



## **Incidence and Factors Related to Stroke in the Month before, during and after Fasting in Iran**

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ARTICLE INFO	ABSTRACT
<p><i>Article type:</i> Research Paper</p>	<p><b>Introduction:</b> The month of "Ramadan" is a remarkable instance of strong influences of culture and religion in Iranian people's behaviors and habits. Studies have reported different results in the rate of incidence, hospitalizations, time pattern and risk factors affecting stroke during fasting. This study was conducted with the aim of determining the incidence and factors related to stroke in the month before, during and after fasting in Yasuj, Iran.</p>
<p><i>Article History:</i> Received: 05 Oct 2023 Accepted: 06 Jan 2024 Published: 22 May 2024</p>	<p><b>Methods:</b> This retrospective cross-sectional study was conducted on stroke patients referred to Yasuj hospitals, Iran from January 2018 to December 2020 (Shaban, Ramadan and Shawwal 1443 AH). Complete medical records of 40 stroke patients with inpatient records were used. Stroke cases were separated by month, based on age, gender and other risk factors, as well as the time of incidence of stroke. Data were analyzed using SPSS v.28 software.</p>
<p><i>Keywords:</i> Stroke Fasting Incidence Factors related</p>	<p><b>Results:</b> According to the findings of this study, 23 patients (57.5%) were male and 17 patients (42.5%) were female. The number of hospitalized patients with stroke in the months of Shaban, Ramadan and Shawwal were 12, 12 and 13 respectively. No significant correlation was observed in terms of the incidence of stroke during the month of Ramadan and other two months. In addition, there was no any significant difference between different months in terms of the studied variables (stroke history, cardiovascular diseases, hypertension, hyperlipidemia, and smoking).</p> <p><b>Conclusion:</b> This study indicated that fasting in Ramadan does not increase the incidence of stroke. Proper medical advice can significantly prevent strokes during Ramadan.</p>

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### **Introduction**

The country of Iran has outstanding cultural and religious roots and a brilliant scientific background. Among the most obvious and the most robust relationships existing in every small and large societies, there is a deep relationship between culture and public health, and Iranian society is not an exception for this rule [1].

There are a large number of studies focusing on the effects of fasting in Ramadan on different aspects of human health. The studies conducted in Iran and other countries have indicated that fasting in Ramadan has been effective in enhancing the psychological (mental) status of students and in alleviating stress, anxiety and depression of fasting people [2, 3]. Furthermore, the studies performed on the incidence of stroke

during Ramadan have shown irrelevance and changes limited to the time of stroke [4, 5].

Stroke is the second cause of deaths across the world and, irrespective of the cerebrovascular disease, the fifth cause of mortalities. It is among the main causes of disability. With respect to increase of incidence in developing countries, the ischemic cerebral stroke caused by arterial occlusion is the main cause of most of the cases [6, 7].

The main mechanism in most of the arterial ischemic cerebral strokes is thrombosis and subsequent vascular stenosis [8]. Theoretically, dehydration and increment of hemoglobin, hematocrit and platelet subsequent to fasting can make the patient susceptible to this complication through creating hypercoagulable state [9, 10].

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Diabetes, hypertension, hyperlipidemia, smoking and cerebrovascular disease are among the most important risk factors in arterial ischemic stroke. So far, many studies have investigated the changes of these factors during fasting [11-13]. Studies have shown that fasting has an effect on the cardiovascular system, including the development of atherosclerosis, benefits for type 2 diabetes, lowering blood pressure, and other cardiovascular risk factors [14]. Other studies have shown that fasting can reduce the risk of cardiovascular disease by improving weight control, hypertension, dyslipidemia, and diabetes [15].

The obtained findings have revealed that, subsequent to fasting, the levels of total cholesterol, VLDL, LDL, triglyceride and glucose reduced and the level of HDL increased in blood. Additionally, systolic and diastolic blood pressure reduces due to fasting. The incidence of acute coronary syndromes, atrial fibrillation, and acute heart failure showed no significant differences between Ramadan and other months [16]. The studies comparing the incidence rates of arterial ischemic strokes in Ramadan and other months have addressed no significant differences in this regard [4, 17, 18].

The month of Ramadan is a remarkable instance of influences of culture and religion on Iranian people's behaviors and habits, and as it is obvious, it has a great effect on dietary and behavioral habits of people. Therefore, given the importance of stroke and the risk factors involved in it, as well as contradictory results of the previous studies portraying the relationship between stroke and Ramadan, this study was designed concentrating on the incidence of stroke during Ramadan in comparison with its preceding and succeeding months, by taking into account the most important risk factors involved in it.

## Methods

### *Study Design and Setting*

A retrospective cross-sectional study was conducted on stroke patients referred to hospitals in Yasuj city, Iran, from January 2018 to December 2020 (Sha'ban, Ramadan and Shawwal 1443 AH). Yasuj is a city in the southwest of Iran and the capital of Kohgiluyeh and Boyer-Ahmad province. According to the last national census of Iran in 2016, the population of Yasoj was 194,535.

### *Eligibility Criteria and Sample Size*

All patients with a confirmed diagnosis of stroke by a neurologist at admission, with complete medical records, were included in the study. A total of 40 stroke patients who had complete hospitalization records were used.

### *Data Collection*

Medical records of stroke patients were collected during the target period ((Sha'ban, Ramadan and Shawwal 1443 AH)) by referring to the archives and medical records unit of Yasouj hospitals. This information was then separated according to patients' age, gender, status of fasting, history of stroke, hyperlipidemia, diabetes type 2, cerebrovascular diseases, hypertension, smoking, electrocardiograph, pregnancy, history of abortion, history of using OCP (oral contraceptive pills), BUN/CR ratio, level of sodium, and the incidence time of stroke in each month.

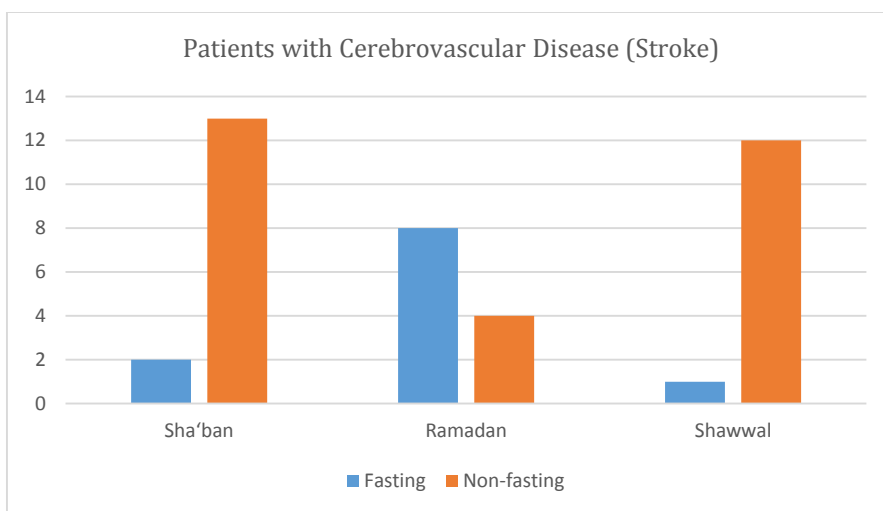
### *Statistical Analysis*

Frequency distribution tables for discrete variables were drawn and statistical indices of mean and standard deviation (SD) were calculated for continuous variables. The required comparisons during different months were conducted based on parametric and non-parametric tests. The level of significance was considered 5%. Before performing any test, the variables were tested for normality. Finally, statistical analysis was done using SPSS v.28 software.

## Results

In present study, there were 40 patients suffering from stroke during the three months. Of this population, 33 patients suffered from ischemic stroke, while 7 suffered from hemorrhagic stroke. Twenty-three patients were male, while 17 were female. The numbers of stroke cases in Sha'ban, Ramadan and Shawwal were 15, 12, and 13, respectively, showing no significant difference ( $P=0.7$ ). Figure 1 shows the number of Patients with cerebrovascular disease (Stroke) and fasting by month.

The table 1 shows the results of investigating the other variables of this study vs. month. In comparison of other variables, no significant difference was observed between three months.



**Figure 1.** Frequency of patients with cerebrovascular disease (Stroke) and fasting by month. Most of patients were among those who had not fasted. The largest number of patients was recorded in Ramadan and then Sha'ban.

**Table 1.** Variables affecting stroke by month

Title		Sha'ban	Ramadan	Shawwal	Total	P.Value
<b>Age (Mean)</b>		62.60	64.58	62.89		0.8
<b>Gender</b>	<b>Male</b>	9 (22.5%)	8 (20%)	6 (15%)	23 (57.5%)	0.6
	<b>Female</b>	6 (15%)	4 (10%)	7 (17.5%)	17 (42.5%)	
<b>Cerebrovascular Disease</b>	<b>No suffering</b>	7 (17.5%)	8 (20%)	6 (15%)	21 (52.5%)	0.5
	<b>Suffering</b>	8 (20%)	4 (10%)	7 (17.5%)	19 (47.5%)	
<b>Blood Pressure</b>	<b>High</b>	2 (5%)	1 (2.5%)	3 (7.5%)	6 (15%)	0.7
	<b>Normal</b>	12 (30%)	10 (25%)	10 (25%)	32 (80%)	
<b>Smoking</b>	<b>Low</b>	1 (2.5%)	1 (2.5%)	0	2 (5%)	0.7
	<b>No</b>	9 (22.5%)	10 (25%)	8 (20%)	27 (67.5%)	
<b>Diabetes History</b>	<b>Yes</b>	6 (15%)	2 (0.05%)	5 (12.5%)	13 (32.5%)	0.6
	<b>No</b>	14 (35%)	12 (30%)	12 (30%)	38 (95%)	
<b>Hyperlipidemia History</b>	<b>Yes</b>	1 (2.5%)	0	1 (2.5%)	2 (5%)	0.6
	<b>No</b>	13 (32.5%)	11 (27.5%)	10 (25%)	34 (85%)	
<b>Electrocardiograph</b>	<b>Normal</b>	13 (32.5%)	10 (25%)	11 (27.5%)	34 (85%)	1
	<b>Atrial Fibrillation</b>	2 (5%)	2 (5%)	2 (5%)	6 (15%)	
<b>History of OCP usage in Women</b>	<b>No</b>	3 (17.6%)	3 (17.6%)	3 (17.6%)	9 (52.8%)	0.4
	<b>Yes</b>	3 (17.6%)	1 (6%)	4 (23.6%)	8 (47.2%)	
<b>History of Abortion in Women Population</b>	<b>No</b>	5 (29.41%)	4 (23.52%)	7 (41.17%)	16 (94.11%)	0.2
	<b>Yes</b>	1 (5.89%)	0	0	1 (5.89%)	
<b>Body Sodium Level</b>	<b>Normal</b>	12 (30%)	11 (27.5%)	13 (32.5%)	36 (90%)	0.2
	<b>High</b>	3 (7.5%)	1 (2.5%)	0	4 (10%)	
<b>History of Stroke</b>	<b>No</b>	13 (32.5%)	11 (27.5%)	13 (32.5%)	37 (92.5%)	0.4
	<b>Yes</b>	2 (5%)	1 (2.5%)	0	3 (7.5%)	
<b>BUN/Cr*</b>	<b>Low</b>	1 (2.5%)	1 (2.5%)	2 (5%)	4 (10%)	0.7
	<b>Normal</b>	14 (35%)	11 (27.5%)	11 (27.5%)	36 (90%)	
<b>Familial History of Stroke</b>	<b>No</b>	9 (22.5%)	6 (15%)	8 (20%)	23 (57.5%)	0.8
	<b>Yes</b>	6 (15%)	6 (15%)	5 (12.5%)	17 (42.5%)	
<b>Comparison by month</b>		15	12	13	40	0.7

\*BUN = Blood Urea Nitrogen (mg/dL), Cr = Creatinine (mg/dL)

**Discussion**

In this study, 40 patients with stroke were examined. According to the findings of the

present study, the lowest incidence of stroke occurred in the month of Ramadan compared to the previous month (Sha'ban) and the following

month (Shawwal). Almost 1.6 billion Muslims live across the world [19]. Although Islam has different degree of importance for Muslims in different countries, the importance of fasting in Ramadan is very high for most of Muslims. In a multi-national study conducted in 39 countries in the form of more than 38000 personal interviews in 80 different languages, it was shown that among the Muslims of Southeast Asia, South Asia, North Africa and Sub-Saharan Africa, an average of 94 to 99 percent said that they fast during Ramadan [20].

The findings of the present study showed that 32.5% of stroke cases during these three months had a history of smoking, and 2 (0.05%) of the people who had a stroke in Ramadan. The Muslims all over the world are obliged to fast from dawn to dusk during the month of Ramadan. This will considerably change their dietary habits for a whole month. In addition to diet, other habits, such as smoking, physical exercise and sleep order, change significantly during this month [21]. While, at the first glance, these alterations might seem frightening, the incidence of cerebrovascular diseases had not increased significantly.

The findings of this study showed that among the 12 cases of stroke in Ramadan, 1 case had a history of stroke and 6 cases had a family history of stroke. In comparison with the other times of a year, no significant differences had been indicated in incidence and diagnosis of or hospitalization due to critical cardiac conditions, such as CHF, MI, and ischemic or hemorrhagic stroke, during Ramadan [22]. There are satisfying evidences in humans and animals indicating that fasting can prevent metabolic syndrome, as one of the main causes of different mental diseases. This means that fasting has a decreasing influence on mental diseases, through preventing from metabolic syndrome [21].

In this study, 57.5% of patients were male. Also, the number of male patients in Ramadan was twice as high as that of female patients. However, this difference was not significant statistically. In a retrospective study by Bener et al. in 2006, investigating the incidence of ischemic and hemorrhagic strokes in a 13-year period during Ramadan and comparing it with its preceding and succeeding months, no significant difference was observed between Ramadan and other months in terms of gender [23]. In addition, in the study of Tabrizi et al., who conducted an

epidemiological investigation of neurological diseases in Sari from the beginning of Ramadan to the end of Shawwal, there was no significant difference in terms of gender [24]. Therefore, it has been evident that stroke may happen in both sexes and special attention should be paid to suspected cases of stroke in both sexes.

Also, this study did not show a significant difference between Ramadan and its preceding and succeeding months, in terms of incidence of stroke. The results of the study of Akhan et al. were similar to this study [25]. Additionally, in a study conducted by al-Suwaidi et al. in Qatar, there was no significant difference in the incidence of stroke one month before, during and one month after Ramadan [26].

In the present study, no significant difference was observed between ischemic and hemorrhagic strokes in Ramadan and other two months. Several studies have shown that the ratio of hemorrhagic to ischemic strokes does not have a significant difference between Ramadan and other months [25, 27].

In a study reported in Iran, cerebral and sinus vein thrombosis (CVT) increased during Ramadan, unlike arterial thrombosis, where most studies have found no difference [17]. In a study in 2012 conducted by Sasan Nejad et al., the relationship between cerebral vein thrombosis and taking contraceptive pills in women was investigated in Ramadan during four consecutive periods from 2006 to 2009. In that period, 70 patients with CVT (11 male and 59 female) were included. 25 cases were hospitalized during the months of Ramadan, significantly higher than the other 32 months ( $P=0.00000019$ ). Given the higher frequency of women (6 times higher) among CVT cases, which were studied in order to investigate the possible risk factors and short-term taking of contraceptive pills, short-term taking of contraceptive pills was declared as the main risk factor ( $P=0.00071$ ). This study indicated that short-term usage of oral contraceptives could be a main risk factor for CVT during Ramadan [28]. According to this study, the main cause of CVT was not fasting but taking OCP among the religious population of women, who deliberately had taken these medicines to prevent from monthly menstruation and full enjoyment of this blessed month. This is while there was no increase in cerebral thrombosis cases in the present study,

which is justifiable in terms of OCP taking, given the small sample size.

The systematic study of Almualem et al. in 2020 evaluated the influence of fasting in Ramadan on cerebrovascular events and multiple risk factors in patients with type II diabetes. In general, 22 studies were reviewed. The results showed that there was no sufficient evidence to relate fasting in Ramadan with increasing or decreasing the incidence of cerebrovascular events in patients with type II diabetes [9].

In the study of Nematy et al. in 2012, the effect of fasting in Ramadan on cardiovascular risk factors was investigated prospectively. This study showed a significant improvement in 10-year coronary heart disease risk score and other cardiovascular risk factors such as lipid profile and systolic blood pressure [29]. Furthermore, the study of Eshghinia et al. in 2013, which investigated the effect of a modified fasting diet on weight loss and CAD risk factors in overweight and obese women, showed a decrease in systolic and diastolic blood pressure during fasting [12].

## Conclusion

This study showed that fasting does not increase the incidence of stroke during Ramadan. It is necessary to provide patients with adequate education on proper hydration during Dawn and Iftar and avoiding insomnia and stress. On the other hand, proper medical advice can significantly prevent strokes during Ramadan.

## Declarations

### Limitation

This was a single-core and retrospective study. Due to small sample size, it was difficult to statistically compare the Ramadan and non-Ramadan cases. Therefore, to better understand this issue, further research, preferably multicenter, is recommended. There is also no information on those who refused to go to hospital, died before arrival, or died at home of acute stroke.

### Suggestions

In this highly descriptive study, the risk factors of stroke in Ramadan were investigated. It is recommended that prospective studies calculate the risk factors and profile of fat and blood sugar and compare them with each other. Also, this study examined one year. It is recommended to conduct this examination with a period of several years and with a larger number of samples.

## Ethics Approval and Consent to Participate

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

This study was approved by the medical ethics committee of Yasuj University of Medical Sciences (approval number: IR.YUMS.REC.1401.160). Permission to collect data from medical records was provided by the hospital department director. The use of collected data was confidential and anonymous. All patients received written information regarding the background and procedures of the study and gave written informed consent prior to entering the study.

## Consent for Publication

Not applicable.

## Availability of Data and Materials

The datasets which was generated and analyzed during the current study and used for the preparation of the manuscript are included in the article submitted for publication.

## Competing Interests

The authors declare no potential conflict of interest.

## Funding

Not applicable.

## Author Contributions

M.S. and M.M.J. Conceived and designed the analysis; M.S. and J.M. and S.R. Collected the data; S.A. and J.M. Contributed data or analysis tools; M.M.J. and S.A. Performed the analysis; All authors reviewed the manuscript.

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