut-offs for body mass index (BMI) and the standard waist circumference to fight the battle against obesity as India will become the global diabetes capital by 2050. The standards have been set for the first time in the Ministry's consensus guidelines for Prevention and Management of Obesity and Metabolic Syndrome. The guidelines were released jointly by the Health Ministry, the Diabetes Foundation of India, the All-India Institute of Medical Sciences (AIIMS), Indian Council of Medical Research, the National Institute of Nutrition and 20 other health organizations [19, 20].

An Indian with a body mass index of 23 kg/m^2 will now be considered overweight and below that as one with normal BMI—unlike the cut-off limit of 25 kg/m^2 earlier. Those with BMI of 25 kg/m^2 will be clinically termed obese (as opposed to 30 kg/m^2 at the international level). According to guidelines, cut-offs for waist circumstances will now be 90 cm for Indian men (as opposed to 102 cm globally) and 80 cm for Indian women (as opposed to 88 cm globally). As per the consensus, the currently recommended cut-offs of BMI recommended include 18 - 22.9 kg/m^2 for normal, 23.0 - 24.9 kg/m^2 for overweight and >25 kg/m^2 for obesity.

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MATERIALS AND METHODS

This prospective study was undertaken at Dr. DY Patil Hospital, Navi Mumbai between April 2009-June 2010. Every fifth patient attending the medical outpatient department was invited to participate in the study. Two hundred and four (204) subjects were enrolled in the study, 111 males and 93 females. Study eligibility criteria included subjects of either gender and between 18-65 years and not taking any anti-diabetic drugs. Pregnant subjects were excluded from the study.

After obtaining the informed consent, person's age, sex, height, weight, waist circumference and hip circumference were recorded. Fasting blood sugar was taken after an 8 hour fast. A fasting sugar level above 126mg/dl was confirmed as a diabetic. Weight was recorded to nearest 0.5 kg and height was recorded to nearest 0.5 cm. Height was measured in the standing position without shoes by using a tape meter, while the shoulder was in a normal position. Body mass index (BMI) was calculated as weight (kg) divided by height squared (meter^2) and was used as the criteria for diagnosis of overweight and obesity. Those with a BMI of 18- 22.9 kg/m^2 were classified as normal weight, while 23.0-24.9 Kg/m^2 were classified as overweight and those with a BMI = 25 Kg/m^2 were defined as obese.

Waist and hip circumferences were measured, using a flexible measuring tape, midway between the xiphoid and the umbilicus during the mid-inspiratory phase and at the maximum circumference in the hip area, respectively. This study was undertaken based on findings of a number of population based studies of obesity undertaken in urban and rural areas of India. The results were reported as mean ± SD. The fasting blood sugar was correlated with BMI and waist circumference using Pearson's correlation. Statistical significance was considered at P value <0.05.

RESULTS

The study sample consisted of 111 males and 93 females. Out of 204 patients, 111 (54%) were males and 93 (46%) were females. The subjects were well matched with respect to age, BMI, Waist circumference and blood sugar (Table 1).

Normal BMI (18-22.9 kg/m^2) was found in 39 patients (19%), 114 patients (58 %) were overweight (23-24.9 kg/m^2) and 51 patients (23%) were obese BMI >25 kg/m^2. 30% of overweight patients and 25% of obese patients were diabetic (Table 2). Overall incidence of diabetes in the study population was 25% (Table 2).

Abnormal waist circumference was observed in 62% (n=126) of the subjects studied. 34% of subjects with abnormal waist circumference were diabetic (Table 3). Women had a higher incidence of abnormal waist circumference compared to the men. 53% males (n=60) had waist circumference above 90cm and 72% females (n=66) had waist circumference above 80cm.

There was a positive correlation between BMI and fasting blood glucose and between waist circumference and fasting blood glucose (Table 4).

Table 1: Anthropometric parameters and Fasting Blood Glucose

	Male (n=111) Mean± SD	Mean±SD Female (n=93)
Age(years)	59.20±9.21	56.57±6.79
BMI (kg/m2)	23.48±2.71	26.41±4.86
Waist Circumference(cm)	94.57±9.6	92.16±11.45
Hip Circumference(cm)	97.8±6.78	98.66±14.5
Waist/Hip Ratio	0.96±0.05	0.94±0.12
Fasting Blood Glucose	151.81±57.55	207.38±74.14

Table 2: Diabetes Mellitus BMI cross tabulation

		BMI Classes			
		Normal Weight (19%)	Overweight (58%)	Obese (23%)	Total
DM	No	34	80	38	152
	Yes	05	34	13	52
Total	39	114	51	204	
% diabetics	13%	30%	25%	25%	

Table 3: Diabetes Mellitus Waist circumferences cross tabulation

		Waist circumference classes		
		Normal Waist (38%)	Abnormal Waist (62%)	Total
Diabetes Mellitus	No	67	83	150
	Yes	11	43	54

Table 4: Correlation coefficients of Blood glucose with BMI and Waist circumference

Parameter	Pearsons correlation coefficient	P value
BMI	0.225	<0.001
Waist Circumference	0.214	<0.001

DISCUSSION

Epidemiological and case-control studies have indicated that Indians are highly susceptible to diabetes and cardiovascular risk even with only modest overweight, central obesity and decrease in physical activity [1, 2, 13, 18].

The Indian Council of Medical Research [15] advises lower body weights for Indian men (60 kg) and women (50 kg) compared to those recommended for developed countries because of the smaller body frames of Indians, lower target BMI values for developing countries have been advised by other experts groups [2, 19-20], 18-22.9 kg/m^2 acceptable, 23-24.9 kg/m ^{2}should be considered over weight and > 25 kg/m^2 as obesity. A recent consultation by a World Health Organization (WHO) expert group suggested that Asians have different associations between body mass indexes, the percentage of body fat and the health risk of type 2 diabetes as compared to the European populations [18].

There has been a rapid emergence of diabetes and cardiovascular disease in urban Indians and Indian immigrants to developing countries [2].

In another study, the prevalence of diabetes was 8.2% in urban India and 2.4% in rural South India [4]. A study conducted in a diabetic clinic at a university hospital, showed a statistically significant higher BMI in diabetic patients compared to non-diabetics [21].

The consumption of total and saturated fats by Indian immigrants to the U.K. is much greater than the consumption by rural Indians. This is known to be associated with increasing prevalence of central obesity, diabetes and cardiovascular risk in Indian urban population and immigrants, compared with lower prevalence in rural populations [1, 12-14].

In most Indians, BMI more than 23 kg/m^2 is associated with central obesity and coronary risk factors [2]. It seems that the margin of safety between normal and abnormal values of BMI is lower for Indians than for population of developed countries. Weight appears to be of fundamental importance in prevention of diabetes and reduction of weight is associated with lower BMI and Waist: Hip ratio [17].

Indians have a genetic predisposition to central obesity that arises from abnormal fat distribution in the body as a result of insulin resistance [5, 7, 16]. There is now significant epidemiological evidence that Waist:Hip ratio more than 0.88 in males and more than 0.85 in females are associated with significant risk of diabetes and cardiovascular mortality in Indians [12-15]. The desirable limits of waist: hip ratio of less than 0.95 in males and less than 0.90 for females proposed for developed countries are thus too high for Indians.

Results indicate that 33% of patients were obese, high Waist: Hip ratio was seen in approximately 19.7% of males and 36.7% of females. Waist circumference more than 80 cm was seen in 66 females (72%) and more than 90cm was seen in 60 males (53%) who participated in the study.

CONCLUSIONS

It can be concluded from this study that there is a positive correlation between fasting blood glucose and BMI and waist circumference. BMI, Waist circumference and Waist to hip ratio are important indicators of obesity and can be used to predict incidence of obesity in Indian population. Further, it is the need of the hour to set guidelines for detection of obesity in Indian population to enable early detection of obesity, so that early and prompt treatment or prevention measures can be started and huge hidden burden of future cardiovascular complications can be reduced.

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