SAS Journal of Medicine
Abbreviated Key Title: SAS J Med
ISSN 2454-5112
Journal homepage: https://saspublishers.com

OPEN ACCESS

Paediatrics

Demographic and Metabolic Risk Profile in First-Ever Stroke Patients with Undiagnosed Prediabetes

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DOI: https://doi.org/10.36347/sasjm.2025.v11i09.004 | **Received:** 08.07.2025 | **Accepted:** 02.09.2025 | **Published:** 06.09.2025

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Abstract **Original Research Article**

Background: Stroke remains a leading cause of mortality and disability worldwide, with increasing incidence in South Asia. Emerging evidence suggests that prediabetes, often undiagnosed, significantly contributes to vascular risk and may influence stroke outcomes. ***Aim of the study:*** The aim of this study was to assess the demographic and metabolic risk profile in first-ever stroke patients with undiagnosed prediabetes. ***Methods:*** This cross-sectional observational study was conducted in Department of Medicine, Sher-E- Bangla Medical College Hospital, Barisal, Bangladesh from 30th March 2015 to 29th September 2015. Total 100 patients aged ≥40 years with first ever acute stroke with no history of diabetes mellitus were included in this study. ***Result:*** The mean age of patients was 57.08 ± 6.78 years, with a male predominance (78%). Males presented younger, while females were mainly aged 61–70 years. Hypertension (68%) and smoking (42%) were the leading risk factors, followed by family history of CVD (30%) and obesity (24%). Based on glycemic status, 18–34% had prediabetes and 18–26% had diabetes, depending on criteria used. Ischemic stroke accounted for 68% of cases, while 32% had hemorrhagic stroke, with most undiagnosed dysglycemia revealed during evaluation. ***Conclusion:*** A large proportion of first-ever stroke patients have undiagnosed prediabetes, often with metabolic and vascular risk clustering. The demographic profile shows a male predominance and urban concentration, with females presenting at relatively older ages.

Keywords: Demographic Profile, Metabolic Risk Profile, First-ever Stroke Patients, and Undiagnosed Prediabetes.

INTRODUCTION

Stroke is still among the leading causes of death and long-term disability across the globe and a significant contributor to the non-communicable disease burden in low, middle, and high-income countries. According to the Global Burden of Disease (GBD) 2019 estimates, stroke remains the second-highest cause of mortality and third-highest cause of disability-adjusted life-years worldwide, with over 12.2 million new strokes and 101 million stroke survivors reported in the year 2019 alone.[1] The very first stroke burden is particularly profound in older groups, where demographic transition and lifestyle changes have furthermore acted to accumulate risk exposure to vascular and metabolic conditions.

The most variable risk factor for ischemic stroke is metabolic risk factor including hypertension, dyslipidemia, central obesity, insulin resistance, and Type 2 diabetes mellitus (T2DM). All these abnormalities tend to occur together in the metabolic

syndrome pattern and have been shown to appreciably increase the risk of first-ever and recurrent strokes.[2,3] T2DM is widely accepted as an independent predictor of the development and severity of stroke, for which hyperglycemia is implicated in endothelial dysfunction, systemic inflammation, and increased atherogenesis. Furthermore, even in the absence of overt diabetes, intermediate hyperglycemic states, referred to as prediabetes, are increasingly implicated in the pathogenesis of vascular events, including ischemic stroke. [4,5]

Prediabetes, as the American Diabetes Association has operationalized by values of glycated hemoglobin (HbA1c) from 5.7% to 6.4%, is an asymptomatic, so-called silent metabolic state with a global prevalence estimated to range between 7% to 15%, depending on diagnostic criteria and sampling of populations. [6,7] Despite its apparently mild description, prediabetes is not a benign condition. There is evidence to suggest that patients in this level of glycemia have early evidence of arterial stiffness, reduced availability of nitric oxide, damage to endothelial cells, and low-grade chronic inflammatory milieu, each of them individually proclivities to cerebrovascular and cardiovascular events.[8] But unlike diabetes, prediabetes is often undiagnosed, especially in acute clinical settings such as stroke, where glycemic testing may be limited to random blood glucose or fasting plasma glucose alone.

There has been new evidence of an extensive diagnostic gap in acute stroke environments, where a high percentage of patients are diagnosed with unidentified hyperglycemia or prediabetes on first hospital presentation. [9,10] Despite the worth of HbA1c testing as a robust retrospective indicator of chronic dysglycemia, it is not yet universally incorporated into acute stroke treatment pathways. Its underutilization results in significant under-detection of metabolic risk and consequently to lost potential for early lifestyle or pharmacologic intervention for secondary prevention. [11,12] Failure to perform routine screening is most significantly felt in socioeconomically disadvantaged and ethnically diverse populations, where barriers to preventive care and services add further to disparity. [13,14]

While the effect of stroke in individuals with diagnosed diabetes is characteristically well documented, much less is known about the demographic and metabolic profile of patients who have undiagnosed prediabetes and experience stroke. Current evidence points towards the possibility that this subgroup may be distinct with respect to age, ethnicity, risk profiles, and access to care relative to normoglycemic or diabetic counterparts. [15,16] The lack of comparative metabolic and sociodemographic information is a significant knowledge gap with direct implications for clinical risk stratification, health equity, and secondary prevention targeting. Therefore, the current study was conducted to assess the demographic and metabolic risk profile in first-ever stroke patients with undiagnosed prediabetes.

OBJECTIVES

To assess the demographic and metabolic risk profile in first-ever stroke patients with undiagnosed prediabetes.

METHODS & MATERIALS

This cross-sectional observational study was conducted in Department of Medicine, Sher-E- Bangla Medical College Hospital, Barisal, Bangladesh from 30th March 2015 to 29th September 2015. Total 100 patients aged ≥40 years with first ever acute stroke with no history of DM were included in this study. Patients diagnosed with diabetes and patients on anti-diabetic medication were excluded. Written informed consent was obtained from all participants. Diagnosis and type of acute stroke were confirmed by CT scan. Fasting plasma glucose (FPG), 2-hour postload glucose levels were measured according to operational definition. After overnight fasting (at least 8 h), fasting plasma glucose levels are measured. After overnight fasting, a solution of 75 g glucose in 250 ml water is ingested by the patient. Two hours after ingestion, the 2-hour postload glucose levels are measured. Diabetes was defined as a fasting serum glucose ≥126 mg/dL (≥7 mmol/L) or 2-h PPG ≥200 mg/dL (≥ 11.1 mmol/L). Prediabetes was defined as fasting serum glucose between 100 and 125 mg/dL (5.6 and, 6.9 mmol/L) or 2-h PPG between 140 and 199 mg/dL (7.8 and, 11 mmol/L) among participants without a history of diabetes. Normal glycemia was defined as fasting serum glucose below 100mg/dL (5.6mmol/L), 2-h PPG below 140 mg/dL (7.8 mmol/L) HbA1C- ≤ 5.6%. A standardized questionnaire was used for collection of information by interviewing patients. After collection of all information, these data were checked, verified for consistency and edited for finalized result. After editing and coding, the coded data directly entered into the computer by using SPSS version 6. Data cleaning validation and analysis was performed using the SPSS/PC software and graph and chart by MS excel. A "P" value <0.5 considered as significant. Prior to the commencement of this study, the research protocol was approved by the ethical committee in SBMCH.

RESULTS

Table-I presents the demographic characteristics of the study patients. The mean age of patients was 57.08 ± 6.78 years, with the majority belonging to the 51–60year age group (38%), followed by 61–70 years (28%) and 41–50 years (26%), while only 8% were above 70 years. A male preponderance was noted, with 78% of the participants being men compared to 22% women. In terms of occupation, businesspersons (26%) and housewives/retired individuals (16% each) were the most common categories, followed by service holders (14%),

unemployed (12%), daily workers (10%), and garments workers (6%). Regarding residence, two-thirds of the participants (66%) were from urban areas, whereas 34% resided in rural settings.

Table-II highlights the age and sex distribution of the patient which further illustrates the demographic profile. Among males, the highest proportion was observed in the 51–60year age group (38.46%), followed by 41–50 years (30.76%) and 61–70 years (16%), with 10.25% aged above 70 years. In contrast, females were predominantly older, with 54.54% in the 61–70year group, 36.36% in the 51–60year group, and only 9.09% in the 41–50year group; none were above 70 years.

Table-III shows the pre-existing risk factors among the study patients. Hypertension was the most prevalent risk factor, present in 68% of patients, followed by smoking in 42%. A positive family history of premature cardiovascular disease (CAD, CVD) was noted in 30%, while obesity was recorded in 24%. Other risk factors included heart disease in 16%, hyperlipidemia in 10%, and heavy alcohol intake in 4% of patients.

Table-IV illustrates the fasting plasma glucose (FPG) and 2-hour post-prandial glucose (2-h PPG) status of the study population (N=100) provides insight into the glycemic distribution. Based on FPG, 58% of patients were normoglycemic (<5.6 mmol/L), 24% had prediabetes (5.6–6.9 mmol/L), and 18% had diabetes (≥7.0 mmol/L). On the basis of 2-h PPG, 44% were normoglycemic (<7.8 mmol/L), 30% had prediabetes (7.8–11.0 mmol/L), and 26% were diabetic (≥11.1 mmol/L).

Figure 1 demonstrates the type of stroke. In this study, majority (68%) of patients showed ischemic stroke and 32% patients showed hemorrhagic stroke.

Diagnosis of patients shown in Table-V presents the distribution of glycemic categories among the study participants based on different diagnostic criteria. Using fasting plasma glucose (FPG), 24% of patients were identified as prediabetic, 18% as diabetic, and 58% as normoglycemic. When classified by 2-hour post-prandial glucose (2-h PPG), 30% were prediabetic, 26% diabetic, and 44% normoglycemic. Assessment with HbA1c criteria showed a slightly higher proportion of prediabetes (34%) and diabetes (24%), while 42% were normoglycemic. However, when integrating all diagnostic measures into a combined glycometabolic status, 18% of patients were ultimately classified as prediabetic, 12% as diabetic, and the majority, 70%, as normoglycemic.

Table-I: Demographic characteristics of the study patients (N=100)

Characteristics	Categories	Number of Patients	Percentage (%)
Age (years)	41–50	26	26
	51–60	38	38
	61–70	28	28
	>70	8	8
	Mean ± SD	57.08 ± 6.78	
Sex	Male	78	78
	Female	22	22
Occupation	Service holder	14	14
	Business	26	26
	Daily worker	10	10
	Housewife	16	16
	Garments worker	6	6
	Unemployed	12	12
	Retired	16	16
Residence	Urban	66	66
	Rural	34	34

Table-II: Age and sex distribution of the patient (N=100)

Age (years)	Number of patients		Total
	Male (n= 39)	Female (n= 11)	
41-50	24(30.76%)	2(9.09%)	26
51-60	30(38.46%)	8(36.36%)	38
61-70	16(16%)	12(54.54%)	28
>70	8(10.25%)	0	8

Table-III: Pre-existing risk factors among the study patients (n=100)

Risk factors	Number of patients	Percentage (%)
Hypertension	68	68
Smoking	42	42
Family history of premature CAD, CVD	30	30
Heart diseases	16	16
Hyperlipidaemia	10	10
Obesity	24	24
Heavy alcohol intake	4	4

Table-IV: Fasting plasma glucose (FPG) and 2 hour post prandial glucose (2-h PPG) status of the study population (N=100)

Serum glucose (mmol/l)	Number of patients		Percentage (%)
	FPG	2-h PPG	
< 5.6	58	-	58%
5.6–6.9	24	-	24%
≥ 7	18	-	18%
<7.8	-	44	44%
7.8–11.0	-	30	30%
≥11.0	-	26	26%

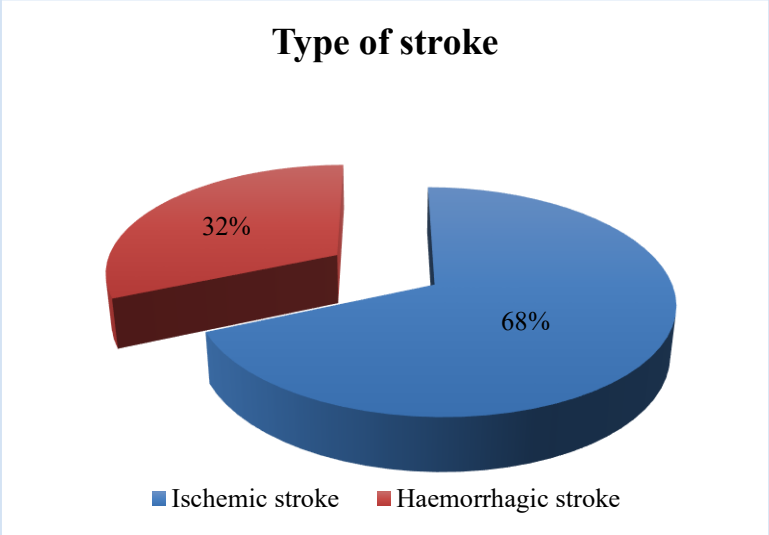

Figure 1: Distribution of the patients according to type of stroke (N=100)

Table-V: Diagnosis of patients

Test status	Prediabetes	Diabetes	Normoglycemia
FPG (mmol/l)	24 (24%)	18 (18%)	58 (58%)
2-h PPG (mmol/l)	30 (30%)	26 (26%)	44 (44%)
HbA1c	34 (34%)	24 (24%)	42 (42%)
Combination of Glycometabolic status	18 (18%)	12 (12%)	70 (70%)

DISCUSSION

The mean age of presentation of stroke among this group was 57.08 years and the highest age group affected was between 51–60 years. This relatively younger age of presentation for stroke is in accordance with South Asian findings in which stroke presents a decade earlier than in developed countries. [17] Our result of male predominance also corroborates findings from numerous population-based studies, which state that men are at higher risk of suffering a stroke in middle age, although women tend to present later in life, often because of protective hormonal factors and greater longevity. [18] The higher female prevalence in the older age groups within our cohort supports this trend.

Among vascular risk factors, the most prevalent one was hypertension occurring in 68% of patients, followed by smoking (42%) and obesity (24%). Such an aggregation of risk factors points towards the classic metabolic syndrome highly associated with the development of stroke. In both Western and Asian populations, the most significant modifiable risk factor

for hypertension has been recognized by studies as 55% to 75% of stroke patients.[19] Our findings are in accordance, which emphasizes the significance of managing blood pressure to avoid stroke. The smoking prevalence identified is high and a reflection of lifestyle regional risk, particularly among men, and conforms to the INTERSTROKE study evidence that explained tobacco use as a main driver of global stroke burden. [19] The additional 30% of patients with a positive cardiovascular family history is also a reflection of the interplay of environmental exposure and genetic predisposition in the etiology of stroke risk.

One of the most prominent characteristics of our study is the assessment of glycemic status based on more than a single criterion of diagnosis. By FPG, 24% were diabetic and 18% prediabetic, while in comparison, with 2-h PPG, a significantly higher proportion was prediabetic (30%) and diabetic (26%). HbA1c levels diagnosed 34% of patients as prediabetes and 24% as diabetes, thus identifying more cases than when FPG was used alone. These differences are consistent with previous research that confirmed HbA1c is likely to diagnose more individuals as dysglycemic, particularly in populations whose glucose levels are uncertain. [20] Similarly, Jiang *et al.,* [21] reported that postprandial glucose can detect more abnormalities in glucose compared to fasting glucose, and thus 2-h PPG is more sensitive for the identification of early dysglycemia. Our findings confirm this, as both 2-h PPG and HbA1c criteria identified a higher proportion of prediabetic patients compared to FPG.

Since a combined diagnostic approach was used, however, the overall prevalence of dysglycemia reduced to 18% prediabetes and 12% diabetes whereas most of the patients (70%) were normoglycemic. The reduction is a function of non-overlapping classification across diagnostic modalities and highlights the diagnostic challenge in defining glycemic status in acute stroke patients. They reached similar conclusions, illustrating that Yao *et al.,* [22] were able to indicate that the prevalence of dysglycemia was highly variable depending on the criteria of diagnosis used, and that using multiple measures could produce more conservative estimates. Remarkably, undiagnosed prediabetes and diabetes remain highly prevalent in acute stroke groups, highlighted by Wang et al. [23], who showed nearly one-third of ischemic stroke patients were experiencing undetected prediabetes, a prevalence consistent with the 30–34% identified by us in our study by 2-h PPG and HbA1c, respectively.

The greater proportion of ischemic stroke in our population (68%) compared to hemorrhagic stroke (32%) is in accordance with global epidemiological trends, albeit the ratio of hemorrhagic strokes appears higher than in the majority of Western countries, where ischemic strokes comprise almost 80–85% of all strokes. [24] The discrepancy might be attributed to geographical differences in the prevalence of hypertension, deficiencies in treatment, and genetic susceptibility.

Our findings collectively highlight that unrecognized dysglycemia, diabetes or prediabetes, is common in first-ever stroke patients and may often go undetected if a fasting glucose-based diagnostic test is used. Early diagnosis and treatment of prediabetes represent a critical window of opportunity for secondary prevention and risk stratification.

Limitations of the study

In our study, there was small sample size and absence of control for comparison. Study population was selected from one center in Barisal, so may not represent wider population. The study was conducted at a short period of time.

CONCLUSION

This study highlights that a substantial proportion of first-ever stroke patients without prior diabetes have undiagnosed prediabetes, often accompanied by traditional vascular risk factors such as hypertension, smoking, and obesity. The demographic profile shows a male predominance and urban concentration, with females presenting at relatively older ages. These findings emphasize the hidden metabolic risk in stroke patients, underscoring the importance of early glycemic assessment for improved risk stratification and targeted secondary prevention in high-risk populations.

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