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Correlation between fasting insulin and blood pressure in obese and non-obese middle aged Indian adults

KEYWORDS: Fasting insulin, hypertension, obesity

Dr.Raja ReddyP
Assistant professor, Department of Physiology, Sri Devaraj Urs Medical College

Dr. Lakshmaiah V
Professor, department of Medicine, Sri Devaraj Urs Medical College

Dr. Karthiyanee Kutty
Professor, Department of Physiology, Sri Devaraj Urs Medical College

Dr. Madhavi ReddyM
Clinical Nutritionist, Department of medicine, Sri Devaraj Urs Medical College

ABSTRACT *A total of two eighty seven individual adults attending to medicine outpatient department, with age group of 35-50 years were included in the study.Anthropometric and biochemical parameters were evaluated by standard procedures. Statistical analysis was established.Significant systolic blood pressure (SBP) (p<0.003) and diastolic blood pressure (DBP) (p<0.044) were observed with BMI variations. The observed anthropometric parameters like weight (p<0.001), height (p<0.003), WC (0.001), HC (0.001) were found highly significant with BMI classification. Fasting insulin levels were found highly significantwas positively correlated with diastolic blood pressure (p< 0.046) of BMI <25 kg/m2.The highly significant serum total cholesterol (P<0.002) and triglycerides (p<0.034) were observed with BMI variations. There were no significant difference observed for HDL-cholesterol (p<0.641) and LDL-cholesterol (P<0.062) with BMI variations. However VLDL (p< 0.034) showed highly significant with BMI variations. Strong correlation was observed between fasting insulin and blood pressure in obese subjects.*

INTRODUCTION

Hypertension is a frequent and almost ubiquitous health disorder, prevalent both in developed and developing countries[1].A significant association has been demonstrated and confirmed between insulin resistance and essential hypertension, independent of glucose intolerance and obesity[2]. Fasting insulin is a clinical index reflecting the state of glucose metabolism. Hyperinsulinemia, as a compensation for impaired glucose tolerance, is known to be an early clinical manifestation of insulin resistance [3]. Insulin resistance and hyperinsulinemia are known to have profound relationship with various medical diseases, such as metabolic syndrome, cardiovascular disease, and obesity[4-7]. These diseases are significantly associated with hypertension, which suggest a clinical relation between Hyperinsulinemia and hypertension. Previous experimental studies have reported cellular and molecular mechanism in which elevated insulin level could raise blood pressure [8-10].

However, clinical evidences are still insufficient to provide a definite etiologic association between hyperinsulinemia and development of hypertension in middle aged obese and non-obese adults. Furthermore, data is limited regarding whether risk of hypertension increases in specific age, ethnicity and to observe relation in obese and non-obese adults. Thus, this study is planned to investigate the relationship between fasting insulin level and blood pressure in middle aged obese and non-obese adults.

Objectives:

1. Tocompare the fasting insulin levels in obese and non-obese subjects
2. To correlate fasting insulin levels to blood pressure

MATERIAL AND METHODS

Study design and setting

Adults attending to medicine outpatient department, with age group of 35-50 years were included in the study. A total of two eighty seven individuals were included in the study using convenience sampling. Type 1 and 2 diabetes mellitus, peripheral vascular disease, acute or chronic infection, cancer, hepatic disease; myocardial infarction was excluded from the study. Written informed consent was obtained from all the subjects.

Study questionnaire

Data was collected by means of questionnaire. Questionnaire consisted of age, gender, weight, height, body mass index (BMI), waist circumference (WC), hip circumference (HC), waist-hip ratio (WHR) and blood pressure (BP) and biochemical investigations, fasting blood glucose (FBS), post prandial blood glucose (PPBS), glycosylated hemoglobin (HbA1c) and serum lipid profile, total cholesterol (TC), triglycerides (TG), high-density lipoprotein cholesterol (HDL-c) and low-density lipoprotein cholesterol (LDL-c) and renal parameters like serum creatinine and serum uric acid and fasting insulin levels were measured.The following data will be retrieved from the medical records from October 2012 to May 2013.

Anthropometry and clinical measurements

Weight was measured (to the nearest 0.5 kg) with the participant standing motionless on a weighing scale without shoes or any heavy garments, and weight equally distributed over each leg. Height was measured(to the nearest 0.1cm) using a standards non-elastic tape measure with the participant standing erect against a wall, without shoes, and the head looking straight and the BMI was calculated by weight in kilogram divided by height in meter square. Waist circumference (WC) was measured using a standard non-elastic tape (measure to the nearest 0.1cm). The participant was asked to stand with the arms by the sides and to breathe out normally. Standing to the side of the participant, the inferior margin (lowest point) of the last rib and the crest of the ilium (top of the hip bone) was located and marked with a fine skin marker. The midpoint between

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the two was marked and measurement for waist circumference was taken at the level of this midpoint. The hip circumference (HC) was measured around the maximum circumference of the hips. Sitting blood pressure (BP) was measured using by blood pressure apparatus. Two readings were taken at an interval of 10 min. If difference between the two readings were more than10 mm Hg, a third reading of BP was recorded. The mean of 2 (or 3) readings were taken as the final measurement.

Biochemical investigations

The department of Biochemistry at the RL Jalappa Hospital and Research Center wasdoing the biochemical standardization. Fasting blood glucose and post prandial blood glucose and HbA1c were estimated by glucose/oxidase peroxidase-4-aminophenazonephenol; Randox method. Fasting insulin was measured by standard procedure. In lipid profile, cholesterol was estimated by cholesterol oxidase/p-aminophenzone, Randox method; triglycerides by glycerol phosphate oxidase peroxidase aminophenazone method, high-density lipoprotein (HDL-c) by the precipitation method using phosphotungstate/magnesium. LDL-c and VLDL-c was calculated using Friedewald's formula and the renal parameters were estimated by standard laboratory procedures.

Body mass index classification

As per WHO guidelines[11]Normal - BMI 18.5-24.99; over weight- BMI ≥25-29.99; obesity-BMI≥30.As per India-specific guidelines[12]Normal - BMI 18.5-22.9; over weight-BMI≥23-24.9; obesity BMI ≥25.

Central obesity

As per (NCEP-ATP III) [13] Waist circumference should be > 102 cm for men and > 88 cm for women. As per India-specific guidelines[12]Waist circumference should be >90 cm for men and >80 cm for women. As per WHO [14] Waist-Hip Ratio (WHR) > 0.9 for men or >0.85 for women.

Pre-hypertension and hypertension

According to Joint National Committee VII guidelines [15]Pre-hypertension:120-139/80-89 mmHg and hypertension: ≥140/≥90 mmHg.

Dyslipidemia[16]

Hypercholesterolemia: Total serum cholesterol level ≥200 mg/dl, Hypertriglyceridemia: Fasting serum triglycerides levels ≥ 150 mg/dl, Decreased high-density lipoprotein cholesterol (HDL): Fasting serum HDL-cholesterol <40mg/dl for males and <50 mg/dl for females. Increased low-density lipoprotein (VLDL): Fasting serum VLDL cholesterol ≥30mg/dl.

STATISTICAL ANALYSIS

Data analysis was done using SPSS version 16. Mean and standard deviation were used for continuous variables. Pearson correlation test was used to find association between variousfactors and statistical significance was established at a level of P< 0.05.

RESULTS

Table 1: Baseline data of the subjects

<18.5 (n=23)		BMI				Total	p value
		18.5 to 24.99 (n=121)	25 to 29.99 (n=113)	>30 (n=30)			
Sex	F:M	14:9	52:69	45:68	19:11	130:157	0.05
Age		46.48±4.4	45.08 ± 4.4	44.96±3.85	45.1±3.92	45.15 ± 4.15	0.458
SBP		114.78±15.62	119.75±12.35	123.06±12.69	126.00±11.32	12.9±0.7	0.003**
DBP		74.35±9.9	79.21±10.1	79.67±13.1	83.20±9.15	79.42 ±11.3	0.044**
Weight		42.57±7.07	59.67±8.76	71.49±9.7	79.67± 11.9	65.04±13.41	<0.0001**
Height		154.74±15.9	161.38±16.9	162.5±10.2	152.53±20.4	160.35±15.3	0.003**
W C		79.0±14.3	88.36±10.6	94.5±7.2	102.43±14.9	91.5±11.8	<0.0001**
H C		81.78±12.7	91.36±10.1	98.8±8.9	109.3±20.2	95.43±13.2	<0.0001**
WHR		0.98±0.21	0.97±0.15	0.95±0.12	0.92±0.13	0.96±0.14	0.316

Table 2: Glycemic Profile of the subjects

	BMI				Total	p value
	<18.5 (n=23)	18.5 to 24.99 (n=121)	25 to 29.99 (n=113)	>30 (n=30)		
FBS	84.65±27.5	89.4±49.4	89.35±40.1	82.77±21.8	88.31±42.1	0.840
PPBS	130.5±55.3	137.8±77.3	137.7±56.2	132.2±41.8	136.6±64.5	0.936
HbA1c	5.89±1.07	6.11±1.55	6.08±1.2	5.94±0.71	6.06±1.32	0.846
Fasting Insulin	3.53±1.5	6.5±2.79	11.2±5.44	11.86±6.01	8.67±5.14	<0.0001**

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Figure 1: Box plot showing Fasting Insulin levels with respect to BMI

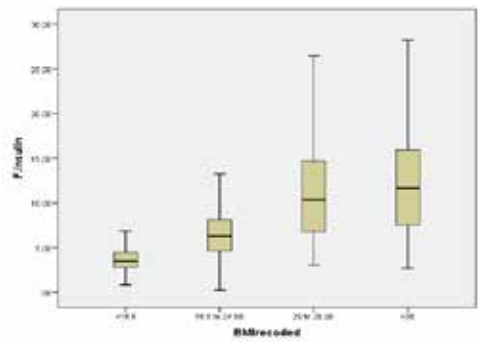

Table 3:Correlation of BMI with Systolic and Diastolic Blood pressure

Classification of BMI		BMI <25 (n=144)		BMI >25 (n=143)	
Blood pressure		Systolic	Diastolic	Systolic	Diastolic
Fasting Insulin	Pearson Correlation	0.139	0.167*	0.170*	0.207*
	p value	0.096	0.046**	0.043**	0.013**

Table4: Lipid and Renal Profile of the subjects

	BMI				Total	p value
	<18.5 (n=23)	18.5 to 24.99 (n=121)	25 to 29.99 (n=113)	>30 (n=30)		
Total Cholesterol	150.52±28.3	179.7±45.4	188.17±42.67	182.73±31.5	181.02±42.8	0.002**
Triglycerides	124.22±63.6	170.64±100.7	186.48±89.7	172.3±90.1	173.29±93.8	0.034**
HDL	38.91±6.9	39.58±7.6	38.42±7.6	39.77±6.4	39.09±7.4	0.641
LDL	86.96±25.1	106.29±43.1	109.86±33.5	107.21±25.1	37.03±2.201	0.062
VLDL	24.74±12.6	34.26±20.6	38.12±21.4	35.03±18.1	35.10±20.4	0.034**
Serum Creatinine	0.75±0.17	0.79±0.22	0.81±0.19	077± 0.26	0.79 ± 0.21	0.722
Serum Uric acid	3.83±1.02	4.52±1.23	5.13±1.32	4.88±1.43	4.74±1.33	<0.0001**

The mean study subjects age were 45.15 years (table1) and the total subjects enrolled were 287 and 130 subjects were females and males were 157. Significant systolic blood pressure (SBP) (p<0.003) and diastolic blood pressure (DBP) (p<0.044) were observed with BMI variations. The lowest SBP (114.78) and DBP (74.35) were found with BMI <18.5 kg/m2 and the highest SBP (126.00) and DBP (79.42) were observed in subjects BMI >30kg/m2. The observed anthropometric parameters like weight (p<0.001), height (p<0.003), WC (0.001), HC (0.001) were found highly significant with BMI classification. Among the studied subjects only 121 subjects were found BMI between 18.5 to 24.99 kg /m2, 23 subjects were found BMI < 18.5 kg/m2and 113 studied subjects were overweight with BMI 25-29.99 kg/m2 and 30 subjects were found to have BMI >30 kg/m2. The lowest WC (79cm) and HC (81.78cm) were observed in subjects BMI<18.5 Kg/m2 and the highest WC (102 cm) and HC (95.43cm) were found in subjects BMI >30kg/m2. However WHR was not correlated significantly with BMI variations.

Glycemic profile of the study subjects were described in table 2. The mean FBS were ranged from 84.65 to 89.40 mg/dl with irrespective of the BMI values. The subjects with BMI > 30 kg/m2 showed the mean values of 82.77 mg/dl and PPBS was 132.2 mg/dl whereas the HbA1c (5.94%) was also with in the normal limits. Subjects with BMI <18.5 kg/m2 were having fasting insulin levels 3.53 and the total mean fasting insulin levels of the subjects were 8.67. The glycemic profiles of FBS, PPBS and HbA1c were not found significant with BMI variations whereas the fasting insulin levels were found highly significant with BMI variations studied. Fasting insulin was highly significant positive correlation (table 3) was observed with diastolic blood pressure (p< 0.046) of BMI <25 kg/m2.

Lipid levels of the study subjects are described in Table 4. The highly significant serum total cholesterol (P<0.002) and triglycerides (p<0.034) were observed with BMI variations. There were no significant difference observed for HDL-cholesterol (p<0.641) and LDL-cholesterol (P<0.062) with BMI variations. However VLDL (p< 0.034) showed highly significant with BMI variations. The renal parameters (table 4) of serum creatinine (p<0.722) were found not significant and serum uric acid (P<0.0001) showed highly significant with BMI. Twenty three subjects were found with BMI <18.5 and thirty subjects were observed BMI more than 30 kg/m2. The most of the study subjects were found the triglycerides more than 150mg/dl and none of the study subjects showed HDL-cholesterol more than 40mg/dl. The higher mean values for triglyceride (186.48mg/dl), total cholesterol (188.17mg/dl), LDL-cholesterol (109.86mg/dl) and VLDL-cholesterol (38.12mg/dl) and lower mean values HDL-cholesterol were observed with the BMI 25 to 29.99 mg/dl. The renal parameters of serum creatinine (0.81mg/dl) and serum uric acid 5.13mg/dl) were also showed higher mean values with BMI between 25 to 29.99kg per m2.

5. DISCUSSION

All the subjects were divided into four groups according to the BMI classification. Significant SBP and DBP were observed with BMI variations. As the BMI increases the Blood pressure values were also increased. The minimum systolic and diastolic blood pressure were observed in BMI <18.5 kg/m2 and the maximum systolic and diastolic blood pressure were observed in subjects having BMI >30kg/m2. So this study suggests that blood pressure is closely linked to obesity. Previous cross-sectional studies have shown weak

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and inconsistent relations between insulin concentration and blood pressure in non-diabetic subjects, some of the inconsistency perhaps being explained by the confounding effects of obesity[17, 18]. The study by Modan et al[19] emphasizes the strong associations seen between obesity and hyperinsulinemia.Mbanya et al[20] found that hypertensive subjects with NIDDM had increased fasting concentrations of insulin, a result consistent with the hypothesis that elevated concentrations of insulin might play a role in the pathogenesis of hypertension.The subjects WC and HC were also increased as the BMI increased and significant difference were observed with BMI variations. This is well known evidence that as the WC and HC increases the BMI increases[21]. Obesity is a positive risk factor in the development of type 2 diabetes dyslipidemia, insulin resistance and hypertension which are linked more strongly to intra-abdominal or upper body fat than to overall adiposity[22].Fasting insulin levels were slightly elevated according to BMI, but the levels were with in physiological range. The significant levels of uric acid were observed with BMI this may be due to the positive energy balance in studied subjects and elevated uric acid is a consistent feature of the insulin resistance [23]. The highly significant serum total cholesterol (P<0.002) and triglycerides (p<0.034) were observed with BMI variations. There were no significant difference observed for HDL-cholesterol (p<0.641) and LDL-cholesterol (P<0.062) with BMI variations. However VLDL (p< 0.034) showed highly significant with BMI variations. The most of the study subjects were found the triglycerides more than 150mg/dl and none of the study subjects showed HDL-cholesterol less than 40mg/dl. Several investigations(ref) were reported significant correlations between BMI and lipid profile and suggested the importance for insulin resistance.

6. CONCLUSION

Our study demonstrates significance correlation between fasting insulin and hypertension in obese and non –obese subjects. Despite the findings of the study, it remains possible that a relation exists between insulin concentrations and blood pressure in adults. However obesity is a positive risk factor in the development of type 2 diabetes dyslipidemia, insulin resistance and hypertension which are linked more strongly to intra-abdominal or upper body fat than to overall adiposity. Hence measures such as educational programs, screening and prevention need to be taken at the peripheral level.

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