Original Article

Obesity and Hypertension among Type-2 Diabetes Mellitus Patients: Analysis of Gender and Age Matched Rural Population of South Punjab, Pakistan

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Abstract

Objective: To study the association between obesity and hypertension (HTN) among type-2 diabetes mellitus (T2DM) patients by analyzing age and gender matched rural population of South Punjab, Pakistan.

Methods: This cross-sectional study was conducted at the outpatient department of medicine, Aleena Hospital, Bahawalpur, Pakistan from 1st January 2021 to 30th December 2022. A total of 2538 known patients of T2DM of either gender aged above 18 years with a minimum disease duration of 6 months. All patients had rural residential status. For each male or female patient, gender and age was matched in the next coming patients so that we had equal number of male and female patients corresponding to very similar age. The prevalence of HTN was noted. For Body mass index (BMI) labeling, Asian criteria was used as normal if BMI below 23 kg/m2, overweight if ≥23 kg/m2 and obese if ≥25 kg/m2.

Results: The mean age and BMI were 50.55±11.75 years and 26.20±5.48 kg/m2 respectively. There were 703 (27.7%) patients who had normal BMI whereas 387 (15.2%) and 1448 (57.1%) were overweight and obese respectively. Hypertension was noted among 1069 (42.1%) patients. Hypertension was noted to have significant association with female gender (p<0.001), increasing age (p<0.001), increasing BMI (p<0.001) and increasing duration of diabetes (p<0.001). BMI had significant association with age (p<0.001), increasing duration of diabetes (p=0.048) and HTN (p<0.001). Female gender was found to have significant association with HTN + overweight / obesity (p<0.001). Increasing age was linked with HTN + overweight / obesity (p<0.001). Duration of diabetes had significant association with HTN + overweight/obesity (p<0.001).

Conclusion: In rural population, female gender had significant association with hypertension, overweight and obesity. Increasing age and duration of diabetes were significantly linked with hypertension and higher BMI.

Keywords: Body mass index, diabetes mellitus, hypertension, obesity, overweight.

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Introduction

Diabetes mellitus is known to be one of the most common public health issues globally. In "non-communicable chronic diseases (NCCD)", diabetes mellitus and hypertension are the most common contributors to mortality in adults worldwide. In NCCD, diabetes and hypertension are estimated to be responsible for 68% of global deaths whereas around 75% of these deaths occur in developing countries.[1] Recent data from "international

Diabetes Federation (IDF)" calculated the prevalence of diabetes in Pakistani adult population to be 26.7% which means that almost 1 out of every 4 adults are affected by diabetes mellitus.[2] Global estimates have recorded one quarter of the population to have hypertension and along with diabetes, this duo is a cause of major concern affecting both developed and developing countries.[3]

South Asian population is at relatively higher risk of

general obesity.[4] During the last few decades, there has been an increase of 0.4 kg/m² per decade in BMI of the global population while obesity burden increased from 6% in 1980 to 12% in 2008.[5,6] Recent local showed that the prevalence of overweight and obesity is round 62% in type-2 diabetes mellitus (T2DM).[6]

Considering vast majority of T2DM or hypertensive patients from developing countries are under optimal control, they are always at increased risk of developing complications.[7] Obesity along with hypertension (HTN) and T2DM is a potential threat to the affected individuals but whatever evidence exists, there is diversity regarding inclusion criteria and social/cultural routines of the sub-populations.[8] Up to the best of our knowledge, no study exists that compared the age matched males and females having T2DM regarding the existence of HTN and/or obesity/overweight so the present study was thought to provide useful insights about these aspects in our local population. The research was aimed to study the association between obesity and HTN among T2DM patients by analyzing age and gender matched rural population of South Punjab, Pakistan.

Methods

This cross-sectional study was performed at the out-patient department of medicine, Aleena Hospital, Baha-walpur, Pakistan from 1st January 2021 to 30th December 2022. Approval from Hospital Ethical Committee was obtained (letter number: HRC/05/2021). Informed and written consents were acquired from all patients involved in this study. No specific sample size calculations were done for this study and we enrolled all cases as per inclusion and exclusion criteria reporting within the study duration.

Inclusion criteria were known patients of T2DM of either gender aged above 18 years with a minimum disease duration of 6 months. All patients had rural residential status. All patients having any kinds of acute ailment or mental disability were excluded. Patients having diabetic foot ulcers (as per foot examination) were also not included. For each male or female patient, gender and age was matched in the next coming patients so that we had equal number of male and female patients corresponding to very similar age. Age was rounded off close to a complete year where a period of more than 6 months was taken as full complete year. Rural area was labeled as any living area/town below district level.

At the time of enrollment, medical record was checked while clinical history was taken and physical examination was performed. Socio-demographic and clinical characteristics including disease history were noted. Necessary laboratory investigations including HbA1c levels were ordered. HbA1c ≤ 7% was labeled as "good glycemic control" while HbA1c > 7% was designated as "bad glycemic control". For BMI labeling, Asian criteria was used as normal if BMI below 23 kg/m², overweight if ≥23 kg/m² and obese if ≥25 kg/m². Hyper-tension was described as either systolic blood pressure ≥140 mmHg and/or diastolic blood pressure ≥90 mmHg. Patients taking any kinds of anti-hypertensive drugs were also considered hypertensives. All patients were divided into four groups: i) Normal BMI, ii) Normal BMI+HTN, iii) overweight/obese, iv) HTN+ Overweight/ obese. A special format was designed to record all study data.

For data analysis, "Statistical Package for Social Sciences (SPSS)", version 26.0 was employed. Frequency and percentages were shown for categorical data whereas mean and standard deviation (SD) were calculated for numeric data. Comparison of qualitative data was performed employing chi-square test while numeric data was compared employing analysis of variance (ANOVA) in between study groups. $P<0.05$ was considered statistically significant.

Results

In a total of 2538 patients, 1269 (50.0%) were male and 1269 (50.0%) female representing an exact male to female ratio of 1:1. The mean age was 50.55±11.75 years (ranging between 18-90 years) and 1768 (69.7%) patients were aged between 36-60 years. The mean BMI was calculated to be 26.20±5.48 kg/m². There were 703(27.7%) patients who had normal BMI whereas 387(15.2%) and 1448 (57.1%) were overweight and obese respectively. Mean duration of disease 5.97±5.86 years (ranging between 6 months to 44 years). HbA1c was performed in 1067 patients, out of which 159 (14.9%)

Table 1: *Characteristics of T2DM Patients (n=2538)*

Characteristics		Number (%)
Gender	Male	1269 (50.0%)
	Female	1269 (50.0%)
Age (years)	18-35	300 (11.8%)
	36-60	1768 (69.7%)
	>60	470 (18.5%)
BMI	Normal	703 (27.7%)
	Overweight	387 (15.2%)
	Obese	1448 (57.1%)
Duration of diabetes (years)	<1	667 (26.3%)
	1-5	988 (38.9%)
	6-10	520 (20.5%)
	>10	363 (14.3%)
Smokers		193 (7.6%)
Hypertension		1069 (42.1%)

patients good glycemic control while remaining 908 (85.1%) were having bad glycemic control. The mean HbA1c was 9.55±2.27%. Hypertension was noted among 1069 (42.1%) patients. Table-1 has details about the characteristics of T2DM patients analyzed.

Hypertension was noted to have significant association with female gender (p<0.001), increasing age (p<0.001), increasing BMI (p<0.001) and increasing duration of diabetes (p<0.001) as shown in table-2.

Table 2: *Stratification of Study Variables with respect to Hypertension in T2DM Patients (N=2538)*

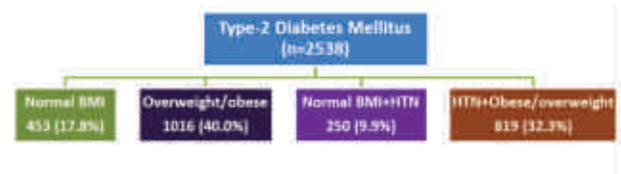| Study Variables		Hypertension		P-value
		Yes (n=1069)	No (n=1469)	
Gender	Male	442 (41.3%)	827 (56.3%)	<0.001
	Female	627 (58.7%)	642 (43.7%)	
Age (years)	18-35	76 (7.1%)	224 (15.2%)	<0.001
	36-60	743 (69.5%)	1025(69.8%)	
	>60	250 (23.4%)	220 (15.0%)	
BMI	Normal	250 (23.4%)	453 (30.8%)	<0.001
	Over-weight	154 (14.4%)	233 (15.9%)	
	Obese	665 (62.2%)	783 (53.3%)	
Duration of diabetes (years)	<1	133 (12.4%)	534 (36.4%)	<0.001
	1-5	445 (41.6%)	543 (37.0%)	
	6-10	277 (25.9%)	243 (16.5%)	
	>10	214 (20.0%)	149 (10.1%)	
Smokers		87 (8.1%)	106 (7.2%)	0.387

Body Mass Index was found to have significant association with age (p<0.001), increasing duration of diabetes (p=0.048) and hypertension (p<0.001) as shown in table-3.

All patients were divided into 4 groups and the details are shown in Figure-1.

Figure-1: *Distribution of Type-2 Diabetes Mellitus*

Female gender was found to have significant association with HTN + overweight / obesity (p<0.001). Increasing age was having significant relationship with HTN + overweight / obesity (p<0.001). Duration of diabetes was also found to have significant association with HTN + overweight/obesity (p<0.001). Significant differences also existed among different study groups with regards to HbA1c levels (p=0.021) as shown in table-4.

Discussion

The present study seems to be the first one analyzing T2DM patients from a rural population who were matched for gender and age with an aim to analyze the burden and impact of HTN and obesity. In the present study, we found that 72.3% T2DM patients were either overweight (15.2%) or obese (57.1%). Data from developed world reports even higher proportion of overweight and obesity ranging between 85.8–90% among T2DM patients.[9-11] Studies from developed countries have disclosed the prevalence of overweight and obesity in T2DM to be between 24.4-87.7%.[12-17] All these studies highlight that burden of obesity is very high among patients of T2DM.

In this study, we found that hypertension was significant more common among T2DM patients who were females

Table 3: *Stratification of Study Variables with respect to BMI in T2DM Patients (N=2538)*

Study Variables		BMI			P-value
		Normal (n=703)	Overweigh (n=387)	Obese (n=1448)	
Gender	Male	339(48.2%)	189 (48.8%)	741 (51.2%)	0.387
	Female	364(51.8%)	198 (51.2%)	707 (48.8%)	
Age (years)	18-35	74 (10.5%)	45 (11.9%)	180 (12.4%)	<0.001
	36-60	459(65.3%)	266 (68.7%)	1043(72.0%)	
	>60	170(24.2%)	75 (19.4%)	225(15.5%)	
Duration of diabetes (years)	<1	157(22.3%)	106 (27.4%)	404(27.9%)	0.048
	1-5	295(42.0%)	141 (36.4%)	552(38.1%)	
	6-10	142(20.2%)	75 (19.4%)	303(20.9%)	
	>10	109(15.5%)	65 (16.8%)	189(13.1%)	
Smokers		55(7.8%)	33 (8.5%)	105(7.3%)	0.679
Hypertension		250(35.6%)	154 (39.8%)	665(45.9%)	<0.001

Table 4: *Distribution of Study Variables with respect to Study Groups (n=2538)*

Study Variables		Normal BMI	Overweight/ obese	Normal BMI+HTN	HTN+ Overweight / obese	P-Value
Gender	Male	241 (53.2%)	586 (57.7%)	98 (39.2%)	344 (42.0%)	<0.001
	Female	212 (46.8%)	430 (42.3%)	152 (60.8%)	475 (58.0%)	
Age (years)	18-35	61 (13.5%)	163 (16.0%)	13 (5.2%)	63 (7.7%)	<0.001
	36-60	300 (66.2%)	725 (71.4%)	159 (63.6%)	584 (71.3%)	
	>60	92 (20.3%)	128 (12.6%)	78 (31.2%)	172 (21.2%)	
Duration of diabetes (years)	<1	132 (29.1%)	402 (39.6%)	25 (10.0%)	108 (13.2%)	<0.001
	1-5	181 (40.0%)	362 (35.6%)	114 (45.6%)	331 (40.4%)	
	6-10	81 (17.9%)	162 (15.9%)	61 (24.4%)	216 (26.4%)	
	>10	59 (13.0%)	90 (8.9%)	50 (20.0%)	164 (20.0%)	
Smokers		32 (7.1%)	74 (7.3%)	23 (9.2%)	64 (7.8%)	0.730
HbA1c		9.84±2.72	9.86±2.34	9.50±2.23	9.33±2.05	0.021

(58.7% in females vs. 41.3% in males, p<0.001). Recent data from neighboring Afghanistan correlates well where the authors analyzing T2DM patients revealed that 76.8% females had hypertension versus 59.7% males.[18] A study by Li M et al from China showed that female gender was an independent predictor of hypertension among T2DM patients.[19]

This study also found that female gender was having significant association with HTN and overweight/ obesity. Previous local data has highlighted female patients of T2DM to have significant association with overweight and obesity.[20] The international literature has also shown that female T2DM patients are more obese than male.[21,22] As the present research recruited aged and gender matched patients of T2DM, the significant association of female gender with HTN and overweigh and obesity exhibits that this association is strong even if cases are matched for age. We were unable to analyze lipid profile in the current set of patients, it has been noted by other researchers in the past that cluster of metabolic risk factors are significantly more linked to female gender. A recent study published by Cruz MS et al from Brazil noted that 92.9% hypertensive T2DM patients were female.[25] We found that increasing age and duration of diabetes were also significantly related with HTN and overweight/ obesity. Recent data have found hypertension to have significant positive correlation with increasing age among T2DM patients.[18] In T2DM patients, a recent study estimating 16-year risk of obesity found aged group between 18-65 to have the highest risk (81%).[19]

Large sample size and matched gender and age were some of the strengths of this study. Being a single center study with cross-sectional study design were some of the limitations of this study. Prospective trials should be planned to evaluate outcomes among different sets of T2DM patients to further add to what is known about the effects of various socio-demographics and clinical characteristics of these patients.

Conclusion

In rural population, female gender had significant association with hypertension, overweight and obesity. Increasing age and duration of diabetes were significantly linked with hypertension and higher BMI.

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