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RELATIONSHIP BETWEEN BMI AND HBA1C IN PATIENTS WITH OBESITY

Aparna Rahman[1*], Md. Zahid Alam[2], Shabnam Jahan Hoque[2], Farhana Afroz[2]

ABSTRACT

Background: The global rise of obesity is alarming, not only for its increasing prevalence but also for its constellation of associated diseases that diminish life quality and expectancy. In developing countries like Bangladesh, tackling obesity-related metabolic and other morbidities pose a significant challenge.Obesity demonstrably strengthens the links between diabetes, hypertension, coronary artery disease, stroke, and even mortality associated with these events. This study investigated the connection between body mass index (BMI) and glycemic status (measured by HbA1c) of both diabetic and non-diabetic obese individuals in Bangladesh, along with the spectrum of morbidities leading to hospitalization. Understanding these connections empower clinicians to prioritize specific management goals and ultimately lessen obesity-related morbidity in this population. **Materials and Method:** This prospective observational study has been carried out at a tertiary hospital among 50 patients with clinical obesity (BMI >30 kg/m²) and excluded those with pathological causes of obesity, e.g.hypothyroidism, Cushing's syndrome, etc. The anthropometric measurement, glycemic status, and obesity related complications were recorded for all patients. BMI was stratified into three groups, Group I (BMI 30.1-40 kg/m²), Group II (BMI 40.1-50 kg/m²) and Group III (BMI >50 kg/m²) where HbA1c in these groups were compared to find out any association including morbidity. Data analysis was performed with SPSS for windows version 22.0 and then was presented in tables and charts. **Results:** The cohort included 41(82.0%) women and 9 (18.0%) men. The mean age of the obese patients was 54.71 years with almost half being in the agegroup of 51-60 years (46.0%). Majority i.e. 43 (86.0%) of the patients had a BMI ranging from 30.1-40 kg/m². Among the study subjects, 28 had diabetes mellitus (56%) and the rest were non-diabetic (44%). There was a significant relationship found between HbA1c and BMI of the obese patients with diabetes mellitus (p = 0.009). Scatter diagram showedsignificant correlation between BMI and HbA1c in obese diabetes patients(r=0.622; p=0.001).**Conclusion:** This study identified a positive correlation between BMI and HbA1c in diabetic patients, but not in non-diabetic ones. Further research is needed to explore the mechanisms at play in non-diabetic patients with higher BMI.

Key words: BMI, HbA1c, Obesity.

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INTRODUCTION

The global surge in obesity presents a formidable challenge, not only due to its escalating prevalence but also for its ripple effect on numerous chronic diseases. This complex condition disrupts metabolic equilibrium, often leading to a cluster of morbidities that significantly compromise life quality and expectancy[1]. In developing countries like Bangladesh, where healthcare resources are often constrained, tackling the burden of obesity-related illnesses is particularly pressing[2].

1*. Department of Cardiology, Medical College for Women & Hospital, Dhaka, Bangladesh. Email: aparnadr28@gmail.com [Address of correspondence].

2. Department of Cardiology, BIRDEM General Hospital, Shahbag, Dhaka, Bangladesh.

Among the spectrum of comorbidities associated with obesity, diabetes mellitus (DM) stands out as a major concern. Characterized by chronic hyperglycemia, DM significantly increases the risk of cardiovascular complications, renal dysfunction, and other debilitating conditions[3]. Obesity, through its multifaceted effects on insulin sensitivity and secretion, serves as a potent driver of DM development. Numerous studies have established a strong association between BMI, a commonly used measure of obesity, and increased risk of DM[4,5]. Yet, understanding the intricacies of this relationship, particularly within the context of established obesity, remains critical for optimizing patient management and mitigating diabetes risk.

HbA1c, a glycated hemoglobin assay, serves as a valuable indicator of long-term glycemic control in individuals with DM. By providing an integrated measure of blood sugar levels over approximately three months, HbA1c offers crucial insights into treatment efficacy and potential glycemic complications[6]. In the context of obesity, research suggests a positive correlation between BMI and HbA1c levels, indicating poorer glycemic control with increasing body weight[7,8]. While this association suggests a potential role for BMI in predicting and monitoring glycemic status in obese individuals, further exploration is needed to elucidate the nuances of this relationship.

Understanding the specific relationship between BMI and HbA1c in patients with obesity holds significant clinical implications. Firstly, it can inform risk stratification, allowing healthcare professionals to identify individuals at higher risk of developing DM based on their BMI and HbA1c levels. This early identification can facilitate timely interventions like lifestyle modifications or early initiation of pharmacological therapy, potentially preventing or delaying the onset of DM and its associated complications[9].

Secondly, exploring the association between BMI and HbA1c can help personalize treatment strategies for established obesity. By monitoring HbA1c levels alongside BMI changes, clinicians can assess the effectiveness of interventions and tailor treatment plans to achieve optimal glycemic control. This personalized approach can potentially improve long-term health outcomes and prevent the development of obesity-related complications[10].

Therefore, the purpose of this study is to explore the BMI-HbA_1c link and hospitalization patterns in Bangladesh, and to empower the clinicians to prioritize management goals and reduce obesity-related hospitalizations.

MATERIALS AND METHOD

The nature of this research was a prospective observational study which was carried out on 50 patients attending a tertiary care level hospital in Bangladesh. The study recruited a group of participants with a specific condition i.e. simple obesity in this case and followed them over time to observe their outcomes (glycemic status and obesity-related complications). This design allows for identification of associations between BMI and HbA_1c, but does not establish cause-and-effect relationships.

The inclusion criteria limited participation to individuals with simple obesity. This excludes subjects whose obesity could be attributed to underlying medical conditions like hypothyroidism or Cushing's syndrome, allowing for better isolation of the BMI-related effects. Each patient was examined by a registered doctor and informed written consent was taken for their participation in this study. The sociodemographic characteristics of patients such as age and sex were recorded in the registry. The study also collected the following data types:

- **Anthropometric measurements**: Height, weight, waist circumference, etc., allowing calculation of BMI, a widely used measure of obesity.

- **Glycemic status**: HbA1c levels, which provide an indication of long-term blood sugar control and are a key indicator in diabetes management.

The subjects were then divided into three different groups according to their BMI (30.1-40, 40.1-50, and >50 kg/m^2), and HbA1c levels were analyzed and compared to find out if any association was present.

For statistical analysis, SPSS (Statistical Package for Social Sciences) for Windows version 22.0 was used. The data was then presented as tables and charts. Quality was assured in every step of the research including data collection, data processing, and data entry and analysis. All necessary ethical considerations were considered prior to the study.

RESULTS

This study investigated the relationship between BMI and glycemic control (measured by HbA1c) in 50 adult patients, predominantly female. The majority i.e. 23 (46%) patients fell within the 51–60-year age group, with no significant association observed between age and BMI distribution (Table-1).

The most common BMI range across all age groups was 30.1-40.0 kg/m^2, highlighting a tendency towards overweight or mild obesity within the sample (Table-1). Sex also did not significantly influence BMI distribution, with the majority of female participants again falling within the 30.1-40.0 kg/m^2 range (Figure-1).

The study subjects had DM (56%) and non-diabetic were (44%) (Figure-2). Other co morbidities were hypertension (52%), osteoarthritis ofknee joints (22%), hyperlipidemia (20%), and chronic stable angina (14%) (Figure-3).

Delving deeper into the data, the study revealed that over half (56%) of the patients had DM. While the duration of DM did not show a significant connection to BMI (Table-2), a significant association emerged between HbA1c levels and BMI groups specifically within the diabetic population (Table-3). Conversely, no such association was observed among non-diabetic patients, implying that the impact of BMI on HbA1c may be primarily relevant within the context of existing diabetes (Table-4).

Patients with higher BMIs exhibited significantly higher HbA1c levels, indicating poorer glycemic control. This positive correlation (r=0.622; p=0.001) suggests a clear link between increasing body mass and compromised glycemic regulation in individuals with diabetes (Figure-4).

Table 1: Distribution of age according to BMI (n=50)

Age group (years)	BMI (kg/m^2)						Total	*p*-value
	30.1-40.0 kg/m^2 (n=43)		40.1-50.0 kg/m^2 (n=5)		>50 kg/m^2 (n=2)			
	n	%	n	%	n	%		
≤50	9	20.9	0	0.0	1	50.0	10	0.259^{ns}
51-60	19	44.2	3	60.0	1	50.0	23	
61-70	11	25.6	0	0.0	0	0.0	11	
>70	4	9.3	2	40.0	0	0.0	6	
Mean Age (± S. D) = 54.71 (± 7.32) years								

ns= not significant; *p* value reached from Chi square test

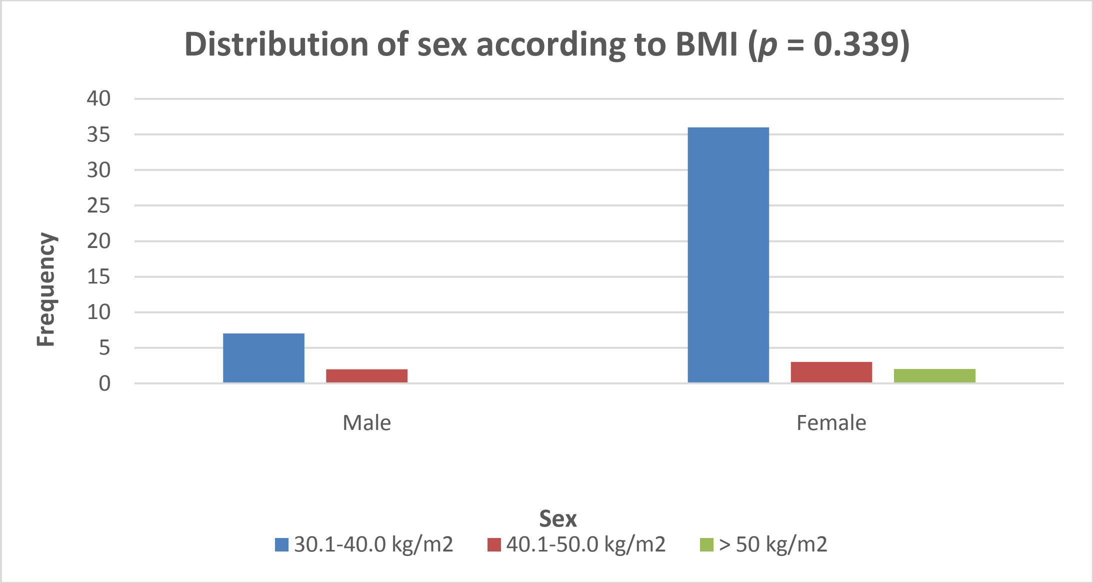

Figure 1: Distribution of sex according to BMI (n=50)

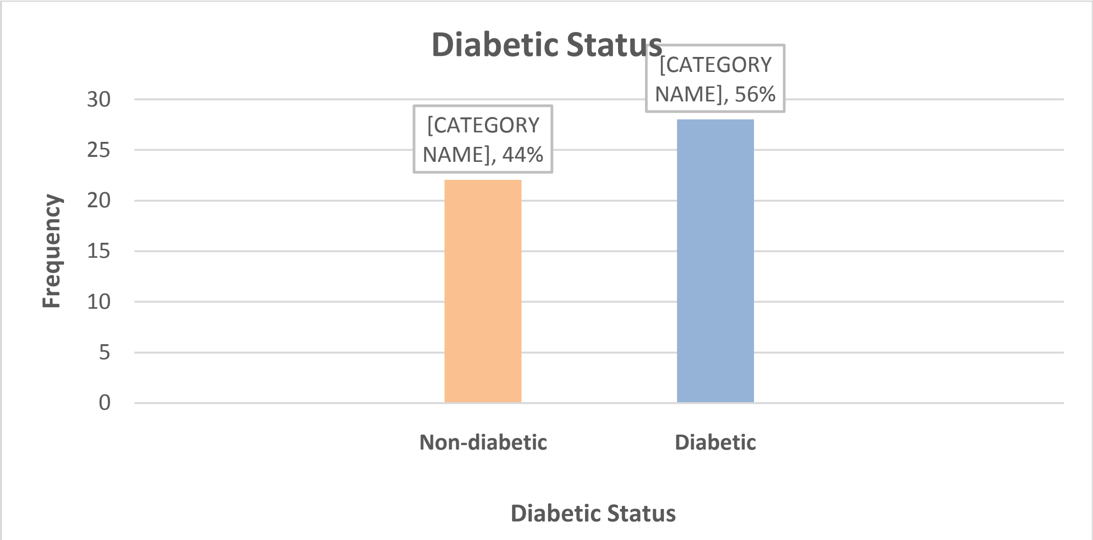

Figure 2: Distribution of patients according to diabetic status (n=50)

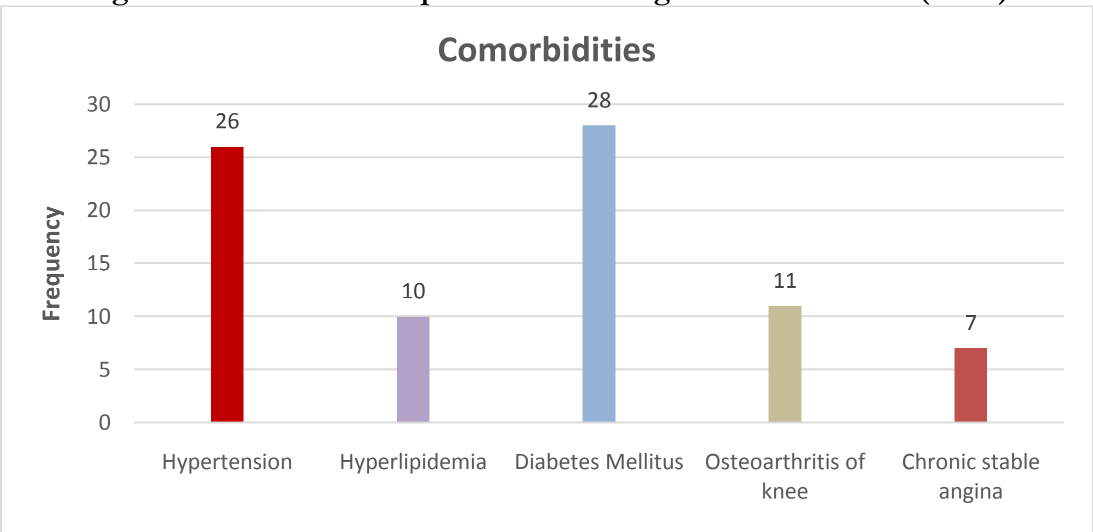

Figure 3: Distribution of patients according to comorbidities (n=50)

Table 2 : Association of BMI with duration of DM (n=28)

	BMI (kg/m^2)			*p*- value
	30.1-40.0 kg/m^2 (n=24)	40.1-50.0 kg/m^2 (n=2)	>50 kg/m^2 (n=2)	
Duration of DM (years) [Mean± S. D]	12.71±7.16	17.00±14.14	17.00±7.07	0.583^{ns}

ns = not significant; *p* value reached from ANOVA test

Table 3 : Association of BMI with HbA1c in DM patients (n=28)

	BMI (kg/m^2)			*p* - value
	30.1-40.0 kg/m^2 (n=24)	40.1-50.0 kg/m^2 (n=2)	>50 kg/m^2 (n=2)	
HbA1c (%) [Mean±S. D]	10.88±2.04	14.75±0.21	14.25±1.91	0.009^{s}

s= significant; *p* value reached from ANOVA test

Table 4 : Association of BMI with HbA1c in non-DM patients (n=22)

	BMI (kg/m^2)			*p* - value
	30.1-40.0 kg/m^2 (n=19)	40.1-50.0 kg/m^2 (n=3)	>50 kg/m^2 (n=0)	
HbA1c (%) [Mean ± S. D]	5.71±0.64	5.23±0.51		0.233^{ns}

ns=not significant; *p* value reached from unpaired t-test

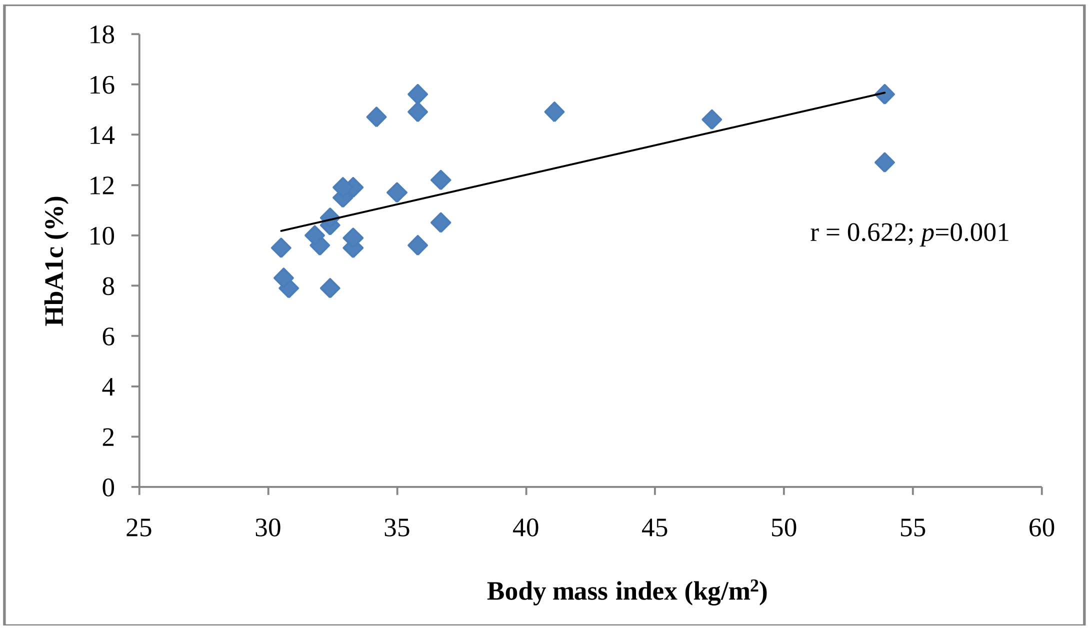

Figure 4: Scatter diagram showing significant correlation (r=0.622; *p*=0.001) between BMI and HbA1c in diabetes patients.

DISCUSSION

This study explored the association between BMI and glycemic control (HbA1c) in adult patients, revealing interesting insights into the influence of body mass on diabetes management. While there were no significant associations between age or sex and BMI distribution, a striking connection emerged within the diabetic population. Patients with higher BMIs exhibited significantly poorer glycemic control, as evidenced by their elevated HbA1c levels. This finding reinforces the established link between obesity and diabetes risk, but further emphasizes the impact of body mass on glycemic regulation specifically in individuals already diagnosed with the condition.

The observed positive correlation between BMI and HbA1c in diabetic patients (r=0.622; *p*=0.001) aligns with previous research. A meta-analysis by Amini et al. demonstrated a significant association between increasing BMI categories and higher HbA1c levels in individuals with type 2 diabetes, highlighting the detrimental effects of excess weight on glycemic control[11]. Similarly, a study by Shin et al. reported a relationship between BMI and HbA1c in Korean adults with diabetes, emphasizing the importance of weight management for effective diabetes management [12].

The study found no association between BMI and HbA1c in non-diabetic patients. This suggests a potential amplifier effect of pre-existing diabetes on the influence of body mass on glycemic control. As established, insulin sensitivity and secretion are crucial for regulating blood sugar levels. Disruptions caused by diabetes can significantly increase vulnerability to the metabolic consequences of obesity[13]. In contrast, non-diabetic individuals, particularly those in the early stages, might still possess compensatory mechanisms to maintain adequate glycemic control despite higher BMI. These mechanisms could involve increased insulin production by the pancreas to counteract insulin resistance.

However, the findings also suggest potential heterogeneity within the non-diabetic group. Some individuals may be progressing towards pre-diabetes, with subtle impairments in insulin sensitivity that have not yet reached the threshold for a diabetes diagnosis. In such cases, the impact of BMI on HbA1c might be less pronounced compared to individuals with established diabetes where insulin dysregulation is more severe. Future research could benefit from incorporating markers for pre-diabetes alongside BMI and HbA1c measurements. This more comprehensive approach would allow us to explore the possibility that the relationship between body mass and glycemic control weakens along the spectrum from healthy to pre-diabetic to diabetic states, ultimately providing better understanding of this complex interplay.

Several potential mechanisms could explain the observed link between BMI and HbA1c in diabetic patients. Excess adipose tissue, particularly visceral fat, is associated with increased inflammatory markers and insulin resistance, both of which contribute to impaired glycemic control[14]. Additionally, obesity can lead to impaired beta-cell function, further compromising insulin secretion and contributing to hyperglycemia[15].

These findings have significant clinical implications for diabetes management. Recognizing the strong association between BMI and HbA1c in diabetic patients underscores the importance of incorporating weight management strategies into comprehensive diabetes care plans. Lifestyle interventions, such as dietary modifications and increased physical activity, can effectively promote weight loss and improve glycemic control in individuals with diabetes[16,17].

Furthermore, pharmacological interventions targeting weight management, such as liraglutide and GLP-1 receptor agonists, have shown promising results in improving glycemic control and reducing cardiovascular risk in patients with diabetes and obesity[18,19].

LIMITATIONS OF THE STUDY

It is important to acknowledge some limitations of our study. The relatively small sample size and predominance of female participants limit the generalizability of the findings. Additionally, the cross-sectional nature of the study precludes establishing causal relationships between BMI and HbA1c. Further research with larger, more diverse samples and longitudinal designs is needed to confirm and expand upon these findings.

CONCLUSION

This study investigated the relationship between BMI and glycemic control (HbA1c) in diabetic and non-diabetic patients. While a positive correlation was found between increasing BMI and HbA1c in diabetic patients, there was no such association in non-diabetic participants. This suggests that pre-existing diabetes might be a key factor influencing how body mass affects blood sugar control.

The findings highlight the importance of closely monitoring both BMI and HbA1c in diabetic patients to manage weight and minimize complications. However, the lack of association in non-diabetic individuals necessitates further research. Future studies should explore the mechanisms at play in this group, particularly for those with higher BMI. Investigating factors beyond BMI, such as diet, exercise, and genetics, could also be valuable. Additionally, including markers for pre-diabetes might clarify the relationship between body mass and glycemic control in the early stages of the disease. By comprehensively examining these factors, we can develop more targeted weight management and diabetes prevention strategies, ultimately improving patient outcomes and quality of life.

CONFLICT OF INTEREST

There is no conflict of interest.

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