



Original Article



Frequency and Precipitating Factors of Hyperglycemic and Hypoglycemic Emergencies in Diabetic Patients Presenting at Tertiary Care Hospital, Islamabad

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ABSTRACT

Diabetes mellitus (DM) is a highly widespread chronic metabolic condition and one of the major challenges to the health care system because of its acute and chronic complications.

Objective: To determine the frequency and precipitating factors of hyperglycemic and hypoglycemic emergencies among diabetic patients presenting to a tertiary care hospital in Islamabad. **Methods:** A cross-sectional study at the Department of Medicine, Pakistan Institute of Medical Sciences, Islamabad, between 5th April 2025 and 5th October, 2025. The enrolled sample size was 150 diabetic patients with altered consciousness (GCS $\leq$ 13) between the ages of 30 and 80 years using non-probability consecutive sampling. A structured pre-tested proforma was used to gather socio-demographic and clinical information such as type and duration of diabetes, modality of treatment, comorbidity, and past glycemic emergency. The Chi-square test, t-test, and the Mann-Whitney U test was applied, and a p-value of less than 0.005 was considered statistically significant. **Results:** Hyperglycemic emergencies were found to be 64.0%, and hypoglycemic emergencies were found to be 36.0%. The predictors of hyperglycemia that had significant values were missed insulin/medication (AOR = 4.21, $p < 0.001$), infection (AOR = 3.67, $p = 0.001$), and poor dietary adherence (AOR = 1.92, $p = 0.045$). Hypoglycemia was independently predicted by excess levels of insulin/OHA (AOR = 5.62, $p < 0.001$). **Conclusion:** Hyper and hypoglycemic crises are frequently observed in diabetic patients, and they are mostly caused by modifiable factors, including missed medications, infections, noncompliance with diets, overdosing, and missed meals. By focusing on these particular factors, it is possible to minimize morbidity and enhance the outcome.

INTRODUCTION

Diabetes mellitus (DM) is a highly widespread chronic metabolic condition and one of the major challenges to the health care system because of its acute and chronic complications [1, 2]. Among them, hyperglycemic and hypoglycemic crises are life-threatening acute complications that often result in emergency department visits and hospitalization [3]. Hyperglycemic emergencies

encompass diabetic ketoacidosis (DKA) and hyperosmolar hyperglycemic state (HHS), compared to hypoglycemia, which involves mild cases of signs and symptoms, and in severe cases, this can be accompanied by coma, seizures, and death [4]. Diabetes has become a significant global problem in the past decades, especially in the low- and middle-income countries, where healthcare facilities are



scarce, and patient education is very poor [5]. A recent systematic review indicated that DKA, HHS, and severe hypoglycemia are among the most frequent acute diabetic crises, and the scope and predictors of those complications are not well defined in developing nations [6]. DKA and HHS are hyperglycemic crises that are usually precipitated by factors that can be identified [7]. Furthermore, the burden of hyperglycemic crises in the resource-constrained context is also subject to socio-economic barriers, low access to healthcare, and late presentation [8]. Various risk factors have been identified in studies, such as high doses of insulin, skipped meals, kidney failure, past cases of hypoglycemic events, and old age [9]. In 2024, a cross-sectional study stated that missing meals and hypoglycemic drugs were some of the most prevalent triggers of hypoglycemic events, and lifestyle behavior and treatment adherence were crucial [10]. Recognition of precipitating factors is essential to formulate specific interventions like patient education, structured follow-up, and protocol-driven management strategies in emergency departments. Early detection of high-risk persons and risk factors that can be managed will reduce hospitalization, enhance glycemic control, and reduce mortality related to diabetic crisis considerably. Additionally, tertiary care hospitals are referral hospitals, where acutely ill patients arrive and allow an analysis of the burden and trends related to such emergencies in a real-world clinical environment. This research seeks to offer evidence-based information to inform preventive measures, enhance clinical management guidelines, and minimize the cost of acute diabetic complications in Pakistan by determining the prevalent antecedents and patient factors linked to these emergencies.

The current study hypothesized that the primary causes of hyperglycemic crises would be missed medications, infections, and non-adherence to diet, whereas hyperglycemic crises would be related to excessive drug intake, lack of meals, and advanced age. The current study aimed to determine the frequency and the precipitating factors of hyperglycemic and hypoglycemic emergencies in diabetic patients presenting to a tertiary care hospital in Islamabad.

METHODS

It was a cross-sectional research study carried out in the Department of Medicine, Pakistan Institute of Medical Sciences (PIMS), Islamabad. The research was conducted and conducted in 6 months, from 5th April 2025 to 5th October, 2025. The Institutional Review and Ethics Board (IREB) of PIMS gave ethical approval (Approval No: F-5-2/2024(ERRC)/PIMS; dated 11th November 2024). The calculation of the sample size was determined based on the WHO sample size calculation software. Using a prevalence

rate of 46.6%, an error margin of 8%, and a confidence level of 95%, it was estimated that 150 patients were required [11]. The sampling technique used was a non-probability consecutive sampling method. Adults aged 30–80 years with a known diagnosis of type 1 or type 2 diabetes mellitus presenting to the Emergency Department of PIMS with altered consciousness (Glasgow Coma Scale ≤ 13) were recruited. Eligible participants included those with clinical and laboratory evidence of hyperglycemic crises or hypoglycemic crises. Patients were excluded if they had conditions that could independently affect glucose metabolism, including thyroid disorders, pregnancy, other endocrinopathies, or a history of malignancy or chemotherapy. After identifying the eligible patients, the patient gave informed consent or, in case the patient could not do it because of an altered mental status, an attendant or a legally authorized representative. Clinical and socio-demographic data, such as age, gender, residence, education, presentation symptoms, Glasgow Coma Scale [12], vital signs, and physical examination, were gathered prospectively during the presentation using a structured and pre-tested data collection pro forma. Routine diagnostic investigations, including random and fasting blood glucose, HbA1c, serum ketones, arterial blood gases, serum electrolytes, renal function test, and serum osmolality, were also documented at the presentation. These clinical and laboratory findings were then used to classify the patients as hyperglycemic or hypoglycemic emergencies. The factors that precipitated were determined via direct interviews with patients or their attendants.

The results were analyzed with the Statistical Package of Social Sciences (SPSS) version 26 (IBM Corp., Armonk, NY, USA). The Shapiro-Wilk test was used to test the normality of continuous variables. Continuous variables that were normally distributed were described in terms of mean and standard deviation (SD), and non-normally distributed variables were described in terms of median and interquartile range (IQR). Frequencies and percentages were used to describe categorical variables. The frequency of hyperglycemic and hypoglycemic emergencies was the primary outcome variable. Proportions representing the prevalence of each type of emergency were computed as 95% intervals. The Chi-square test was used to compare categorical variables. To compare the continuous variables, an independent samples t-test was applied to compare normally distributed data, whereas a Mann-Whitney U test was applied to compare non-normally distributed data. Binary logistic regression analysis was conducted to determine independent variables that were related to hyperglycemic and hypoglycemic crises. The data of variables whose p-value was less than 0.20 in the univariate analysis were included in the multivariate

logistic regression model. To identify the strength of association between precipitating factors and glycemic emergencies, adjusted odds ratios (AORs) and 95% confidence intervals were reported. Variance inflation factor (VIF) was used to test multicollinearity, and the Hosmer-Lemeshow goodness-of-fit test was used to test model fitness. All analyses were taken to be statistically significant at a p-value of less than 0.005.

RESULTS

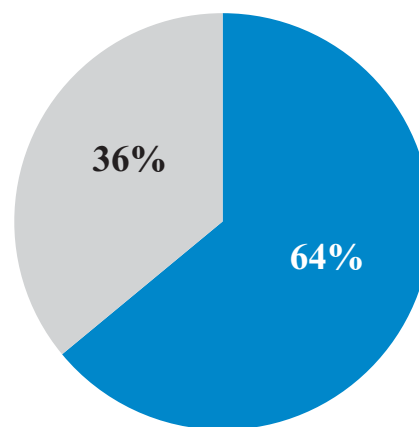
The study included 150 diabetic patients with glycemic emergencies, with a mean age of 57.4 ± 11.2 years and a slight male predominance. Most participants were urban residents and had type 2 diabetes, with a disease duration commonly between 5 and 10 years. Insulin was the most frequently used treatment, and a substantial proportion had prior glycemic emergencies and comorbid conditions, particularly hypertension (Table 1).

Table 1: Socio-Demographic and Clinical Characteristics of Study Participants (n=150)

Variables	Category	n (%) / Mean $\pm$ SD
Age (Years)	Mean $\pm$ SD	57.4 $\pm$ 11.2
Gender	Male	82 (54.7%)
	Female	68 (45.3%)
Residence	Urban	97 (64.7%)
	Rural	53 (35.3%)
Education Status	Illiterate	46 (30.7%)
	Primary	41 (27.3%)
	Secondary	38 (25.3%)
	Graduate & above	25 (16.7%)
Type of Diabetes	Type 1	38 (25.3%)
	Type 2	112 (74.7%)
Duration of Diabetes	<5 Years	44 (29.3%)
	5–10 Years	61 (40.7%)
	>10 Years	45 (30.0%)
Treatment Modality	Insulin	72 (48.0%)
	Oral Hypoglycemics	53 (35.3%)
	Combination therapy	25 (16.7%)
Previous Glycemic Emergency	Yes	59 (39.3%)
	No	91 (60.7%)
Comorbidities	Hypertension	98 (65.3%)
	Cardiovascular Disease	41 (27.3%)
	Chronic Kidney Disease	29 (19.3%)

There were 64.0% hyperglycemic crises, e.g., diabetic ketoacidosis and hyperosmolar hyperglycemic state, and 36.0% hypoglycemic crises. The 95% confidence interval of hyperglycemic emergencies was 54.4% to 73.6%, and the 95% confidence interval of hypoglycemic emergencies was 26.4% to 45.6% (Figure 1).

Frequency of Glycemic Emergencies



■ Hyperglycemic Emergencies (DKA/HHS) ■ Hypoglycemic Emergencies

Figure 1: Frequency of Glycemic Emergencies (n=150)

Hyperglycemic patients were generally younger with a shorter duration of diabetes but showed poorer long-term glycemic control, along with higher BMI, systolic blood pressure, and serum potassium levels. In contrast, hypoglycemic patients were older with longer disease duration and had relatively higher serum creatinine levels, indicating a possible association with impaired renal function. These findings highlight distinct clinical and metabolic profiles between the two groups (Table 2).

Table 2: Comparison of Continuous Variables by Emergency Type (n=150)

Variables	Hyperglycemic (n=96), Mean $\pm$ SD	Hypoglycemic (n=54), Mean $\pm$ SD	p-value
Age (years)	55.5 $\pm$ 11.0	60.0 $\pm$ 11.5	0.021*
Duration of Diabetes (years)	7 (4–10)	9 (5–13)	0.033*
Random Blood Glucose (mg/dL)	485 $\pm$ 130	52 $\pm$ 14	<0.001*
HbA1c (%)	10.9 $\pm$ 2.1	8.1 $\pm$ 1.7	<0.001*
BMI (kg/m ²)	28.1 $\pm$ 3.4	26.5 $\pm$ 3.1	0.012*
Systolic BP (mmHg)	138 $\pm$ 16	132 $\pm$ 15	0.045*
Diastolic BP (mmHg)	85 $\pm$ 10	82 $\pm$ 9	0.078
Serum Creatinine (mg/dL)	1.2 (0.9–1.5)	1.4 (1.1–1.8)	0.022*
Serum Potassium (mmol/L)	4.2 $\pm$ 0.5	3.7 $\pm$ 0.4	<0.001*

Missed medications, infections, and dietary noncompliance were significantly associated with hyperglycemic emergencies, whereas excessive medication intake and missed meals were the main triggers for hypoglycemia ($p < 0.005$). No significant differences were observed between the groups regarding cardiovascular events, recent surgery or trauma, or alcohol intake. These findings highlight distinct precipitating factors for each type of glycemic emergency (Table 3).

Table 3: Precipitating Factors of Glycemic Emergencies

Precipitating Factors	Hyperglycemic, n (%)	Hypoglycemic, n (%)	χ^2 Test	p-value
Missed Insulin/Medication	61 (63.5%)	12 (22.2)	26.4	<0.001*
Infection	52 (54.2%)	8 (14.8%)	23.7	<0.001*
Dietary Noncompliance	39 (40.6%)	11 (20.4%)	6.7	0.010*
Excess Insulin/OHA	4 (4.2%)	31 (57.4%)	56.3	<0.001*
Missed Meals	9 (9.4%)	29 (53.7%)	44.1	<0.001*
Cardiovascular Event	12 (12.5%)	6 (11.1%)	0.06	0.800
Surgery/Trauma	8 (8.3%)	3 (5.6%)	0.38	0.530
Alcohol Intake	6 (6.3%)	7 (13.0%)	1.9	0.170

Multivariate analysis identified non-adherence to medication, infections, and poor dietary compliance as key independent predictors of hyperglycemic emergencies. In contrast, excessive medication use, missed meals, and older age were strongly associated with hypoglycemic events. These findings highlight distinct risk profiles, emphasizing the need for targeted prevention and patient-specific management strategies (Table 4).

Table 4: Binary Logistic Regression Analysis of Factors Associated with Hyperglycemic and Hypoglycemic Emergencies (n=150)

Variables	Hyperglycemia AOR, (95% CI, p-value)	Hypoglycemia AOR, (95% CI, p-value)
Missed Insulin/Medication	4.21 (2.01-8.81), <0.001*	1.12 (0.50-2.52), 0.780
Infection	3.67 (1.74-7.75), 0.001*	1.31 (0.55-3.13), 0.540
Poor Dietary Adherence	1.92 (1.01-3.65), 0.045*	1.48 (0.73-3.02), 0.270
Duration of Diabetes >10 Years	1.88 (0.92-3.84), 0.080	1.21 (0.62-2.36), 0.570
Insulin Therapy	1.31 (0.67-2.56), 0.420	1.05 (0.49-2.23), 0.900
Excess Insulin/OHA Dose	0.87 (0.34-2.20), 0.770	5.62 (2.71-11.63), <0.001*
Missed Meals	0.92 (0.39-2.17), 0.850	4.87 (2.34-10.13), <0.001*
Older Age (>60 Years)	0.78 (0.36-1.66), 0.520	2.11 (1.01-4.42), 0.047*
Chronic Kidney Disease	1.13 (0.52-2.46), 0.760	1.94 (0.89-4.25), 0.090

DISCUSSION

Diabetic emergencies such as hyperglycemic episodes and hypoglycemic episodes are important morbidity and hospitalization causes in any part of the world. Hyperglycemic crises were more prevalent than hypoglycemic ones, as we found that almost two-thirds of the group were affected. The fact that missed insulin or medication doses and infection are the leading precipitating factors to hyperglycemic emergencies in this current study is consistent with the literature on this topic in developing countries, where noncompliance and intercurrent illness are the most common precipitations of severe hyperglycemia [13, 14]. In the same way, a cross-sectional study conducted in Pakistan by Rahak et al. reported that infection was the most frequently occurring precipitant of DKA (68.7%), with missed insulin doses

representing a smaller but significant fraction (12.2%) [15]. This finding is supported by longitudinal analyses indicating that long disease history is a risk factor for metabolic variability and complications. The current finding of longer diabetes history and worse long-term glycemic control (increased HbA1c) in hyperglycemic emergencies supports this finding. Whereas other studies have underlined the necessity of new-onset diabetes to act as a risk factor of DKA, especially within the context of type 1 diabetes, adult cohorts have repeatedly demonstrated chronic dysregulation as a significant predictor of severe hyperglycemia [6, 16]. Hypoglycemic crises were strongly linked to older age (>60 years) in our study, with an odds ratio of over twice that of younger patients (p=0.047). The result is consistent with the prior research, which established old age, kidney comorbidities, and some antidiabetic treatment as independent risk factors of inpatient hypoglycemia. Despite the important risk factor studies in hospitalized patients like that of Alghamdi et al. before 2021 which emphasized insulin regimen, infection and nutritional status as the determinants of inpatient hypoglycemia, modern cross-sectional studies in St. John's Medical College Hospital in India, observed older age, lower education, renal comorbidities, and the use of sulfonylureas as the independent risk factors of inpatient hypoglycemic episodes [17, 18]. This is in accordance with our results that the odds of hypoglycemia were more than twice when age >60 years (p=0.047). Comparative international studies reinforce both similarities and differences. The multicenter retrospective observational study on infections in DKA and HHS highlighted respiratory and urinary infections as frequent triggers, echoing our data, where infections substantially raised the risk of hyperglycemic emergencies [19]. Additionally, research examining outcomes in diabetic emergencies among acute care settings in North India identified DKA as the most frequent endocrine emergency, with advanced age and comorbidities correlating with severity and adverse outcomes, aligning with our findings on age and prolonged disease duration contributing to emergency risk [20].

This study provides important insights into the frequency and precipitating factors of diabetic emergencies, but several limitations should be acknowledged. It was conducted at a single tertiary hospital, limiting generalizability, and its cross-sectional design prevents causal inference. Reliance on patient recall for medication adherence, diet, and missed meals may introduce bias, while incomplete laboratory data restricts comprehensive biochemical assessment. A prevalence of 46.6% of the population in Italy was used to calculate the sample size, which might not be the best representation of a local Pakistani setting because of the demographic and healthcare systems differences. This dependency on

foreign data may influence the external validity of the results and must be taken into account during the interpretation of the results. Despite these limitations, the findings identify key modifiable risk factors that can inform targeted interventions to prevent acute glycemic crises. Further studies in Pakistan and other South Asian communities should focus on larger multicenter studies that can confirm the prevalence and precipitating factors of glycemic emergencies. Structured medication adherence programs, dietary counseling, and personalized antidiabetic therapy for older adults should be evaluated by interventional studies. Also, implementing predictive risk tools in emergency departments could help identify individuals at high risk early and reduce the number and severity of hyperglycemic and hypoglycemic crises.

CONCLUSIONS

Hyperglycemic and hypoglycemic crises continue to be a major burden on diabetic patients and have unique precipitating factors. Hyperglycemic crises can be mainly linked to missed medications, infections, and lack of adherence to a healthy diet, and hypoglycemic emergencies are more susceptible in older patients. They are provoked by an overdose of medications and missed food.

Authors' Contribution

Conceptualization: MAA

Methodology: JH, SW, MH

Formal analysis: JH

Writing and Drafting: JH, MAA, MH, AK, MS

Review and Editing: JH, MAA, SW, MH, AK, MS

All authors approved the final manuscript and take responsibility for the integrity of the work

Conflict of Interest

All the authors declare no conflict of interest.

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