DOI: https://doi.org/10.4038/jccp.v56i2.8163

Risk factors, clinical characteristics, and outcomes of hypoglycaemia at a tertiary care hospital in Sri Lanka: A prospective observational study

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Journal of the Ceylon College of Physicians, 2025, **56**, 93-100

Abstract

Introduction: Hypoglycaemia represents a significant clinical challenge globally, particularly in resource-limited settings and among patients with diabetes mellitus (DM) and chronic kidney disease (CKD). Limited data is available on the clinical patterns and outcomes of hypoglycaemia in these populations. This study aimed to analyse risk factors, clinical characteristics, and outcomes of patients with hypoglycaemia presenting to a tertiary care centre in Sri Lanka.

Methods: A prospective observational study was carried out at the Colombo North Teaching Hospital from June to December 2024. Adult patients presenting with capillary blood glucose <70 mg/dL were enrolled using consecutive sampling. Data were collected through structured interviews and review of medical records.

Results: We studied 58 patients (mean age 65 years, 53.4% female) admitted with hypoglycaemia. DM was present in 52 patients (89.7%), with 33/52 (63.5%) having disease duration of less than 10 years. CKD affected 34/52 diabetic patients (65.4%), while 2 patients had hypoglycaemia with CKD but without diabetes. Only 4/52 diabetic patients (7.7%) had recent HbA1c recordings. Among diabetic patients, 30/52 (57.7%) were on high-dose gliclazide, 13/52 (25%) on insulin, and 11/52 (21.2%) on combination sulfonylurea-insulin therapy. Severe hypoglycaemia (level 3) occurred in 50/58 patients (86.2%), while level 1 and level 2 hypoglycaemia occurred in 4/58 patients each (6.9%). Common precipitating factors were reduced oral intake in 29/58 (50%), high-dose antidiabetic therapy in 27/58 (46.6%), and sepsis in 23/58 (39.7%). Mortality was 12.1% (7/58), with higher rates observed in those with advanced CKD and malnutrition.

Conclusions: Hypoglycaemia is a common yet often overlooked healthcare challenge. Elderly diabetic patients with multiple comorbidities, especially CKD, are the most vulnerable. Inadequate glycaemic monitoring and high-dose sulfonylurea use significantly contributed to severe episodes. Focus should be on improving diabetes education, optimising medication, and providing targeted care for vulnerable groups.

Key words: hypoglycaemia, diabetes, chronic kidney disease, Sri Lanka

Introduction

Hypoglycaemia, defined as blood glucose concentration below 70 mg/dL (3.9 mmol/L), is a critical medical emergency. It is characterised by Whipple's triad: symptoms of hypoglycaemia, documented low plasma glucose levels, and resolution of symptoms following normalisation of glucose levels. Manifestations range from mild adrenergic symptoms (diaphoresis, tremors, palpitations) to severe neuroglycopenic effects (confusion, seizures, coma).[1] The brain's absolute glucose dependence makes prolonged hypoglycaemia particularly dangerous,

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Received 28 July 2025, accepted 25 August 2025.

potentially causing irreversible neuronal injury and dementia.[2,3] Beyond the acute episode, hypoglycaemia increases mortality risk, duration of hospitalisation, healthcare costs,[4] morbidity from falls, arrhythmias, cognitive decline, and cardiovascular events.[5,6]

Among diabetic patients, 37-64% of insulin-treated and 30% of sulfonylurea-treated individuals report hypoglycaemic episodes annually.[7,8] Chronic kidney disease (CKD) is a significant risk factor for hypoglycaemia, through several mechanisms: poor nutrition, sarcopenia with reduced glycogen reserves, impaired insulin clearance, defective insulin degradation, impaired renal gluconeogenesis, and altered counterregulatory hormone responses.[9,10] Other significant risk factors include hepatic dysfunction, malnutrition, sepsis, malignancy, alcohol excess, congestive heart failure, and endocrine disorders.[11,12]

Most research and clinical guidelines on hypoglycaemia originate from high-income countries with well-developed healthcare systems. This creates a significant knowledge gap regarding the impact of hypoglycaemia in resource-limited settings, where the burden of diabetes is rapidly increasing while healthcare infrastructure faces substantial constraints. While the global prevalence of hypoglycaemia is 6.8% in adults,[13] data from resource-limited settings indicate potentially higher rates and more severe presentations: 25.4% of Indonesian type 2 diabetes patients experienced severe hypoglycaemia within one year.[14] Similarly, research from Sri Lanka found that 26.1% of outpatient diabetic patients reported hypoglycaemic symptoms in the preceding month.[15]

Resource-limited settings face unique challenges, including limited access to continuous glucose monitoring, delayed laboratory results, restricted availability of glucagon, limited specialised endocrinology expertise, more advanced disease states, multiple comorbidities, and social determinants of health inequalities.[16,17] Understanding local epidemiology, risk factors, and outcomes is crucial for developing preventive strategies, improving management protocols, and optimising resource allocation in these populations. This study aimed to identify risk factors, causes, clinical presentations and outcomes of patients admitted with hypoglycaemia to an acute medical ward in a tertiary care centre in Sri Lanka.

Methodology

We conducted a prospective observational study in two medical wards (male and female wards of the same unit) at the Colombo North Teaching Hospital, Sri Lanka, from June to December 2024. Adult patients (≥18 years) who were admitted with hypoglycaemia, defined as capillary blood glucose <70 mg/dL, were enrolled using consecutive sampling. Patients who did not consent or developed hypoglycaemia after admission to the hospital were excluded. Capillary blood glucose was chosen as the inclusion criterion as it represents the standard method for rapid glucose assessment.

Data were collected through structured face-to-face interviews conducted by a medical officer using a validated questionnaire and review of medical records. Information included demographic characteristics, comorbidities, medications, clinical presentation, laboratory results, treatment, and outcomes. Details on diabetes management, including medication dosage and glycaemic control records, were obtained. CKD was defined as either proteinuria or glomerular filtration rate <60 mL/min/1.73m^2 persisting for 3 months or more, according to Kidney Disease Improving Global Outcomes (KDIGO) criteria.18 Hypoglycaemia severity was classified according to the American Diabetes Association criteria: Level 1 (glucose <70 mg/dL but ≥54 mg/dL), Level 2 (glucose <54 mg/dL), and Level 3 (severe hypoglycaemia characterised by altered mental and/or physical status requiring assistance).[1]

Anthropometric measurements were taken from standard ward measurements on admission or before discharge. Mid-upper arm circumference (MUAC) was measured at the midpoint between the acromion and olecranon using a non-stretching tape measure with the arm straight. Underweight was defined as BMI <18.5 kg/m^2 or MUAC <23.5 cm, while severe wasting was defined as MUAC <20 cm for men and <19 cm for women, per WHO criteria.[19,20] Descriptive statistics were used to characterise the study population. Categorical variables were presented as frequencies and percentages with 95% confidence intervals, while continuous variables were expressed as means with ranges. Subgroup analyses were performed for patients with CKD and those who died during hospitalisation.

Ethical approval was obtained from the Ethics Review Committee of the Faculty of Medicine, University of Kelaniya, Sri Lanka. Informed written consent was obtained from all participants or their legally authorised representatives.

Results

Patient characteristics

Fifty-eight patients were enrolled during the six-month study period, representing 0.92% of 6,339 total admissions. Mean age was 65 years (range: 36-88), with 31 females (53.4%) and 27 males (46.6%).

Mean BMI was 23.34 kg/m^2 (range: 15-32) and mean mid-upper arm circumference was 25.49 cm (range: 14-40). Eight patients (13.8%) had BMI <18.5 kg/m^2, while 17 (29.3%) had MUAC <23.5 cm, including 13 (22.4%) with MUAC <19 cm, indicating significant malnutrition.

Regarding educational attainment, 1/58 patients (1.7%) held a postgraduate qualification, 15/58 (25.9%) had completed GCE advanced level (A/L) education, 7/58 (12.1%) were educated up to GCE ordinary level (O/L), and 35/58 (60.3%) were educated below ordinary level.

Sixteen patients (27.6%) reported at least one hypoglycaemic episode in the preceding three months.

Comorbidities and medications

Diabetes mellitus (DM) was present in 52/58 patients (89.7%); 50 had type 2 diabetes and 2 had diabetes secondary to chronic pancreatitis. Among diabetic patients, 33/52 (63.5%) had a disease duration of less than 10 years. Only 4/52 patients (7.7%) had a recent recorded HbA1c measurement (ie within the previous 3 months).

Multiple non-communicable diseases (NCDs) were common. Among the 52 diabetic patients, 48 (92.3%) had two or more additional NCDs; hypertension was the most frequent (36/52, 69.2%), followed by CKD (34/52, 65.3%) (Table 1). Six patients without diabetes presented with hypoglycaemia: two had chronic alcohol dependence, two had advanced CKD, one had advanced cirrhosis, and one had advanced COPD with chronic steroid use.

Polypharmacy (≥5 medications) was documented in 25/58 patients (43.1%). Among the 52 diabetic patients, sulfonylurea was the most prescribed medication (46/52, 88.5%), with 30/52 (57.7%) receiving high dose gliclazide (defined as ≥160 mg/day) and 8/52 (15.4%) on maximum doses (320 mg daily). Multiple oral hypoglycaemic agents were used by 39/52 patients (75%), while 13/52 (25%) received insulin. Eleven patients taking insulin were on combination therapy with a sulfonylurea. None were on insulin monotherapy.

Clinical presentation

Severe hypoglycaemia (level 3) was observed in 50/58 patients studied (86.2%). Level 1 and level 2 hypoglycaemia were each seen in 4/58 patients (6.9%) (Table 2). The most common clinical manifestations were reduced responsiveness in 36/58 patients (62.1%), altered behaviour in 29/58 (50%), and confusion in 26/58 (44.8%). Seizures were noted in 5/58 patients (8.6%), but none presented in hypoglycaemic coma. Evidence of infection (CRP >40 mg/L) was present in 23/58 persons (39.7%), with 7/58 (12.1%) having CRP >100 mg/L.

Precipitating factors

The main precipitants for hypoglycaemic events were reduced appetite or poor oral intake in 29/58 patients (50%), high-dose antidiabetic therapy in 27/58 patients (46.6%), and sepsis in 23/58 patients (39.7%). Many patients had more than one precipitating factor contributing to their hypoglycaemic episode (Table 3).

Table 1. Comorbidities amongst patients with diabetes in the study population (n=52)

Comorbidity	*Male*	*Female*	*Total (n)*	*Percentage amongst diabetic patients (n=52)*
Hypertension	13	23	36	69.2%
Chronic kidney disease	13	21	34	65.3%
Ischaemic heart disease	10	13	23	44.2%
Alcohol dependence	7	0	7	13.5%
Previous stroke	2	4	6	11.5%
Chronic liver disease	2	1	3	5.8%
Disseminated malignancy	1	1	2	3.8%

Table 2. Hypoglycemia Severity (n=58)

Blood Glucose Level	*Level 1*	*Level 2*	*Level 3*	*Total*
<40 mg/dL	0 (0%)	0 (0%)	11 (22.0%)	11 (19.0%)
40-49 mg/dL	0 (0%)	2 (50%)	16 (32.0%)	18 (31.0%)
50-54 mg/dL	0 (0%)	2 (50%)	16 (32.0%)	18 (31.0%)
55-70 mg/dL	4 (100%)	0 (0%)	7 (14.0%)	11 (19.0%)
Total	**4**	**4**	**50**	**58**

Table 3. Precipitating factors of hypoglycaemia

Factor	*Frequency (n)*	*Percentage*
Reduced appetite/ poor oral intake	29	50.0%
High-dose antidiabetic therapy	27	46.6%
Sepsis	23	39.7%
Acute kidney injury	13	22.4%
Recent therapy escalation	11	19.0%

Treatment and outcomes

Management primarily involved withholding antidiabetic medications and administering intravenous dextrose boluses to 54/58 patients (93.1%). Twelve patients (20.7%) required dextrose infusions while four patients (6.9%) with refractory hypoglycaemia received subcutaneous octreotide. Glucagon was not used for any patient in this study.

Thirty-six patients (62.1%) were discharged with alterations to their antidiabetic regimen to less stringent targets, 15/58 (25.9%) were discharged without any antidiabetic medications, and 7/58 (12.1%) succumbed to their illness while in hospital.

Hospital stays ranged from 1 to 30 days, with 37/58 patients (63.8%) discharged within five days.

Chronic kidney disease subgroup

A total of 36/58 patients (62.1%) had CKD, of whom 34 also had diabetes. Sixteen patients were in end-stage kidney disease (44.4%), with nine on regular haemodialysis. Previous hypoglycaemia was reported in 14/36 patients (38.9%) compared to 16/58 (27.6%) in the overall study population. Severe hypoglycaemia occurred in 31/36 CKD patients (86.1%), with mortality affecting 5/36 (13.9%).

Mortality analysis

Seven patients died during hospitalisation (12.1%). The deceased group had a higher prevalence of CKD, with 5/7 (71.4%) having advanced CKD. Severe malnutrition was evident in this group, with 3/7 patients (42.9%) having a BMI <18.5 kg/m^2 and 4/7 (57.1%) having MUAC <19cm. All deceased patients experienced severe hypoglycaemia with glucose levels <50 mg/dL. Acute kidney injury was the most common precipitant, present in 6/7 (85.7%), followed by sepsis in 4/7 (57.1%).

Predictors of mortality

To identify independent predictors of in-hospital mortality a univariate analysis was performed, followed by multivariate logistic regression. Table 4 presents the baseline characteristics stratified by outcome. Univariate analysis identified several variables associated with increased mortality risk. Severe malnutrition (BMI <18.5 kg/m^2) showed the strongest association with mortality (OR 37.5, 95% CI: 3.13-448.61), followed by acute kidney injury (OR 6.22, 95% CI: 1.18-32.76) and recent antidiabetic dose increment (OR 4.03, 95% CI: 0.75-21.55) (Table 5).

Variables with p<0.20 in univariate analysis were entered into a multivariate logistic regression model using backward elimination. The final model retained four independent predictors of mortality (Table 6).

Table 4. Baseline characteristics by mortality outcome

Characteristic	*Died (n=7)*	*Survived (n=51)*
Mean age (years)	72.0	64.7
Male gender	4 (57.1%)	23 (45.1%)
BMI <18.5 kg/m^2	3 (42.9%)	1 (2.0%)
Diabetes mellitus	5 (71.4%)	47 (92.2%)
Chronic kidney disease	5 (71.4%)	31 (60.8%)
End-stage kidney disease	3 (42.9%)	13 (25.5%)
Acute kidney injury	4 (57.1%)	9 (17.6%)
Sepsis	4 (57.1%)	19 (37.3%)
Level 3 hypoglycaemia	7 (100%)	43 (84.3%)

Table 5. Univariate analysis of mortality predictors

Variable	*Odds Ratio*	*95% CI*	*p-value*
BMI <18.5 kg/m^2	37.50	3.13-448.61	0.004
Acute kidney injury	6.22	1.18-32.76	0.031
Recent dose increment	4.03	0.75-21.55	0.103
Advanced age (>75 years)	2.44	0.48-12.45	0.283
Sepsis	2.25	0.45-11.13	0.320
End-stage kidney disease	2.19	0.43-11.12	0.348
Male gender	1.62	0.33-8.00	0.555
Chronic kidney disease	1.61	0.28-9.13	0.594
Poor appetite/intake	0.72	0.15-3.55	0.687
Diabetes mellitus	0.21	0.03-1.47	0.118

Table 6. Multivariate logistic regression analysis of mortality predictors

Variable	*β Coefficient*	*Standard Error*	*Adjusted OR*	*95% CI*	*p-value*
BMI <18.5 kg/m^2	3.89	1.24	48.9	4.4-542.1	0.002
Acute kidney injury	2.14	0.89	8.5	1.5-47.9	0.016
Age >75 years	1.67	0.85	5.3	1.0-28.1	0.049
End-stage kidney disease	1.23	0.78	3.4	0.7-16.2	0.115

The multivariate model demonstrated good discriminatory power (AUC 0.87, 95% CI: 0.74-0.96; Nagelkerke R^2=0.52). Severe malnutrition emerged as the strongest predictor with 49-fold increased odds of death (adjusted OR 48.9, 95% CI: 4.4-542.1, p=0.002), present in 3/7 deaths (42.9%) versus 1/51 survivors (2.0%). Acute kidney injury was also strongly predictive (adjusted OR 8.5, 95% CI: 1.5-47.9, p=0.016), present in 4/7 deaths (57.1%) versus 9/51 survivors (17.6%). Advanced age over 75 years showed 5.3-fold increased odds (95% CI: 1.0-28.1, p=0.049), while end-stage kidney disease showed a trend (adjusted OR 3.4, 95% CI: 0.7-16.2, p=0.115).

Discussion

During the six-month study period, 58 out of 6,339 patients (0.92%) admitted to the two medical wards presented with hypoglycaemia. This group was characterised by older age and multiple comorbidities, particularly DM and CKD. The majority had level 3 hypoglycaemia, likely reflecting that only severe cases reach tertiary care, as milder episodes are managed at the community level.

The 27.6% prevalence of prior hypoglycaemic episodes in the study group closely aligns with the 26.1% reported in a previous study from a similar settings,[15] reinforcing the premise that previous hypoglycaemia is a strong predictor of future episodes.[21,22] The predominance of diabetic patients (89.7%) in the study population supports the well-known fact that DM is a major risk factor for hypoglycaemia requiring hospitalisation.[23] Despite a diabetes duration of less than 10 years in 63.5% of the patients, the presence of multiple comorbidities and early complications is notable. This apparent mismatch suggests either poor long-term glycaemic control following diagnosis or, more likely, undiagnosed disease for an extended period before the first diagnosis.

The widespread use of sulfonylureas in 46/52 diabetic patients and high-dose gliclazide in 30/52 represents a significant modifiable risk factor. Sulfonylureas can cause prolonged hypoglycaemia, especially in patients with renal or hepatic impairment. The absence of insulin monotherapy and frequent use of multiple oral agents indicate suboptimal management of diabetes.

HbA1c results were not available in 48/52 diabetic patients (92.3%). This finding highlights the scarcity of HbA1c testing facilities in many state-sector hospitals, suboptimal patient assessment in over-burdened clinics, and limited physician awareness of the importance of regular HbA1c monitoring for long-term diabetes management. Along with inappropriate medication choices, this highlights significant gaps in the quality of diabetes care, likely reflecting resource constraints and inadequate follow-up systems. Polypharmacy in 25/58 patients (43.1%) had further complicated management.

The low educational attainment observed (only 25.9% completed the GCE Advanced Level, with 60.3% educated below the GCE Ordinary Level) likely contributes to poor health literacy and inadequate diabetes self-management. Lower educational levels are linked to poorer recognition of hypoglycaemia warning signs and medication non-adherence, compounding hypoglycaemia risk in resource-limited settings.24 Improving patient knowledge could significantly reduce hospitalisations. Education on recognising early warning signs and the immediate administration of fast-acting carbohydrates (15-20 grams of glucose or fruit juice) is essential. In the Sri Lankan setting, culturally appropriate programmes using visual aids and local language materials tailored to patients with limited formal education should target high-risk groups, including those with previous hypoglycaemic episodes, CKD, or malnutrition. Family caregiver training is equally vital for preventing severe episodes requiring hospitalisation.

The complex interplay between comorbidities and hypoglycaemia is shown by 48/52 diabetic patients (92.3%) presenting with two or more non-communicable diseases. CKD affected 36 out of 58 patients (62.1%) and represents a potent risk factor for hypoglycaemia through impaired insulin clearance, reduced renal gluconeogenesis, and altered counter-regulatory responses.

An all-cause mortality rate of 12.1% was observed in the study group. Multivariate regression analysis identified severe malnutrition (BMI <18.5 kg/m^2) as the strongest predictor of mortality, underscoring the critical importance of nutritional assessment and intervention. Acute kidney injury also increased the odds of death, reflecting impaired glucose homeostasis and illness severity. Advanced age (>75 years) contributed independently to mortality risk, consistent with increased frailty. A risk stratification model can serve as a practical tool for identifying high-risk patients who require intensive monitoring.

Limitations of this study include a small sample size, short duration, single-centre design, the use of capillary rather than venous glucose testing (information bias), residual confounding, and selection bias, which limit generalizability and statistical power. Wide

confidence intervals in the multivariate analysis highlight the need for validation in larger cohorts before clinical implementation.

Risk stratification and clinical pathways are needed to identify high-risk patients, particularly those with CKD, malnutrition, and previous hypoglycaemic episodes. Further research should identify management gaps to reduce hypoglycaemic events in diabetic patients.

Conclusions and recommendations

In this study, hypoglycaemia mainly affected elderly diabetic patients (average age 65 years) with multiple comorbidities, especially CKD (62.1%). The high rate of severe hypoglycaemia (86.2%), widespread use of high-dose sulfonylureas (57.7%), and poor glycaemic monitoring (92.3% without recent HbA1c) pose significant challenges in resource-limited settings. Structured diabetes education, including recognition of hypoglycaemia, self-management with fast-acting carbohydrates, medication optimisation, and improved monitoring, is crucial for reducing hypoglycaemia and improving outcomes in vulnerable groups.

Author declaration

Conflict of interests

The authors declare that they have no conflict of interests.

Ethics approval

Approval from the Ethics Review Committee, Faculty of Medicine, University of Kelaniya. Ref No: P/39/04/2024.

Criteria for authorship:

KRF Conception, data collection and analysis, manuscript drafting. SDS: Study design, manuscript drafting and revision. AP: Conception, study design, manuscript revision. All authors read and approved the final manuscript.

Availability of data and material

The dataset used and analysed during the current study is available from the corresponding author on reasonable request.

Funding

Self-funded.

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