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ASSOCIATION BETWEEN ABNORMAL BODY MASS INDEX AND BLOOD PRESSURE IN DIABETIC PATIENTS IN THE AREA OF KANPUR (NORTH INDIA)

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ABSTRACT

The entire study was carried at Rama Medical College, Hospital and Research Centre, Kanpur jointly in the department of Anatomy and Central Research Laboratory. The main focus was to establishment an association between abnormal body mass index and blood pressure in diabetic patients of this region. The mean age of the participants at the time of registration was around 45.33±9.1years. The mean HbA1c values for hypertension were found significantly different between patients and controls. The mean blood pressure values were mainly systolic calculated at onset of hypertension point and found statistically significant. It was also noted that the systolic blood pressures were recorded to increase gradually with the increase in BMI in the patients. There was a statistically significant increase in the systolic blood pressure between diabeties and non diabeties group (p<0.0001).

KEYWORDS: Systole and Diasystole, Body Mass Index, Hypertension, Statistically Significant

Obesity has been described as a public health problem of epidemic proportions (WHO, 1998). This chapter defines obesity and provides an overview of the literature regarding the prevalence and etiology of obesity, the risk factors and physiological complications associated with obesity and the estimated economic costs of obesity.

Definition & Classification of Obesity

Obesity is characterized by excess adipose tissue and it is normally defined using Quetelet's index, more commonly known as the body mass index (BMI). BMI has been used for many large-scale epidemiological studies and only individuals who are unusually muscular could be misclassified as overweight or obese (Prentice, 1998). BMI is calculated by dividing body weight (kg) by height squared (m2). The World Health Organization (WHO) has published guidelines based on the associations between BMI and all cause mortality and a BMI of 30kg/m2 is widely recognized as the cut off point for adult obesity (see table 1.1). The classification for obesity in children is complicated and is not a perfect measure because during childhood there are sporadic changes in height and body composition. However, internationally based cut-off points have been published (Edmunds, Waters & Elliott, 2001; Cole, Bellizzi, Flegal & Dietz, 2000).

Table 1: WHO Classification of under and overweight in adults according to BMI

Classification	BMI (kg/M2)	Risk of Comorbidities
Underweight	<18.5	Low
Healthy Weight	18.5-24.9	Average
Overweight	25.0-29.9	Increased
Obese Class1	30.0-34.9	Moderate
Obese Class 11	35.0-39.9	Severe
Obese Class III (Morbid)	>40.0	Very Severe

Although BMI is a widely used method for defining obesity it must be acknowledged that the cut-off point is arbitrary and the main function of the categories is to enable comparison with other countries (James, Leach, Kalamara & Shayeghi, 2001). The BMI cut-off point indicates the increased risk of health complications. It does not mean that everyone with a BMI greater than 30kg/m2 will develop obesity-related health problems:

Diabetes

Diabetes is a chronic disease that occurs either when the pancreas does not produce enough insulin or when the body cannot effectively use the insulin it produces (1). There are mainly two types of diabetes; Type 1 diabetes is immune-mediated and requires daily administration of insulin. The other common type is type

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2 diabetes and characterized by insulin resistance or relative insulin deficiency (1, 2). Type 2 diabetes is the most common form and comprises of 90% of people with diabetes around the world (1). The prevalence of type 2 diabetes rates continue to increase with increasing number of patients at risk of serious diabetes-related complications. Having type 2 diabetes is increase the risk of a myocardial infarction two times more and the risk of suffering a stroke two to four times more. It is also a leading cause of blindness, limb amputation and kidney failure (1, 3-5). Although trials of secondary prevention after myocardial infarction show as good or better short term effect of interventions in patients with diabetes as in patients without, patients with diabetes have not had a similar reduction in longer-term case fatality rates of cardiovascular disease (CVD) (6). Population based studies of CVD risk factor trends among subjects with and without diabetes show differing trend in disfavor of those with diabetes (7). Studies of adherence to guidelines for CVD prevention targets in patients with diabetes in general practice have shown that only 13% reach all the targets (8). Previous studies have found appropriate lifestyle intervention and/or drug treatment is effective in delaying or preventing both diabetes and its complications (9-12). Accordingly, simple, sensitive and acceptable tools for identification of subjects at risk are warranted.

Epidemiology of type 2 diabetes

The world prevalence of diabetes in 2010 among adults aged 20-79 years is estimated to 6.4%, affecting 285 million adults (13). Between 2010 and 2030, there is an expected 70% increase in numbers of adults with diabetes in developing countries and a 20% increase in developed countries (13). in several studies that a clustering of features, such as high plasma glucose, obesity, dyslipidemia (high triglyceride and total cholesterol levels low high density lipoprotein (HDL) cholesterol levels and hypertension, referred to as insulin resistance or the metabolic syndrome, is a marker of increased risk for the development of type 2 diabetes as well as for CVD (16,17). Environmental and lifestyle factors are the main causes of the dramatic increase in type 2 diabetes prevalence (18-20). Genetic factors probably identify those most vulnerable to these changes. Furthermore, studies have shown certain ethnic groups to be more susceptible to developing diabetes than others (21, 22).

Risk factors for type 2 diabetes:

Many studies have elaborated the associations between several risk factors and the risk of type 2 diabetes. Body mass index (BMI), lipids, hypertension**,** smoking; physical inactivity, low education, dietary patterns, family history, and recently also specific genes are the most frequently documented risk factors for type 2 diabetes (26-32).

Hypertension

Hypertension is one of the most important causes of the total disease burden in the world (1). According to large observational studies, hypertension is thus associated with high incidence of cardiovascular disease, such as stroke, ischemic heart disease, and other vascular diseases (2-5). An increased incidence of cardiovascular disease has in fact been seen in relation to blood pressure levels across the entire blood pressure distribution (6-8), also within the normal blood pressure range (9-11). For half a century, treatment and awareness of high blood pressure has been insufficient, as described by the rule of halves (12-14), meaning that only half of those identified with hypertension were aware of their condition, and only half of those aware were treated, and of those treated only half achieved treatment goals. Even though treatment has contributed to a reduction of cardiovascular events, the control of high blood pressure and hypertension can still be improved (15).

It is critical that health care providers follow the standards for accurate BP measurement. BP should be categorized as normal, elevated, or stages 1 or 2 hypertension to prevent and treat high BP. Normal BP is defined as <120/<80 mm Hg; elevated BP 120-129/<80 mm Hg; hypertension stage 1 is 130-139 or 80-89 mm Hg, and hypertension stage 2 is ≥140 or ≥90 mm Hg. Prior to labeling a person with hypertension, it is important to use an average based on ≥2 readings obtained on ≥2 occasions to estimate the individual's level of BP. Out-of-office and self-monitoring of BP measurements are recommended to confirm the diagnosis of hypertension and for titration of BP-lowering medication, in conjunction with clinical interventions and tele-health counseling. Corresponding BPs based on site/methods are: office/clinic 140/90, HBPM 135/85, daytime ABPM 135/85, night-time ABPM 120/70, and 24-hour ABPM 130/80 mm Hg. In adults with an untreated systolic BP (SBP) >130 but <160 mm Hg or diastolic BP (DBP) >80 but <100 mm Hg, it is reasonable to screen for the presence of white coat hypertension using either daytime ABPM or HBPM prior to diagnosis of hypertension. In adults with elevated office BP (120-129/<80) but not meeting the criteria for hypertension, screening for masked hypertension with daytime ABPM or HBPM is reasonable.

Antihypertensive drug treatment is a cornerstone in lowering blood pressure (BP), where the majority of

patients often require 2 or more antihypertensive drugs to achieve BP goals (BP<140/90 mmHg in general; BP<130/80 mmHg in patients with diabetes). 2, 5, 8, 9 Factors other than pharmacological treatment affect a patient's ability to achieve BP control, e.g. lifestyle modifications, 10-12 doctor´s inertia13-19 and a patient´s socioeconomic status.20-22

MATERIALS AND METHODS

Body Mass Index-

The formula for calculating BMI is:

$$\text{BMI (kg / m2)} = \frac{\text{Weight (kg)}}{\text{Height (m)}^2}$$

Table 2: Estimation of body mass index

BMI (kg/m2)	Weight Status
Below 18.5	Underweight
18.5 to 24.9	Healthy weight
25.0 and above	Overweight
30.0 and above	Obese

HbA1c

Materials Required:

Collection of blood sample: About 2ml of patient's blood will be collected by vein puncture into a tube, and the tube containing a mixture (anticoagulant mixture) of ethylene diammine tetra acetic acid (EDTA) and sodium fluoride in the ratio of 1:2 (W/W). 5 mg of the mixture is enough for 2ml of blood sample. The tube should be thoroughly shaken for complete mixing.

Study design and population

This is a cross-sectional study. The source population is Type 2 Diabetes Mellitus patients attending diabetic clinic in HUSM, Kubang Kerian Kelantan in February 2010. The inclusion criteria include Type 2 Diabetes Mellitus, Malay and adults aged 18 years old. Newly diagnosed Diabetes Mellitus type 2 patients of less than one year, patients diagnosed as having Diabetic Type 1, gestational diabetes and/or chronic kidney disease were excluded. Systematic random sampling was applied.

Operational definitions

In this study HbA1c values below 6.5% was taken as glycaemic control as recommended by The International Diabetes Federation 13. The HbA1c test is a way to assess blood glucose control during the previous three to four months. It is measured by cation exchanger high performance liquid chromatography (HPLC).

Method of data collection

The methods of data collection were via: questionnaire, physical and anthropometric measurements and review of medical records. Short questionnaire was answered by the patients with guidance from single research assistant in Bahasa Melayu. Socio-demographic characteristics include age, sex, and household income per month, educational level and type of occupation. Type of occupation was classified into sedentary jobs which require prolonged sitting or no physical activity and active jobs which require physical activity. The clinical histories of the patients include the duration of diabetes, family history of diabetes, and family history of obesity, smoking habit, dietary fiber intake habit and physical activity status. The patient was considered smoker if he was smoking at the time of the study.

Data analyses

Data was analyzed using Statistical Packages for Social Sciences (SPSS) version 12.0.1 15. The distributions and frequencies were examined. The continuous variables were expressed as mean and standard deviation or median and inter quartile range. The frequencies and percentages for categorical variables were calculated. The correlation between anthropometric parameters and HbA1c was tested using Pearson product moment correlation and the correlation coefficient *r* was used to test the strength and direction of correlation. Assumptions and outliers were checked using scatter plot.

Blood Pressure Measurement

To reduce misclassification of hypertension, blood pressure should be measured in a standardized fashion (81, 82). Intra-individual variation in blood pressure, rather than a so-called white coat effect (83), is known to cause an overestimation of hypertension, and accordingly repeated readings are recommended (84). The recent ESH/ESC guidelines further recommend (28):

- To allow the patients to sit for 3-5 minutes before beginning blood pressure measurements.
- To take at least two blood pressure measurements in the sitting position spaced 1-2 min apart.
- Consider the mean of the two blood pressure readings if deemed appropriate.
- To use a standard bladder (12-13 cm wide and 35 cm long), but have a larger and a smaller bladder available for large (arm circumference >32 cm) and thin arms (arm circumference 17-22 cm), respectively.

- To have the cuff at the heart level, whatever the position of the patient.

Furthermore, a quiet, comfortable location at normal room temperature is optimal. Ideally, the patient should not recently have eaten, smoked, exercised, or taken caffeine (29, 82). When adopting the auscultator method, the phase I (appearance) and V (disappearance) of Korotkoff sounds should be used to identify systolic and diastolic blood pressure, respectively. Provided that the arm is supported at the heart level, sitting and supine blood pressure measurements are considered comparable (82). The observer should be well trained in the techniques of blood pressure measurement and use an accurate and properly maintained device (28, 85).

The study was approved by the Institutional Ethics Committee. This study was conducted in Rama Medical College Hospital and Research center, Kanpur. Data were recorded from outpatients visited Rama Hospital. In this study total 160 subjects were observed for BMI, type 2 diabetes and hypertension. All 160 participants were diagnosed for hypertension and diabetes. Measurements such as BMI, glycated hemoglobin (HbA1c) levels, and blood pressure readings were made as per international guidelines.

BMI classifications approved by the WHO were used to categories patients: normal weight (BMI=18.5-24.9 kg/m^2), overweight (25.0-29.9), class I obesity (30.0-34.9), class II obesity (35.0-39.9) and class III obesity (≥40). We evaluated associations between BMI and age at onset of hypertension.

RESULTS

Descriptive statistics on the two data sets are summarized in Table 1 and Table 2. The mean age of the participants at the time of registration is around 45.33±9.1years.

The mean HbA1c values for hypertension are significantly different between patients with and without diabetes. The mean blood pressure values mainly systolic measured at onset of hypertension point and found statistically significant. The systolic blood pressures were found to increase progressively with the increase in BMI in both groups of patients. There was a statistically significant increase in the systolic blood pressure between diabeties and non diabeties group ($p< 0.0001$).

Table 3: Calculation of hypertension in diabetic and non diabetic cases and controls

S.N.	Characteristics	Hypertension in patients with T2DM (n=55)	Hypertension in patients without diabetes (n=105)
1.	Sex distribution Male Female	 44.3% (n=25) 55.3% (n=30)	 35.2% (n=37) 64.7% (n=68)
2.	BMI distribution Overweight obesity	 71.4% (n=40) 28.5% (n=15)	 67.6% (n=71) 32.4% (n=34)

Table 4: Calculation of hypertension parameter in diabetic and non diabetic cases and controls

S.N.	Characteristics	Hypertension in patients with T2DM (n=55)	Hypertension in patients without diabetes (n=105)	P value
1.	Mean age	45.33±9.1	43.27±9.6	0.1887
2.	Mean blood pressure Systolic (mmHg)	128.5±18.7	120.38±17.6	0.0069
3.	Mean BMI (kg/m2)	28.7±2.9	38.7 ± 2.7	< 0.0001
4.	Mean HbA1C (%)	7.8±1.0	5.2±0.7	<0.0001

DISCUSSION

This study found similar results as mentioned in HUSM, Kubang Kerian Kelantan in February 2010. The obtained data are also co-related with several co-workers such as stated by Reaven and Banting in 1988.

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