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Risk Factors of First Ever Stroke Patients in Babil Governorate / Iraq. Hospital Based Case-Control Study 2014-2015

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Abstract: ***This hospital-based case-control study, conducted in Babil Governorate, Iraq, from October 2014 to February 2015, investigates risk factors for first-ever stroke among 200 patients and 200 matched controls. Drawing on clinical data, physical exams, and lifestyle assessments, the study identifies hypertension (adjusted OR=25.6), diabetes, atrial fibrillation, smoking, and oral contraceptive use (adjusted OR=18.2) as significant predictors, with ischemic stroke dominating (86% of cases). Gender-specific patterns emerged, with hypertension and obesity notably prominent in women. These findings highlight the urgent need for targeted prevention strategies in Iraq, addressing modifiable risk factors to curb the rising stroke burden in low-to-middle-income settings.***

Keywords: stroke risk factors, hypertension, diabetes, Iraq, case-control study

1. Introduction

Stroke represents one of the most significant challenges to global public health, serving as both a major cause of mortality and the primary source of long-term adult disability worldwide (1-4). Defined by the World Health Organization as rapidly developing clinical signs of focal cerebral dysfunction lasting more than 24 hours or leading to death of vascular origin (5), stroke manifests through two primary mechanisms: ischemic infarction (accounting for approximately 85% of cases) and hemorrhagic events (6,7). The global burden of this cerebrovascular catastrophe continues to escalate, particularly in low- and middle-income countries (LMICs) where approximately 85% of stroke-related deaths occur (8). Current epidemiological trends paint an alarming picture - while high-income nations have achieved a 42% reduction in stroke incidence through effective prevention strategies over the past four decades (9), LMICs face a 100% increase in cases during the same period (10), widening the global disparity in stroke burden.

The epidemiological transition in developing nations like Iraq has created a perfect storm for cerebrovascular disease. According to WHO estimates, Iraq's age-adjusted stroke mortality rate stands at 81.25 per 100,000 population and ranks 108th globally (11). Compounding this crisis is the high prevalence of silent cerebral infarction, affecting 19% of Iraq's population (12), which independently increases subsequent stroke risk by two-to threefold (9,13). This silent epidemic reflects broader systemic challenges in Iraq's healthcare landscape, where surveillance gaps and fragmented prevention programs hinder effective stroke management. The situation in Babil Governorate remains particularly obscure, as no previous studies have examined stroke epidemiology in this region, despite its demographic significance within Iraq's healthcare system.

Iraq's stroke profile reveals several disturbing trends when examined through the lens of modifiable risk factors. The country's prevalence of hypertension (40.4%), diabetes (10.4%), and hypercholesterolemia (37%) often exceeds global averages (14-20). Particularly concerning are lifestyle factors - smoking rates (21.9% vs global 18%), physical inactivity (56.7% vs 31%), and obesity (66.9% vs 47%) all substantially surpass worldwide norms (16-19). These risk factors coalesce into a dangerous syndemic, with 91% of Iraqis consuming fewer than five daily servings of fruits and vegetables (21), creating ideal conditions for cerebrovascular pathology. The INTERSTROKE study's seminal finding that ten modifiable risk factors account for 90% of global stroke risk (21) takes on particular urgency in the Iraqi context, where multiple high-prevalence risks intersect in the same population.

Existing Iraqi stroke studies reveal both consistencies and puzzling variations in risk factor profiles. Research from Basrah identified hypertension, ischemic heart disease, and smoking as predominant risks (21), while Erbil studies highlighted oral contraceptive use and obesity as significant contributors (22). The Ramadi investigation confirmed hypertension and diabetes as major factors, and a Baghdad study revealed critical gaps in transient ischemic attack management, with only 25% of cases receiving appropriate care (21). These regional disparities underscore the necessity for location-specific epidemiological data, particularly in understudied areas like Babil Governorate. Without such granular understanding, national stroke prevention strategies risk being either inefficient or altogether misdirected.

The present study emerges from this urgent need for localized evidence. Focusing specifically on first-ever stroke cases in Babil Governorate, our research investtigates both traditional and emerging risk factors through a hospital-based case-control design. We hypothesize that hypertension, diabetes mellitus, cardiac diseases, dyslipidemia, smoking, physical inactivity, unhealthy dietary patterns, obesity, snoring, and

oral contraceptive use all demonstrate significant associations with stroke occurrence in this population. This comprehensive approach allows us to: (1) quantify population-attributable risks for each factor, (2) establish prevalence rates among cases and controls, and (3) analyze biochemical markers including lipid profiles and glucose levels. Crucially, our study design enables examination of risk factor clustering - a particularly relevant consideration given Iraq's high prevalence of metabolic syndrome components.

Methodologically, our investigation builds upon lessons from landmark stroke studies while adapting to Iraq's unique healthcare context. The Dubbo Study's emphasis on atrial fibrillation as an ischemic stroke predictor (44), Tanzania's findings regarding HIV and stroke risk (21), and Pakistan's documentation of sedentary lifestyle impacts all inform our multidimensional approach. By incorporating validated assessment tools for sleep disorders (using Epworth Sleepiness Scores as per Davies et al. [21]) and detailed lifestyle evaluations, we aim to capture the complex interplay of biological and behavioral stroke determinants. This approach proves particularly relevant given Iraq's documented issues with sleep-disordered breathing and its 19.7% prevalence of undiagnosed hypertension among stroke patients (14-20).

The potential implications of this research extend beyond academic circles to direct clinical and public health applications. In the short term, our findings can guide hospital-based stroke prevention initiatives in Babil's healthcare facilities. Intermediate applications include informing regional awareness campaigns targeting high-prevalence, high-impact risks like hypertension control and smoking cessation. Long-term, the study provides evidence for policymakers to advocate for strengthened primary care systems capable of sustained risk factor modification. This proves particularly crucial given that 77% of strokes represent first-ever events (21), emphasizing the irreplaceable value of primary prevention. The experience of Oxfordshire, UK, where comprehensive risk factor management yielded a 40% reduction in age-specific stroke incidence over two decades (21), serves as both inspiration and validation for such population-health approaches.

Within the broader context of Iraq's healthcare challenges, this study addresses critical gaps in non-communicable disease surveillance and prevention. As the country's stroke-related Years of Life Lost (YLLs) climbed from 8th position in 1990 to 6th by 2010 (22), the need for evidence-based interventions becomes increasingly acute. Our research coincides with growing recognition of stroke's economic devastation - with global costs estimated at $51.2 billion annually in direct healthcare expenses and lost productivity (9) - making prevention not just a medical imperative but also an economic necessity. For resource-constrained settings like Babil Governorate, identifying high-yield, cost-effective prevention targets could dramatically alter the region's cerebrovascular disease trajectory.

Ultimately, this study represents more than an academic exercise; it constitutes a vital step toward evidence-based stroke prevention in a chronically underserved population. By elucidating Babil Governorate's unique risk factor profile while contextualizing findings within global stroke literature, we aim to provide both immediate actionable insights and long-term surveillance benchmarks. As LMICs brace for projected increases in stroke incidence and mortality (9), such localized research becomes indispensable for developing targeted, effective prevention strategies that can alleviate one of the 21st century's most pressing public health challenges.

2. Methodology

2.1 Technical Design

a) Study Design & Setting: A hospital-based case-control study was conducted in Babil Governorate, Iraq (population: ~1.8 million), from October 2014 to February 2015. Cases were recruited from Merjan and Hilla Teaching Hospitals, the only facilities with neurology, CT/MRI, and ICU services for stroke patients.
b) Study Population: Participants aged ≥12 years residing in Babil were included.
c) Cases: First-ever stroke patients, confirmed by CT/MRI and specialist diagnosis.
d) Controls: Hospital-matched patients (age ±5 years, same sex) without stroke/TIA history.
e) Exclusions: Non-residents, secondary stroke (e.g., trauma/tumor-induced), and critically ill controls (e.g., cancer, organ failure) to avoid bias in variables like BMI and diet (ethical/scientific reasons).
f) Sample Size: Using Epi Info 7 (90% power, 95% CI, OR ≥2, 40% control exposure based on Iraq's hypertension prevalence [14]), 189 cases and 189 controls were calculated (+5% for attrition; total N=400). Consecutive non-random sampling was applied.

2.2 Data Collection

a) Questionnaire: Adapted from WHO STEPS, covering demographics, medical history (hypertension, DM, CAD, AF), smoking, physical activity (≥30 mins/day, 5 days/week [23]), diet (Harvard Healthy Eating Plate [24]), and snoring.
b) Physical Exams:
   - BMI: Weight (kg)/height (m^2). For bedridden patients, weight was estimated via arm/abdomen/calf circumferences using a validated formula (error <1kg vs. 3.6–9kg in Brazilian/Indian formulae [25, 26]). Height used demi-span calculations [27].
   - BP: Measured 3x (mercury sphygmomanometer; JNC-VII criteria [28]). Hypertension: ≥140/90 mmHg or on medication.
   - ECG: Assessed for CAD/AF.
c) Lab Tests:
   - FPG ≥7.0 mmol/L or HbA1c ≥6.5% defined DM [29–31].
   - Cholesterol: ≥5.2 mmol/L = high [80].
d) Imaging: CT/MRI confirmed stroke type (ischemic/hemorrhagic).

2.3 Operational Definitions

- Smoking: Current (≥100 cigarettes lifetime), former, or never [32].

- Diet: Scored via Harvard Plate (healthy: 4–6 points; unhealthy: 0–3 [24, 33]).
- Physical activity: ≥150 mins/week moderate exercise [34].

Statistical Analysis

- Data analyzed using SPSS-20. Chi-square/t-tests compared categorical/numerical variables. Logistic regression (OR, 95% CI; p≤0.05 significant) identified stroke risk factors [35].

Ethical Approval

- Approvals from Babil Health Directorate, Iraqi Ministry of Health, and Arab Board were obtained. Written consent and confidentiality were ensured.

3. Results

1) Socio-demographic Characteristics

The study included 200 first-ever stroke patients (110 males, 90 females) and 200 age/sex-matched controls from Babil Governorate (2014-2015). Key findings:

a) Age Distribution:

- The mean age of cases and controls was closely aligned (males: 64.7±11.6 vs 62.0±11.0; females: 64.6±12.6 vs 63.9±12.4; p>0.05) (Table 1).
- Peak incidence occurred in 60-79 age group (54.5% of cases), with males predominating in 50-69 years and females in ≥70 years (Table 2, Figure 1).

Table 1: Mean age comparison

Gender	Group	N	Mean Age ± SD	p-value
Male	Cases	110	64.7 ± 11.6	0.085
	Controls	110	62.0 ± 11.0	
Female	Cases	90	64.6 ± 12.6	0.708
	Controls	90	63.9 ± 12.4	

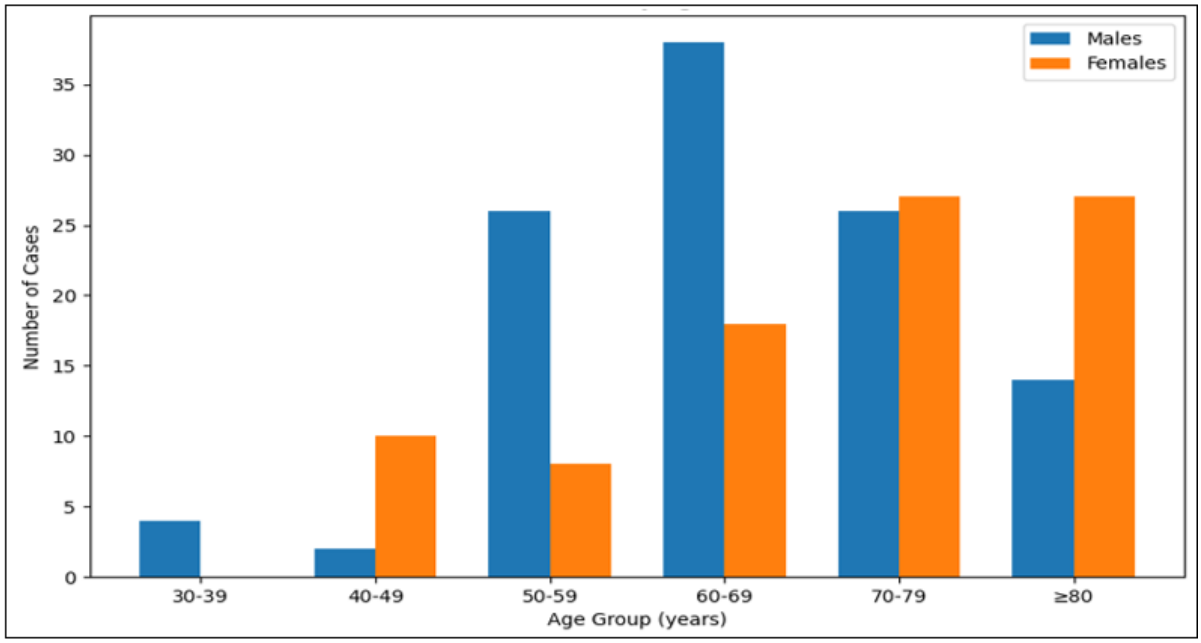

Figure 1: Age and Sex Distribution of First-Ever Stroke Cases (n=200)

2) Stroke Subtypes

a) Ischemic Stroke (IS): Ischemic strokes were the most common in both genders (Figure 2). 86% of all strokes (87.3% male, 84.4% female)

b) Hemorrhagic Stroke (HS): 14% of cases, strongly associated with hypertension (92.9% vs 70.3% in IS; p=0.012)

c) Age Patterns:

- IS peaked in 60-79 years (56.4%)
- HS showed bimodal distribution (40-49 and ≥70 years)

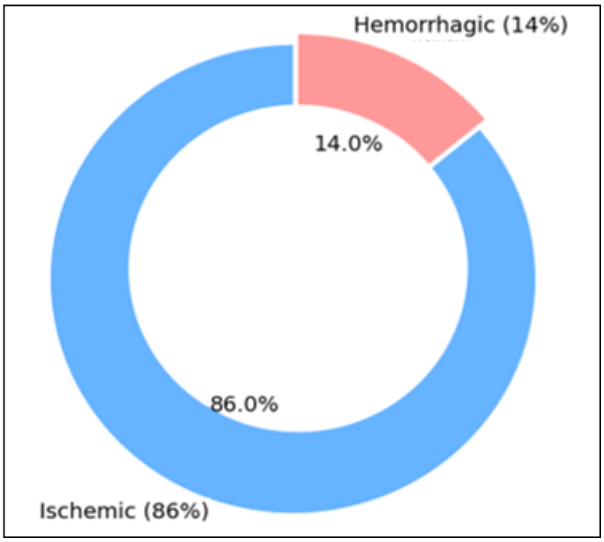

Figure 2: Proportion of ischemic vs. hemorrhagic stroke subtypes by gender

Table 2: Stroke subtypes by age/sex

Age	Ischemic Male	Ischemic Female	Hemorrhagic Male	Hemorrhagic Female
30-39	2 (2.1%)	0	2 (14.3%)	0
60-69	32 (33.3%)	16 (21.1%)	6 (42.8%)	2 (14.3%)

3) Risk Factor Analysis

a) Medical History

- Hypertension: Hypertension prevalence differed markedly between groups (Figure 3).58.2% (male cases) vs 25.5% controls; 92.2% (female) vs 26.7% ($p<0.001$)
- Diabetes: 48.2% (male) vs 21.8%; 56.7% (female) vs 10% ($p<0.001$)
- Oral Contraceptives: 16.7% female cases vs 2.1% controls ($p<0.001$)

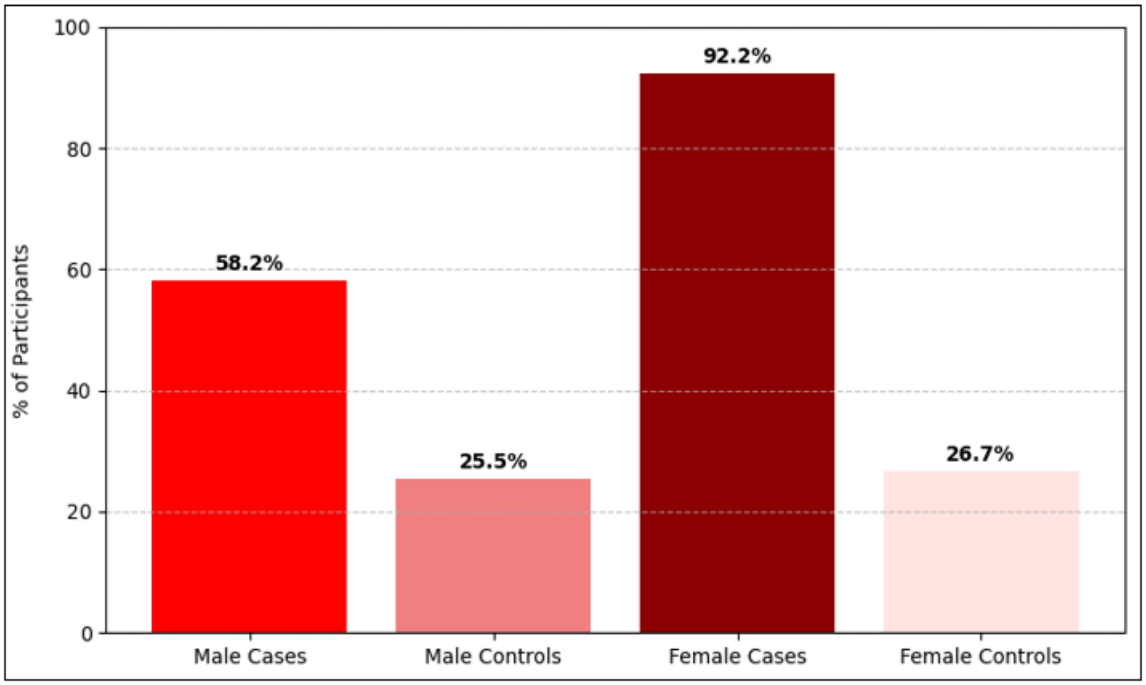

Figure 3: Hypertension Prevalence in Stroke Cases vs. Controls (N=200)

b) Lifestyle Factors:

Table 3: Risk factor prevalence in cases/controls

Factor	Male Cases	Male Controls	p-value	Female Cases	Female Controls	p-value
Current Smoking	40%	30.90%	0.018	17.80%	5.60%	0.031
Physical Inactivity	74.50%	61.80%	0.043	80%	73.30%	0.29

4) Biometric Measurements

a) Blood Pressure:

- Males: 138.8/83.0 mmHg (cases) vs 122.9/75.5 mmHg (controls)
- Females: 149.1/87.4 mmHg vs 119.2/72.3 mmHg ($p<0.001$)

b) BMI:

- 80% male and 73% female cases were overweight/obese vs 55.5%/55.6% controls

Table 4: Metabolic parameters for study participants. N=200

Parameter	Male Cases	Male Controls	p-value	Female Cases	Female Controls	p-value
FPG (mmol/L)	7.8±3.5	6.7±2.8	0.008	8.5±3.7	5.8±1.1	<0.001
Cholesterol	5.1±1.3	4.7±1.0	0.009	5.5±1.1	4.8±0.7	<0.001

5) Multivariate Analysis

The strongest predictors were hypertension (aOR=25.6) and OCP use (aOR=18.2) (Figure 4).

Key predictors (Adjusted ORs):

a) Females:

- Hypertension: OR=25.6 (95%CI:7.7-85.1)
- OCP Use: OR=18.2 (2.2-152.7)

b) Males:

- Atrial Fibrillation: OR=4.7 (1.6-13.5)
- Diabetes: OR=3.5 (1.8-6.9)

Protective Factors:

c) Healthy diet reduced risk by 65% in males (OR=0.35) and 81% in females (OR=0.19)

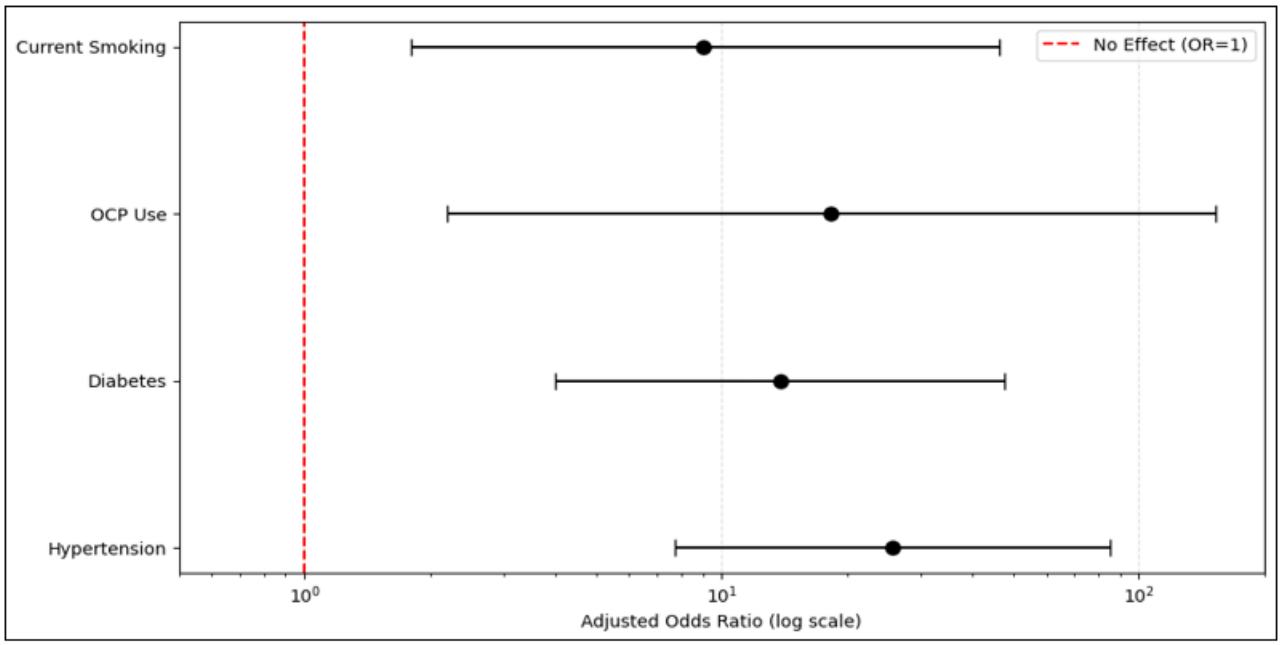

Figure 4: Forest plot of adjusted odds ratios for significant stroke risk factors

4. Discussion

This study highlights that modifiable risk factors—hypertension, diabetes mellitus (DM), heart disease, and unhealthy lifestyle—are major contributors to stroke in Iraq. Ischemic stroke (IS) constituted the majority of cases (consistent with studies from Erbil and Turkey [36, 37]), potentially linked to Westernized diets, smoking, and physical inactivity, which elevate obesity and metabolic disorders [38].

1) Socio-Demographics

a) Age: 92% of patients were >50 years (higher than Erbil [39], Al-Ramadi [40], and India [41]), aligning with global trends where two-thirds of strokes occur in those >65 [42]. Mean age was 64.6 years, comparable to Basrah (63.8) [38] but lower than Iran (68.1) [43].

b) Gender: Male predominance (1.22:1 ratio) matched Erbil (1.1:1) [64] and India (1.44:1) [41]. Males had strokes at younger ages, exacerbating economic impacts.

c) Marital/Education Status: Unmarried women had higher stroke risk (consistent with Sweden [44]). Most cases were illiterate/primary-educated, complicating prevention efforts.

2) Key Risk Factors

a) Hypertension:

- Present in 58.4% of males (vs. 71% in the USA [45]) and higher in females. Hypertensive females had 25× higher stroke risk (vs. 3× in males). Uncontrolled BP doubled stroke mortality risk [146].
- HS cases had higher hypertension prevalence than IS (contrary to Erbil [64]).

b) Heart Disease:

- CAD: 26.2% in IS vs. 0% in HS (vs. 7.8% IS/10.3% HS in Denmark [47]).
- AF: 9.8% in males (vs. 6% in Baghdad [29]), with 9× higher stroke risk (vs. Taiwan [48]).
- DM: Males are 3× higher risk (vs. India [61]); females: 13× higher risk. Elevated FPG increased risk by 32–46%. Poor glycemic control reflected mismanagement [49].

c) Lifestyle:

- Smoking: Females had 9× higher risk (vs. 2× in INTERSTROKE [50]).
- Diet: Low fruit/vegetable intake (<5 servings/day) and high red meat consumption raised risk (consistent with INTERSTROKE [50]).
- Physical Inactivity: Cases were less active than controls (vs. Erbil [39]).

d) Other Factors:

- OCP Use: Females had 18× higher risk (vs. 4× in Helsinki [51]).
- BMI: Obesity was higher in cases (65.3% vs. 48% controls [39]), but not significantly linked to stroke in males.
- Cholesterol: Elevated levels in cases (vs. India [41]), but no significant risk association (vs. Taiwan [48]).

3) Limitations

- Recall bias due to patient-reported data.
- Hospitalized controls may not represent the general population.
- Inability to infer causality (inherent to case-control design).

5. Conclusions

This study found first-ever stroke was most common in men >60 years, with ischemic strokes predominating. Stroke patients showed significantly higher rates of hypertension, diabetes, heart disease, atrial fibrillation, smoking, obesity, and physical inactivity compared to controls. Women faced additional risks from oral contraceptive use and family history of stroke. Biochemically, cases had elevated glucose, cholesterol and blood pressure levels, though paradoxically, uncontrolled hyperglycemia was more frequent in controls.

Clear gender differences emerged: women's stroke risk was strongly linked to hypertension, diabetes, smoking and high BMI, while men were particularly vulnerable to atrial fibrillation. These findings align with global patterns and highlight critical intervention points: improved hypertension and diabetes control, smoking cessation programs, and targeted AF screening in men. The results call for sex-specific prevention strategies in Iraq's public health approach to stroke.

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