Study of Hypertension and Dyslipidaemia with Obesity in patients with Type II Diabetes Mellitus

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Abstract:

Introduction: Diabetes and hypertension are among the most common non-communicable diseases affecting our population. They are the important risk factors for cardiovascular morbidity and mortality. **Objective**: The study was performed to estimate the association of hypertension and dyslipidaemia with increasing body weight and obesity in Type II diabetics. **Method:** This one year cross sectional study was conducted by enrolling 677 diabetics subjects from rural health training centre of integral institute of medical sciences, Lucknow, India. MS excel was used for data analysis. Descriptive statistics were used for number and percentages and associations were estimated using chi-square test. **Results:** Most of the subjects belonged to overweight category (36.91%) followed by obese (32.3%). Majority of subjects (38.4%), were within 40 – 50 years of age in which most of them belonged to overweight category (39.2%) followed by obese (31.5%). Out of total study subjects, 62% were males and 38% were females. Means of HbA1C, lipid parameters, blood pressure were found significantly associated with dyslipidemia and hypertension. **Conclusion:** Association of hypertension and dyslipidemia in obese diabetics signifies that these patients may be at a higher risk of developing cardiovascular diseases and a precise action or self-care management is required.

Key words: Dyslipidaemia, HbA1c, Hypertension, Type II Diabetes Mellitus

Introduction:

Diabetes Mellitus (DM) is a foremost public health problem all over the world.[1] Magnitude of diabetes mellitus is growing worldwide at an alarming rate. Around 170 million people were suffering from this ailment worldwide in the year 2000 and the prevalence of diabetes is expected to be twice by 2025 as per WHO reports.[2] Diabetes mellitus is a most common non-communicable ailment even in developing country like India. It affects life expectancy of closely 40 million people in India and of equivalent magnitude in other developing countries. India is identified as diabetes capital. Epidemiological development has led to rise of diseases like diabetes, obesity and associated metabolic disorders.[3-5] Diabetes and its types enforces incorrectly high human, economic and social costs on countries at all income categories. About 1.5 million deaths have been attributed to this deadly disease. Load is rising speedily among the lower and middle class earning countries like India.[6] Starting of diabetes among Indians happens a decade earlier than compared to the western world.[7,8] Most of the studies have also shown that optimum blood pressure control and within range lipid profiles confer cardiovascular benefits in patients with type II diabetes. Decrease in 10 mm Hg systolic blood pressure was connected with risk reduction of 12% in diabetic complications, 15% in diabetes related deaths, 11% in myocardial infarction and 13% in micro-vascular complications.[9,10] Similarly,

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decrease in the levels of low-density lipoprotein cholesterol (LDL-C) caused in lower occurrence of major coronary artery risks in diabetics.[11] Apparently, obesity plays a pernicious role in the patho-physiology of hypertension and diabetes, hereafter clustering of risk factors seems to have a superior influence on worse disease outcomes rather than separate risk factors.[12] Thus, metabolic syndrome, such as diabetes with associated occurrence of hypertension, dyslipidaemia, pro-inflammatory and prothrombic states can add towards composite pathological situations involving many pathways.[10] The existing literature evidences evaluating the association of hypertension and dyslipidaemia in obese diabetics is scarce. Thus, the present study, was aimed at investigating the association of hypertension, dyslipidaemia with obesity in diabetics.

Method:

This prospective cross-sectional community-based survey was conducted from December 2018 to December 2019 and enrolled 677 diabetics subjects aged 18 years and above residing in the study area for at least two years. The sample size needed for the study was calculated using the equation: $n = z^2 p[1 – p] /d^2$

Where n = the sample size; z = the statistic for the 95% level of confidence used in the power analyses, which was 2.58; p = the expected prevalence or the proportion used, which was 0.5; and d = the precision used, which was 0.05. The minimum sample size estimated for the study was 666 patients. The study enrolled 677 patients who were attending the centre during the study period.

The purposive sampling technique was used to select the study subject. The study area comprised of the field practice areas of the rural health training centre of the Department of Community Medicine, Integral institute of medical sciences and research, Lucknow, India.

Inclusion criteria:

1. All the participants having history of diabetes mellitus for more than 5 years at the time of enrolment.
2. Participants who have given written consent.

Exclusion criteria:

1. Pregnant women and seriously sick persons (bedridden or in terminal phase of chronic disease).
2. All patients of Type I diabetes mellitus.

- Patient's data was then segregated according to body mass index (BMI, kg/m^2) described below;
- Obesity Degree of obesity was categorized as per National Heart, Lung and Blood Institute's definition for overweight and obesity.[13] Body mass index (BMI, kg/m^2) was calculated using the formula given below: BMI = weight (kg)/ $(height)^2$ (m)
- BMI based weight categories include, underweight; <18.5 kg/m^2, normal weight; 18.5-24.9 kg/m2and overweight; 25-29.9 kg/m^2. Greater than 30 kg/m^2 was classified as obese.
- Patient's having fasting glucose > 125 mg/dL, having HbA1c levels > 7%. DM was defined according to the levels of HbA1c as per American Diabetes Association (ADA) Guidelines 2015. HbA1c levels of < 7% and > 7% were considered controlled and uncontrolled diabetes, respectively.[14]
- Hypertensive patients: Before the measurement the patients were asked to empty their bladder, it was also ensured that caffeine or nicotine were not consumed within last 30 minutes of attending OPD. Then the patient was asked to sit comfortably on chair, having his/her both legs rested on floor for atleast 5 minutes and the cuff should be . Then two readings of blood pressure were taken and average of the two was taken and charted. The patients having systolic and diastolic blood pressure more than 140 and 90 mm Hg, respectively[15] were considered as hypertensives.
- Dyslipidemia: The patients enrolled were advised to get the needed investigations done in the institute`s lab. Patients were measured dyslipidemic based on elevated cholesterol or serum triglycerides levels. A total cholesterol (TC) level > 200 mg/dL or triglyceride (TG) level > 150 mg/dL was considered as abnormal[16]. Similarly, low density lipoproteins (LDL) > 100 mg/dL or high density lipoproteins [HDL] < 40 mg/dL in men and < 50 mg/dL in women were measured for dyslipidaemia.

Ethical Consideration:

The study was approved by the Institutional Research Committee [IRC] & the Institutional Ethics Committee [ERC].

Statistical analysis:

Data entry and statistical analysis were performed using the Microsoft Excel. Chi-square test and t-test were used to estimate the association of demographic variables and to examine the proportions of disease prevalence with respect to obesity class. Statistical significance was taken as p value < 0.05.

Results:

Age gender wise distribution of study subjects with respect to BMI described in table 1. As per BMI categories, most of the subjects belonged to overweight category [36.91%] followed by obese [32.3%] and minimum percentage of study subjects comprised in underweight category i.e., [3.4%]. Maximum number of study subjects,260 [38.4%], were within 40 – 50 years of age in which most of them from overweight category [39.2%] followed by obese 31.5%. Out of total study subjects, 62% were males and 38% were females. (Table 1)

Table 2 described the distribution of hypertensive and non- hypertensive study subjects with respect to BMI. In non-hypertensive study subjects, 33.9% were obese, in pre-hypertensive study subjects, 33.3% were obese and in hypertensive study subjects, 36.2% were obese. Maximum percentage of obese study subjects were belonged to hypertension category. Out of total study subjects, one fourth of the study subjects were belongs to normal weight category.(Table 2)

Table 3 shows the variation in un-controlled Lipid Profiles of study subjects with respect to BMI. Out of total, obese study subjects, nearly 36.4% subjects had uncontrolled total cholesterol, 40.9% with uncontrolled triglycerides, 42.1% with un-controlled low density lipoproteins and 38.1% with un-controlled high density lipoproteins. Similar results were also found in overweight category. In normal weight category, about 25.8% subjects had uncontrolled total cholesterol, 24.0% with uncontrolled triglycerides, 22.1% with un-controlled low density lipoproteins and 23.8% with un-controlled high density lipoproteins. (Table 3)

Table 4 illustrates that the glycaemic control, lipid profile and blood pressure values. Maximum variation was found in Triglyceride [mg/dl], followed by total cholesterol [mg/dl] and HbA1c [g%] showed minimum variation in results. In which the Means of HbA1C, lipid parameters, SBP and DBP which highlights the statistically significant association with dyslipidemia and hypertension.(Table 4)

Table 1: Age and gender wise distribution of diabetics with respect to BMI

Variables	Under Weight [< 18.5] n= 19	Normal Weight [18.5 – 24.9] n=182	Over Weight [25.0 – 29.9] n=241	Obese [>60.0] n=235	Total n=677
Age group [years]					
18-20	4[33.3]	5[41.7]	2[16.7]	1[8.3]	12
20- 30	4[9.1]	15[34.1]	13[29.5]	12[27.3]	44
30- 40	4[2.4]	35[21.0]	62[37.1]	66[39.5]	167
40 – 50	5[1.9]	71[27.4]	102[39.2]	82[31.5]	260
50 – 60	0[0.0]	41[27.2]	43[28.5]	67[44.3]	151
>60	2[4.7]	15[34.9]	19[44.2]	7[16.3]	43
Total	19	182	241	235	677
Gender					
Male	11[2.6]	110[26.2]	145[34.5]	154[36.7]	420
Female	8[3.1]	72[28.0]	96[37.4]	81[31.5]	257
Total	19	182	241	235	677

Table 2: Distribution of diabetics with respect to BMI and Hypertension

Variables	Under Weight [< 18.5] n= 19	normal weight [18.5 – 24.9] n=182	Over Weight [25.0 – 29.9] n=241	obese [>60.0] n=235	Total n=677
Normal	10[4.4]	70[31.3]	68[30.4]	76[33.9]	224
Pre-hypertension	5[2.9]	44[25.7]	65[38.1]	57[33.3]	171
Hypertension	4[1.4]	68[24.1]	108[38.3]	102[36.2]	282
Total	19	182	241	235	677

**The chi-square statistic is 9.51. The p-value is 0.15. The result is not significant at p < .05*

Table 3: Distribution of Altered Lipid Profiles of Diabetics according to BMI

Variables	Under Weight [< 18.5]	Normal Weight [18.5 – 24.9]	Over Weight [25.0 – 29.9]	Obese [>30.0]	Total
Total Cholesterol	7[3.1]	58[25.8]	78[34.7]	82[36.4]	225
Triglycerides	6[2.4]	61[24.0]	83[32.7]	104[40.9]	254
Low density lipoproteins	5[2.6]	42[22.1]	63[33.2]	80[42.1]	190
High density lipoproteins	5[3.1]	38[23.8]	56[35.0]	61[38.1]	160

**The chi-square statistic is 2.22. The p-value is 0.99. The result is not significant at p < .05*

Table 4: Glycaemic control, lipid profile and blood pressure values among diabetics

Variables	Mean ± SD		t value	*p* value
	Male	Female		
HbA1c [g%]	6.98 ± 1.34	6.01 ± 2.20	76.23	<0.001
Total cholesterol [mg/dl]	205 ± 43.21	199 ± 51.0	87.98	<0.001
Triglyceride [mg/dl]	156.21± 57.77	149.8± 61.1	34.66	<0.001
HDL [mg/dl]	78.87 ± 8.09	76.23 ± 9.99	67.66	<0.001
Systolic BP [mmHg]	134.40 ±15.56	128.8 ±22.3	44.76	<0.001
Diastolic BP [mmHg]	87.78 ± 8.99	91.3 ± 11.2	89.78	<0.001

Discussion:

Hypertension in Type II diabetic patients clusters with other CVD risk factors such as microalbuminuria, central obesity, insulin resistance, dyslipidaemia, hypercoagulation, increased inflammation and left ventricular hypertrophy.[17] This clustering of risk factors in diabetic patients ultimately results in the development of CVD, which is the major cause of premature mortality in these patients. Many studies suggested that hypertension, dyslipidaemia and diabetes are common conditions associated with obesity.[18,19] In present study, majority of male, between 40 – 50 years of age, belongs to overweight and obese. Moreover, obese exhibited percentage increases, compared to normal weight population. According to studies suggests, obesity can contribute towards hypertension, dyslipidaemia and hyperglycaemia, thus can modulate cardiovascular disease [CVD] risks.[10] In

this regard, HbA1c, triglycerides, total cholesterol and blood pressure, SBP & DBP, has been shown to associate significantly with obesity in diabetics of Indian origin.[20] Numerous studies suggest that most of diabetics, regardless of gender, having hypertension, dyslipidaemia and obesity were often reported in patients above 50 years of age.[18] In present study, pre-hypertensive study subjects, 33.3% were obese and in hypertensive study subjects, 36.2% were obese. Many literature suggest that hypertension and diabetes are strongly associated with body weight and obesity.[19,21] A study conducted in Spain showed that diabetics having obesity are more prone to develop hypertension and dyslipidaemia - 92.6% patients had dyslipidaemia and 73.7% had hypertension.[16] Similarly, it is reported that the prevalence of hypertension in western population increase with age and obesity, yet even adjusted for age and obesity, hypertension prevalence was still 1.5 times higher in diabetics.[23] In addition, present study showed maximum percentage of obese study subjects were belonged to hypertension category. Literature also determined that type II diabetes and hypertension are strongly associated with, the retina and kidney, while the alike association having lower evidence for obesity and dyslipidaemia.[24,25] Literature suggested that hypertension along with diabetes are key players in expanding diabetic problems and cardiovascular disease risks rather than obesity and dyslipidaemia. Moreover, the association between diabetes and metabolic dysregulators, such as dyslipidemia and obesity have been reported previously.[26] In this regard, a strong association has been observed between HbA1c of diabetics (type II) and dyslipidemic obesity, with strong positive association of HbA1c with triglycerides and cholesterol.[20,26] Ogbera AO reported reduced HDL-C and elevated LDL-C to be the prevalent lipid abnormalities in their patients with DM and only few were on treatment.[27] In present study, almost 36.4% obese subjects had uncontrolled total cholesterol, 40.9% with uncontrolled triglycerides, 42.1% with un-controlled low density lipoproteins and 38.1% with un-controlled high density lipoproteins. Similar results were also found in overweight category. In addition, Prabodh et al reported that the negative association of HDL and HbA1c imply that with an elevation of HbA1c, HDL value declines and positive correlation of TG and TC with HbA1c suggest that higher the HbA1c, more is the lipid values A fall in HDL is due to the accelerated activity of hepatic lipase in diabetics.[20] The quantitative changes in lipid profile is due to increased availability of glucose for VLDL synthesis and decrease in lipoprotein lipase to clear VLDL from the circulation. Increased production of VLDL and reduced clearance result in the elevation of triglycerides.[20] Hypertension is associated with a four fold increased mortality among patients with DM and antihypertensive therapy is found to be beneficial.[28] Dyslipidemia is a well established risk factor for CVD and when hypertensioncoexists with DM, risk of CVD increases by 75% and further contributes to morbidity and mortality.[9,17]

Conclusion: The association of hypertension and dyslipidemia in obese diabetics suggests that these patients may be at a higher risk of developing cardiovascular diseases. This warrants an immediate precise action or self-care management. Further follow up studies need to be done in these patients to find the extent of contribution of hypertension and Dyslipidemia individually or both to the development of cardiovascular complications.

Recommendations: The subjects who were at higher risk of developing cardiovascular diseases should be screened for other complications (Retinopathy, Neuropathy, Nephropathy), along with diet modifications, physical activity, Self blood glucose monitoring {SBGM}, and adherence to treatment.

Declaration:

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Conflict of Interest: Nil

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