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Gender-Based Disparities in Glycemic Control: Insights from Diabetes Mellitus Populations

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Abstract

Background: Diabetes mellitus (DM) is a chronic metabolic disorder characterized by persistent hyperglycemia due to either inadequate insulin secretion, insulin action, or both. Disparities in glycemic control among different demographic groups, particularly between genders, have been observed and warrant further investigation. This study aims to assess the gender-based disparities in glycemic control among a population of individuals with diabetes mellitus. **Material & Methods:** This study was a cross-sectional design to assess gender-based disparities in glycemic control among individuals with diabetes mellitus, 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 primary outcome measure of glycemic control as assessed by the most recent HbA1c levels. Chi-square tests examined associations between gender and categorical variables like FBG levels and HbA1C. Pearson correlation coefficients were calculated to assess the strength of linear relationships between gender and glycemic control measures, with statistical significance set at $p < 0.05$. **Results:** Among the 108 participants, males (n=30) showed a relatively balanced distribution with 53.3% (n=16) having fasting blood glucose levels within the range of 4.4-7.2 mmol/L and 46.7% (n=14) having levels above 7.2 mmol/L. In contrast, females (n=78) exhibited a marked disparity, with only 18.0% (n=14) having within the range of 4.4-7.2 mmol/L and a significant 82.1% (n=64) presenting with above 7.2 mmol/L. Among the 108 participants, males (n=30) had 36.67% (n=11) with HbA1C levels below 7% and 63.3% (n=19) with levels at or above 7%. In contrast, females (n=78) had a lower percentage with controlled HbA1C levels, with only 21.80% (n=17) below 7% and a substantial 78.2% (n=61) at or above 7%. **Conclusions:** Based on the findings of this study, it is recommended to develop and implement gender-specific intervention programs aimed at improving glycemic control among females with diabetes, focusing on education, lifestyle modification, and adherence to medication.

Keywords:- Glycemic control, Gender-based disparities, Diabetes Mellitus.

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INTRODUCTION

Diabetes mellitus (DM) is a chronic metabolic disorder characterized by persistent hyperglycemia due to either inadequate insulin secretion, insulin action, or both. It is associated with long-term damage, dysfunction, and failure of various organs, particularly the eyes, kidneys, nerves, heart, and blood vessels.[1] The global prevalence of diabetes has been rising steadily, posing significant health, social, and economic burdens.[2] Effective glycemic control is crucial for preventing or delaying complications associated with diabetes.[3] However, disparities in glycemic control among different demographic groups, particularly between genders, have been observed and warrant further investigation.[4] Gender differences in diabetes management and outcomes have been documented in numerous studies. Biological, social, and behavioral factors contribute to these disparities.[5] Women with diabetes often experience greater difficulties in achieving glycemic control compared to men.[6] Hormonal fluctuations, particularly those related to the menstrual cycle, pregnancy, and menopause, can impact blood glucose levels and insulin sensitivity in women.[7] Additionally, psychosocial factors, such as stress and depression, which are more prevalent among women with diabetes, can adversely affect self-care behaviors and glycemic control.[8] Men, on the other hand, may exhibit different patterns of health-seeking behavior and risk profiles. Studies have shown that men are less likely to engage in regular health check-ups and adhere to treatment regimens, potentially leading to poorer glycemic control.[9] Furthermore, men often present with more severe forms of diabetes at diagnosis, which may complicate disease management.[10] Understanding these gender-specific differences is essential for developing tailored interventions aimed at improving glycemic control in both men and women.[11] The importance of achieving optimal glycemic control in diabetic patients cannot be overstated. The primary marker for long-term glycemic control is glycated hemoglobin (HbA1c), which reflects average blood glucose levels over the past two to three months.[12] The American Diabetes Association (ADA) recommends an HbA1c target of less than 7% for most adults with diabetes, although individual targets may vary based on patient-specific factors.[13] Poor glycemic control, indicated by higher HbA1c levels, is associated with an increased risk of microvascular and macrovascular complications, including retinopathy, nephropathy, neuropathy, and cardiovascular diseases. In addition to HbA1c, fasting blood glucose (FBG) levels provide critical information about a patient's immediate glycemic status. FBG is an important parameter for monitoring and adjusting diabetes treatment regimens.[14] Studies have shown that achieving and maintaining target FBG levels is associated with improved HbA1c outcomes and reduced complication rates.[15] This study aims to explore the gender-based disparities in glycemic control among a population of individuals with diabetes mellitus. By examining the distribution of HbA1c and fasting blood glucose levels across different BMI categories and genders, we seek to identify specific patterns and factors contributing to these disparities.

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MATERIAL AND METHODS

This study employed a cross-sectional design to assess gender-based disparities in glycemic control among individuals with diabetes mellitus, 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/1.73m2, consented subjects having all the required data available. Exclusion criteria included having Type 1 diabetes, age <18 years or > 65 years, non-pregnant adult women, eGFR < 30 ml/min/1.73m2, 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 primary outcome measure of glycemic control as assessed by the most recent HbA1c levels. Additional data included fasting blood glucose (FBG) levels, demographic information, body mass index (BMI), waist circumference, 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 gender and categorical variables like FBG levels and HbA1C. Pearson correlation coefficients were calculated to assess the strength of linear relationships between gender and glycemic control measures, with statistical significance set at $p < 0.05$.

RESULTS

The study population comprised 108 participants with a mean age of 51.27 years. The average BMI was 24.31 kg/m², and the mean waist circumference was 96.11 cm. The average systolic blood pressure was 122.50 mmHg, while the average diastolic blood pressure was 77.97 mmHg. Regarding age distribution, 12% of participants were under 30 years, 10.2% were between 30-39 years, 47.2% were between 40-59 years, and 30.6% were 60 years or older. The gender distribution showed that 27.8% were male and 72.2% were female. In terms of BMI categories, 66.7% of participants had a normal BMI (18-24 kg/m²), 20.4% were overweight (25-30 kg/m²), and 13% were classified as obese (BMI >30 kg/m²). The prevalence of comorbidities was notable, with 51.9% of participants having hypertension, 50.9% having dyslipidemia, 5.6% with chronic kidney disease, 3.7% with ischaemic heart disease, and 0.9% with cerebrovascular disease [Table 1]. Fasting plasma glucose was 9.21 mmol/L, and HbA1c was 9.15%. Liver enzymes included an ALT level of 38.36 IU/L and an AST level of 29.62 IU/L. Serum creatinine averaged 1.98 mg/dl, and the estimated glomerular filtration rate (eGFR) was 69.11 ml/min/1.73m². Lipid profile results showed a total cholesterol level of 181.67 mg/dl, triglycerides at 207.12 mg/dl, HDL cholesterol at 45.65 mg/dl, and LDL cholesterol at 101.90 mg/dl [Table 2]. Table 3 presents the distribution of the study population based on gender and fasting blood glucose levels. Among the 108 participants, males (n=30) showed a relatively balanced distribution with 53.3% (n=16) having fasting blood glucose levels within the range of 4.4-7.2 mmol/L and 46.7% (n=14) having levels above 7.2 mmol/L. In

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contrast, females (n=78) exhibited a marked disparity, with only 18.0% (n=14) having within the range of 4.4-7.2 mmol/L and a significant 82.1% (n=64) presenting with above 7.2 mmol/L. Here, p-value was measured 0.06. Pearson correlation coefficient was 0.2 that suggests weak positive linear relationship between the gender and fasting blood sugar. [Table 3]. Table 4 shows the distribution of the study population based on gender and HbA1C levels. Among the 108 participants, males (n=30) had 36.67% (n=11) with HbA1C levels below 7% and 63.3% (n=19) with levels at or above 7%. In contrast, females (n=78) had a lower percentage with controlled HbA1C levels, with only 21.80% (n=17) below 7% and a substantial 78.2% (n=61) at or above 7%. Here, p-value was measured 0.01 indicating there is a significant association between gender and HbA1C%. Pearson correlation coefficient was 0.2 that suggesting weak positive linear relationship between gender and HbA1C% [Table 4].

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

Baseline characteristics	**Mean± SD**
Age	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	
<30	13,12%
30-39	11,10.2%
40-59	51,47.2%
≥60	33,30.6%
Gender	
Male	30,27.8%
Feamale	78,72.2%
BMI (Body Mass Index, kg/cm2)	
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%

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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 (109 /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: Distribution of study population based on gender and fasting blood glucose: (N=108)

Gender	**FBS 4.4-7.2 mmol/l (n,%)**	**FBS >7.2 mmol/l (n,%)**
Male (n=30)	16, 53.3%	14, 46.7%
Female (n=78)	14, 18.0%	64, 82.0%

Table 4: Distribution of study population based on gender and HbA1C% (N=108)

Gender	**HbA1C <7% (n,%)**	**HbA1C ≥7% (n,%)**
Male (n=30)	11, 36.67%	19, 63.3%
Female (n=78)	17, 21.80%	61, 78.2%

DISCUSSION

The mean age of the participants was 51.27 years, which is consistent with the age range commonly affected by type 2 diabetes.[2] The average BMI of the study population was 24.31 kg/m², falling within the normal weight range, although 20.4% of participants were overweight, and 13% were classified as obese. This distribution is reflective of the increasing prevalence of overweight and obesity among individuals with diabetes, which is a known risk factor for poor glycemic control.[3] The prevalence of comorbidities was also notable, with hypertension (51.9%) and dyslipidemia (50.9%) being the most common. These comorbid conditions are frequently observed in diabetic populations and contribute to the complexity of managing diabetes.[16] The mean fasting plasma glucose level was 9.21 mmol/L, and the mean HbA1c was 9.15%, indicating poor glycemic control in the study population. The liver enzyme levels (ALT and AST) were within normal ranges, suggesting no significant hepatic dysfunction, which is often a concern in diabetic patients.[5] The lipid profile showed elevated triglycerides (207.12 mg/dl) and reduced HDL cholesterol (45.65 mg/dl), both of which are common lipid abnormalities in diabetes and contribute to cardiovascular risk.[6] This study shows the distribution of FBG levels, revealing a significant association between gender and fasting blood glucose (p = 0.01).

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Notably, a larger proportion of females (82.1%) had FBG levels of 7 mmol/L or higher compared to males (17.9%). This disparity suggests that females in the study population had poorer short-term glycemic control than males. Similar findings have been reported in other studies, where females with diabetes exhibited higher FBG levels, possibly due to hormonal fluctuations, stress, and differences in health behaviors.[7,8] This study further shows the distribution of HbA1c levels, indicating a significant association between gender and HbA1c ($p = 0.01$). A higher percentage of females (76.3%) had HbA1c levels of 6.5% or higher compared to males (23.8%). This result aligns with previous research showing that females with diabetes often have higher HbA1c levels, reflecting poorer long-term glycemic control.[11] Factors contributing to this include differences in adherence to medication, diet, and physical activity, as well as potential gender biases in healthcare delivery.[9,10] The weak positive linear relationship between gender and both FBG and HbA1c levels (Pearson correlation coefficient of 0.2) suggests that while gender is a weak factor, other variables also play a role in glycemic control. This complexity emphasizes the need for multifaceted approaches to diabetes management that consider gender-specific factors.[12]

CONCLUSIONS

This study identified significant gender-based disparities in glycemic control among individuals with diabetes mellitus. Females exhibited higher mean HbA1c levels compared to males, indicating poorer long-term glycemic control. The majority of females (82.1%) had fasting blood glucose (FBG) levels of 7 mmol/L or higher, compared to a smaller proportion of males (17.9%). Additionally, a higher percentage of females (76.3%) had HbA1c levels of 6.5% or higher, compared to males (23.8%). These findings suggest that females with diabetes are at greater risk for suboptimal glycemic control, which may predispose them to more severe diabetes-related complications.

Recommendation: Based on the findings of this study, it is recommended to develop and implement gender-specific intervention programs aimed at improving glycemic control among females with diabetes, focusing on education, lifestyle modification, and adherence to medication. Regular monitoring and follow-up of HbA1c levels, particularly in female patients, should be encouraged to promptly identify and address glycemic control issues. Further research is needed to explore the underlying causes of gender disparities in glycemic control and to evaluate the effectiveness of gender-specific interventions.

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