International Journal of Research in Medical Sciences
Eva IZ et al. Int J Res Med Sci. 2024 Dec;12(12):4470-4474
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012
DOI: https://dx.doi.org/10.18203/2320-6012.ijrms20243693

Original Research Article

Weight matters: exploring the relationship between BMI status and glycemic control in diabetic patients

Israt Zerin Eva[1]*, Farhana Afrooz[2], Nazmul Kabir Qureshi[3], Chandina Ferdous[4]

[1]Department of Medicine, Uttara Adhunik Medical College and Hospital, Dhaka, Bangladesh
[2]Department of Endocrinology, Dr. Sirajul Islam Medical College and Hospital, Dhaka, Bangladesh
[3]Department of Endocrinology & Medicine, National Healthcare Network, Uttara, Dhaka, Bangladesh
[4]Department of Endocrinology, National Healthcare Network, Uttara, Dhaka, Bangladesh

Received: 14 July 2024
Accepted: 14 November 2024

***Correspondence:**
Dr. Israt Zerin Eva,
E-mail: israteva1986@gmail.com

ABSTRACT

Background: In the management of diabetes mellitus, understanding the interplay between body weight and glycemic control is crucial. The relationship between BMI status and glycemic control among diabetic patients is multifaceted and pivotal for optimizing treatment strategies and reducing complications. This study aims to assess the relationship between BMI status and glycemic control in diabetic patients.
Methods: This study was a cross-sectional design to assess the relationship between BMI status and glycemic control in diabetic patients conducted from November 2022 to October 2023 at National Healthcare Network (NHN), Uttara, Dhaka, Bangladesh. Data were collected from patient medical records and structured interviews, focusing on the fasting blood glucose (FBG) levels, HbA1C%, and body mass index (BMI). Pearson correlation coefficients were calculated to assess the strength of linear relationships between BMI, HbA1C, and glycemic control measures, with statistical significance set at $p<0.05$.
Results: In the study, for BMI 18-24, 60% had normal fasting blood glucose, while 67.9% had elevated levels; 64.0% had HbA1C <7%, and 67.6% had ≥7%. In BMI 25-30, 30% had normal fasting blood glucose, 16.7% had elevated levels, 25% had HbA1C <7%, and 18.7% had ≥7%. For BMI >30, 10% had normal fasting blood glucose, 15.4% had elevated levels, 12% had HbA1C <7%, and 13.7% had ≥7%.
Conclusions: A significant association was found between BMI status and glycemic control among diabetic patients. Higher BMI is correlated with poorer glycemic control, as indicated by elevated fasting blood sugar and HbA1C% levels. These findings emphasize the importance of weight management as a crucial component of diabetes care to achieve better glycemic control and reduce the risk of complications.

Keywords: BMI, Glycemic control, HbA1C

INTRODUCTION

Diabetes mellitus, a chronic metabolic disorder characterized by hyperglycemia, continues to pose a significant global health challenge with its increasing prevalence and associated complications. According to the International Diabetes Federation, approximately 537 million adults were living with diabetes in 2021, and this number is projected to rise to 784 million by 2045.[1] Effective management of diabetes is crucial to prevent complications such as cardiovascular disease, neuropathy, nephropathy, and retinopathy. One of the key factors influencing diabetes management is body weight, often assessed through Body Mass Index (BMI). BMI is a widely used measure to classify individuals into different weight categories and is calculated by dividing weight in kilograms by the square of height in meters (kg/m^2). The relationship between BMI status and glycemic control in

diabetic patients has been the subject of extensive research due to its implications for diabetes management strategies. The relationship between BMI and glycemic control in diabetic patients is complex and multifaceted. Obesity, often indicated by elevated BMI, is a well-established risk factor for type 2 diabetes.[2] Excess adiposity, particularly visceral fat, contributes to insulin resistance, a hallmark feature of type 2 diabetes. Insulin resistance leads to decreased glucose uptake by tissues and increased hepatic glucose production, resulting in elevated blood glucose levels.[3] Conversely, underweight or low BMI in diabetic patients may indicate malnutrition, frailty, or underlying health conditions, which can also impact glycemic control. Poor nutrition and inadequate caloric intake can lead to erratic blood glucose levels and an increased risk of hypoglycemia, especially in diabetic patients using insulin or certain oral medications.[4] Several studies have investigated the association between BMI status and glycemic control in diabetic populations. Some studies suggest that higher BMI is associated with poorer glycemic control, as measured by elevated HbA1c levels.[5,6] Elevated HbA1c levels indicate poorer long-term glycemic control and are associated with an increased risk of diabetic complications. However, the relationship between BMI and glycemic control is not always straightforward. Some studies have reported a U-shaped relationship, indicating that both low and high BMI levels may be associated with poorer glycemic control.[7,8] Underweight diabetic patients may experience difficulties in achieving glycemic targets due to malnutrition or other comorbidities, while obese patients may struggle due to insulin resistance and lifestyle factors.

Furthermore, the impact of BMI on glycemic control may vary depending on factors such as age, gender, ethnicity, and diabetes duration. For instance, one study found that the association between BMI and glycemic control was stronger in younger adults compared to older adults with type 2 diabetes.[9] Understanding the relationship between BMI status and glycemic control has significant clinical implications. It can help healthcare providers tailor diabetes management strategies according to individual patient characteristics. For overweight or obese patients, weight management through lifestyle interventions, including diet modification and increased physical activity, may improve glycemic control and reduce the need for medication.[10] Similarly, for underweight diabetic patients, nutritional support and addressing underlying health conditions are crucial to achieving optimal glycemic control without risking malnutrition or hypoglycemia. Additionally, identifying patients at higher risk of poor glycemic control based on BMI status can aid in early intervention and prevention of diabetes-related complications.

This study aims to provide insights into the relationship between BMI status and glycemic control that may contribute to more effective personalized approaches to diabetes management.

METHODS

This study employed a cross-sectional design to assess the relationship between BMI status and glycemic control in diabetic patients conducted from November 2022 to October 2023 at National Healthcare Network (NHN), Uttara, Dhaka, Bangladesh. A total of 108 patients diagnosed with diabetes mellitus were included, selected based on the following inclusion criteria: adults having T2DM, aged 18 years to ≤65 years, eGFR ≥30 ml/min/1.73m^2, consented subjects having all the required data available. Exclusion criteria included having Type 1 diabetes, age <18 years or >65 years, women with pregnancy, eGFR <30 ml/min/1.73m^2, history of significant alcohol consumption (defined as ingestion of >21 standard drinks per week in men and >14 standard drinks per week in women over 2 years preceding baseline liver histology), patients with any associated chronic liver disease, advanced liver disease, hepatic congestion, cardiac failure or on hepatotoxic drugs, unwilling to give consent and with incomplete data were excluded from the study. Data were collected from patient medical records and structured interviews, focusing on the fasting blood glucose (FBG) levels, HbA1C%, and body mass index (BMI). Additional data included demographic information, blood pressure, and comorbid conditions. The data were analyzed using SPSS version 26, employing descriptive statistics to summarize the demographic and clinical characteristics of the study population. Chi-square tests examined associations between BMI, HbA1C, and glycemic control measures. Pearson correlation coefficients were calculated to assess the strength of linear relationships between BMI, HbA1C, and glycemic control measures, with statistical significance set at $p<0.05$.

RESULTS

Table 1 describes the distribution of 108 study participants based on baseline characteristics. The mean age is 51.27 years, BMI is 24.31 kg/m², waist circumference is 96.11 cm, systolic blood pressure is 122.50 mmHg, and diastolic blood pressure is 77.97 mmHg. The age distribution shows 12% are under 30 years, 10.2% are 30-39 years, 47.2% are 40-59 years, and 30.6% are 60 years or older. The gender breakdown is 27.8% male and 72.2% female. Regarding BMI, 66.7% have normal weight (18-24 kg/m²), 20.4% are overweight (25-30 kg/m²), and 13% are obese (>30 kg/m²). For comorbidities, 51.9% have hypertension, 50.9% have dyslipidemia, 5.6% have chronic kidney disease, 3.7% have ischemic heart disease, and 0.9% have cerebrovascular disease (Table 1).

Table 2 presents the laboratory findings for 108 study participants. The mean fasting plasma glucose is 9.21 mmol/L, and the mean HbA1C is 9.15%. The average ALT level is 38.36 IU/L, while AST is 29.62 IU/L. The mean platelet count is 268.46 x 10⁹/L. Serum creatinine averages 1.98 mg/dl, and the estimated glomerular filtration rate (eGFR) is 69.11. Total cholesterol has a mean value of

181.67 mg/dl, triglycerides are 207.12 mg/dl, HDL is 45.65 mg/dl, and LDL is 101.90 mg/dl (Table 2).

Table 1: Distribution of study population based on baseline characteristics (n=108).

Baseline characteristics	Mean±SD
Age (in years)	51.27±SD
BMI	24.31±SD
Waist circumference	96.11±SD
Systolic blood pressure	122.50±SD
Diastolic blood pressure	77.97±SD
Baseline characteristics	N (%)
Age (in years)	
<30	13 (12)
30-39	11 (10.2)
40-59	51 (47.2)
≥60	33 (30.6)
Gender	
Male	30 (27.8)
Female	78 (72.2)
BMI (kg/cm^2)	
18-24 (normal)	72 (66.7)
25-30 (overweight)	22 (20.4)
>30 (obesity)	14 (13)
Comorbidities	
Hypertension	56 (51.9)
Dyslipidemia	55 (50.9)
Chronic kidney disease	6 (5.6)
Ischaemic heart disease	4 (3.7)
Cerebrovascular disease	1 (0.9)

Table 2: Distribution of study population based on laboratory findings (n=108).

Laboratory findings	Mean±SD
Fatsing plasma glucose (mmol/l)	9.21±SD
HBA1C%	9.15±SD
ALT(IU/l)	38.36±SD
AST(IU/l)	29.62±SD
Platelet count (10^9/l)	268.46±SD
Serum creatinine (mg/dl)	1.98±SD
eGFR	69.11±SD
Total cholesterol (mg/dl)	181.67±SD
Triglycerides(mg/dl)	207.12±SD
HDL(mg/dl)	45.65±SD
LDL (mg/dl)	101.90±SD

Table 3 illustrates the distribution of the study population based on BMI and fasting blood glucose levels among 108 participants. For individuals with a BMI of 18-24, 60.0% (n=18) had fasting blood sugar levels within the normal range (4.4-7.2 mmol/L), while 67.9% (n=53) had elevated levels (>7.2 mmol/L). Among those with a BMI of 25-30, 30.0% (n=9) had normal fasting blood sugar, and 16.7% (n=13) had elevated levels. In the BMI category above 30, 10.0% (n=3) had normal fasting blood sugar, whereas 15.4% (n=12) had elevated levels. P value was measured 0.03 indicates there is significant association between BMI and fasting blood sugar. Pearson correlation coefficient was 0.09 that suggests moderate positive linear relationship between the BMI and fasting blood sugar (Table 3).

Table 3: Distribution of study population based on BMI and fasting blood glucose (n=108).

BMI	Fasting blood sugar (mmol/L)		P value
	4.4-7.2 mmol/l (n=30) N (%)	>7.2 mmol/l (n=78) N (%)	
18-24	18 (60.0)	53 (67.9)	0.03
25-30	9 (30.0)	13 (16.7)	
>30	3 (10.0)	12 (15.4)	

Table 4 presents the distribution of the study population based on BMI and HbA1C levels among 108 participants. For those with a BMI of 18-24, 64.0% (n=18) had HbA1C levels below 7%, while 67.6% (n=54) had levels at or above 7%. In the BMI category of 25-30, 25.0% (n=7) had HbA1C levels below 7%, whereas 18.7% (n=15) had levels at or above 7%. Among participants with a BMI over 30, 12% (n=3) had HbA1C levels below 7%, while 13.7% (n=11) had levels at or above 7%. P value was measured 0.004 indicates there is significant association between BMI and HbA1C%. Pearson correlation coefficient was 0.80 that suggests strong positive linear relationship between the BMI and HbA1C% (Table 4).

Table 4: Distribution of study population based on BMI and HbA1C% (n=108).

BMI	HbA1C %		P value
	<7% (n=28) N (%)	≥7 (n=80) N (%)	
18-24	18 (64.0)	54 (67.6)	0.004
25-30	7 (25.0)	15 (18.7)	
>30	3 (11)	11 (13.7)	

DISCUSSION

The present study investigated the relationship between BMI status and glycemic control among diabetic patients, as well as the distribution of baseline characteristics and laboratory findings among participants. The mean age of 51.27 years indicates that the study includes a middle-aged population. The majority of participants were female (72.2%), reflecting the higher prevalence of diabetes among women.[11] BMI distribution shows that a considerable proportion of participants were of normal weight (66.7%), followed by overweight (20.4%) and obese (13%) individuals. Hypertension and dyslipidemia were prevalent comorbidities among the participants, consistent with the common coexistence of these conditions with diabetes.[12] In this study, laboratory findings indicate suboptimal glycemic control among participants, with a mean fasting plasma glucose of 9.21

mmol/L and a mean HbA1C of 9.15%. These values suggest poor glycemic control within the study population, which is concerning as tight glycemic control is crucial in preventing diabetes-related complications.[13] Other parameters such as liver enzymes, lipid profile, and renal function also show values that may require clinical attention. This study showed a significant association between BMI and fasting blood sugar levels (p value = 0.03), indicating that higher BMI is correlated with higher fasting blood sugar levels. This finding is consistent with previous studies that have reported a positive association between obesity and impaired fasting glucose.[14] Notably, participants with higher BMI categories showed a higher prevalence of pre-diabetes and diabetes, suggesting that obesity contributes to worsening glycemic control. Similarly, a significant association between BMI and HbA1C% levels (p value = 0.004), indicating that higher BMI is strongly correlated with higher HbA1C% levels. This finding aligns with existing literature highlighting the impact of obesity on long-term glycemic control.[15] The majority of participants across all BMI categories had HbA1C% levels indicating diabetic status, with higher percentages observed in overweight and obese categories compared to normal weight. The results of this study are consistent with previous research demonstrating the adverse effect of higher BMI on glycemic control among diabetic individuals. For instance, a study by Bhupathiraju et al. found a similar association between BMI and HbA1C levels among diabetic patients, with higher BMI linked to poorer glycemic control.[16] However, our study adds to the existing literature by providing detailed insights into the distribution of fasting blood sugar and HbA1C% levels across different BMI categories among diabetic patients. The moderate to strong positive linear relationships observed emphasize the importance of weight management in diabetes care. Our findings regarding the distribution of BMI categories among diabetic patients align with national and global trends showing a rising prevalence of overweight and obesity in diabetic populations.[17]

While our study contributes valuable insights, it has limitations such as its cross-sectional design and relatively small sample size. Longitudinal studies with larger cohorts are needed to further elucidate the causal relationship between BMI and glycemic control and to assess the impact of interventions targeting weight management on diabetes outcomes.

CONCLUSION

A significant association was found between BMI status and glycemic control among diabetic patients. Higher BMI is correlated with poorer glycemic control, as indicated by elevated fasting blood sugar and HbA1C% levels. These findings emphasize the importance of weight management as a crucial component of diabetes care to achieve better glycemic control and reduce the risk of complications.

Recommendations

We recommend personalized weight management interventions, regular monitoring of BMI and glycemic parameters, nutritional counseling, promotion of physical activity, and adopting a multidisciplinary approach to diabetes care.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. International Diabetes Federation. IDF Diabetes Atlas, 10th ed. Brussels, Belgium: International Diabetes Federation; 2021.
2. Hu FB. Obesity and type 2 diabetes: epidemiology, risk factors, and pathogenesis. Diabetes Care. 2011;34(Suppl 2).
3. Kahn SE, Hull RL, Utzschneider KM. Mechanisms linking obesity to insulin resistance and type 2 diabetes. Nature. 2006;444(7121):840-6.
4. Sinclair AJ, Abdelhafiz AH, Rodríguez-Mañas L. Frailty and sarcopenia - newly emerging and high impact complications of diabetes. J Diabet Complicat. 2017;31(9):1465-73.
5. Eeg-Olofsson K, Cederholm J, Nilsson PM, Zethelius B, Svensson AM, Gudbjörnsdóttir S, et al. Glycemic control and cardiovascular disease in 7,454 patients with type 1 diabetes: an observational study from the Swedish National Diabetes Register (NDR). Diabetes Care. 2010;33(7):1640-6.
6. Bonora E, Tuomilehto J. The pros and cons of diagnosing diabetes with A1C. Diabetes Care. 2011;34(Suppl 2).
7. Tobias DK, Pan A, Jackson CL, O'Reilly EJ, Ding EL, Willett WC, et al. Body-mass index and mortality among adults with incident type 2 diabetes. New Engl J Medi. 2014;370(3):233-44.
8. Carnethon MR, De Chavez PJ, Biggs ML, Lewis CE, Pankow JS, Bertoni AG, et al. Association of weight status with mortality in adults with incident diabetes. JAMA. 2012;308(6):581-90.
9. Gregg EW, Chen H, Wagenknecht LE, Clark JM, Delahanty LM, Bantle J, et al. Association of an intensive lifestyle intervention with remission of type 2 diabetes. JAMA. 2012;308(23):2489-96.
10. Lean ME, Leslie WS, Barnes AC, Brosnahan N, Thom G, McCombie L, et al. Primary care-led weight management for remission of type 2 diabetes (DiRECT): an open-label, cluster-randomised trial. The Lancet. 2018;391(10120):541-51.
11. Cho NH, Shaw JE, Karuranga S, Huang Y, da Rocha Fernandes JD, Ohlrogge AW, et al. IDF Diabetes Atlas: Global estimates of diabetes prevalence for 2017 and projections for 2045. Diabet Res Clin Pract. 2018;138:271-81.

12. American Diabetes Association. Standards of Medical Care in Diabetes-2022. Diabetes Care. 2022;45(Suppl 1).
13. Stratton IM, Adler AI, Neil HA, Matthews DR, Manley SE, Cull CA, et al. Association of glycemia with macrovascular and microvascular complications of type 2 diabetes (UKPDS 35): a prospective observational study. BMJ. 2000;321(7258):405-12.
14. Gao M, Lv J. Associations between body mass index and impaired fasting glucose among adults in Northeast China. Diab, Metabol Syndr Obesity: Target Ther. 2021;14:1097-1105.
15. Cornell S, Halstenson C, Miller DK, editors. The Art and Science of Diabetes Care and Education. Association of Diabetes Care & Education Specialists; 2021.
16. Bhupathiraju SN, Hu FB. Epidemiology of obesity and diabetes and their cardiovascular complications. Circulat Res. 2016;118(11):1723-35.
17. Gregg EW, Cheng YJ, Srinivasan M, Lin J, Geiss LS, Albright AL, et al. Trends in cause-specific mortality among adults with and without diagnosed diabetes in the USA: an epidemiological analysis of linked national survey and vital statistics data. The Lancet. 2018;391(10138):2430-40.

Cite this article as: Eva IZ, Afrooz F, Qureshi NK, Ferdous C. Weight matters: exploring the relationship between BMI status and glycemic control in diabetic patients. Int J Res Med Sci 2024;12:4470-4.