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RESEARCH ARTICLE
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# ADMISSION BLOOD GLUCOSE AND BLOOD PRESSURE AS PREDICTORS IN ACUTE ISCHEMIC STROKE: A PROSPECTIVE OBSERVATIONAL STUDY

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## ABSTRACT

Background: Stroke is the leading cause of morbidity and mortality worldwide.(1) Though admission blood pressure and glucose have been individually linked to short-term prognosis after ischemic stroke, their joint relationship with neurological outcome and in-hospital mortality remains incompletely defined in many settings and may be influenced by baseline severity, pre-existing disease, and measurement protocols.

Objectives: To evaluate the correlation between blood glucose and blood pressure levels at admission and their impact on the short-term functional outcomes and the mortality among the adults admitted with Acute ischemic stroke. Primary objective: to determine whether admission systolic blood pressure (SBP) and admission blood glucose are independently associated with short-term functional outcome (defined as change in NIHSS between admission and discharge) and in-hospital mortality among adults admitted with acute ischemic stroke.

Methods: A prospective observational study was conducted among 100 patients admitted with CT/MRI confirmed acute ischemic stroke at Government Thiruvarur Medical College between May 2021 to May 2022. Demographic, clinical and biochemical data, including systolic blood pressure (SBP), diastolic blood pressure (DBP) and blood glucose levels, were recorded on admission. Functional outcomes were assessed using the National Institutes of Health Stroke Scale (NIHSS) at discharge. Statistical analysis were performed using IBM SPSS version 26. Descriptive statistics, Mann–Whitney U test, Chi-square test, and Pearson correlation were applied, with $p < 0.05$ considered statistically significant.

Results: Of the 100 patients, 60% were male and the predominant age group was 59–68 years (33%). Elevated SBP, DBP, and blood glucose levels were noted in 62%, 59%, and 69% of the patients, respectively. The mean (± SD) SBP, DBP, and blood glucose were 146.40 ± 38.07 mmHg,

89.50 ± 18.28 mmHg, and 229.88 ± 122.78 mg/dL. Correlation analysis revealed a strong positive correlation between SBP and DBP ($r = 0.868$, $p < 0.001$), whereas blood glucose showed weak, non-significant correlations with both SBP ($r = 0.069$, $p = 0.496$) and DBP ($r = 0.126$, $p = 0.216$). Among the 82 patients assessed for outcome, 46 (56.1%) improved, 23 (28%) remained unchanged, and 13 (15.9%) worsened based on NIHSS scores.
Conclusion: Admission hypertension demonstrated a significant association with stroke outcome, whereas hyperglycaemia exhibited a weak, non-significant relationship with blood pressure parameters. These findings suggest that hypertension plays a more decisive role than hyperglycaemia in influencing the early prognosis in acute ischemic stroke. Early detection and integrated control of both blood pressure and glucose levels are essential for improving short-term outcomes and reducing mortality.

**Keywords:** Acute ischemic stroke, blood pressure, blood glucose, NIHSS, Diabetes, Hypertension, prognosis

## Introduction

Stroke, a major component of cardiovascular disease, continues to pose a substantial global health challenge. It represents the second leading cause of death worldwide and the foremost cause of long-term disability. Despite advances in acute stroke care, the burden of stroke remains high, especially in low- and middle-income countries such as India. [(2)]

Epidemiological data indicate a recent stabilization of previously declining stroke-related mortality but with a concurrent increase in incidence. Between 1988 and 1998, stroke-related deaths in the United States rose by 5.3%, and projections suggest that the direct medical costs of stroke could escalate from USD 273 billion in 2010 to USD 818 billion by 2030 [(3)]. These trends reflect an aging population and the rising prevalence of diabetes and hypertension—two well-established, modifiable risk factors for stroke [(4)].

Hypertension accelerates vascular damage through endothelial dysfunction, arterial stiffening, and impaired cerebral autoregulation. Diabetes mellitus contributes to macrovascular and microvascular changes, promoting inflammation and thrombosis. Hyperglycemia during the acute phase of stroke has been associated with larger infarct size and poorer functional outcomes, though findings remain inconsistent [(5)].

While the individual impacts of hypertension and diabetes on stroke outcomes are recognized, the interaction between admission blood glucose and blood pressure and their combined influence on acute prognosis remain underexplored in Indian populations.

This study was therefore undertaken to examine the correlation between admission blood glucose levels and blood pressure, and to determine their predictive value for short-term outcomes among patients presenting with acute ischemic stroke.

## METHODOLOGY

A prospective observational study was conducted in the Department of General Medicine, Thiruvarur Medical College and Hospital, Tamil Nadu, India, over a period of one year (May 2021–May 2022). The study protocol was reviewed and approved by the Institutional Ethics Committee of Thiruvarur Medical College (Approval No: IEC/TMC/2021/048). Written informed consent was obtained from all participants or their legal guardians. The study included 100 cnsecutive inpatients diagnosed with acute ischemic stroke confirmed by CT or MRI brain.

Inclusion Criteria

- Patients of both sexes with clinical and radiological evidence of acute ischemic stroke.
- Age ≥ 18 years.
- Presentation within 72 hours of symptom onset.
- Provision of informed consent.

Exclusion Criteria

- Hemorrhagic stroke or transient ischemic attack.
- Patients with active infection or sepsis.
- Known endocrinological disorders affecting glucose metabolism other than diabetes mellitus.
- Refusal to provide consent.

Data Collection

A predesigned proforma was used to record demographic variables, presenting symptoms, level of consciousness (sensorium), duration of illness, blood pressure, blood glucose, and outcomes at discharge. Blood pressure was measured using a standard mercury sphygmomanometer on admission. The blood glucose levels were determined using fasting and random plasma glucose samples. Stroke severity and progression were assessed using the National Institutes of Health Stroke Scale (NIHSS) at admission and discharge.

Blood pressure and glucose measurement: Admission blood pressure was measured with a calibrated sphygmomanometer. First measurement on arrival was recorded. Venous plasma glucose was measured in the hospital. Random plasma glucose at admission was used for analysis, and fasting values were used when available.

Definitions

- Hypertension: Systolic BP ≥ 140 mmHg and/or diastolic BP ≥ 90 mmHg on admission.
- Hyperglycemia: Random blood glucose > 200 mg/dL or fasting glucose > 126 mg/dL.
- Outcome: Classified as *recovered* or *death* during hospitalization.

Statistical Analysis

The data were analyzed using IBM SPSS Statistics version 26. Descriptive statistics were computed for all the variables. Continuous variables were expressed as mean ± standard deviation (SD) and categorical variables were expressed as frequencies and percentages. To assess data normality, Shapiro–Wilk test was used. As several variables exhibited non-normal distributions, non-parametric tests were used for group comparisons.

The Mann–Whitney U test was used to compare continuous variables between groups (e.g., outcome categories) and the Chi-square test was used for categorical data. Relationships between admission blood glucose, systolic blood pressure and diastolic blood pressure were assessed using Pearson's correlation coefficient (r) to determine the strength and direction of the association. Correlation strength was interpreted as: weak (<0.3), moderate (0.3–0.7) or strong (>0.7). Statistical p-value < 0.05 was considered statistically significant.

To investigate the relationship between blood glucose, blood pressure and stroke outcomes at admission, we conducted a prospective observational study in the Department of General Medicine, including patients admitted with acute ischemic stroke over a specified period. Blood glucose levels and blood pressure measurements were recorded for all participants on arrival at the hospital. Stroke outcomes were assessed using National Institutes of Health Stroke Scale at discharge and follow-up appointments.

## RESULTS

A total of 100 patients admitted for acute ischemic stroke were included in the study. Of these, 60 (60%) were males and 40 (40%) were females, with male predominance. The age of the participants ranged from 39 to 88 years, with the most commonly affected group between 59–68 years (33%). The distribution of age and sex is presented in Table 1.

### Demographic and Clinical Characteristics

The clinical parameters evaluated included the level of consciousness, duration of illness before admission, length of hospital stay, and outcome at discharge. Sixty patients (60%) were conscious at presentation, 33 (33%) were drowsy, and 7 (7%) were unconscious. The duration of illness prior

to hospital presentation was less than 1 day in 49%, 1–2 days in 27%, and more than 2 days in 24% of patients. The duration of hospitalization was less than 1 day in 21%, 1–5 days in 34%, and more than 5 days in 45% of patients. The in-hospital mortality rate was 38%, with 62% of patients recovering and being discharged in a stable condition (Table 1).

**Systemic Parameters**

Among the 100 patients, 62% presented with elevated systolic blood pressure (SBP), 59% with elevated diastolic blood pressure (DBP), and 69% with elevated blood-glucose levels on admission. The mean ± SD SBP, DBP, and blood glucose were 146.40 ± 38.07 mmHg, 89.50 ± 18.28 mmHg, and 229.88 ± 122.78 mg/dL, respectively (Table 2).

**Correlation between Blood-Glucose and Blood-Pressure Parameters**

Correlation analysis was performed using Pearson's correlation coefficient (r) to evaluate the association between the three continuous variables: —blood glucose, systolic blood pressure and diastolic blood pressure. A weak positive correlation was found between blood glucose and DBP ($r = 0.126$, $p = 0.216$) and between blood glucose and SBP ($r = 0.069$, $p = 0.496$), both not statistically significant. A strong and statistically significant positive correlation was observed between SBP and DBP ($r = 0.868$, $p < 0.001$), indicating that an increase in systolic pressure was closely associated with an increase in diastolic pressure (Table 3).

**Functional Outcome (NIHSS Score Dynamics)**

National Institutes of Health Stroke Scale (NIHSS) was used to assess the functional outcomes in 82 patients with moderate-to-severe stroke. Of these, 46 (56.1%) showed improvement in NIHSS score at discharge, 23 (28.0%) remained unchanged, and 13 (15.9%) worsened. Overall, more than half of the patients showed neurological improvements during hospitalization (Table 4). Patients with controlled or moderate blood -pressure levels tended to have better outcomes than those with persistently elevated pressures, while blood glucose levels at admission showed no significant relationship with NIHSS change.

These findings demonstrate that while hyperglycemia showed only weak and non-significant associations with blood -pressure parameters, hypertension exhibited a strong internal correlation and appeared to have a more decisive influence on short-term outcomes and mortality among patients with acute ischemic stroke.

**Table 1. Demographic and Clinical Characteristics of Study Participants (n = 100)**

| Parameter | Category | Frequency (n) | Percentage (%) |
|---|---|---|---|
| Sex | Male | 60 | 60 |
| | Female | 40 | 40 |
| Age (years) | 39–48 | 16 | 16 |
| | 49–58 | 26 | 26 |
| | 59–68 | 33 | 33 |
| | 69–78 | 11 | 11 |
| | 79–88 | 14 | 14 |

| | | | |
|---|---|---|---|
| Sensorium | Conscious | 60 | 60 |
| | Drowsy | 33 | 33 |
| | Unconscious | 7 | 7 |
| Duration of illness before admission | < 1 day | 49 | 49 |
| | 1–2 days | 27 | 27 |
| | > 2 days | 24 | 24 |
| Hospital stay | < 1 day | 21 | 21 |
| | 1–5 days | 34 | 34 |
| | > 5 days | 45 | 45 |
| Outcome at discharge | Recovered | 62 | 62 |
| | Death | 38 | 38 |

Most patients were male, with the predominant age group being 59–68 years. Consciousness was preserved in 60% of cases, and the overall in-hospital mortality rate was 38%.

**Table 2. Distribution of Systemic Parameters among Study Participants (n = 100)**

| Parameter | Category | Frequency (n) | Percentage (%) |
|---|---|---|---|
| Systolic BP | High | 62 | 62 |
| | Normal | 11 | 11 |
| | Low | 27 | 27 |
| Diastolic BP | High | 59 | 59 |
| | Normal | 15 | 15 |
| | Low | 26 | 26 |
| Blood glucose | High | 69 | 69 |
| | Normal | 5 | 5 |
| | Low | 26 | 26 |
| Systolic BP (mmHg) | Mean ± SD | 146.40 ± 38.07 | — |
| Diastolic BP (mmHg) | Mean ± SD | 89.50 ± 18.28 | — |

| | | | |
|---|---|---|---|
| Blood glucose (mg/dL) | Mean ± SD | 229.88 ± 122.78 | — |

Most patients presented with hypertension and hyperglycaemia, reflecting significant hemodynamic and metabolic derangements on admission.

**Table 3. Correlation between Admission Blood Glucose and Blood-Pressure Parameters (n = 100)**

| Variables Compared | Correlation Coefficient (r) | p-value | Statistical Significance | Interpretation |
|---|---|---|---|---|
| Blood glucose vs Diastolic BP | 0.126 | 0.216 | Not significant ($p > 0.05$) | Weak positive correlation — no statistical significance |
| Blood glucose vs Systolic BP | 0.069 | 0.496 | Not significant ($p > 0.05$) | Very weak positive correlation — not statistically meaningful |
| Systolic BP vs Diastolic BP | 0.868 | < 0.001 | Highly significant ($p < 0.001$) | Strong positive correlation — statistically significant association |

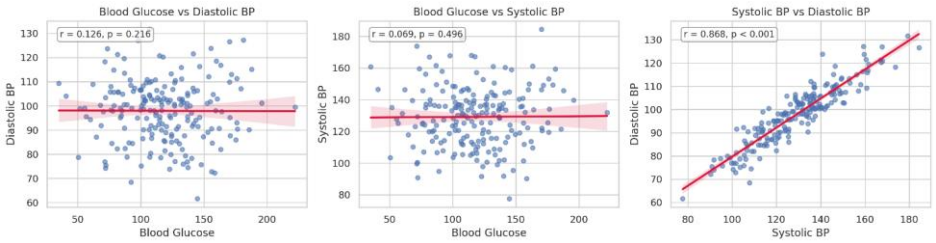
Systolic and diastolic blood pressures were strongly correlated ($r = 0.868$, $p < 0.001$), whereas blood glucose showed only weak, non-significant relationships with both parameters.

**Table 4. NIH Stroke Scale (NIHSS) Score Dynamics and Outcome Association (n = 82)**

| NIHSS Change Between Admission and Discharge | Number of Patients (n) | Percentage (%) | Outcome Interpretation |
|---|---|---|---|
| Improved (NIHSS score decreased) | 46 | 56.1 | Favorable outcome |
| Unchanged | 23 | 28 | Stable neurological status |
| Worsened (NIHSS score increased) | 13 | 15.9 | Poor prognosis |
| Total | 82 | 100 | — |

Over half (56%) of the patients demonstrated neurological improvement, 28% remained unchanged, and 16% deteriorated. Functional recovery was more frequent among patients with controlled blood-pressure values than among those with persistently high BP readings.

**Figure 1**




Image

Figure 1 explains :
1) Blood Glucose vs Diastolic BP
Pattern: A diffuse cloud with no clear slope.

Interpretation: This association was weak and not statistically significant. A small apparent upward drift likely reflects a random variation rather than a true relationship.

2) Blood Glucose vs Systolic BP
Pattern: Similarly diffuse with essentially flat trend.
Interpretation: No significant linear relationship was observed. Any observed slope was minimal and statistically non-significant; therefore, glucose levels did not appear to correlate with SBP in this sample.

3) Systolic BP vs Diastolic BP
Pattern: Tight, upward-sloping band of points.
Interpretation: Strong, highly significant, and positive linear relationship. Individuals with higher SBP tended to have higher DBP, which was consistent with the expected hemodynamic coupling.
SBP and DBP are strongly and linearly correlated.
Blood glucose showed weak, non-significant relationships with both SBP and DBP; therefore, there was no evidence of clinically meaningful linear associations in this dataset.

## DISCUSSION

This prospective observational study evaluated the relationship between admission blood glucose and blood pressure with short-term functional outcomes and mortality in patients with acute ischemic stroke. Among the 100 patients enrolled, males were more frequently affected (60%), with the most common age group being 59–68 years, a finding consistent with global stroke epidemiology indicating a higher male prevalence and rising incidence in the sixth decade of life [1,6,7].

In this study, most patients presented with elevated systolic and diastolic blood pressures (62% and 59%, respectively) and hyperglycemia (69%) at admission. The mean systolic and diastolic pressures were 146.40 ± 38.07 mmHg and 89.50 ± 18.28 mmHg, respectively, while the mean blood glucose was 229.88 ± 122.78 mg/dL. These findings confirm that both hypertension and hyperglycaemia are frequent metabolic derangements in the acute phase of ischemic stroke [8,9.10].

Correlation analysis revealed a strong positive association between systolic and diastolic blood pressures ($r = 0.868$, $p < 0.001$), indicating that elevations in one parameter closely mirrored the other. However, blood glucose showed only a weak, non-significant correlation with both systolic ($r = 0.069$, $p = 0.496$) and diastolic ($r = 0.126$, $p = 0.216$) pressures. This suggests that, while both hypertension and hyperglycemia are prevalent, they may act through independent pathophysiological pathways that influence stroke outcomes.

These findings are consistent with those of Di Napoli and Papa (2003), who reported that elevated admission blood pressure was independently associated with poor outcomes in acute ischemic stroke [11]. Similarly, Robinson et al. (1997) and Leonardi-Bee et al. (2002) demonstrated that uncontrolled hypertension in the acute phase predicts higher mortality and worse neurological recovery [12,13,14]. In contrast, several studies, including those by Gray et al. (1987) and Berger and Hakim (1986), found that hyperglycaemia is associated with a larger infarct size and increased risk of cerebral edema, although not necessarily with early functional outcomes [15,16]. The absence of a significant glucose–pressure correlation in the current study suggests that hyperglycaemia may worsen stroke outcomes through metabolic and inflammatory mechanisms rather than direct hemodynamic effects.

Regarding functional recovery, 56% of the patients showed improvement in the NIH Stroke Scale (NIHSS) scores by discharge, while 16% worsened. The observation that patients with better-controlled blood pressure had more favorable neurological outcomes reinforces the notion that post-

stroke blood pressure management plays a pivotal role in recovery, as supported by the UKPDS (1998) and LIFE (2002) trials demonstrating that tight BP control significantly reduces the risk of recurrent stroke and vascular complications [17,18].

Taken all together, these results emphasize that hypertension remains a stronger determinant of early mortality and morbidity than hyperglycaemia in acute ischemic stroke, although both warrant prompt identification and control. The weak correlation between glucose and pressure implies separate but additive mechanisms, highlighting the need for integrated management strategies targeting both hemodynamic and metabolic stability.

**Study Limitations**

This was a single-center prospective observational study with a modest sample size. Confounding factors such as medication use, comorbidities and long-term glycemic control were not analyzed. Functional outcomes were assessed only at discharge; Thus, long-term recovery patterns could not be evaluated. Moreover, the study did not employ multivariable modeling to adjust for covariates which might have influenced the results.

**Future Directions**

Future studies should incorporate multivariate regression analysis and longitudinal follow-up to determine independent predictors of outcome and recurrence. Incorporating biomarkers such as HbA1c, IL-6, and high-sensitivity CRP would provide further insights into the inflammatory-metabolic axis linking hypertension, diabetes, and stroke progression.

This study demonstrates that hypertension exerts a stronger and statistically significant impact on early outcomes following acute ischemic stroke than hyperglycemia. The lack of a significant glucose–pressure correlation suggests independent pathogenic pathways, while the strong internal correlation between systolic and diastolic pressures highlights the importance of early, integrated blood-pressure control to improve short-term prognosis and reduce mortality.

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