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Neuroimaging of brain stroke in Kirkuk: Etiology, Accuracy and Clinical features

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Abstract

Background: Stroke remains the second leading cause of death globally, with approximately 90% of cases classified as ischemic strokes. Neuroimaging plays a pivotal role in the diagnostic framework, yet formal studies correlating radiological findings with clinical features remain limited, particularly in resource-limited settings such as Kirkuk, Iraq.

Objective: This study aimed to comprehensively evaluate the role of neuroimaging in diagnosing brain stroke, identify underlying etiologies within the local population, and establish correlations between radiological findings and clinical patient presentations.

Methods: A clinical cross-sectional study was conducted at Kirkuk Teaching Hospital and Azadi Teaching Hospital, involving 36 patients presenting with acute neurological manifestations suggestive of cerebrovascular accident. Data collection included demographic characteristics, lifestyle factors (smoking, physical activity, diet), clinical neurological examination, medical history, and neuroimaging findings using non-contrast CT (NCCT), MRI, and neurological ultrasound. Statistical analysis was performed using SPSS with descriptive statistics**.**

Results: The sample comprised 61.1% males and 38.9% females, with 50% of patients aged 60 years or older. Left-sided weakness was the most common physical symptom, while expressive aphasia occurred in 83.3% of cases, and right-sided visual changes in 75%, indicating dominant hemisphere involvement. Most patients presented within the critical 1–3 hour "golden period." Males demonstrated higher physical activity (59.5%) but also significantly higher smoking rates (over 77% with smoking history) and fatty diet consumption (40.9%). High blood cholesterol was the leading risk factor in males (22.7%), while high blood sugar predominated in females (21.4%). NCCT was the primary imaging modality (91.7% of cases). Acute ischemic changes were observed in 53.9% of patients, with left middle cerebral artery infarction being the most common finding. Chronic changes, particularly deep white matter hyperintense signals, were present in 30.6% of patients, indicating underlying small vessel disease.

Conclusion: Stroke in Kirkuk predominantly affects older males with high burdens of modifiable risk factors, particularly smoking, high-fat diet, and hyperlipidemia. The high prevalence of chronic small vessel disease suggests long-standing untreated vascular pathology. Gender-specific prevention strategies, enhanced MRI utilization, and strengthened acute stroke response systems are urgently needed to improve diagnostic accuracy and patient outcomes in the region.

Keywords: Stroke, neuroimaging, ischemic stroke, computed tomography, magnetic resonance imaging, risk factors, Kirkuk, cerebrovascular accident, aphasia, small vessel disease.

1.2 Introduction

Worldwide, stroke is the second most common cause of death, followed by ischemic heart disease. Each year, around 795,000 strokes occur in the United States. In other word there is at least one stroke every 40 seconds, and one stroke-related death every 4 minutes. Most strokes happen outside of acute care hospitals. Recent clinical trials have shown that lowering blood pressure can alter the risk of adverse stroke outcomes. Moreover, Mediterranean diet rich in nuts and good cholesterol has been linked to a decreased risk of stroke. [1]

While laboratory tests and brain imaging are crucial for refining diagnoses and making treatment decisions, bedside clinical assessment remains vital as it is the initial step in the diagnostic process and often influences next step in more advanced procedures management. Even advanced imaging techniques like diffusion-weighted MRI can yield ambiguous imgaing results. Despite the necessity for quick and accurate clinical diagnoses in the era of thrombolysis, formal studies on clinical assessments are limited. [2]

The majority of strokes classified as ischemic strokes (IS). Timely diagnosis and treatment of ischemic stroke are essential to reduce further complications. [3] Due to its superior soft-tissue contrast, MRI is more effective than CT during the hyperacute and acute phases of stroke. Brain MRI can be performed with or without gadolinium IV contrast and is utilized to assess acute ischemic stroke, transient ischemic attacks (TIA), and hemorrhagic brain lesions. In the past, MRI was not recommended for patients with pacemakers, metallic foreign bodies, aneurysm clips, implantable devices, or those with claustrophobia. However, new technology devices are now compatible with MRI or considered MR conditional, meaning they can safely be used in low magnetic field scanners under specific conditions. Still, Performing MRI on morbidly obese patients can also present challenges. Not to forget using IV gadolinium contrast with cautions in patients with renal impairment or allergies to contrast agents. [4]

1.2 Aim of the study

The objective of this study is to conduct a comprehensive evaluation of the role of neuroimaging in the diagnostic framework of brain stroke within the clinical context of Kirkuk health setting. This research aims to investigate the underlying etiologies of stroke in the local population while concurrently assessing the diagnostic accuracy of existing imaging modalities. Additionally, the study seeks to establish a definitive correlation between radiological findings and the clinical features exhibited by patients, thereby providing an integrated understanding of how neuroimaging enhances the precision of stroke management and improves patient outcomes in the region.

2.1 Study Design and Setting

This clinical cross-sectional study was conducted to evaluate the role of neuroimaging in diagnosing brain strokes, identifying their etiologies, and correlating them with clinical features. The study was carried out at the main teaching hospitals in Kirkuk Governorate, specifically Kirkuk Teaching Hospital and Azadi Teaching Hospital, which serve as the primary centers for neurological emergencies in the region.

2.2 Study Population and Sampling

The study involved a sample of 36 patients presenting with acute neurological manifestations suggestive of a cerebrovascular accident (CVA). The sample was selected based on clinical presentation and subsequent referral for neuroimaging during the study period.

2.3 Inclusion and Exclusion Criteria

Inclusion Criteria: Patients of both genders and various age groups (from under 20 to over 60 years) who presented with sudden neurological deficits such as hemiparesis, speech disturbances, or visual changes within the "golden window" or early acute phase.

Exclusion Criteria: Patients with neurological deficits secondary to non-vascular causes (e.g., primary brain tumors, metabolic disturbances, or peripheral nerve disorders) were excluded to focus strictly on stroke etiologies.

2.4 Data Collection Tools

Data were collected using a structured approach comprising three main components:

Demographic and Lifestyle Assessment: Information regarding age, gender, education level, and occupation was documented. Additionally, modifiable risk factors including smoking habits, physical activity levels, and dietary patterns were assessed via a specialized questionnaire.

Clinical Neurological Examination: A meticulous documentation of symptoms was performed, focusing on the duration of onset, type of body weakness (facial, upper, or lower limb), sensation loss (numbness), speech disturbances (aphasia), and visual or gait impairments.

Medical History: Patients were screened for pre-existing chronic conditions, including hypertension, diabetes mellitus, and hyperlipidemia.

2.5 Neuroimaging Protocols

Patients underwent radiological evaluation to confirm the diagnosis and differentiate between stroke types. The imaging modalities utilized included:

- Non-Contrast Computed Tomography (NCCT): Used as the primary first-line diagnostic tool for 91.7% of the sample to exclude intracranial hemorrhage.
- Magnetic Resonance Imaging (MRI): Utilized for detailed assessment of ischemic changes and tissue viability in selected cases.
- Neurological Ultrasound: Applied in specific instances to evaluate vascular status .

2.6 Statistical Analysis

The collected data were analyzed using SPSS 2026 descriptive statistics. Frequencies and percentages were used to represent categorical variables (such as gender, type of stroke, and imaging findings), while means and standard deviations (±SD) were calculated for continuous variables (such as age, weight, acute & chronic imaging finding).

3.1 Demographic characteristic of the studied sample:

The study involved 36 patients with neurological manifestation attending the teaching hospital in Kirkuk governorate (Kirkuk & Azadi) hospital. the studied sample consist of 22 males (61.1%) & 14 females (38.9%) (table 1) (fig 1)

Table 1. The frequency distribution of the studied sample gender

Gender	Frequency	Percent	Valid Percent	Cumulative Percent
Male gender	22	61.1	61.1	61.1
Female gender	14	38.9	38.9	100.0
Total	36	100.0	100.0	

The age of the studied sample divided into six age group from less than 20 years to more than 60 years. (Table 2) Among the studied sample, the majority (50%) of them were at the sixth decade (60 yrs old & more) of their life. While (22%) of them were at the fourth

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decade of their life (40-49 years old). The third (22.2%) of them were at the fifth decade of their life(50-59 years old). (fig2)

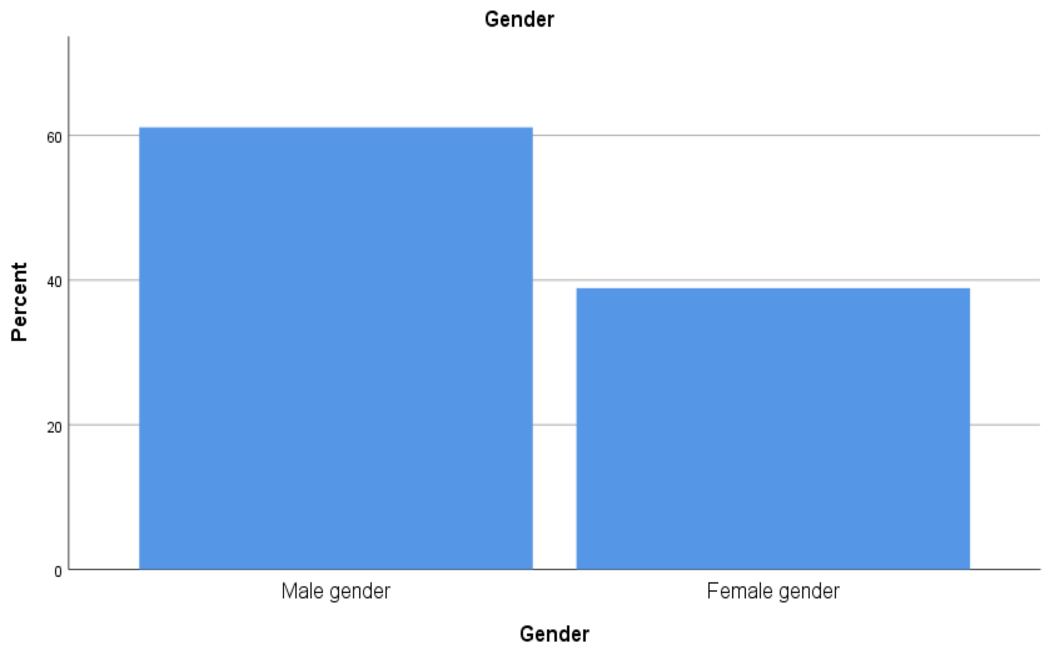

Fig 1. Gender distribution of the studied sample

Table 2. The age frequency distribution of the studied sample

Age					
		Frequency	Percent	Valid Percent	Cumulative Percent
	Less than 20 years old	1	2.8	2.8	2.8
	40-49 years old	9	25.0	25.0	27.8
	50-59 years old	8	22.2	22.2	50.0
	More than 60 years old	18	50.0	50.0	100.0
	Total	36	100.0	100.0	

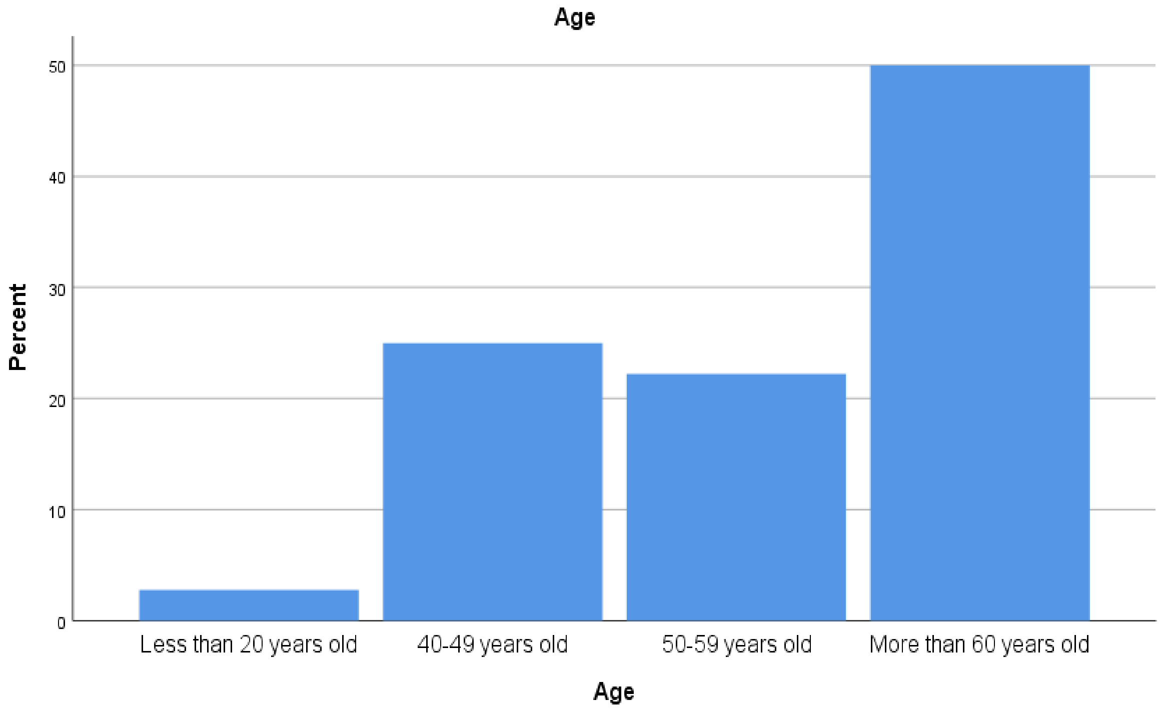

Fig 2. Bar diagram of age distribution of the studied sample

The education of the studied sample was summarized in table 3. The majority of the them were well educated (41.7%). (Fig3)

Table 3. The education distribution of the studied group.

Education level					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Primary school	5	13.9	14.3	14.3
	Secondary school	12	33.3	34.3	48.6
	High school	3	8.3	8.6	57.1
	Higher education	15	41.7	42.9	100.0
	Total	35	97.2	100.0	
Missing	System	1	2.8		
Total		36	100.0		

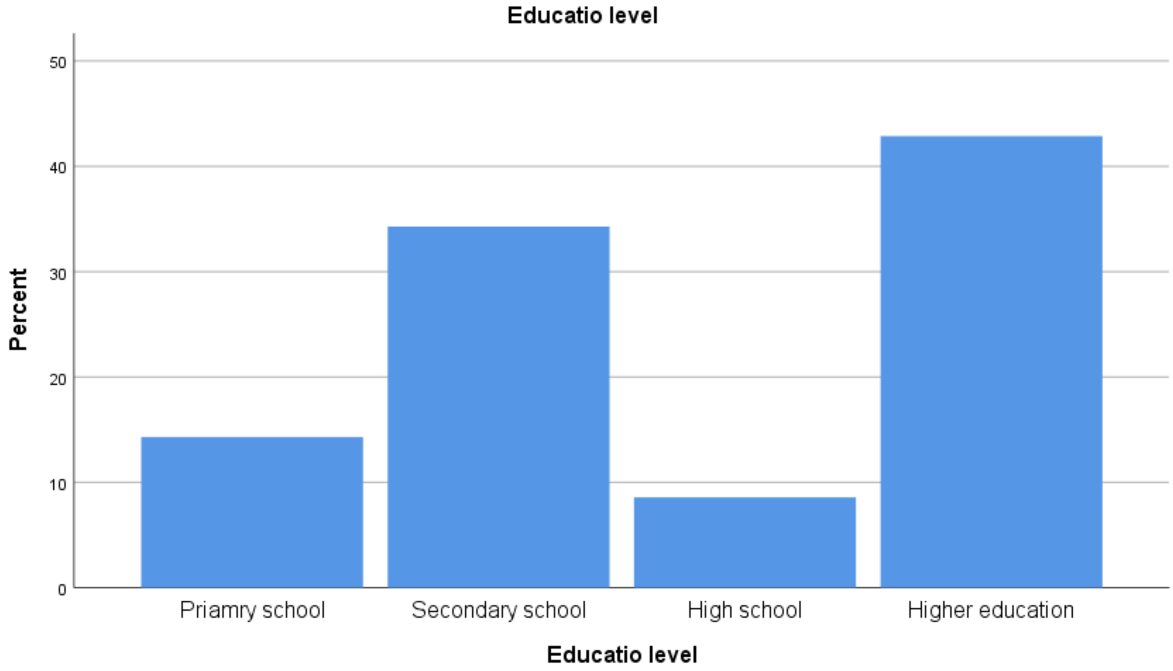

Fig 3. The education distribution of the studied sample.

The occupation of the studied sample was summarized in table 4. Few of the studied sample were retired (11%) while the rest were working in the governmental & private sector together (88%). (Fig .4)

Table 4. The occupation distribution of the studied group.

Occupation				
	Frequency	Percent	Valid Percent	Cumulative Percent
Governorate employment	16	44.4	44.4	44.4
Private sector	16	44.4	44.4	88.9
Retired	4	11.1	11.1	100.0
Total	36	100.0	100.0	

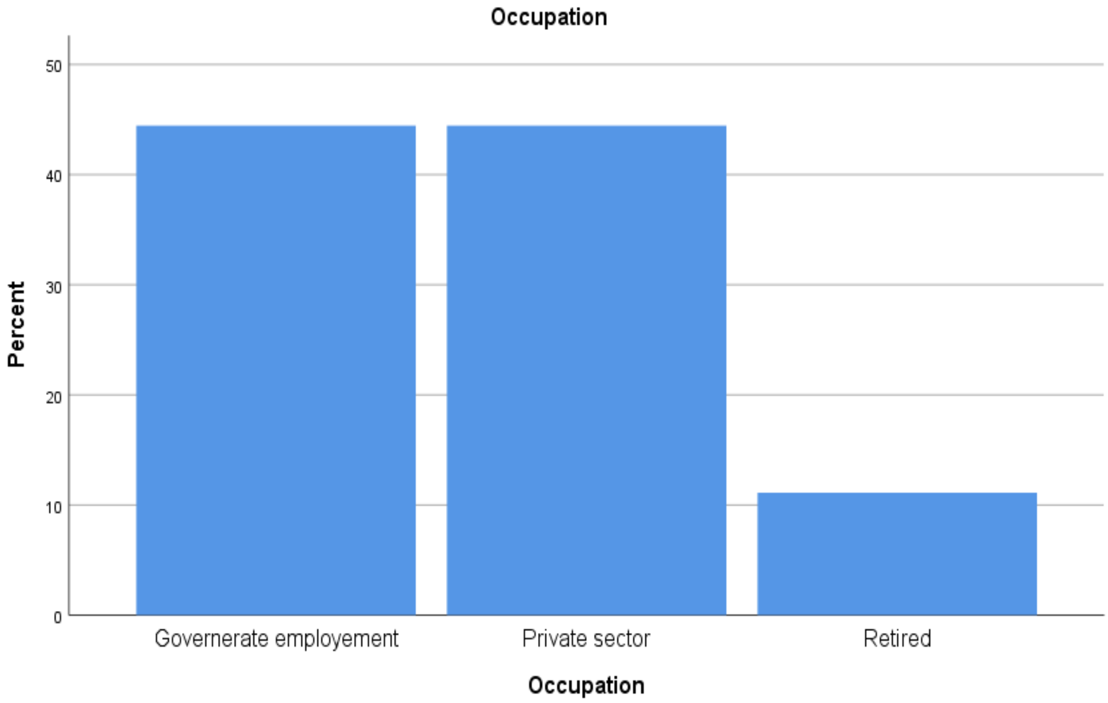

Fig 4. The occupation distribution of the studied sample

2.2 Clinical characteristics of the studied sample:

The studied sample (n=36) where patients complain of neurological impairment attending the neurological department in Kirkuk teaching hospital. Meticulous documentation of their neurological symptoms. The duration of the reported symptoms was falling within 1-3 hours period. (fig 5)

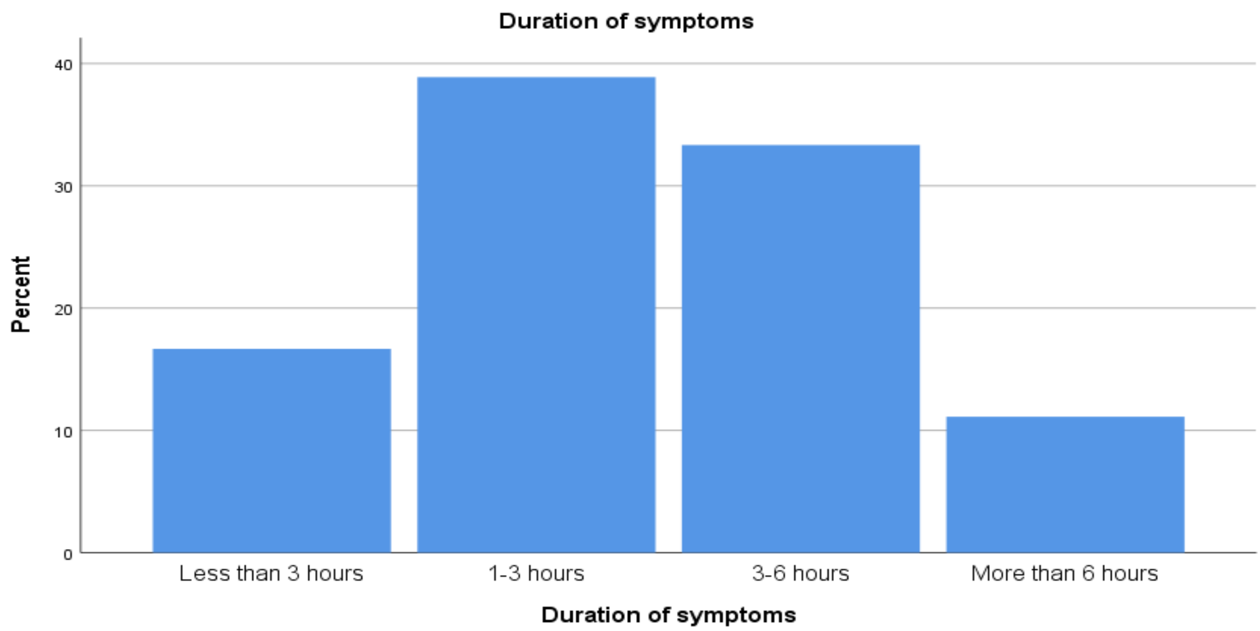

Fig 5. The duration period of the reported neurological symptom

The body weakness was reported and summarized in below. Left sided weakness were the most common reported symptoms: face (30.6%), Upper limb (41.7%) & Lower limb (30.6%). Table 5

Table 5. The frequency & descriptive measures of body weakness.

Face weakness				
Mean (1.14±1.073)	**Frequency**	**Percent**	**Valid Percent**	**Cumulative Percent**
Normal	14	38.9	38.9	38.9
Right sided weakness	7	19.4	19.4	58.3
Left sided weakness	11	30.6	30.6	88.9
Both sided weakness	4	11.1	11.1	100.0
Total	36	100.0	100.0	
Upper limb				
Mean (5.03±2.372)	**Frequency**	**Percent**	**Valid Percent**	**Cumulative Percent**
Normal	6	16.7	16.7	16.7
Right upper limb weakness	7	19.4	19.4	36.1
Left upper limb weakness	15	41.7	41.7	77.8
Both sided upper limb weakness	8	22.2	22.2	100.0
Total	36	100.0	100.0	
Lower limb				
Mean (7.19±4.572)	**Frequency**	**Percent**	**Valid Percent**	**Cumulative Percent**
Normal	10	27.8	27.8	27.8
Right lower limb weakness	8	22.2	22.2	50.0
Left lower limb weakness	11	30.6	30.6	80.6
Both sided lower sided weakness	7	19.4	19.4	100.0
Total	36	100.0	100.0	

The body sensation in a form of numbness was reported and summarized in below. The most common reported numbness symptoms as fellow: Upper limb (33.3%), face (17.8%) & Lower limb (8.3%). Table 6.

Table 6. The frequency & descriptive measures of body numbness

Face sensation				
Mean (1.08±1.811)	Frequency	Percent	Valid Percent	Cumulative Percent
Normal	26	72.2	72.2	72.2
Right sided numbness	3	8.3	8.3	80.6
Left sided numbness	5	13.9	13.9	94.4
Both sided numbness	2	5.6	5.6	100.0
Total	36	100.0	100.0	
Upper Limb sensation				
Mean (2.69±3.897)	Frequency	Percent	Valid Percent	Cumulative Percent
Normal	24	66.7	66.7	66.7
Right upper limb numbness	4	11.1	11.1	77.8
Left upper limb numbness	3	8.3	8.3	86.1
Both sided upper limb numbness	5	13.9	13.9	100.0
Total	36	100.0	100.0	
Lower limb sensation				
Mean (0.97±3.282)	Frequency	Percent	Valid Percent	Cumulative Percent
Normal	33	91.7	91.7	91.7
Right lower limb numbness	2	5.6	5.6	97.2
Both lower limb numbness	1	2.8	2.8	100.0
Total	36	100.0	100.0	

The speech disturbances were reported and summarized in below. The most common reported speech problems were expressive aphasia (83.3%) with a mean of (1.17±0.453). Table 7

Table 7. The frequency & descriptive measures of speech disturbances

Speech disturbance					
Mean (1.17±0.453)		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Expressive aphasia	30	83.3	85.7	85.7
	Receptive aphasia	4	11.1	11.4	97.1
	Difficulty in repeating the same sentences	1	2.8	2.9	100.0
	Total	35	97.2	100.0	
Missing	System	1	2.8		
Total		36	100.0		

The visual disturbances were also reported and summarized in below. The most common reported visual disturbance was right sided visual changes (75%) with a mean of (1.25±0.439). Table 8

Table 8. The frequency & descriptive measures of visual disturbances

Visual disturbance					
Mean (1.25±0.439)		Frequency	Percent	Valid Percent	Cumulative Percent
	Right visual disturbance	27	75.0	75.0	75.0
	Left visual disturbance	9	25.0	25.0	100.0
	Total	36	100.0	100.0	

The gait disturbances were also reported and summarized in below. The most common reported balance disturbance was in the gait (52.8%) with a mean of (1.64±0.762). Table 9

Table 9. The frequency & descriptive measures of gait /balance disturbances

Gait & balance				
Mean (1.64±0.762)	Frequency	Percent	Valid Percent	Cumulative Percent
Gait disturbance	19	52.8	52.8	52.8
Dysmetria	11	30.6	30.6	83.3
Vertigo	6	16.7	16.7	100.0
Total	36	100.0	100.0	

The headache was also reported and summarized in below. The most common reported headache type was unilateral type (52.8%) with a mean of (1.58±0.692). Table 10

Table 10. The frequency & descriptive measures of headache type

Headache				
Mean (1.58±0.692)	Frequency	Percent	Valid Percent	Cumulative Percent
Unilateral headache	19	52.8	52.8	52.8
Bilateral headache or occipital headache	13	36.1	36.1	88.9
Periorbital unilateral headache	4	11.1	11.1	100.0
Total	36	100.0	100.0	

3.2 The Well-being, health characteristics & risk factors measurements of the studied sample

The studied samples weight was (66.91±6.546) kg for male versus (61.79±6.375) kg for female. (fig 6)

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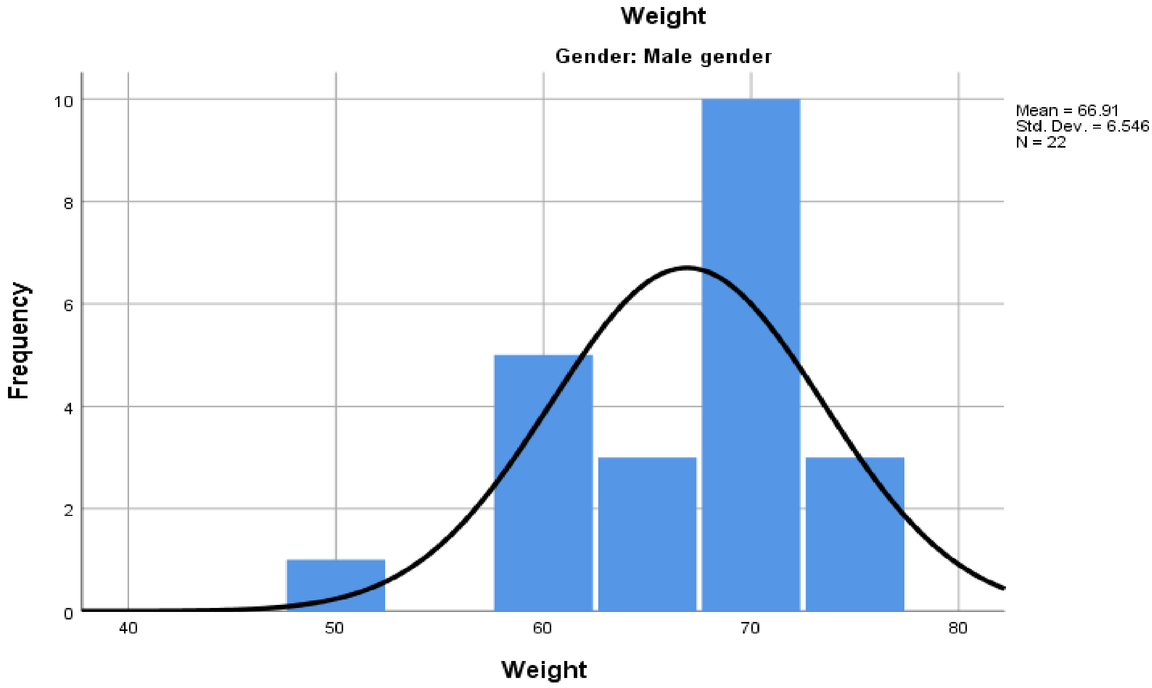

Fig 6. The frequency & descriptive measures of studied sample weight according to male gender.

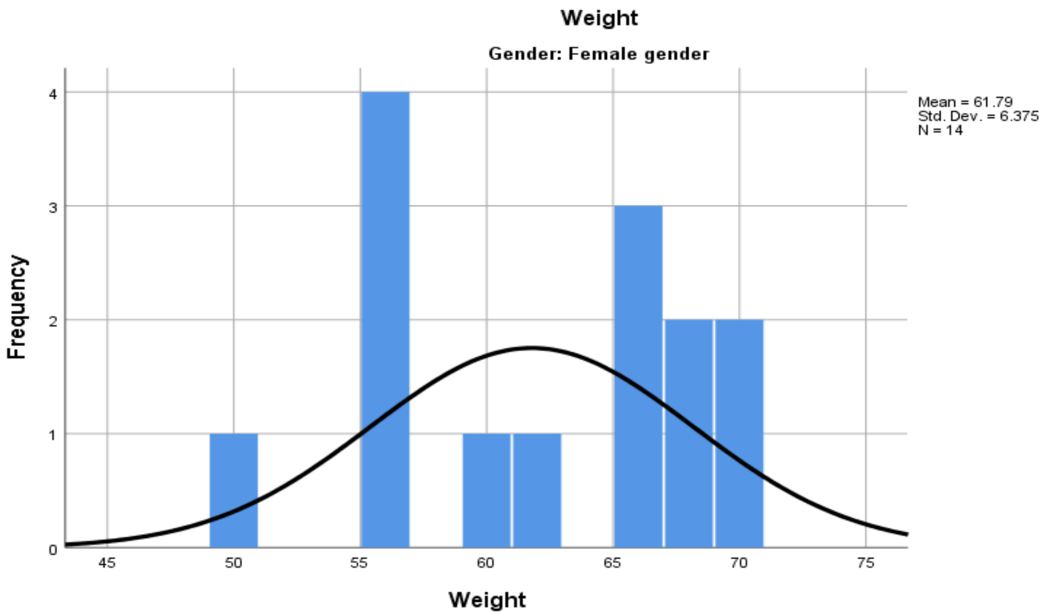

Fig 7. The frequency & descriptive measures of studied sample weight according to female gender.

The physical activity was assess using a questionnaire about total minutes spent in regular aerobic exercise &/or strenuous over hard activity. Male group showed higher physical activity compared to female group (59.5%), (21.4%) in sequence.

The smoking habit was assessed. Male group showed higher smoking history compared to female group. Most of the male group smoked at least half packet per day (32.8%) while most of the female were nonsmoker (92.9%). Table 12

The main diet was documented. Both group diet were mainly proteinoids type (45.5%) to (71.4%) male & female respectively. While the second most common diet in both groups were fatty diet. Noticeably, fatty diet was higher percentage in male compared to female group (40.9%) to (14.3) respectively. Table 13

The other risk factors in close relation to cerebrovascular accident pathogenesis were assessed. The most common report risk factor reported in male group was high blood cholesterol (22.7%) versus high blood sugar risk factor in female group (21.4%). Table 14

3.3 The imaging characteristics of the studied sample

The most common neuroimaging had been taking was non contrasted CT scan in 33 patients then MRI in 2 patients followed by neurological ultrasound in one patient. Table 15.

Twenty-three patient (53.9%) had showed acute ischemic changes in their neuroimaging. The top three most common acute ischemic changes were left middle cerebral artery infarction, right parieto-occipital lobe infarction & bilateral lenticular ischemic changes .Table 16 (fig 7)

Moreover, neuroimaging had showed chronic changes due to old pathology. Deep white matter hyper intense signal was the most common of all chronic changes (30.6%). While the type of neuroimaging findings due to chronic changes were mainly followed an old ischemic change (50%). Table 17 and 18

Table 11. The frequency & descriptive questionnaire about physical activity according to sex.

Physical exercise						
Sex			Frequency	Percent	Valid Percent	Cumulative Percent
Male		At least 150min of aerobic exercise or 75min of hard exercise weekly	13	59.1	59.1	59.1
		At least 100min of aerobic exercise or 50min of hard exercise weekly	8	36.4	36.4	95.5
		At least 50min of aerobic exercise or 25min of hard exercise weekly	1	4.5	4.5	100.0
		Total	22	100.0	100.0	
		Mean	1.45			
		Std. Deviation	0.596			
Female		At least 150min of aerobic exercise or 75min of hard exercise weekly	3	21.4	21.4	21.4
		At least 100min of aerobic exercise or 50min of hard exercise weekly	8	57.1	57.1	78.6
		At least 50min of aerobic exercise or 25min of hard exercise weekly	2	14.3	14.3	92.9
		Less than 50min of aerobic exercise or 25min of hard exercise weekly	1	7.1	7.1	100.0
		Total	14	100.0	100.0	
	Mean		2.07			
	Std. Deviation		0.829			

Table 12. The frequency & descriptive about smoking habit according to sex

Smoking habit						
Sex			Frequency	Percent	Valid Percent	Cumulative Percent
Male		None smoker	5	22.7	22.7	22.7
		Quiet smoking more than a year	6	27.3	27.3	50.0
		Smoke half packet a day	7	31.8	31.8	81.8
		Smoke one packet a day	3	13.6	13.6	95.5
		Smoke more than one packet a day	1	4.5	4.5	100.0
		Total	22	100.0	100.0	
		Mean	2.50			
		Std. Deviation	1.144			
Female		None smoker	13	92.9	92.9	92.9
		Quiet smoking more than a year	1	7.1	7.1	100.0
		Total	14	100.0	100.0	
		Mean	1.07			
		Std. Deviation	0.267			

Table 13. The frequency & descriptive about diet type according to gender

Diet						
Sex			Frequency	Percent	Valid Percent	Cumulative Percent
Male		Protein diet mainly	10	45.5	45.5	45.5
		Fat diet mainly	9	40.9	40.9	86.4
		Carbohydrate diet mainly	3	13.6	13.6	100.0
		Total	22	100.0	100.0	
		Mean	1.68			
		Std. Deviation	0.716			
Female		Protein diet mainly	10	71.4	71.4	71.4
		Fat diet mainly	2	14.3	14.3	85.7
		Carbohydrate diet mainly	1	7.1	7.1	92.9
		Balanced healthy diet	1	7.1	7.1	100.0
		Total	14	100.0	100.0	
		Mean	1.50			
		Std. Deviation	0.941			

Table 14. The frequency & descriptive about multiple risk factors according to gender

Risk factors					
Sex		Frequency	Percent	Valid Percent	Cumulative Percent
Male	High blood sugar	1	4.5	4.5	4.5
	High blood pressure	1	4.5	4.5	9.1
	High blood cholesterol	5	22.7	22.7	31.8
	DM, HPT & hyperlipemia	3	13.6	13.6	45.5
	DM & hyperlipidemia	1	4.5	4.5	50.0
	DM & positive family history of CVA	1	4.5	4.5	54.5
	HPT & hyperlipidemia	5	22.7	22.7	77.3
	Hyperlipidemia & positive family history of CVA	1	4.5	4.5	81.8
	DM, HPT & positive family history	1	4.5	4.5	86.4
	HPT, hyperlipidemia & positive family history of CVA	2	9.1	9.1	95.5
	DM, hyperlipidemia & positive family history of CVA	1	4.5	4.5	100.0
	Total	22	100.0	100.0	
	Mean	7.05			
	Std. Deviation	4.006			
Female	High blood sugar	3	21.4	21.4	21.4
	High blood pressure	2	14.3	14.3	35.7
	DM, HPT & hyperlipemia	2	14.3	14.3	50.0
	DM & hyperlipidemia	1	7.1	7.1	57.1
	DM & HPT	2	14.3	14.3	71.4
	DM & positive family history of CVA	1	7.1	7.1	78.6
	HPT & hyperlipidemia	1	7.1	7.1	85.7
	DM, HPT & positive family history	1	7.1	7.1	92.9
	HPT, hyperlipidemia & positive family history of CVA	1	7.1	7.1	100.0
	Total	14	100.0	100.0	
	Mean	5.64			
	Std. Deviation	3.992			

Table 15. The frequency distributi3on of imaging type

Imaging type				
	Frequency	Percent	Valid Percent	Cumulative Percent
MRI	2	5.6	5.6	5.6
CT scan	33	91.7	91.7	97.2
Neurological ultrasound	1	2.8	2.8	100.0
Total	36	100.0	100.0	

Table 16. The frequency distribution of acute neuroimaging changes

	Frequency	Percent	Valid Percent	
Bilateral ACA ischemic infarction	1	2.8	2.8	2.8
Bilateral lenticular ischemic infarction	2	5.6	5.6	8.3
Bilateral loss of corticomedullary differentiation & hemorrhagic ventricles	1	2.8	2.8	11.1
Brain stem hemorrhage	1	2.8	2.8	13.9
Centrum semioval Ischemic changes	1	2.8	2.8	16.7
Left basal ganglia lenticular ischemic changes	1	2.8	2.8	19.4
Left caudate nucleus & lentiform hemorrhagic venous changes	1	2.8	2.8	22.2
Left centrum semioval infarction	1	2.8	2.8	25.0
Left lenticular ischemic changes	1	2.8	2.8	27.8
Left MCA ischemic infarction	2	5.6	5.6	33.3
Left medulla oblingata ischemic changes	1	2.8	2.8	36.1
Left occipital ischemic changes	1	2.8	2.8	38.9
Left para-falcine ischemic changes	1	2.8	2.8	41.7
Left parietal lenticular ischemic changes	1	2.8	2.8	44.4
Left parietal lobe ischemic changes	2	5.6	5.6	50.0
Right inferior cerebellar ischemic infarction	1	2.8	2.8	88.9
Right parietooccipital ischemic infarction	2	5.6	5.6	94.4
Right posterior branch of ACA ischemic infarction	1	2.8	2.8	97.2
Right posterior parietal lobe ischemic changes	1	2.8	2.8	100.0
None	13	36.1	36.1	86.1
Total	36	100.0	100.0	

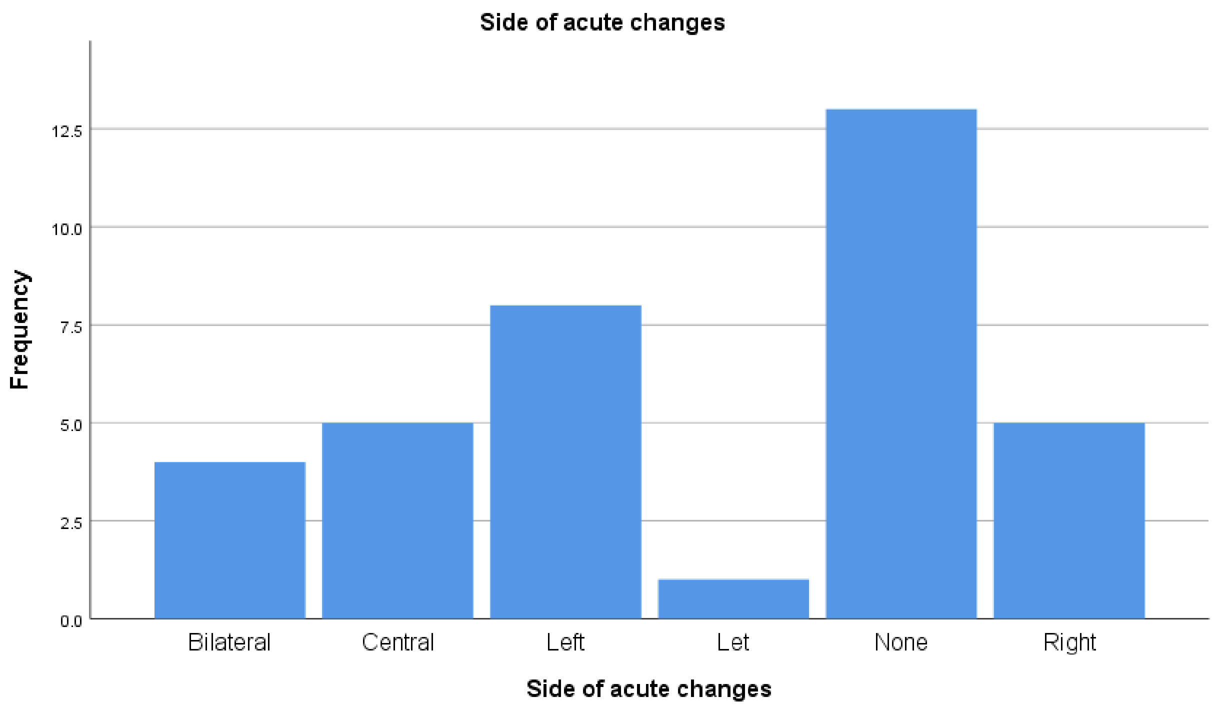

Fig 8. The frequency distribution of brain region with acute changes

Table 17. The frequency distribution of chronic neuroimaging changes

Chronic imaging changes				
	Frequency	Percent	Valid Percent	Cumulative Percent
Bilateral transverse sinuses	1	2.8	2.8	2.8
Chronic small vessel's ischemic changes	1	2.8	2.8	5.6
Cortical hyperintense signal	1	2.8	2.8	8.3
Deep white matter & subcortical hyperintense signal	4	11.1	11.1	19.4
Deep white matter hyperintense signal	11	30.6	30.6	50.0
Deep white matter hyperintense signal & encephalomalacia	1	2.8	2.8	52.8
Deep white matter hyperintense signal, encephalomalacia & gliosis	1	2.8	2.8	55.6
Deep white matter, subcortical & lenticular nucleus hyperintense signal	1	2.8	2.8	58.3
Dilated superficial cortical & internal cerebral veins	1	2.8	2.8	61.1
Hypothalamic hyperintense signal	1	2.8	2.8	63.9
None	9	25.0	25.0	88.9
Right cerebellar signal void	1	2.8	2.8	91.7
Subcortical hyperintense signal	1	2.8	2.8	94.4
Subcortical white matter hyperintense signal	1	2.8	2.8	97.2
White matter hyperintense central & hypointense rim	1	2.8	2.8	100.0
Total	36	100.0	100.0	

Table 18. The frequency distribution of the type of chronic Brain changes

Type of chronic changes				
	Frequency	Percent	Valid Percent	Cumulative Percent
	1	2.8	2.8	2.8
Aplasia &/or hypoplasia	1	2.8	2.8	5.6
Atrophic changes	1	2.8	2.8	8.3
Chronic insult	1	2.8	2.8	11.1
Demyelination changes	1	2.8	2.8	13.9
Encephalomalacia & gliosis	1	2.8	2.8	16.7
Ischemic changes	18	50.0	50.0	66.7
Ischemic changes/ demyelination changes	1	2.8	2.8	69.4
Ischemic changes	1	2.8	2.8	72.2
None	8	22.2	22.2	94.4
Old hemorrhagic changes / cavernoma	1	2.8	2.8	97.2
Veins dilatation	1	2.8	2.8	100.0
Total	36	100.0	100.0	

4. Discussion

The demographic analysis of the studied sample in Kirkuk reveals a significant predominance of male patients, who constituted 61.1% of the total cases, while females accounted for 38.9%. This finding is consistent with established epidemiological data suggesting that men generally face a higher risk of stroke than women, particularly before the age of 85, a disparity often attributed to the protective hormonal effects of estrogen in premenopausal women and a higher prevalence of lifestyle-related risk factors among men Appelros et al.,[24]. Furthermore, the age distribution highlights a critical trend, as 50% of the participants were in their sixth decade, reinforcing the widely accepted medical consensus that advancing age is the most significant non-modifiable risk factor for cerebrovascular accidents. Previous studies have demonstrated that the incidence of stroke nearly doubles for every decade of life after age 55, a pattern that the Kirkuk sample closely mirrors Wolf et al., 1991.[25]

Beyond biological factors, the study provides a nuanced look at behavioral risks where a clinical paradox emerges; while the male group exhibited higher levels of physical exercise, they also displayed much higher rates of tobacco use, with over 77% having a history of smoking. This is a critical observation because global research indicates that cigarette smoking is a potent catalyst for atherosclerosis and doubles the risk of ischemic stroke Shinton & Beevers, 1989[26]. Dietary habits further complicate this profile, as a significant portion of males consumed a diet primarily high in fats, which are directly linked to hyperlipidemia, a major precursor to arterial occlusion. These findings align with the INTERSTROKE study, which identified poor diet and smoking as two of the ten leading modifiable risk factors responsible for 90% of the global stroke burden O’Donnell et al., 2010. [27]

Clinically, the neurological impairments recorded in this cohort underscore the severity of the condition, with left-sided weakness being the most frequently reported physical symptom. This physical impairment was often accompanied by significant speech disturbances, specifically expressive aphasia in 83.3% of cases, suggesting that the majority of strokes in this population affected the dominant hemisphere of the brain. Such findings are clinically consistent with the recorded 75% prevalence of right-sided visual changes. The urgency of these symptoms is highlighted by the fact that most patients reported onset within a 1–3-hour window, which is the vital "golden period" for medical intervention; as emphasized in neurological research, "time is brain," and every minute of delay results in the loss of millions of neurons Saver, 2006. [28]

The medical etiology of the sample further distinguishes risk factors by gender, identifying high blood cholesterol as the leading factor for men while high blood sugar was more prevalent among women. This trend is particularly concerning because meta-analyses have shown that diabetic women have a 25% higher relative risk of stroke compared to diabetic men Peters et al., 2014[29]. Additionally, the frequency of hypertension—often found in combination with diabetes and hyperlipidemia—confirms its status as the single most important modifiable risk factor for stroke globally Lawes et al., 2004. [30]

Finally, the diagnostic methodology relied heavily on non-contrasted CT scans, which were used in 91.7% of cases. While CT is the gold standard for rapidly excluding intracranial hemorrhage, it often lacks the sensitivity to detect early ischemic changes compared to MRI. In this study, 53.9% of patients showed acute ischemic changes on imaging, with Left Middle Cerebral Artery (MCA) infarction being a primary finding. The prevalence of chronic findings, such as deep white matter hyperintense signals in 30.6% of patients, points to a high rate of underlying small vessel disease. This type of chronic pathology is frequently associated with long-term hypertension and serves as a strong predictor of future major stroke events and cognitive decline Wardlaw et al., 2013. [31]

5.1 Conclusion and Recommendations

The study concludes that stroke in the Kirkuk region predominantly affects the male population, with a significant concentration of cases occurring in patients aged 60 and older. The high prevalence of modifiable risk factors, particularly smoking and high-fat diets among men, and diabetes mellitus among women, underscores a critical public health challenge. Clinically, the dominance of left-hemispheric symptoms, such as right-sided visual disturbances and expressive aphasia, highlights the debilitating nature of these events. While non-contrasted CT remains the primary diagnostic tool due to its accessibility and speed in emergency settings, the findings of chronic small vessel disease in a large portion of the sample indicate a long-standing burden of untreated vascular issues within the community.

Consequently, it is recommended that local health authorities in Kirkuk implement targeted public health campaigns focusing on smoking cessation and nutritional education, specifically addressing gender-specific risks like hyperlipidemia in men and glycemic control in women. Furthermore, there is an urgent need to enhance diagnostic capabilities by increasing the availability and utilization of MRI and Diffusion-Weighted Imaging (DWI) to improve the detection of early ischemic changes that might be missed by standard CT scans. Medical facilities should also prioritize the establishment of specialized "Stroke Units" to ensure that patients arriving within the critical 1–3 hour golden window receive rapid thrombolytic therapy. Finally, future research should involve larger, multi-center longitudinal studies to better understand the long-term outcomes and rehabilitation success of stroke survivors in the region.

5.2 Recommendation

Given the male predominance (61.1%) and high smoking rate (over 77%) among men, sex-specific public health interventions are urgently needed. For men, prioritize smoking cessation programs, lipid-lowering therapies (given high cholesterol as a leading factor), and dietary modifications to reduce high-fat intake. For women, enhance screening and management of hyperglycemia and diabetes, noting the higher relative stroke risk in diabetic women compared to men.

With 50% of strokes occurring in the sixth decade of life, routine cardiovascular and cerebrovascular risk assessments should begin no later than age 50 in the Kirkuk population. Community outreach programs should target individuals aged 55–65 for blood pressure, glucose, and lipid screening, even if asymptomatic.

As far as risk reduction, the observed paradox—higher exercise but higher smoking in males—suggests that exercise alone is insufficient.

- Launch integrated lifestyle interventions that simultaneously address diet (reducing fats), tobacco, and physical activity.
- Emphasize that smoking doubles ischemic stroke risk, countering any false reassurance from regular exercise.

Since most patients presented within the 1–3 hour “golden period” (Saver, 2006), Kirkuk’s emergency medical services and hospitals must: Maintain rapid triage protocols for suspected stroke. Ensure 24/7 access to non-contrasted CT scanning (already used in 91.7% of cases) and expand capacity for MRI when early ischemia is suspected but CT is negative. Train emergency staff to recognize dominant hemisphere symptoms (e.g., expressive aphasia in 83.3%, right-sided visual changes in 75%) as red flags for left MCA territory strokes.

The finding of deep white matter hyperintense signals in 30.6% of patients indicates a high burden of chronic hypertension-related microvascular disease.it is recommended to implement long-term blood pressure control programs for at-risk adults. Moreover, use brain imaging findings (even incidental chronic changes) as an opportunity for aggressive secondary prevention to reduce future major stroke and cognitive decline.

While CT is effective for ruling out hemorrhage, its limited sensitivity for early ischemic changes means that MRI should be used more frequently in patients with persistent neurological deficits but negative initial CT. This is particularly relevant given that only 53.9% of patients showed acute ischemic changes on CT.

Future Research Directions

Local studies should:

- Investigate why diabetic women in Kirkuk have a potentially higher stroke risk than diabetic men (consistent with Peters et al., 2014).
- Track 90-day outcomes to correlate imaging findings (e.g., white matter disease) with functional recovery.
- Conduct community-based surveys to quantify the true prevalence of undiagnosed hypertension, hyperlipidemia, and diabetes in the region.

ETHICAL APPROVAL

The research protocol was approved by the Ethical Research Committee of the College of Health and Medical Techniques, Al-Qalam University. We declare that the Helsinki Declaration had been followed in the study.

INFORMED CONSENT

Participants were aware of the purpose of the study and provided informed consent prior to the participations.

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