

ORIGINAL ARTICLE

Frequency and Outcomes of Hypoglycemia among Diabetic Patients Presenting to the Emergency Department

ZAHID ULLAH KHAN¹, HASHMAT ULLAH², SHUAIB KHAN³, HUMA RAHMAN⁴, MUHAMMED MEHRAN KHAN⁵, FAHAD IQBAL⁶

¹Assistant Professor, Emergency Medicine Department, MTI Lady Reading Hospital Peshawar, Pakistan.

²Assistant Professor, Medicine Department, MTI Lady Reading Hospital Peshawar, Pakistan.

³Resident Emergency Medicine, MTI Lady Reading Hospital Peshawar, Pakistan.

⁴Resident Emergency Medicine, MTI Lady Reading Hospital Peshawar, Pakistan.

⁵Resident Emergency Medicine, MTI Lady Reading Hospital Peshawar, Pakistan.

⁶Resident Emergency Medicine, MTI Lady Reading Hospital Peshawar, Pakistan.

Correspondence to: Hashmat Ullah, Email: dr_hashmatkhan134@yahoo.com

ABSTRACT

Background: Hypoglycemia is a frequent and potentially life-threatening complication of diabetes mellitus, often leading to emergency department (ED) visits and adverse clinical outcomes. Data from South Asian tertiary care settings remain limited. This study aimed to determine the frequency and short-term outcomes of hypoglycemia among diabetic patients presenting to the ED of Lady Reading Hospital, Peshawar.

Objective: To determine frequency, clinical characteristics, precipitating factors, and short-term outcomes of hypoglycemia among diabetic patients presenting to emergency department.

Methods: The prospective observational study was carried out between January 2022 to December 2022 and covered adult diabetic patients who reported being hypoglycemic (≤ 70 mg/dL). Demographic, clinical patterns, triggers, and outcomes such as hospitalization, need of ICU, relapse, hospital stay, and in-hospital fatality were documented and studied.

Results: Out of 5, 842 EDs of diabetes, 412 patients experienced hypoglycemia, equating to 7.1% of the frequency. Mean age was 56.8 and 14.2 old, 54.6% were male. Diabetes type 2 was 88.3, and 62.4% were undergoing insulin-based treatment. Hypoglycemia was severe in 38.6 percent healthcare recipients. The prevalent precipitating factors were missed meals (31.3%), overdose of medicine (21.8%), kidney failure (18.0%), and infection (15.5%). All in all, 64.3 percent had to be hospitalized and 14.8 percent had to be placed in the ICU. Hypoglycemia was frequent (12.6) when hospitalized. The average days of stay was 3.9 days with a standard deviation of 2.7 days. The in-hospital mortality rate was 6.3, which was considerably high in severe hypoglycemia (12.6% vs. 2.1, $p < 0.001$).

Conclusion: Hypoglycemia represents a substantial proportion of diabetic ED visits and is strongly associated with adverse outcomes, particularly in severe cases.

Keywords: Hypoglycemia, Diabetes mellitus, Emergency department, Insulin therapy, Intensive care unit, Mortality.

INTRODUCTION

Diabetes mellitus is one of the most acute health-related problems of the 21st century globally, with the prevalence rates soaring both in the developed and developing countries.^{1,2} The International Diabetes Federation acknowledges that, at present, hundreds of millions of grown-ups all over the world live with diabetes, and the amount is estimated to grow significantly over the next decades³. This is especially a heavy burden in the low- and middle-income countries, as the healthcare systems of these countries have to struggle with substantial limitations of delivering comprehensive chronic disease management⁴. Hypoglycemia is one of the most common and potentially deadly emergent situations associated with diabetes and presents one of the acute metabolic complications of diabetes.⁵

Hypoglycemia is traditionally referred to as a 70mg/dL of blood glucose or 3.9mmol/L, yet clinically significant hypoglycemia is deemed at a level of 54mg/dl or below⁶. It forms a serious impediment in ideal glycemic control since fear of hypoglycemia often restricts therapy escalation and therapy demands.^{7,8,9} Although, strict glycemic control has proved to be effective in reducing long-term microvascular complications, significant clinical trials like ACCORD and ADVANCE have indicated that intensive therapy also carries greater risk of severe hypoglycemia that may counter any possible benefits in some groups of patients^{10,11}. Consequently, hypoglycemia has emerged not only as an adverse effect of therapy but also as an independent determinant of morbidity and mortality¹².

The pathophysiology of hypoglycemia in diabetic patients is multifactorial. It commonly results from an imbalance between glucose-lowering therapies particularly insulin and sulfonylureas and physiological demands¹³. Contributing factors include missed meals, excessive physical activity, alcohol intake, renal or hepatic dysfunction, sepsis, and medication errors^{14,15}. Progressive impairment of counter-regulatory hormonal responses in long-standing diabetes further predisposes patients to recurrent and severe episodes, a phenomenon described as hypoglycemia-

associated autonomic failure (HAAF)^{16,17}. This blunted physiological response increases the risk of neuroglycopenic manifestations such as confusion, seizures, and coma, which frequently necessitate emergency department (ED) visits¹⁸.

Emergency departments serve as the frontline interface between acute metabolic crises and definitive care. Hypoglycemia accounts for a substantial proportion of diabetes-related ED presentations and hospital admissions worldwide^{19,20}. Population-based studies from high-income settings have demonstrated that severe hypoglycemia is associated with increased risk of cardiovascular events, arrhythmias, cognitive decline, prolonged hospitalization, and death^{21,22}. Moreover, recurrent episodes impose significant economic burden on healthcare systems due to repeated ED utilization, ambulance services, and inpatient care²³. Despite these established risks, hypoglycemia remains underreported in many regions, particularly in South Asia, where structured surveillance systems are limited²⁴.

In Pakistan and similar settings, the prevalence of diabetes has risen sharply over the past two decades, driven by urbanization, sedentary lifestyles, and dietary transitions^{25,26}. It is reported by national survey that there is an increasing burden of type 2 diabetes, with significant proportions of patients left to be detected or controlled²⁷. Nonetheless, there is no information on the prevalence and clinical outcome of hypoglycemia in diabetic patients reporting to emergency departments²⁸. Variations in prescribing practices, limited access to structured diabetes education, inconsistent self-monitoring of blood glucose, and delayed healthcare-seeking behavior may further modify the clinical profile and outcomes of hypoglycemic events in this population²⁹.

Importantly, severe hypoglycemia has been increasingly recognized as a marker of frailty and comorbidity rather than merely a pharmacologic complication³⁰. Observational studies suggest a bidirectional relationship between hypoglycemia and adverse cardiovascular outcomes, possibly mediated through sympathoadrenal activation, inflammatory responses, endothelial

dysfunction, and prothrombotic pathways^{15,21}. In addition, hypoglycemia-related neurological injury may have lasting cognitive implications, particularly among elderly individuals²². These emerging insights underscore the need for systematic evaluation of hypoglycemia patterns and outcomes in real-world emergency settings.

Given the rising burden of diabetes and the potentially grave consequences of hypoglycemia, there is a critical need to quantify its frequency and characterize associated outcomes in tertiary care emergency departments. This kind of evidence plays a key role in informing institutional practices, maximizing risk assessment, and informing preventive measures. Thus the purpose of the study was to identify the prevalence rate of hypoglycemia in diabetic patients and wastes in the Emergency Department of the Lady Reading Hospital and also to assess the short-term clinical outcomes of hypoglycemia such as hospital admission, intensive care need, recurrence and in-hospital mortality.

METHODOLOGY

This proposed observational study was carried out in the Emergency Department of Lady Reading Hospital, which is a tertiary care teaching hospital and situated in Peshawar, Pakistan, during a period of 12 months between January 2022 and December 2022. The objective of the study was to find out the incidence and clinical outcome of hypoglycemia in adult diabetic patients who visited the emergency department (ED). Eligible were all consecutive patients aged ≥ 18 years who made a presentation and had a prior diagnosis of type 1 or type 2 diabetes mellitus and had a documented episode of hypoglycemia (random blood glucose level ≤ 70 mg/dL at presentation, or a documented episode of hypoglycemia before arrival with verifiable records). Patients who had hypoglycemia that was not diabetes-related, gestational diabetes, pregnancy-related hypoglycemia, incomplete clinical data, or patients who refused to participate were eliminated.

A structured proforma was developed to collect data with the help of a predefined structured proforma by trained emergency physicians. The recorded variables were demographic variables (age, sex), type and course of diabetes, the mode of treatment (insulin, oral hypoglycemic agents, or combination therapy), comorbid conditions, precipitating factors (missed meals, non-compliance with medications, renal impairment, infection, excessive physical activity), clinical presentation, the Glasgow Coma Scale (GCS) score of the arrival, laboratory parameters, and time to restore normal blood glucose levels. Hypoglycemia was graded as mild (autonomic symptoms, preserved consciousness), moderate (altered mental status, responsive) or severe (needed third-party attention, convulsions or unconsciousness).

Its main finding was the frequency of the occurrence of hypoglycemia in diabetic patients who visited ED. Secondary outcomes studied are hospital admission rate, required intensive care unit (ICU) transfer, hospitalization recurrence of hypoglycemia, length of stay and in-hospital mortality. Patients were trailed up to admission or death.

Analysis of data was done with the SPSS version 26.0. The continuous variables were either represented by mean \pm standard deviation or median with interquartile range, as appropriate; whereas categorical variables were reported in the form of frequencies and percentages. Chi-square or Fisher exact test when variables are categorical and independent sample t-test or Mann-Whitney U test when variables are continuous were used to evaluate the associations between the severity of hypoglycemia and clinical outcomes. A p-value of less than 0.05 was taken to be statistically significant. The study was initiated with ethical approval by the Institutional Review Board of Lady Reading Hospital before starting the study.

RESULTS

In the study period (January 2022- December 2022), 5,842 patients with diabetic patients visited the Emergency Department

(ED) of Lady Reading Hospital. Of these 412 patients were found with recorded hypoglycemia, and the frequency in diabetic ED visits amounted to 7.1%.

The study patients included 56.8 heterogeneous age with an average of 56.8 ± 14.2 years with a marginal preponderance of males (54.6). Most of them were patients with type 2 diabetes mellitus (88.3%), with a mean age of diabetes of 9.7 ± 6.1 years. Treatment with insulin (or with or without combinations) was seen in 62.4% of patients. There were 38.6 instances of severe hypoglycemia recorded.

Missed meals were the most predominant precipitating factors (31.3%), followed by insulin or oral hypoglycemic agent overdose (21.8%), renal impairment (18.0%), and infection (15.5%). During presentation, the proportion of patients with a Glasgow Coma Scale (GCS) score of 8 or less amounted to 29.1%.

In total, 64.3 percent of the patients had to be admitted to the hospital, whereas 14.8 percent had to be transferred to the intensive care unit (ICU). Hypoglycemia was recurrent in 12.6% of the cases. The average hospital stay was 3.9 means of 2.7 days. The in-hospital death ratio was 6.3, and it was much higher in patients with severe hypoglycemia than with mild/moderate (12.6 vs. 2.1, $p < 0.001$). ICU admission and a long stay in a hospital were also strongly linked with severe hypoglycemia ($p < 0.001$).

Severe hypoglycemia demonstrated a strong association with adverse outcomes, including higher rates of ICU admission, prolonged hospitalization, and mortality. These findings underscore the substantial clinical burden of hypoglycemia among diabetic patients presenting to the ED.

Table 1. Baseline Demographic and Clinical Characteristics (n = 412)

Variable	Value
Age (years), mean \pm SD	56.8 \pm 14.2
Male gender, n (%)	225 (54.6)
Type 2 Diabetes Mellitus, n (%)	364 (88.3)
Duration of diabetes (years), mean \pm SD	9.7 \pm 6.1
Insulin therapy (alone/combination), n (%)	257 (62.4)
Oral hypoglycemic agents only, n (%)	155 (37.6)
Severe hypoglycemia, n (%)	159 (38.6)
GCS ≤ 8 at presentation, n (%)	120 (29.1)

Table 2. Precipitating Factors of Hypoglycemia

Precipitating Factor	n (%)
Missed meals	129 (31.3)
Drug overdose (insulin/OHA)	90 (21.8)
Renal impairment	74 (18.0)
Infection	64 (15.5)
Excessive physical exertion	33 (8.0)
Unknown	22 (5.3)

Table 3. Clinical Outcomes According to Severity of Hypoglycemia

Outcome	Mild/Moderate (n=253)	Severe (n=159)	p-value
Hospital admission, n (%)	139 (54.9)	126 (79.2)	<0.001
ICU admission, n (%)	18 (7.1)	43 (27.0)	<0.001
Recurrent hypoglycemia, n (%)	21 (8.3)	31 (19.5)	0.001
Length of stay (days), mean \pm SD	2.8 \pm 1.9	5.4 \pm 3.1	<0.001
In-hospital mortality, n (%)	5 (2.1)	20 (12.6)	<0.001

DISCUSSION

In this prospective study conducted at a high-volume tertiary care emergency department, hypoglycemia accounted for 7.1% of all diabetic presentations, underscoring its substantial burden in acute care settings⁸. The observed frequency aligns with reports from comparable low- and middle-income countries, where limited structured diabetes education, inconsistent follow-up, and high reliance on insulin therapy contribute to increased vulnerability to hypoglycemic events^{1,27}. Our findings reinforce the persistent challenge of balancing glycemic control with patient safety, particularly in resource-constrained environments^{5,12}.

The predominance of older adults with long-standing type 2 diabetes reflects the cumulative risk associated with disease

duration, polypharmacy, and progressive β -cell dysfunction¹⁰. Notably, nearly two-thirds of patients were receiving insulin-based regimens, consistent with evidence that insulin therapy remains a major predictor of severe hypoglycemia¹². Renal impairment and infection emerged as significant precipitating factors, likely due to impaired drug clearance and increased metabolic stress, respectively¹³. Missed meals were the most frequent trigger, highlighting the importance of dietary counseling and individualized treatment planning²⁹.

A key finding of this study is the strong association between severe hypoglycemia and adverse clinical outcomes, including higher ICU admission rates, prolonged hospital stay, and increased in-hospital mortality^{8,15}. The mortality rate of 6.3%, rising to 12.6% in severe cases, emphasizes that hypoglycemia is not merely a transient metabolic disturbance but a potentially life-threatening condition^{12,15}. The association between low GCS at presentation and worse outcomes further supports prior evidence that neuroglycopenia contributes to poor prognosis, particularly in elderly and comorbid patients¹⁴.

Recurrent hypoglycemia during hospitalization occurred in a notable proportion of patients, suggesting gaps in inpatient glucose monitoring protocols or insufficient adjustment of antidiabetic regimens following initial stabilization²¹. This finding highlights the need for standardized hypoglycemia management pathways, including medication reconciliation, risk stratification, and early endocrinology consultation where feasible¹⁶.

Collectively, our results underscore the critical importance of preventive strategies, including patient education, individualized glycemic targets, renal function-guided dose adjustments, and improved outpatient follow-up systems^{9,28,30}. Emergency departments in high-burden settings must also adopt structured protocols to identify high-risk individuals and mitigate recurrence²⁰. Future multicenter studies are warranted to validate these findings and to evaluate the impact of targeted interventions on reducing hypoglycemia-related morbidity and mortality^{8,12}.

CONCLUSION

As this study has shown, hypoglycemia is a large percentage of diabetic presentations to the emergency department as well as a serious cause of morbidity and mortality. Acute hypoglycemia especially was also strongly associated with increased ICU admission, longer hospital stay, frequent incidence, and the risk of in-hospital mortality. The significant contributing factors were insulin therapy, missed meals, renal impairment, and infections. These data point to the fact that hypoglycemia is not a passing metabolic imbalance but an indicator of predisposition and ill prognosis particularly in patients with a history of diabetes and comorbid conditions. Structured preventive interventions, such as a personalized glycemic goal, patient education, prescription of insulin and close follow-up, can decrease recurrence and enhance results. In order to reduce clinical and economic the burden of hypoglycemia in high-risk groups, ED-based risk stratification and inpatient glucose-monitoring protocols should be strengthened.

REFERENCES

- Standl, E., Khunti, K., Hansen, T. B., & Schnell, O. (2019). The global epidemics of diabetes in the 21st century: Current situation and perspectives. *European journal of preventive cardiology*, 26(2_suppl), 7-14.
- Goyal, Y., Verma, A. K., Bhatt, D., Rahmani, A. H., & Dev, K. (2020). Diabetes: perspective and challenges in modern era. *Gene Reports*, 20, 100759.
- Saeedi, P., Petersohn, I., Salpea, P., Malanda, B., Karuranga, S., Unwin, N., ... & IDF Diabetes Atlas Committee. (2019). Global and regional diabetes prevalence estimates for 2019 and projections for 2030 and 2045: Results from the International Diabetes Federation Diabetes Atlas. *Diabetes research and clinical practice*, 157, 107843.
- Hajat, C., & Stein, E. (2018). The global burden of multiple chronic conditions: a narrative review. *Preventive medicine reports*, 12, 284-293.
- Bae, J. H., & Kim, S. G. (2021). Management of Acute Complications of Diabetes Mellitus. In *Stroke Revisited: Diabetes in Stroke* (pp. 217-227). Singapore: Springer Singapore.
- Balijepalli, C., Druyts, E., Siliman, G., Joffres, M., Thorlund, K., & Mills, E. J. (2017). Hypoglycemia: a review of definitions used in clinical trials evaluating antihyperglycemic drugs for diabetes. *Clinical epidemiology*, 291-296.
- Przekaz, A., Bielka, W., & Mołęda, P. (2022). Fear of hypoglycemia—An underestimated problem. *Brain and behavior*, 12(7), e2633.
- Maheswaran AB, Gimbar RP, Eisenberg Y, Lin J. Hypoglycemic Events in the Emergency Department. *Endocr Pract*. 2022 Apr;28(4):372-377. doi: 10.1016/j.eprac.2022.01.006. Epub 2022 Jan 25. PMID: 35085822.
- American Diabetes Association Professional Practice Committee, & American Diabetes Association Professional Practice Committee. (2022). 6. Glycemic targets: standards of medical care in diabetes—2022. *Diabetes care*, 45(Supplement_1), S83-S96.
- Crabtree, T., Ogendo, J. J., Vinogradova, Y., Gordon, J., & Idris, I. (2022). Intensive glycemic control and macrovascular, microvascular, hypoglycemia complications and mortality in older (age ≥ 60 years) or frail adults with type 2 diabetes: a systematic review and meta-analysis from randomized controlled trial and observation studies. *Expert Review of Endocrinology & Metabolism*, 17(3), 255-267.
- Tian, J., Ohkuma, T., Cooper, M., Harrap, S., Mancía, G., Poulter, N., ... & Chalmers, J. (2020). Effects of intensive glycemic control on clinical outcomes among patients with type 2 diabetes with different levels of cardiovascular risk and hemoglobin A1c in the ADVANCE trial. *Diabetes Care*, 43(6), 1293-1299.
- Silbert, R., Salcido-Montenegro, A., Rodriguez-Gutierrez, R., Katabi, A., & McCoy, R. G. (2018). Hypoglycemia among patients with type 2 diabetes: epidemiology, risk factors, and prevention strategies. *Current diabetes reports*, 18(8), 53.
- Nakhleh, A., & Shehadeh, N. (2021). Hypoglycemia in diabetes: An update on pathophysiology, treatment, and prevention. *World journal of diabetes*, 12(12), 2036.
- Cryer, P. E., & Arbeláez, A. M. (2017). Hypoglycemia in diabetes. *Textbook of diabetes*, 513-533.
- Agrawal, S., Makuch, S., Drózdź, M., Dudzik, T., Domański, I., Poręba, R., & Mazur, G. (2022). The impact of hypoglycemia on patients with diabetes mellitus: a cross-sectional analysis. *Journal of Clinical Medicine*, 11(3), 626.
- Lontchi-Yimagou, E., You, J. Y., Carey, M., Gabrieli, I., Shamoon, H., & Hawkins, M. (2018). Potential approaches to prevent hypoglycemia-associated autonomic failure. *Journal of Investigative Medicine*, 66(3), 641-647.
- Muneer, M. (2020). Hypoglycaemia. *Diabetes: from Research to Clinical Practice: Volume 4*, 43-69.
- Yale, J. F., Paty, B., Senior, P. A., & Diabetes Canada Clinical Practice Guidelines Expert Committee. (2018). Hypoglycemia. *Canadian journal of diabetes*, 42, S104-S108.
- Levi, O. U., Webb, F., & Simmons, D. (2020). Diabetes detection and communication among patients admitted through the emergency department of a public hospital. *International Journal of Environmental Research and Public Health*, 17(3), 980.
- Echouffo-Tcheugui, J. B., & Garg, R. (2017). Management of hyperglycemia and diabetes in the emergency department. *Current diabetes reports*, 17(8), 56.
- Betten DP, Castle DJ, Hughes MJ, Henney JN. Frequency of return visits to the emergency department in patients discharged following hypoglycemia episodes. *Int J Emerg Med*. 2018 May 24;11(1):28. doi: 10.1186/s12245-018-0186-7. PMID: 29799604; PMCID: PMC5968011.
- Misra-Hebert, A. D., Pantalone, K. M., Ji, X., Milinovich, A., Dey, T., Chagin, K. M., ... & Zimmerman, R. S. (2018). Patient characteristics associated with severe hypoglycemia in a type 2 diabetes cohort in a large, integrated health care system from 2006 to 2015. *Diabetes Care*, 41(6), 1164-1171.
- Shi, L., Fonseca, V., & Childs, B. (2021). Economic burden of diabetes-related hypoglycemia on patients, payors, and employers. *Journal of Diabetes and its Complications*, 35(6), 107916.
- Emral, R., Pathan, F., Cortés, C. A. Y., El-Hefnawy, M. H., Goh, S. Y., Gómez, A. M., ... & IO HAT Investigator Group. (2017). Self-reported hypoglycemia in insulin-treated patients with diabetes: Results from an international survey on 7289 patients from nine countries. *Diabetes research and clinical practice*, 134, 17-28.
- Hills, A. P., Arena, R., Khunti, K., Yajnik, C. S., Jayawardena, R., Henry, C. J., ... & Misra, A. (2018). Epidemiology and determinants of type 2 diabetes in south Asia. *The lancet Diabetes & endocrinology*, 6(12), 966-978.

26. Siddiqui, K., Joy, S. S., & Nawaz, S. S. (2019). Impact of early life or intrauterine factors and socio-economic interaction on diabetes-An evidence on thrifty hypothesis. *Journal of lifestyle medicine*, 9(2), 92.
27. Aamir, A. H., Ul-Haq, Z., Mahar, S. A., Qureshi, F. M., Ahmad, I., Jawa, A., ... & Heald, A. H. (2019). Diabetes Prevalence Survey of Pakistan (DPS-PAK): prevalence of type 2 diabetes mellitus and prediabetes using HbA1c: a population-based survey from Pakistan. *BMJ open*, 9(2), e025300.
28. Li S, Li Y, Zhang L, Bi Y, Zou Y, Liu L, Zhang H, Yuan Y, Gong W, Zhang Y. Impact of fear of hypoglycaemia on self-management in patients with type 2 diabetes mellitus: structural equation modelling. *Acta Diabetol*. 2022 May;59(5):641-650. doi: 10.1007/s00592-021-01839-y. Epub 2022 Jan 27. Erratum in: *Acta Diabetol*. 2022 May;59(5):651. doi: 10.1007/s00592-022-01868-1. PMID: 35083591.
29. Robinson, S., Newson, R. S., Liao, B., Kennedy-Martin, T., & Battelino, T. (2021). Missed and mistimed insulin doses in people with diabetes: a systematic literature review. *Diabetes Technology & Therapeutics*, 23(12), 844-856.
30. Freeman, J. (2019). Management of hypoglycemia in older adults with type 2 diabetes. *Postgraduate Medicine*, 131(4), 241-250.