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# Metabolic Syndrome and Ischemic Stroke

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## ABSTRACT

**Background :**
Patients with metabolic syndrome are more likely to have an ischemic stroke.
**Objectives:**
This research aimed to see whether metabolic syndrome was linked to ischemic stroke in patients.
**Patients and methods:**
Forty-five patients admitted to Afaq general hospital in Al-Qadisiyah with ischemic stroke confirmed by CT/scan were examined and screened for metabolic syndrome criteria.
**Results:**
Metabolic syndrome was present in 40% of ischemic stroke patients, with metabolic syndrome being more common in females than males.
**Conclusion :**
These results suggest that there is a strong link between metabolic syndrome and ischemic stroke, which is more common in women.

## INTRODUCTION

Stroke is the primary cause of acquired disability in adults and the second leading cause of death in most countries [(1)]. Stroke is the leading cause of death in low- and middle-income countries, accounting for more than 85% of all stroke deaths worldwide [(2)]. Stroke is the leading cause of acquired persistent disability in adults around the world and the second leading cause of death in those over the age of 60. According to the World Health Organization, a new patient has a stroke every two seconds, and a new patient dies or becomes disabled as a result of a stroke every six seconds (WHO). A stroke kills 5.8 million people every year, which is more than the combined deaths from AIDS, tuberculosis, and malaria. As a result, the World Health Organization (WHO) has proclaimed stroke to be the twenty-first century's incoming disease. Furthermore, recent statistics indicate that a growing number of young patients are being admitted to hospitals for stroke, with data showing that about 30% of all stroke patients are under 65 [(3)].

The metabolic syndrome is a set of cardiovascular risk factors that all affect a single person simultaneously (abdominal obesity AR hero genic dyslipidemia, elevated blood pressure, insulin resistance, prothrombotic state & pro-inflammatory state). The metabolic syndrome affects nearly 50 million people in the United States (roughly one in every four),

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placing them at a higher risk of diabetes and cardiovascular disease [(4)]. People with metabolic syndrome are twice as likely to die from myocardial infarction or stroke and three times as likely to experience them than people without it [(5)]. (If type 2 diabetes is not already present, they have a fivefold increased risk) [(6)].

The metabolic syndrome, a common cause of coronary artery disease, can be characterized by the presence of three of five quantitatively defined markers that function together to cause or exacerbate the development of atherosclerosis and coronary artery disease at any time. According to the National Cholesterol Education Program's third adult treatment panel, LDL cholesterol is a form of cholesterol found in the human body.

**Patients Identification**

The metabolic syndrome (MS) can only be diagnosed clinically if certain conditions are met. The "metabolic syndrome" (MS) is diagnosed when three or more of the "risk factors" mentioned below are existing (7). MS risk factors and their associated levels, as determined by the NCEP Adult (National Cholesterol Education Program).

Treatment Panel Ill are:

1. Women with a waist circumference of more than 88 cm have central (abdominal) obesity (waist circumference).
2. Serum triglyceride 150 mg/dl(1 7mmol/L.) or more.
3. Men's serum high-density lipoprotein is less than 40 mg/dl (1 mmol/L), and women's serum high-density lipoprotein is less than 50 mg/dl (1.3 mmol/L).
4. "Blood pressure" 130/ 85 mmHg.
5. 110 mg/dl (6.1 mmole/L) "fasting plasma glucose".

Since the consequences of these risk factors are multiplicative rather than additive, individuals who have a combination of risk factors are at the highest risk. As a result, risk management should be based on a systematic approach that considers all observable risk factors[(8)].

**Components of metabolic syndrome**

The following factors, as stated by NCEP ATP III, contribute to metabolic syndrome.;-

**1- Central obesity**

The number of calories consumed in resting cellular activity and physical labour and the number of calories consumed in food affect the body's weight [(9)]. You will lose weight if your diet exceeds your commitment over time. Calorie consumption is influenced by various factors, including genetics, social climate, food availability, intelligence, personal psychology, and multiple redundant neurohormonal signals that are still poorly understood [(10)].

Obesity has now reached epidemic proportions all over the world. According to the World Health Organization, 2.3 billion people (31.3%) were obese in 2015, with over 700 million (9.6%) obese. Obesity is a strong predictor of ischemic stroke, particularly in younger patients. As a result, obese patients may become a more significant proportion of those seeking stroke treatment and care [(11)]. Because of the inflammation caused by excess fatty tissue, obesity will raise the risk of stroke; this can cause blood circulation issues and an increased risk of blockages, all of which can lead to strokes [(12)]. Sleep apnea, a form of

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sleep breathing disorder, is more common in obese people [13]. High blood pressure, abnormal heart rhythms, and stroke are all risks associated with sleep apnea [14].

**2- Triglyceride level**

Hypertriglyceridemia can cause atherosclerosis and thrombogenicity, both of which can result in an ischemic stroke. Hypertriglyceridemia helps the development of atherosclerosis through a variety of mechanisms. In addition to LDL-C particles, "triglyceride-rich lipoproteins," including very-low-density lipoprotein and "intermediate-density lipoprotein", become embedded in blood vessel walls and have been linked to human "atherosclerotic plaques" [15].

In healthy young men with no risk factors for coronary heart disease, "transient hypertriglyceridemia" induced by intravenous infusion of a triglyceride emulsion was linked to decreased vascular reactivity (CHD) [16]. An observational analysis of patients with normal LDL-C found a correlation between "chronic hypertriglyceridemia and endothelial dysfunction"[17].

Endothelial cell dysfunction is thought to be associated with increased adhesion cell molecule expression [18].Patients of hypertriglyceridemia have an increase in "cell adhesion molecules"[19].

**HDL level**

Lipoproteins are cholesterol-rich protein-phospholipid complexes. HDL is the smallest and densest lipoprotein due to its high level of protein. Around half of its weight is made up of proteins, with apoprotein A-I (apoA-I) responsible for 70% of that. twenty-first-century) Reverse cholesterol transfer, "antioxidant effects, anti-inflammatory effects, antithrombotic effects", and endothelial function modification are all ways HDL protects against atherosclerosis. [21] HDL can protect the elderly from stroke, especially nonfatal and ischemic strokes [22]. In the elderly and among various race / ethnic groups, higher HDL-C levels are related to decreased risk of ischemic stroke. These findings back up HDL-role C's as a modifiable stroke risk factor [23] and add to the growing body of evidence linking lipids to stroke**.**

**3- Diabetes Mellitus**

Diabetes patients have a higher level of atherosclerosis and a more significant percentage of atherogenic risk factors such as high blood pressure and lipids. "The Centers for Disease Control and Prevention (CDC) is an acronym for the Centers for Disease Control and Prevention, diabetes and Prediabetes in the United States: National Estimates and General Information, National Diabetes Fact Sheet, 2011. Atlanta, GA: Centers for Disease Control and Prevention, United States Department of Health and Human Services, 2011. Diabetes has been related to a higher risk of stroke, and a higher mortality rate after a stroke" [24]. "Type-2 diabetes mellitus (T2DM)" becomes more common in both developing countries and developed countries. [25].

Obesity rates have risen rapidly across the world, coinciding with an increase in diabetes cases. Diabetes causes various micro and macrovascular changes, which can lead to serious health problems, including stroke. Despite progress in decrease the risk of stroke over the last two decades, the recent increase in diabetes rates risks reversing these gains. Cerebral minor vessel disorders, one of the few "mechanistic stroke subtypes", are risky for people with diabetes. Hyperglycemia increases the chances of getting a stroke [26].

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**Hypertension**

Hypertension is the most common cause of stroke [27]. Acute ischemic stroke patients often develop hypertension, and previously normotensive patients may experience a brief rise in blood pressure (BP) [30]. The mechanism that causes blood pressure to rise at the start of a stroke is unknown, and there are still questions about how to react appropriately. Without the use of drugs, blood pressure can drop unexpectedly and unpredictably [29].

High blood pressure is the first controllable vascular risk factor, responsible for 10.4 million deaths globally; it's linked to a higher risk of stroke and a poor prognosis [30]. Chronic hypertension causes damage to the brain, which increases the risk of stroke and dementia [31]. Indeed, hypertension is linked to stroke risk in a reliable, independent, and linear way [32]**.**

## METHOD

This study focuses on the "Adult Treatment Panel III of the New National Cholesterol Education Program (NCEP)", which accepted metabolic requirements.

**Study deign and patients:**

In this study, the patients were 45 patients (of both sexes) aged 49-87 years who presented with "ischemic stroke" who had been admitted to the hospital's medical ward in Afaq general hospital AL-Qadisiyah city from February 2019 to December 2020. They were screened for MS criteria.

**Laboratory methods:**

1. Serum TG and HDL measurement:

The measurement is done by enzymatic determination of TG and HDL in the serum using kits manufactured by randox laboratories ltd, USA.

Procedure:

3ml of fasting venous blood was obtained, centrifuged for 5-10 minutes at 37°C, and TG and HDL were measured using spectrophotometry at a wavelength of 500nm to ensure correct lipid profile measurement in the first 72 hours after ischemic stroke.

2. Blood glucose measurement:

Since one of the inclusion criteria for metabolic syndrome is impaired fasting glucose, this was achieved using the enzymatic colourimetric (god – pap) process, which involved drawing one ml of venous blood after fasting for eight hours. Measurement was done by mixing with specific reagent and incubating for 10 minutes at 37◦ or 30 minutes at 20-25c◦ with wavelength similar to triglyceride and HDL measurement but with kits manufactured by Biolabo, Maizy, France.

3. "Waist circumference":

Waist measurement was taken with a "non-stretchable fiber measuring tape". Just one layer of clothing may be worn at a time. The waist girth was calculated using the smallest horizontal girth between the costal margins and the iliac crests at decreased respiration.

4. Measurement of blood pressure:

It was done by using a mercury sphygmomanometer in either arm when the patient relaxed in a supine position and the arm at the heart level. We apply the cuff to the upper arm with the center of the bladder over the brachial artery. Inflation of the bladder was done until the brachial pulse is impalpable, then continue inflation of the cuff for another ten mmHg.

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When the pulse becomes impalpable, then deflate the cuff slowly until the familiar sound is first heard. This reading is the systolic blood pressure and then the continuation of deflation until the sound disappears, representing the diastolic blood pressure.

**Statistical analysis (cross sectional study**):

The T-test was used to calculate the relation between various variables in a statistical study performed with the statistical kit for social studies ( SPSS 15). "A statistically significant level is defined as a P value of < 0.05".

## RESULT

In the presenting study, the total number of patients is 45 patients with ischemic stroke 18 (40%) found to have a constellation of MS criteria. 27(60%) of them were considered as Non-MS as shown in table (1)

Table (1) the occurrence of metabolic syndrome in ischemic stroke patients

| | No. | Percent |
|---|---|---|
| Metabolic syndrome patients. | 18 | 40 |
| Non-metabolic syndrome patients. | 27 | 60 |
| Total | 45 | 100% |

Table (2) "The prevalence of metabolic syndrome" in each gender is shown.

| | MS | | Non-MS | | Total |
|---|---|---|---|---|---|
| | No. | Percent | No. | Percent | |
| Male | 10 | 38% | 16 | 62% | 26 |
| Female | 8 | 42% | 11 | 58% | 19 |

Table (3) shows the mean of age of both groups ( MS and Non-MS) patients.
The difference between the two groups is of no significant.

| | Range of ages | Mean | SD | p-value |
|---|---|---|---|---|
| MS | 49-85 | 55.2 | 13.4 | 0.8 |
| Non-MS | 51-87 | 54.8 | 12.5 | |

Table(4) shows the range and mean of ages of both sexes in MS patients.
There is no substantial difference between the two groups.

| | No. | Range | Mean | SD | P-value |
|---|---|---|---|---|---|
| Male | 10 | 49-87 | 57.1 | 11.3 | 0.6 |
| Female | 8 | 52-81 | 55.4 | 13.2 | |

Table(5) shows the factors than constitute the MS and their percentage in both MS and Non-MS patients.

| Variables | MS patients (18) | Non-MS patients (27) |
|---|---|---|

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| | | |
|---|---|---|
| Obesity (WC)<br>Male>102cm<br>Female>88cm | 56% | 22% |
| TG>150 mg/dL | 50% | 30% |
| HDL<br>Male<40mg/dL<br>Female<50mg/dL | 50% | 22% |
| Blood pressure<br>≥130/ ≥85 mmHg | 83% | 41% |
| Fasting glucose ≥ 110 mg/dL | 67% | 37% |

Table (6) There was a substantial difference in "waist circumference, TG, blood pressure (systolic and diastolic), and fasting blood glucose" when MS and non-MS patients were compared.

| | GROUP | N | Mean±Std. Deviation | p-value |
|---|---|---|---|---|
| WC | Metabolic | 18 | 101.88±10.83 | 0.001* |
| | Non metabolic | 27 | 93.29±8.267 | |
| TG | Metabolic | 18 | 180±46.57 | 0.002* |
| | Non metabolic | 27 | 137.4±13.59 | |
| HDL | Metabolic | 18 | 41.38±7.40 | 0.76 |
| | Non metabolic | 27 | 42.4±7.542 | |
| SBP | Metabolic | 18 | 153.61±16.437 | 0.001* |
| | Non metabolic | 27 | 127.7±7.880 | |
| DBP | Metabolic | 18 | 92.2±9.429 | 0.003* |
| | Non metabolic | 27 | 77.592±6.418 | |
| FBS | Metabolic | 18 | 122.2±16.74 | 0.001* |
| | Non metabolic | 27 | 99.44±11.698 | |

* Statisticallysignificant difference.

## DISCUSSION

Metabolic syndrome studies included the average population and patients with Atheros sclerotic disease like coronary artery disease, peripheral artery disease and cerebral artery disease. Regarding ischemic stroke, many studies were done on "the prevalence of Metabolic syndrome" by using "NCEP ATP III criteria" and other criteria ( like IDF, WHO, AHA criteria )

"The prevalence of metabolic syndrome" in patients with ischemic stroke was 40% in the current research, which was equivalent to other studies.

One of these studies is a study at Liaquat university hospital Hyderabad in Pakistan in 2015 for 134 patients. The mic stroke found 39;67% had met the criteria of "Metabolic syndrome" according to NCEP ATP III standard [33]).

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Another study in northern Manhattan (NOMAS) found 44% of patients with ischemic stroke had fulfilled the criteria of metabolic syndrome[34].
Another study was done in "komfo Anokye teaching hospital (KATH)" in Kumasi in Ghana found that 46.88% of 224 patients with ischemic stroke have metabolic syndrome[35].
Regarding the prevalence of sex, the results showed a mild increased "prevalence of metabolic syndrome" in females than males (42%) versus (38%). According to the NOMAS report, females have a higher MS prevalence than males (48 per cent vs 38 per cent) [34]. Another study was done in the neurology ward of AL Zahra hospital Isfahan. . In this study found that metabolic syndrome also more prevalent in females than males (52%) versus (44%) [36].

The female predominance may be attributed to differences in MS medical requirements between men and women, such as waist circumference and HDL cholesterol levels [37].This study discovered that high blood pressure was the most common metabolic syndrome risk factor (83 per cent), followed by high blood sugar (67 % ).
Hypertension was also the most familiar portion of Metabolic syndrome in "the komfo Anokye teaching hospital (KATH) in Kumasi, Ghana", where it was elevated (94 %) ([35]).
Hypertension was also the most common component of "metabolic syndrome" that was elevated (86 %), followed by elevated HDL (54 %) (34) in the (NOMAS) research**.**

## CONCLUSION

According to the study, the association and importance of metabolic syndrome as a frequent cause of ischemic stroke, making confirmation and handling of risk factors of metabolic syndrome is one of the preventive approaches for ischemic stroke.

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