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Original Article

Identify the existence of general and central obesity by anthropometric measurements in the diabetic population

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ABSTRACT

Introduction: Obesity is usually defined according to body mass index (BMI) cut-offs. However, BMI cannot provide information on the distribution of body fat. Central obesity, as assessed by waist circumference (WC), is more strongly associated with the risk of hypertension, dyslipidaemia, type 2 diabetes, cardiovascular disease, cancer and all-cause mortality.

Aim: To identify the existence of general and central obesity by anthropometric measurements and to compare anthropometric parameters in the control and prediabetic subjects.

Material and Method: The present study was conducted in the department of Physiology Gandhi Medical College and associated Hamidia Hospital Bhopal, during 2010 - 2011. The Fasting Blood sugar, Lipid Profile and Fasting Insulin Biochemical investigation was done in the department of Biochemistry of the institute. The anthropometric measurement including Weight (kg), Height (cm), Body mass index (kg/m2), Waist circumference (cm), Hip circumference (cm), Waist Hip ratio. was recorded.

Result: The 120 subjects aged 30-60, maximum numbers of Prediabetic were in the age group of 40-50 years. In the control group 66% women as compared to the men 32%, In prediabetic group 72% subjects were showed general obesity, central adiposity was identified in 84%. It was observed that body mass index and waist circumference were significantly higher in prediabetic subject.

Conclusion: This study has important implications for identification of subjects at higher risk for future type 2 diabetes and suggested that mass screening of prediabetic subjects and aggressive risk modification and close follow-up should be considered for prediabetic subjects with metabolic syndrome.

Keywords: Anthropometric measurement, diabetic, obesity, prediabetics

INTRODUCTION

Obesity is a serious public health issue worldwide including the developing countries like China.[1,2] It is well-established that childhood obesity is associated with many cardiovascular risk factors such as hypertension, dyslipidemia, metabolic syndrome, and Type 2 diabetes in children and in adults.[3] In addition, obesity at childhood may track into adulthood.[4] In the majority of studies, obesity is usually defined according to body mass index (BMI) cut-offs. However, BMI cannot provide information on the distribution of body fat.[5] Central obesity, as assessed by waist circumference (WC), is more strongly associated with the risk of hypertension, dyslipidemia, Type 2 diabetes, cardiovascular disease, cancer and all-cause mortality than generalized obesity as defined by BMI.[6,7]

Insulin resistance is a pathological situation characterized by a lack of physiological response of peripheral tissue to insulin action leading to the metabolic and hemodynamic disturbances known as the metabolic syndrome. The main feature of this condition include dyslipidemia, (high triglyceride and low high-density lipoprotein cholesterol levels) hypertension, glucose intolerance or Type 2 diabetes, hyperuricemia, or gout, abdominal obesity, hypercoagulability, and defect in the fibrinolytic system,

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hyperandrogenism, fatty liver, and an increased incidence of coronary heart disease.[8] Aim and objectives of our study was to identify the existence of general and central obesity by anthropometric measurements in the study population and to compare anthropometric parameters in the control and prediabetic subjects.

MATERIALS AND METHODS

The present study was conducted in the Department of Physiology at Gandhi Medical College and associated Hamidia Hospital Bhopal, during 2010-2011. Total 120 subjects in the age group range of 30-60 years attending the different medical outpatient departments (OPDs) were selected based on the inclusion and exclusion criteria. The fasting blood sugar, lipid profile, and fasting insulin biochemical investigation was done in the department of Biochemistry of the Institute. After written consent the anthropometric measurement including weight (kg), height (cm), BMI (kg/m^2), WC (cm), hip circumference (cm), waist-hip ratio was recorded. The age below 30 years and above 60 years, fasting blood glucose >126 mg/dl and subjects taking hormonal therapy or hormonal contraceptive, lipid lowering drug and drug to control blood sugar level were excluded from the study.

Body Weight

The weight of each subject was recorded on the same platform beam balance, barefooted with the minimum clothing on the body. The subject was made to stand erect on the center of the platform without touching anything else weight was recorded in kilogram up to the accuracy of 100 g. The zero error was minimized to maximum; machine was checked repeatedly from time to time to avoid error.

Height

Using a vertical measuring rod, height was measured without shoes; the subject was made to stand on a flat floor with feet parallel and with heels, buttock, shoulder and back of head touching the rod. The head was held perfectly erect with the lower border of the orbit in the same horizontal plane as the external auditory meatus and arm hanging at the side in a natural manner. Metallic block was lowered gently to make contact with scalp and reading was taken.

BMI Calculation

$$\text{BMI} = \frac{\text{Weight in kg}}{\text{Height in meter}^2}$$

RESULTS

The study comprised of 120 subjects aged 30-60 years attending the different medical OPDs in Gandhi Medical College and associated Hamidia - Hospital Bhopal. According to ADA 2007 all the subjects having fasting serum glucose (FSG) <100 mg/dl were included in the control groups subjects having FSG ≥100-125 mg/dl categorized into prediabetic group.[9]

In the age range 30-40 years 29% men (31.2 ± 15 years) and 38% women (33.5 ± 4.3 years) were studied, 48% men (45.1 ± 2.9 years) and 38% women (43.5 ± 2.7 years) were in the age range 40-50 studied. In the age range 50-60 years 23% men (54 ± 1.4 years) and 24% women (53.6 ± 1.5 years) were studies.

In prediabetic group 29% men (34.8 ± 3.74 years) and 38% women (34.3 ± 2.9 years) were studied in the 30-40 age range 48% men (47.3 years) were in the age range 40-50 years studied. In the age group, 50-60 years 23% men (56.7 ± 3.5 years) and 24% women (57.4 ± 3.5 years) were studied. Maximum numbers of prediabetic were in the age group of 40-50 years (Table 1).

In the present study, out of 42 subjects having BMI <25, 15 subjects (36%) showed, insulin resistance. Taking BMI as gold standard the study population was classified into normal weight (BMI 18.5-24.9 kg/m^2) and overweight/obese (BMI >25 kg/m^2 categories).

In the control group 78% men (22.8 ± 2.1 kg/m^2), 66% women (23.4 ± 76 kg/m^2) were classified as normal weight. 22% men (26.5 ± 1.2 kg/m^2) 34% women (26.8 ± 1.4 kg/m^2) fell into overweight/obese group. Based on WC 55% (91.2 ± 7.6) subjects were identified as having central adiposity. Central adiposity was more common in women (79, WC 89.91 ± 81 cm) as compared to the men (32%, WC 94.4 ± 5.3 cm).

In prediabetic group based on BMI (>25 kg/m^2) 72% subjects were showed general obesity (26.9 ± 1.8 kg/m^2). 68% men (27.1 ± 2.1 kg/m^2) and 76% women (26.6 ± 1.7 kg/m^2) fell

Table 1: Age-wise classification of study population

Variable	Control group (*n*=60)			Prediabetic group (*n*=60)		
Age groups (years)	Men (*n*=31)	Women (*n*=29)	Overall (*n*=60)	Men (*n*=31)	Women (*n*=29)	Overall (*n*=60)
30-40						
Mean	31.2±1.5	35.5±4.3	32.3±3.4	34.8±3.70	34.3±2.9	35.4±2.9
n (%)	9 (29)	11 (38)	20 (33)	9 (29)	11 (38)	20 (33)
>40-50						
Mean	45.1±2.9	43.5±2.7	44.4±2.9	47±3.0	46.8±3.2	46.9±3.0
n (%)	15 (48)	11 (38)	26 (43)	15 (48)	11 (38)	26 (43)
>50-60						
Mean	54.3±1.4	53.6±1.5	54±1.41	56.7±3.5	57.4±3.5	57.1±3.4
n (%)	7 (23)	7 (24)	14 (24)	7 (23)	7 (24)	14 (24)

Table 2: Mean values of anthropometric parameters in study population

Variable	Range	Control group (*n*=60)			Prediabetic group (*n*=60)		
		Men (*n*=31)	Women (*n*=29)	Overall (*n*=60)	Men (*n*=31)	Women (*n*=29)	Overall (*n*=60)
BMI (kg/m²)	18.5-24.9	22.8±2.1	23.4±1.6	22.6±1.9	23.5±2.3	22.2±1.8	23.1±2.1
	n (%)	(78)	(66)	43 (72)	(32)	(24)	17 (28)
	>25	26.5±1.2	26.8±1.4	26.6±1.3	27.1±2.1	26.6±1.7	26.9±1.8
	n (%)	(22)	(34)	17 (28)	(68)	(76)	43 (72)
WC (cm)	Men <90 Women <80	84.8±4.1	75.7±5.2	82.8±5.8	82.9±6.4	72.7±3.1	78.8±7.3
	n (%)	(68)	(21)	27 (45)	(23)	(10)	10 (16)
	Men >90 Women >80	94.4±5.3	89.91±8.1	91.2±7.6	100.2±9.9	94.1±7.9	97±9.4
	n (%)	(32)	(79)	33 (55)	(77)	(90)	50 (84)

WC: Waist circumference

Table 3: Comparison of anthropometric parameters in study group (student ´*t*' test)

Variable	Prediabetic group (*n*=60)	Control group (*n*=60)	*t* value	*P* value
Age (years)	45.43±8.77	42.61±8.70	1.876	NS
BMI (kg/m²)	25.74±2.61	23.69±7.98	4.213	<0.001
WC (cm)	94.15±11.07	87.45±7.8	3.809	<0.001

BMI: Body mass index, WC: Waist circumference, NS: Not singnificant

Table 4: Comparison of anthropometric parameters in insulin resistant study population

Variable	Control group (*n*=4)	Prediabetic group (*n*=52)
BMI (kg/m²)		
18.5-24.9	3 (75)	14 (27)
>259	1 (25)	38 (83)
Abdominal obesity (cm)		
Men <90 Women <80	1 (25)	6 (12)
Men ≥90 Women ≥80	3 (75)	46 (88)

BMI: Body mass index

into general obesity. Central adiposity was identified in 84% (97 ± 9.4 cm) prediabetic subjects 77% men (100.2 ± 9.9 cm) and 90% women (94.1 ± 7.0 cm). It was observed that BMI and WC were significantly higher ($P < 0.001$) in prediabetic subject (Table 2).

An attempt has been made to compare anthropometric parameters of control group with prediabetic subjects it was observed that BMI and WC were significantly higher ($P < 0.001$) in prediabetic subject (Table 3).

Out of 52 prediabetic subjects define insulin resistant by Homa index. 38 subjects had general obesity (BMI >25 kg/m²) and 46 subjects exhibited abdominal obesity. General and abdominal obesity was identified in very few control subjects having insulin resistant (Table 4).

DISCUSSIONS

Prediabetic subjects showed 4% insulin resistance at low risk scale (<30), similar finding was reported by Mack *et al*. who studied fasting insulin level as a measure of insulin resistance in Type 2 diabetic patients and 42 control American blacks subjects, they reported insulin resistance in 5% control subjects despite englycemia.[10]

In the present study, 28% control subjects and 72% prediabetic subjects were categorized as obese based on BMI. The 79% control subjects and 84% prediabetic subjects were categorized as having central obesity based on WC. The mean values of BMI (25.94 ± 2.61 kg/m²) and WC (94.15 ± 11.07 cm) of prediabetic subjects were significantly higher than the control subjects (23.69 ± 7.98 kg/m², 87.45 ± 7.8 cm).

Robertson and Harmon reported that prolong Beta cell exposure to high glucose concentration impairs insulin gene transcription; leading to reduced insulin synthesis to development of Type 2 diabetes.[11]

Present study demonstrated that 88% subjects having abdominal adiposity exhibited insulin resistance, 73% subjects having (BMI >25 kg/m²) showed insulin resistance index (>2.6) correlation analysis showed significant positive correlation of WC and BMI with insulin resistance.

Katsuki *et al*. (2008) studied association of increased visceral fat and serum levels of triglycerides with insulin level of triglycerides with insulin resistance in 40 adult Japanes subjects. They reported association of increased visceral fat and serum level of triglyceride with insulin resistance; they suggested that visceral adipose tissue secretes adipocytokines and their circulating level correlates with development of insulin resistance.[12]

Annaswamy Raj *et al*. studied body fat distribution and insulin resistance in 128 healthy Asian Indians and 12 Causasians aged 20-65 years. The study was designed. To examine the relation of insulin sensitivity of visceral fat and lipid profile they reported that significantly elevated fasting insulin and fasting glucose, lower glucose disposition rate greater total abdominal fat and visceral fat in Asian Indian. Contributing to decreased insulin sensitivity and insulin resistance. They suggested that even at lower BMI Asian Indians are profoundly insulin resistance and increased total abdominal fat which may explain their predilection for increased diabetes and coronary heart disease in the present study out of 42 having BMI <25. 15 subjects (36%) showed insulin resistance.[13]

A good positive correlation was found between prediabetic state and metabolic syndrome, positive association between FSG, BMI, abdominal obesity, and dyslipidemia with development of insulin resistance signified that persistent hyperglycemia and dyslipidemia might lead to a development of insulin resistance. Appropriate intervention in the form of weight reduction, changes in dietary habits and increased physical activity could greatly help to prevent, or at least delay the onset of diabetes and thus reduce the burden due to non-communicable diseases in India.[14]

CONCLUSIONS

This study has important implications for identification of subjects at higher risk for future Type 2 diabetes and suggested that mass screening of prediabetic subjects and aggressive risk modification and close follow-up should be considered for prediabetic subjects with metabolic syndrome.

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PEER REVIEW

Double blinded externally peer reviewed.

CONFLICTS OF INTEREST

Nil

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