Unraveling obesity and diabetes connection insights into diabetic Complications

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ABSTRACT

Objective: Obesity has been a considerable risk factor for the development of diabetic complications. The objective of this study was to determine the association between obesity and diabetic complications.

Methodology: A cross-sectional descriptive study was carried out from December 2023 to January 2024. A total of 239 patients, both genders (male and female) with type 2 diabetes mellitus were included from in-patient and out-patient departments presenting to Department of Medicine and Endocrinology Division at MTI Khyber Teaching Hospital, Peshawar. We assessed the height and weight of the patients to calculate BMI as per the Asian Classification of Obesity Patients were further classified as normal (18.5-22.9), overweight (23.0-24.9), and obese (>25). Complications including known microvascular complications (diabetic retinopathy, diabetic nephropathy, and diabetic foot ulcer) and macrovascular complications (cardiovascular and cerebrovascular) were recorded in a well-designed questionnaire.

Results: This study involved 239 participants. The mean age, BMI, and HbA1c were 53.43 years, 27.94 kg/m2, and 9.74%, respectively. The participants had varying durations of diabetes: 36.8% for 0-5 years, 41.0% for 6-10 years, and 22.2% for 11 years and above. BMI categories included normal weight (12.1%), overweight (35.6%), and obesity (52.3%), while HbA1c levels were classified as Good Control (<7%) in 9.6%, Fair Control (7.1% to 8%) in 15.1%, and Poor Control (>8%) in 75.3%. Complications were present in 60.3% of cases, with 39.7% experiencing no complications.

Conclusion: A significant correlation between obesity and increased complications was found in this study. It emphasizes the need for regular evaluation of weight management and diabetes control in such patients. Achieving optimal glycaemic control and addressing associated risk factors might help to mitigate obesity-related complications in individuals with diabetes.

KEYWORDS: Type 2 Diabetes Mellitus, Obesity, Diabetic Complications.

INTRODUCTION

Diabetes mellitus (DM) is a prevalent metabolic disorder associated with severe complications that contribute to heightened morbidity and mortality.[1] As per the 2021 atlas by the International Diabetes Federation (IDF), approximately 537 million individuals are affected by Diabetes mellitus worldwide. However, the prevalence stands at 33 million people within Pakistan.[2] It is a chronic life-threatening disease, causing macro- and micro-vascular complications including cardiovascular and cerebrovascular disease (CVD), diabetic kidney disease (DKD), and diabetic retinopathy (DR), which

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are associated with increased disability and reduced quality of life and life expectancy.[3] Epidemiological data indicates that the global occurrence of obesity has surged to almost 33.3%, marking a twofold increase since 1980.[4]

Diabesity is a term employed to characterize the collective detrimental health consequences arising from both obesity and diabetes mellitus. The global simultaneous surge of obesity and type 2 diabetes mellitus (T2DM) represents a significant public health concern. Some future projections indicate a sixfold rise in the adult obesity population within 40 years, alongside an increase in the number of individuals with diabetes reaching 642 million by 2040.[5] Both conditions, overweight and obesity, are recognized as risk factors for various health issues, including hemodynamic, endothelial, or inflammatory disorders[6], as well as complications related to T2DM.[7,8] Hence obesity plays a significant role in the initiation and progression of macro- and micro-vascular complications in individuals with T2DM. The pathophysiological impact of obesity on the emergence of macro- and microvascular complications in diabetes may arise from an imbalance between adiponectin and leptin, secreted by adipose tissue.[9] Insufficient serum adiponectin and elevated serum leptin levels can contribute to dyslipidemia, inflammation, atherosclerosis, and other chronic complications, which significantly contribute to morbidity in diabetes patients.[7,8] The earlier the onset of T2DM, the higher the probability of developing cardiovascular complications, and consequently early death.[10,11]

Limited studies have been conducted on the links between obesity and diabetic complications in both T2DM and T1DM. This study aims to determine the association between obesity and diabetic complications—both macro-vascular (cardiovascular (CAD) and cerebrovascular (CVA)) and microvascular (diabetic retinopathy, diabetic nephropathy, and diabetic neuropathy / diabetic foot ulcer)—in individuals with T2DM.

METHOD

We conducted a descriptive cross-sectional study at the Department of Medicine and Endocrinology Division, Khyber Teaching Hospital, Pakistan, from December 2023 to January 2024. The hospital's ethical committee approved the study (Ref. No. 805/DME/KMC dated 18/12/2023).

We calculated a sample size of 239 using the OpenEpi tool, with a 10% prevalence of obesity in T2DM patients. A 95% confidence interval, and 5% as a margin of error was taken. A written informed consent was obtained from all the patients fulfilling the inclusion and exclusion criteria. Patients of both genders were registered through non-probability consecutive sampling. We excluded patients with pregnancy, mental or psychiatric issues, those on psychiatric medications, individuals with any malignancy, or on steroids.

Diagnosis of DM was done according to the American Diabetes Association (ADA) guidelines.[12]

We assessed the height and weight of the patients to calculate BMI as per the Asian Classification of Obesity [13]. Patients were further classified as normal (18.5-22.9), overweight (23.0-24.9), and obese (>25).

Diabetes control is categorized based on HbA1c as Good Control (<7%), Fair Control (7.1% to 8%), and Poor Control (>8%).

Complications including known microvascular complications (diabetic retinopathy, diabetic nephropathy, and diabetic neuropathy / diabetic foot ulcer) and macrovascular complications (CVA-stroke and CVS-myocardial infarction / heart failure) were recorded in a well-designed questionnaire.

Statistical Analysis: We analyzed the data using SPSS software (version 26), calculating mean ± standard deviation for numerical variables. Frequencies and percentages were calculated for categorical variables. We used the Chi-square test to analyze the association between the categories of obesity and complications of diabetes. Results with p-value ≤0.05 were considered significant. These findings are visually presented in Tables and Figures.

RESULTS

This study included a total of 239 individuals diagnosed with T2DM. Among these, 139 (58.15%) were male, and 100 (42.37%) were female (Table-I). Among the cases, 88 (36.8%) had a diabetes duration of < 5 years, 98 (41.0%) had a duration of 6-10 years, and 53 (22.2%) had a duration of 11 years and above. Patients' BMI was categorized into Normal weight (12.1%), Overweight (35.6%), and Obesity (52.3%), while HbA1c was classified into Good Control (<7%) in 9.6%, Fair Control (7.1% to 8%) in 15.1%, and Poor Control (>8%) in 75.3%. The association of BMI and Diabetes control is shown in Table-II. Furthermore, out of the total 239 cases, 95 (39.7%) had no complications, while 144 (60.3%) experienced complications. Diabetes complications about BMI are mentioned in Table-III.

Frequency of the various micro and macro vascular complications are presented in Table-IV. Most common microvascular complication observed in our

Table-I: Baseline characteristics of study participants N: 239.

	Mean	*Std. Deviation*
HbA1c	9.74	2.10
BMI	27.94	4.53
Height	162.11	8.16
Weight	74.60	12.33
Age	53.43	8.44

Table-II: Relationship of BMI Categories with HbA1c Categories .

			Good DM control	Fair DM control	Poor DM control	Total
BMI Cate-gories	Normal Weight	Count (Percentage within BMI categories)	4 (13.8 %)	5 (17.2 %)	20 (69.0 %)	29 (100 %)
	Over-weight	Count (Percentage within BMI categories)	10 (11.8 %)	12 (14.1 %)	63 (74.1 %)	85 (100 %)
	Obese	Count (Percentage within BMI categories)	9 (7.2 %)	19 (15.2 %)	97 (77.6 %)	125 (100 %)
Total		Count (Percentage within BMI categories)	23 (9.6 %)	36 (15.1 %)	180 (75.3 %)	239 (100 %)

HbA1c Categories

study participants was neuropathy and diabetic foot ulcer seen in 164 (68.6%) followed by retinopathy in 130 (54.4%) and nephropathy in 85(35.6%). Regarding macro vascular complications 52 (21.8%0 patients presented with heart failure or myocardial infarction followed by stroke in 16 (6.7%).

DISCUSSION

This study demonstrated the association between Obesity, Diabetes Control, and the presence of diabetes complications (micro-vascular and macro-vascular) in patients with T2DM. T2DM affects half a billion people and is a leading cause of morbidity and mortality worldwide.[14] Our study showed a slightly higher number of males (58.15%) as compared to females (42.37%). The mean age of the population studied was 53.43 years a similar study was conducted in China which showed the mean age of the population was 67.4 years, the age difference could be due to their large sample size, life expectancy, and genetic makeup for

Table-III: Association of BMI Categories with Diabetes related complications .

			NO	YES	TOTAL
BMI Cate-gories	Normal weight	Count (Percentage within BMI catego-ries)	14 (48.3%)	15 (51.7%)	29 (100%)
	Overweight	Count (Percentage within BMI catego-ries)	31 (36.5%)	54 (63.5%)	85 (100%)
	Obese	Count (Percentage within BMI catego-ries)	50 (40%)	75 (60%)	125 (100%)
Total		Count (Percentage within BMI catego-ries)	95 (39.7%)	144 (60.3%)	239 (100%)

Complications

Table-IV: Frequency of the Micro and Macro Vascular Complications. (n=239).

Complications	Yes n(%)	No n(%)
Nephropathy / Chronic Kidney Disease	85 (35.6)	154 (64.4)
Retinopathy	130 (54.4)	109 (45.6)
Neuropathy/Diabetic Foot Ulcers	164 (68.6)	75 (31.4)
Heart Failure / Myocardial Infarction	52 (21.8)	187 (78.2)
Stroke	16 (6.7)	223 (93.3)

the onset of diabetes.[15] One more study showed a mean age of 56.1 years in Denmark which is quite near to our study's mean age.[16] Glycaemic control as measured by HbA1c levels, which showed 75.3% of the patients have HbA1c level of more than 8% with a mean HbA1c of 9.7%, a similar study was conducted in the Republic of Srpska which showed a mean HbA1c of 8.32%, reason of high Hba1c in our study could be due to low socioeconomic status and lack of proper diabetes education.[17]

The categorization of BMI was done into Normal Weight, Overweight, and Obesity. Our study showed 52.2% of participants were obese while a study from Denmark showed 21.8% of participants fell in the obesity category. The reason for the higher number could be due to the reason that we took a lower cut-off for obesity as per the Asian population and they use a higher cut-off, secondly, we have a large consumption of carbohydrates as compared to them.[16]

Obesity categories highlighted an important association with glycaemic control. The majority of individuals falling into the "Poor DM Control" category were in the Overweight and Obese BMI ranges. This is also shown by a study done United States which showed higher HbA1c levels in higher classes of obesity.[18]

The analysis of complications within different BMI categories revealed that a higher percentage of complications were observed in the obese category. According to a study done in Korea, a greater baseline visceral fat area has been identified as an independent risk factor for the onset of T2DM.[19]

Limitation: The cross-sectional design of the study limits the ability to establish causation. This single-center approach may limit the generalizability of the findings to a broader population. The study was conducted over a relatively short period from December 2023 to January 2024. The short duration may not capture seasonal variations or long-term trends that could influence the association between obesity and diabetic complications. The study does not extensively explore potential confounding factors such as physical activity, dietary habits, or comorbidities that may contribute to diabetic complications. The BMI categories used in the study (normal weight, overweight, and obesity) may oversimplify the complex relationship between body weight and complications.

CONCLUSION

A significant correlation has been noted between obesity and inadequate management of diabetes, along with its associated complications, particularly in individuals with suboptimal diabetes control. The prevalence of complications is notably elevated among those classified as obese. This underscores the critical need for timely and consistent evaluation of weight management and diabetes control in individuals with diabetes. Achieving optimal glycemic control, providing structured education, conducting thorough risk assessments, and addressing associated risk factors may help to mitigate obesity in this patient population.

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Author's Contribution:

UK: Concept, Design, Literature Review and Proofreading.

ZJ: Literature Review, drafting the manuscript, and proofreading. Acquisition of data and critical review.

JJ: Data collection, Analysis, and interpretation of data.

G: Data collection, Analysis, and interpretation of data.

All authors provided final approval for publication of the manuscript and are responsible for the integrity of the study.