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ORIGINAL RESEARCH

# Prevalence and Predictors of Stroke Among Patients Presenting to the Emergency Department with Dizziness: A Retrospective Cohort Study

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**Abstract:** **Introduction:** Dizziness is a frequent emergency department (ED) complaint, often benign but sometimes due to serious underlying etiologies, including cerebrovascular diseases. This study aimed to estimate stroke prevalence among ED dizzy patients and determine its predictors. **Methods:** This retrospective cohort study was performed at King Fahad Hospital of the University, reviewing all adult ED visits with documented dizziness from January–December 2023. Patients with incomplete records were excluded. Demographics, comorbidities, vital signs, and clinical features were studied and independent predictors of stroke among dizzy patients were identified using Logistic regression analysis. **Results:** A total of 1,660 records were reviewed and 950 adult patients with the mean age of 42.0 ± 16.2 (range 18-93) years were included. The prevalence of stroke was 0.74% (95% confidence interval (CI): 0.35 to 1.54). The prevalence was higher among males (1.60%) and patients aged 50-60 years (2.09%). Male sex (odds ratio (OR): 9.33, 95% CI: 1.12 to 77.8; p = 0.039), older age (OR: 1.05, 95% CI: 1.01 to 1.10; p = 0.017), smoking (OR: 21.8, 95% CI: 3.95 to 120; p < 0.001), diabetes (OR: 24.6, 95% CI: 2.94 to 205; p = 0.003), hypertension (OR: 5.25, 95% CI: 1.17 to 23.7; p = 0.031), hyperlipidaemia (OR:19.9, 95% CI: 4.37 to 91.3; p < 0.0001), tinnitus (OR:10.3, 95% CI: 1.17 to 90.9; p = 0.036), antiplatelet medications (OR: 8.80, 95% CI: 1.66 to 46.7; p = 0.011), and higher systolic blood pressure (OR: 1.04, 95% CI: 1.02 to 1.08; 0.001) were associated with an increased risk of stroke. In addition, presence of any focal neurologic deficit was significantly associated with the higher probability of stroke in dizzy patients. In the final logistic regression model, smoking (adjusted OR (aOR): 22.7, 95% CI: 2.96 to 174; p = 0.003), hyperlipidemia (aOR: 20.2, 95% CI: 3.45 to 117; p = 0.001), and systolic blood pressure (aOR: 1.06, 95% CI: 1.02 to 1.10; p = 0.001) remained significant independent predictors of stroke risk in dizzy patients who referred to the ED. **Conclusions:** Based on the finding of this series, the prevalence of stroke among dizzy patients was 0.74%. Older age, male sex, smoking, diabetes mellitus, hyperlipidaemia, tinnitus, antiplatelet medications, presence of focal neurologic deficit, and higher systolic blood pressure were among the associated factors of stroke in dizzy patients based on univariate analysis. Based on the final models, smoking, hyperlipidemia and increase systolic blood pressure were among the independent predictors of stroke in dizzy cases.

**Keywords:** Dizziness; Stroke; Emergency medicine; Prevalence; Risk factors

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## 1. Introduction

Dizziness, vertigo, or imbalance presents a diagnostic challenge for physicians, as these symptoms are linked to a wide range of medical conditions across different specialties. This challenge is particularly pronounced in the emergency department (ED), where high patient volume, time constraints, and diverse presentations affect accurate diagnosis. Dizziness, which affects nearly 15% to 20% of adults annually, can arise from benign conditions such as vestibular disorders or from more serious underlying etiologies, including cerebrovascular diseases and cardiac arrhythmias (1). An important initial challenge in evaluating dizzy patients is determining whether a vestibular disorder is present, as such conditions account for nearly half of all dizziness presentations (2). While dizziness accounts for nearly 4% of ED visits, the possibility of an underlying cerebrovascular event frequently

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prompts physicians to admit these patients for close monitoring. Consequently, the tendency to hospitalize and closely monitor patients with dizziness can place a significant strain on healthcare resources (1, 3).

Stroke remains a leading cause of serious long-term disability in the United States in 2023 and accounts for more than 795,000 cases annually, with one person experiencing a stroke every 40 seconds and one death occurring every 3 minutes and 14 seconds (4). The two most common symptoms associated with stroke at the time of initial presentation are unilateral weakness and speech disturbances (4, 5). Moreover, stroke patients may present with atypical symptoms beyond the classic manifestations, including headache and dizziness (6). Consequently, a patient presenting with a single nonspecific symptom, such as dizziness or headache, may result in a misdiagnosis of stroke, potentially leading to severe consequences. Moreover, The National Academy of Medicine has highlighted diagnostic accuracy as a public health priority, noting that nearly one in ten strokes are initially misdiagnosed at the first medical encounter (7).

Previous investigations have shown that most cases of dizziness are attributable to benign etiologies, including peripheral vestibular disorders, orthostatic hypotension, and psychogenic conditions, while serious neurological diseases such as stroke or brain tumors are relatively uncommon (8-13). Nevertheless, prior studies have also often lacked a detailed clinical characterization of stroke patients presenting with dizziness. The limited literature on this subject creates uncertainty around identifying clinical characteristics most predictive of stroke risk, a critical factor in ED settings where rapid decision-making is essential. By systematically analysing these elements, we seek to improve clinicians' ability to recognize patients at higher risk for stroke, ensuring that individuals with potentially serious underlying conditions are appropriately managed. These insights may guide future research aimed at refining risk stratification protocols for patients presenting with dizziness. This study aimed to assess the prevalence of stroke in patients who initially presented to the ED with dizziness.

# 2. Methods

## 2.1. Study design and setting

This is a retrospective cohort analysis conducted at King Fahad Hospital of the University (KFHU), a tertiary care center in Al-Khobar, Saudi Arabia. The study involved a comprehensive review of electronic health records (EHRs) to assess the prevalence and predictors of stroke among adult patients presenting to the ED with dizziness from January 2023 to December 2023. Variables including physical examination findings, vital signs, comorbidities, medication use, associated symptoms, and imaging findings were analyzed using multivariate regression analysis and independent predictive factors of stroke in dizzy patients were explored.

The study was conducted in accordance with the Declaration of Helsinki and was approved by the Institutional Review Board (IRB) of KFHU (IRB number: IRB-2024-01-301). All patient data were anonymized and de-identified prior to analysis to ensure confidentiality and privacy.

## 2.2. Participants

Adult patients (≥18 years) with documented symptoms of dizziness in their EHRs during their ED visit were included. We adopted a broad inclusion approach and did not exclude patients based on comorbidities or underlying conditions. Patients with a history of stroke, cardiac arrhythmia, pregnancy, recent head trauma, Ménière's disease, anemia, or other chronic medical conditions were all included in the study. The only exclusion criteria were: Patients younger than 18 years of age and patients with incomplete or missing medical records that precluded reliable data extraction.

## 2.3. Data collection

Demographic characteristics, clinical presentation, associated symptoms, diagnostic and imaging findings, and final outcomes were calculated using the patient's EHRs. The variables collected included age, sex, nationality, smoking status, blood pressure, comorbidities (hypertension, diabetes, hyperlipidaemia), medication use (antiplatelet or anticoagulant therapy), duration of dizziness, associated symptoms (e.g., headache, nausea, tinnitus), neurological findings, imaging results (Brain computed tomography [CT], brain magnetic resonance imaging [MRI]), and confirmation of stroke diagnosis.

To minimize selection bias, we included all eligible patients presenting with dizziness during the study period. Information bias was mitigated by applying consistent inclusion criteria and standardized definitions of stroke and comorbidities. Diagnostic data were extracted from physician-documented assessments and confirmed imaging reports to enhance validity.

In our center, dizziness was defined according to the International Classification of Diseases (ICD-10) code R42 (Dizziness and giddiness). All patients with this code in their ED encounter record during the study period were included. These cases were then cross verified with physician documentation in the EHR to ensure accuracy of the selected patients.

In our emergency department, patients presenting with dizziness are evaluated using a standardized approach. This includes a detailed history to differentiate between vertigo, presyncope, imbalance, or nonspecific lightheadedness; a full set of vital signs; and a neurological and cardiovascular examination. Additional assessments, such as electrocardiography (ECG), laboratory tests (e.g., complete blood count (CBC), blood glucose, electrolytes), and neuroimaging (computed tomography (CT) or magnetic resonance imaging (MRI)), are performed based on clinical suspicion. When indicated, neurologists are consulted for further evaluation. This systematic approach ensures that serious underlying

etiologies such as stroke, cardiac arrhythmias, or intracranial pathology are promptly identified and managed.

Stroke diagnosis was confirmed through a combination of clinical assessments by emergency physicians and neurologists, supported by neuroimaging. All suspected cases underwent brain CT and/or brain MRI, and the final diagnosis was verified based on imaging findings documented in the EHR and confirmed in the admission and discharge summaries.

### 2.4. Statistical analysis

Using census sampling method, adult patients who presented with dizziness to the ED over the 12-month period of January to December 2023 were studied. No formal sample size calculation was performed, as the study aimed to include all eligible cases within the defined time frame. Demographic and clinical characteristics are presented as frequency and percentage for categorical variables or mean with standard deviation (SD) for continuous variables. The prevalence of stroke among patients presenting to the ED with dizziness was estimated along with 95% confidence intervals (CI), both overall and stratified by sex and age.

Univariable logistic regression was conducted to calculate the crude odds ratios (ORs) with the 95% CIs for each predictor. A partially adjusted logistic regression model was first built to control for a limited set of covariates: 1) demographic variables (age, sex, and smoking status), and 2) comorbidities (hypertension, diabetes, hyperlipidemia, coronary artery disease, and previous stroke). Backward stepwise selection ($p < 0.05$) was applied within each set, and only significant factors were retained in these models. A fully adjusted multivariable logistic regression model was then performed using backward stepwise selection ($p < 0.05$) to derive the final model, starting with all potential confounders (including demographics, comorbidities, and clinical measures). Accordingly, the final model retained smoking, systolic blood pressure, and hyperlipidemia as independent risk factors. All Statistical analyses were performed using Stata version 16.1 (StataCorp, College Station, TX, USA), and the significance level was set at 5%. Furthermore, the diagnostic performance of the final multivariable logistic regression model was evaluated by generating a Receiver Operating Characteristic (ROC) curve and through the reported area under the curve (AUC) with 95% CI. Additionally, the Hosmer–Lemeshow test with 10 risk deciles and a decile-based calibration plot was used to assess calibration.

## 3. Results

### 3.1. Baseline characteristics

A total of 1,660 patient records were reviewed, of which 950 patients aged 18 years and older who presented to the ED with dizziness were included. The sociodemographic characteristics of studied patients are shown in Table 1.

The mean age of included patients was 42.0 ± 16.2 years, with a median of 39 years (range 18-93). The largest age group was 31-45 years, representing 35.2% of the sample. The majority of patients were female (60.5%) and Saudi nationals (83.5%). In addition, only 2% were smokers, and most patients (69.2%) presented to the ED on the first day of symptoms.

Stroke patients were older, with a mean age of 57.6 years, compared to 41.9 years in non-stroke patients. Patients who had a stroke were more likely to be smokers compared to those without stroke (28.6% vs. 1.8%). Additionally, stroke patients were predominantly male (85.7%), and the majority of them presented on the first day (57.1%), with the rest (42.9%) presenting within 2-4 days. None of the stroke patients presented after 5 days (Table 1).

Hypertension was the most prevalent comorbidity, affecting 20.5% of the patients, followed by diabetes mellitus, which was observed in 20.1%. A total of 43 patients (4.5%) were on antiplatelet therapy, while 12 patients (1.3%) were on anticoagulants. The most frequently reported symptom was a combination of dizziness and nausea/vomiting (20.9%), followed by headache (14.4%) and dyspnea (6%).

Moreover, stroke patients had notably higher rates of comorbidities, particularly diabetes mellitus (85.7%) and hypertension (57.1%), compared to non-stroke patients (19.6% and 20.3%, respectively). Stroke patients also had significantly higher rates of hyperlipidemia (57.1% vs. 6.3%) and were more likely to be on antiplatelet therapy (28.6% vs. 4.4%) compared to non-stroke patients. Additionally, stroke patients had higher mean systolic blood pressure (SBP) (163.4 vs. 131.8 mmHg), random blood sugar levels (208 vs. 146.8 mg/dL), and slightly higher diastolic blood pressure (83.6 vs. 81.2 mmHg) compared to non-stroke patients.

### 3.2. Prevalence and risk factors of stroke among dizzy patients

Among the 950 patients who presented to the ED with dizziness, the prevalence of stroke was 0.74% (95% CI: 0.35 to 1.54). The prevalence was higher among males 1.60% (95% CI: 0.72 to 3.52) compared to females 0.17% (95% CI: 0.02% to 1.23%). Patients aged 50-60 years had the highest prevalence of stroke at 2.09% (95% CI: 0.79% to 5.45%).

Results from the univariable logistic regression models (Table 1) showed that males were more likely to develop stroke (OR: 9.33, 95% CI: 1.12 to 77.8; $p = 0.039$) compared with females. Age (per year increase) was modestly associated with stroke (OR: 1.05, 95% CI: 1.01 to 1.10; $p = 0.017$), while smoking was the strongest sociodemographic predictor (OR: 21.8, 95% CI: 3.95 to 120; $p < 0.001$). Among comorbidities, diabetes (OR: 24.6, 95% CI: 2.94 to 205; $p = 0.003$), hypertension (OR: 5.25, 95% CI: 1.17 to 23.7; $p = 0.031$), and hyperlipidaemia (OR:19.9, 95% CI: 4.37 to 91.3; $p < 0.0001$) were significantly associated with stroke. Whereas of the included signs and symptoms, only tinnitus was significantly associated with stroke (OR:10.3, 95% CI: 1.17 to 90.9; $p = 0.036$). Antiplatelet medications (OR: 8.80, 95% CI: 1.66 to 46.7; $p = 0.011$) and higher SBP were associated with an increased risk

of stroke (OR: 1.04, 95% CI: 1.02 to 1.08; 0.001). In addition, presence of any focal neurologic deficit was significantly associated with the probability of stroke in dizzy patients (Table1).

After partial adjustment with multivariable logistic regression, age (adjusted OR [aOR]: 1.06, 95% CI: 1.01 to 1.11; p = 0.019), smoking (aOR: 21.6, 95% CI: 3.73 to 125; p = 0.001), diabetes (aOR: 12.2, 95% CI: 1.20 to 124; p = 0.034), and hyperlipidemia (aOR: 5.52, 95% CI: 1.04 to 29.2; p = 0.045) were significantly associated with stroke. In the final logistic regression model, smoking (aOR: 22.7, 95% CI: 2.96 to 174; p = 0.003), hyperlipidemia (aOR: 20.2, 95% CI: 3.45 to 117; p = 0.001), and systolic blood pressure (aOR: 1.06, 95% CI: 1.02 to 1.10; p = 0.001) remained significant independent predictors of stroke risk in dizzy patients referring to the ED (Table 2). The area under the ROC curve as well as calibration plot of the final model are presented in Figure 1.

## 4. Discussion

This study aimed to determine the prevalence of stroke among patients presenting to the ED with dizziness and to identify demographic, clinical, and diagnostic factors associated with an increased risk of stroke. In this retrospective study, we found that among 950 patients who presented to the ED with dizziness, only seven patients (0.74%) were diagnosed with stroke, all of which were of ischemic type. Compared to similar studies, this percentage is relatively low, as a study from Nueces County, Texas, reported that 3.2% of patients presenting with dizziness and vertigo had a stroke or Transient ischemic attack (TIA) (8). Another study in Seoul, Korea, found a stroke prevalence of 4.5% (14), and a New York hospital database reported a prevalence of 4.9% (15).

The study analysis revealed significant demographic influences on stroke prevalence among patients, with older age strongly correlating with an increased risk of stroke. Similar findings were reported in studies of patients presenting to the emergency department with dizziness, highlighting age as an independent risk factor for predicting acute stroke (14). Sex disparities were also evident, showing a markedly higher prevalence of stroke among males compared to females. This finding may be contested by some due to the complexities of stroke risk. Sex significantly influences this risk; men are more likely to have a stroke at younger ages, but women's longer lifespans increase their lifetime risk (16). Additionally, nationality appeared to influence stroke risk, as a higher percentage of stroke patients were non-Saudi.

Diabetes mellitus, hypertension, and dyslipidemia were well-established independent risk factors that increased the likelihood of stroke incidence. Diabetes mellitus patients presenting to the emergency department with dizziness were at higher risk of stroke (85.7%) compared to non-stroke patients (19.6%). This aligns with larger epidemiological studies, which consistently show that individuals with diabetes have an elevated risk of stroke, particularly ischemic stroke (17). In our study, hypertension and dyslipidemia were the second most common risk factors associated with stroke, each accounting for 57.1% of cases. Whereas, according to a study conducted in Nueces County, Texas, hypertension was the most common risk factor (8). Additionally, another retrospective study in a hospital university in Ulsan, Korea, Patients with hypertension were shown to have an increased risk of stroke compared with non-hypertensive patients (56.4%) (14). In relation to dyslipidemia, a systematic review revealed that elevated low-density lipoprotein (LDL) plays a major role in the development of atherosclerosis, which can eventually result in stroke (18). In addition, a cross-sectional study in China found that hypertension and dyslipidemia have a synergistic effect on the development of ischemic stroke (19).

A prior history of stroke was identified in 14.3% of patients in this study. Evidence from a systematic review indicates that stroke recurrence rates have remained stable over the past 20 years, establishing a history of previous stroke as a significant risk factor for future events (20). Additionally, the likelihood of recurrence is notably higher within the first 6 to 12 months following the initial stroke (21, 22).

A significant association was also observed between smoking and stroke patients presenting with dizziness to the emergency department. This finding is particularly relevant given the relatively low smoking prevalence (2%) among participants. This underscores that even a small proportion of smokers can significantly influence the overall risk profile in emergency departments. In addition, smoking has been linked to several risk factors for stroke, including diabetes, high blood pressure, and elevated resting heart rate. Smoking may also play a role in genetic diseases such as Fabry disease, which can impair the central nervous system and lead to cerebral infarction and transient ischemic attacks (23). Symptoms such as headache, dyspnea, nausea, vomiting, and tinnitus were commonly observed in our patient population. However, univariable logistic regression analysis identified tinnitus as the only statistically significant symptom, with a higher likelihood of being associated with stroke development. This finding aligns with the results of the Tromso study, which reported a significant association between tinnitus and ischemic stroke in individuals with pre-existing cardiovascular disease (24). In contrast, the remaining symptoms documented were not found to have a statistically significant association with stroke risk.

Vital signs were collected for all patients, and to our knowledge, this is the first study to take these factors into consideration. We observed that patients with stroke presented with markedly elevated SBP, with a mean of 163.4 mmHg compared to 131.8 mmHg in non-stroke patients. Diastolic blood pressure (DBP) was also slightly higher in stroke patients. Additionally, stroke patients exhibited higher random blood sugar levels. Nevertheless, the only significant independent risk factor identified in our study was elevated SBP.

Medical use of antiplatelet therapy was significantly associated with an increased risk of stroke among patients present-

ing with dizziness, while none of the stroke patients were on anticoagulants. Although this result might seem counterintuitive given the well-established role of antiplatelet therapy in stroke prevention, it can be explained by the presence of underlying comorbidities in stroke patients, such as diabetes, hypertension, and hyperlipidemia. The RESTART trial—although it was conducted on patients following intracerebral hemorrhage (ICH)—similarly demonstrates that ischemic stroke can still occur in patients on antiplatelet therapy but with a lower likelihood compared to those not on the therapy (25). Additionally, a study conducted in the United Kingdom highlighted that despite the proven efficacy of antiplatelets like aspirin in reducing stroke risk, factors such as poor patient adherence, associated comorbidities, medication resistance, and underlying genetic polymorphism can reduce antiplatelet effectiveness, leaving patients vulnerable to ischemic stroke (26).

Figure 1 illustrates the ROC curve (sensitivity vs. 1–specificity) for the final model, which showed excellent discrimination with AUC=0.97 (95% CI: 0.95–0.99). In addition, the model achieved 14.3% sensitivity, 99.4% specificity, PPV of 16.7%, and NPV of 99.2% (reflecting the very low prevalence of stroke). Calibration was adequate: the Hosmer–Lemeshow test using 10 deciles showed no evidence of misfit ($^2$[8] = 1.41, p = 0.994); the decile-based calibration plot also demonstrated close agreement between observed and predicted risks (Figure 2).

## 5. Limitations

Several important limitations were identified in this study. Firstly, the study was limited by its single-center design, which restricts the generalizability of our findings. Incorporating multiple centers in future research would enhance the applicability of the results. Additionally, all stroke cases identified in this study were of the ischemic type. No hemorrhagic strokes were observed during the study period, which may limit the ability to generalize our findings to patients with hemorrhagic stroke. A broader inclusion of stroke types would provide a more comprehensive understanding of the relationship between dizziness and stroke, ultimately facilitating improved risk stratification in emergency care. Furthermore, the study's retrospective design may introduce biases, and the absence of standardized examination tools, such as HINTS (Head Impulse, Nystagmus, Test of Skew), limits the diagnostic accuracy of stroke identification. Addressing these limitations in future research is crucial to validate and expand upon our findings.

The findings of this study have significant implications for clinical practice, particularly in emergency care settings. The strong correlation between age and stroke risk indicates that older adults should be prioritized for thorough evaluations when presenting with dizziness. Furthermore, recognizing the significant role of established risk factors like diabetes, hypertension, and dyslipidemia can inform targeted prevention strategies and interventions. Additionally, the significant link between smoking and stroke risk highlights the need for healthcare providers to assess smoking status in patients with dizziness. Even with low prevalence, smokers face increased stroke risk, especially alongside other factors like diabetes and hypertension. This underscores the importance of integrating smoking cessation programs into care strategies for at-risk patients to improve outcomes. Ultimately, these findings encourage a more refined risk stratification process that could lead to improved patient outcomes. Although the study was conducted at a single tertiary care center in the Eastern Province of Saudi Arabia, the findings may be generalizable to similar emergency department settings with comparable healthcare infrastructure, patient demographics, and clinical workflows. The use of a large, real-world dataset enhances the external validity of the results. Future studies should aim to include a broader patient population and utilize comprehensive diagnostic tools to improve the understanding of stroke risk in similar patient groups.

## 6. Conclusions

Based on the finding of this series, the prevalence of stroke among dizzy patients was 0.74%. Older age, male sex, smoking, diabetes mellitus, hyperlipidaemia, tinnitus, antiplatelet medications, presence of focal neurologic deficit, and higher systolic blood pressure were among the associated factors of stroke in dizzy patients based on univariate analysis. Based on the final models, smoking, hyperlipidemia, and increase systolic blood pressure were among the independent predictors of stroke in dizzy cases. It is recommended that EDs enhance their evaluation protocols for patients with dizziness, particularly focusing on those with a history of stroke or belonging to higher-risk demographics.

## 7. Declarations

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### *7.2. Author contributions*

Abdulelah Alzahrani: AA (Supervision, Data Curation, Writing – Review & Editing), Abdullah Alzahid: AZ (Conceptualization, Supervision), Qasem Almulihi: QA (Conceptualization, Methodology), Mohammad Assiri: MA (Conceptualization, Writing – Review & Editing), Abdulrahman Subaih: AS( Investigation, Writing – Original Draft), Rayan Al Muhanna:

RA (Investigation, Writing – Original Draft), Yasir Khan: YK (Investigation, Writing – Original Draft), Manal Alabdullah: MA (Investigation, Writing – Original Draft), Jood Alkallaf: JA (Investigation, Writing – Original Draft), Eyad Alhashim: EA (Investigation, Writing – Original Draft), Abdulmonem Alsaleh: AS (Formal Analysis) , Sukainah Al Khalaf: SA (Formal Analysis), Deena Aldossary: DA (Conceptualization, Supervision) , Mohannad Alghamdi: MGA (Conceptualization, Supervision). All authors read and approved the final version of manuscript.

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### *7.4. Conflict of Interest*

The authors declare that there is no conflict of interest regarding the publication of this paper.

### *7.5. Using Artificial Intelligence Chatbots*

Artificial intelligence tools (ChatGPT, OpenAI) were solely used to improve the grammar, clarity, and overall readability of the manuscript. All study concepts, data analysis, interpretation of results, and conclusions were developed entirely by the authors. The authors have carefully reviewed and approved the final manuscript and take full responsibility for its content.

### *7.6. Data availability*

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

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**Table 1:** Comparing the baseline characteristics of studied dizzy patients between cases with and without confirmed stroke (N=950)

| Characteristics | All | Stroke | | P-value |
|---|---|---|---|---|
| | | No (n=943) | Yes (n=7) | |
| **Age (years)** | | | | |
| Mean ± SD | 42.0 ± 16.2 | 41.9 ± 16.2 | 57.6 ± 9.7 | 0.010 |
| Median (range) | 39 (18, 93) | 39 (18, 93) | 55 (45, 72) | |
| ≤30 | 267 (28.1) | 267 (28.3) | 0 (0) | |
| 31-45 | 334 (35.2) | 333(35.3) | 1 (14.2) | |
| 46-60 | 214 (22.5) | 211 (22.4) | 3 (42.9) | |
| >60 | 135 (14.2) | 132 (14) | 3 (42.9) | |
| **Sex** | | | | |
| Male | 375 (39.5) | 369 (39.1) | 6 (85.7) | 0.012 |
| Female | 575 (60.5) | 574 (60.9) | 1 (14.3) | |
| **Nationality** | | | | |
| Saudi | 793 (83.5) | 789 (83.7) | 4 (57.1) | 0.060 |
| Non-Saudi | 157 (16.5) | 154 (16.3) | 3 (42.9) | |
| **Smoker** | | | | |
| No | 931 (98) | 926 (98.2) | 5 (71.4) | <0.001 |
| Yes | 19 (2) | 17 (1.8) | 2 (28.6) | |
| **Presentation day** | | | | |
| 1st day | 657 (69.2) | 653 (69.2) | 4 (57.1) | NA |
| 2-4 | 206 (21.7) | 203 (21.5) | 3 (42.9) | |
| 5-7 | 76 (8) | 76 (8.1) | 0 (0) | |
| 8-10 | 11 (1.1) | 11(1.2) | 0 (0) | |
| **Comorbidities** | | | | |
| Hypertension | 195 (20.5) | 191 (20.3) | 4 (57.1) | 0.016 |
| Diabetes Mellitus | 191 (20.1) | 185 (19.6) | 6 (85.7) | <0.001 |
| Hyperlipidemia | 63 (6.6) | 59 (6.3) | 4 (57.1) | <0.001 |
| Coronary Artery Disease | 35 (3.7) | 34 (3.6) | 1 (14.3) | 0.135 |
| Previous stroke | 34 (3.58) | 33 (3.5) | 1 (14.3) | 0.126 |
| **Medications** | | | | |
| Antiplatelets | 43 (4.5) | 41 (4.4) | 2 (28.6) | 0.002 |
| Anticoagulants | 12 (1.3) | 12 (1.3) | 0 (0) | - |
| **Symptoms** | | | | |
| Nausea/vomiting | 199 (20.9) | 197 (20.8) | 2 (28.6) | 0.620 |
| Headache | 137 (14.4) | 136 (14.4) | 1 (14.3) | 0.992 |
| Dyspnea | 57 (6) | 57 (6) | 0 (0) | – |
| Syncope | 36 (3.8) | 36 (3.8) | 0 (0) | - |
| Chest pain | 34 (3.8) | 34 (3.6) | 0 (0) | - |
| Sensory disturbance | 26 (2.7) | 23 (2.4) | 3 (42.9) | <0.001 |
| Gait disturbance | 24 (2.5) | 22 (2.3) | 2 (28.6) | <0.001 |
| Speech disturbance | 10 (1.1) | 7 (0.7) | 3 (42.9) | <0.001 |
| Unilateral weakness | 9 (0.9) | 7 (0.7) | 2 (28.6) | <0.001 |
| **Vital signs** | | | | |
| SBP (mmHg) | 132.1 ± 22.8 | 131.8 ± 22.6) | 163.4 ± 20.3) | <0.001 |
| DBP (mmHg) | 81.2 ± 13.5 | 81.2 ± 13.5) | 83.6 ± 17.8 | 0.645 |
| Heart rate (bpm) | 85.9 ± 16.2 | 86 ± 16.1) | 75.4 ± 27.5 | 0.084 |
| RR (breaths/min) | 18.2 ± 1.32 | 18.3 ± 1.32) | 17.9 ± 1.46 | 0.472 |
| RBS (mg/Dl) | 147.7 ± 107.8 | 146.8 ± 107.6) | 208 ± 112.3 | 0.167 |
| Temperature (°C) | 36.8 ± 0.35 | 36.8± 0.35 | 36.6 ± 0.38 | 0.184 |
| O2 saturation (%) | 98.5 (2.9) | 98.5 (2.9) | 98.1 (1.21) | 0.731 |

Data are presented as mean ± standard deviation (SD), median (interquartile range (IQR)), or frequency (%).
DBP: diastolic blood pressure; SBP: systolic blood pressure; RBS: random blood sugar, RR: Respiratory Rate. Reported p-values are based on the Chi-square test for categorical variables and the independent t-test for numerical variables.

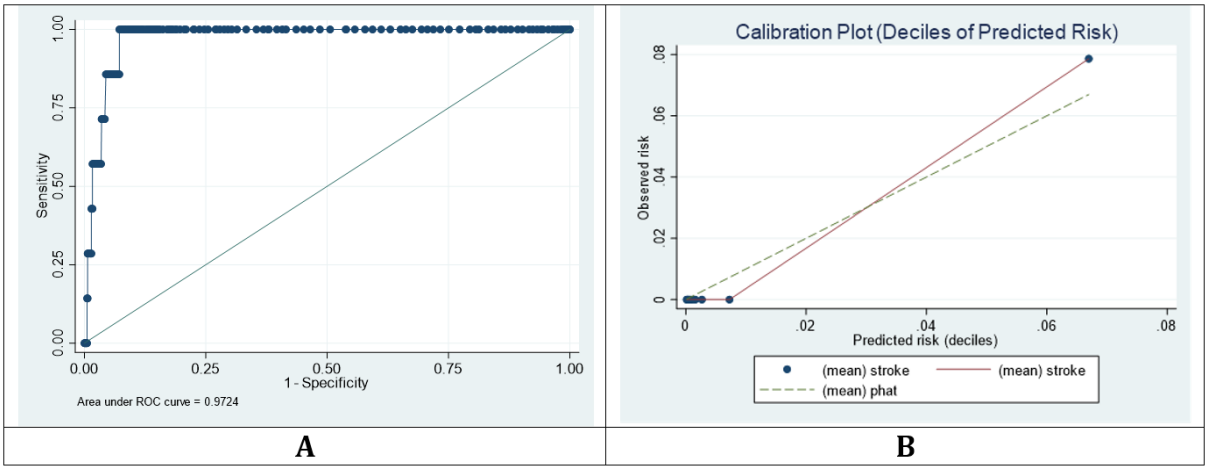


**Figure 1:** A: The area under the receiver operating characteristic (ROC) curve of the final model; B: calibration plot by deciles for the final stroke prediction model.

**Table 2:** Results of multivariate regression analysis for independent predictive factors of stroke among patients referring to the emergency department with dizziness

| Variables | Partially adjusted | | Final adjusted | |
|---|---|---|---|---|
| | aOR (95% CI) | P value | aOR (95% CI) | P value |
| **Age (year)** | | | | |
| Increased age | 1.06 (1.01, 1.11) | 0.019 | - | |
| **Comorbidity** | | | | |
| Smoking | 21.6 (3.73, 125) | 0.001 | 22.7 (2.96, 174) | 0.003 |
| Diabetes | 12.2 (1.20, 124 | 0.034 | - | |
| Hyperlipidemia | 5.52 (1.04, 29.2) | 0.045 | 20.2 (3.45, 117) | 0.001 |
| **Vital signs** | | | | |
| SBP (mmHg) | - | | 1.06 (1.02, 1.10) | 0.001 |

aOR: adjusted odds ratio; CI: confidence interval; SBP: systolic blood pressure. All 7 cases of stroke did not have chest pain, dyspnea, or syncope, and were not on anticoagulant medication; therefore, these variables were not included in the logistic regression models.

This final model was adjusted for smoking status, systolic blood pressure, and hyperlipidemia based on the backward stepwise selection method. All variables were entered into the model, and those with the highest p-value (>0.05) were removed in each step until all remaining variables had p-values ≤ 0.05.

**Table 3:** Univariable and Multivariable Analyses for Predicting Stroke in ER patients

| Variables | Univariable logistic regression models | | Partially adjusted multivariable logistic regression | | Final adjusted multivariable logistic regression | |
|---|---|---|---|---|---|---|
| | Crude OR (95% CI) | P value | Adjusted OR (95% CI) | P value | Adjusted OR (95% CI) | P value |
| Male | 9.33 (1.12, 77.8) | 0.039 | - | | - | |
| Age in years | 1.05 (1.01, 1.10) | 0.017 | 1.06 (1.01, 1.11)[3] | 0.019 | - | |
| Age >65 year[1] | 3.19 (0.61, 16.7) | 0.169 | - | | - | |
| Age >50 years[2] | 13.9 (1.68, 116) | 0.015 | - | | - | |
| Smoking | 21.8 (3.95, 120) | <0.001 | 21.6 (3.73, 125)[3] | 0.001 | 22.7 (2.96, 174)5 | 0.003 |
| Hypertension | 5.25 (1.17, 23.7) | 0.031 | - | | - | |
| Diabetes | 24.6 (2.94, 205) | 0.003 | 12.2 (1.20, 124)[4] | 0.034 | - | |
| Hyperlipidemia | 19.9 (4.37, 91.3) | 0.000 | 5.52 (1.04, 29.2)[4] | 0.045 | 20.2 (3.45, 117)[5] | 0.001 |
| Previous stroke | 4.60 (0.54, 39.3) | 0.163 | - | | - | |
| Coronary artery Disease | 4.46 (0.52, 38.0) | 0.172 | - | | - | |
| Nausea/vomiting | 1.51 (0.29, 7.87) | 0.621 | - | | - | |
| Headache | 0.99 (0.19, 8.28) | 0.992 | - | | - | |
| Tinnitus | 10.3 (1.17, 90.9) | 0.036 | - | | - | |
| Antiplatelet medications | 8.80 (1.66, 46.7) | 0.011 | - | | - | |
| SBP (mmHg) | 1.04 (1.02, 1.08) | 0.001 | - | | 1.06 (1.02, 1.10)[5] | 0.001 |
| DBP (mmHg) | 1.01 (0.96, 1.07) | 0.643 | - | | - | |
| Heart rate (bpm) | 0.95 (0.91, 1.06) | 0.080 | - | | - | |
| Respiratory Rate (breaths/min) | 0.80 (0.44, 1.43) | 0.080 | - | | - | |
| RBS (mg/Dl) | 1.00 (0.99, 1.01) | 0.193 | - | | - | |
| Temperature (°C) | 0.12 (0.01, 1.75) | 0.119 | - | | - | |
| Oxygen Saturation (%) | 0.98 (0.87, 1.11) | 0.749 | - | | - | |

*All 7 cases of stroke did not have chest pain, dyspnea, or syncope, and were not on anticoagulant medication; therefore, these variables were not included in the logistic regression models.

1This variable is binary (<65 vs. ≥65 years).

2This variable is binary (<50 vs. ≥50 years).

3This model was adjusted for demographic characteristics based on the backward stepwise selection method ($p < 0.05$), including age and smoking status.

4This model was adjusted for comorbidities based on backward stepwise selection method ($p < 0.05$), including diabetes and hyperlipidemia.

5This model was adjusted for smoking status, systolic blood pressure, and hyperlipidemia based on the backward stepwise selection method. All variables were entered into the model, and those with the highest p-value (>0.05) were removed in each step until all remaining variables had p-values ≤ 0.05.

**Abbreviations:** CI: Confidence interval; DBP: Diastolic blood pressure; ER: Emergency room; OR: odds ratio; SBP: systolic blood pressure; RBS: Random Blood Sugar.