



The Incidence of Ischemic Stroke and Its Associated Factors in Young Adults in Kermanshah Over a Seven-Year Period

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Received 2019 February 02; Revised 2019 April 01; Accepted 2019 April 09.

Abstract

Background: Cerebrovascular accidents are the most prevalent debilitating neurological disease and the third leading cause of death in the world. Although the incidence of stroke increases with age, its prevalence is growing in the young.

Objectives: In the present study the incidence of ischemic stroke and its associated risk factors was investigated in young adults in the city of Kermanshah, Iran over a seven-year period.

Methods: The present study was conducted on 122 patients below the age of 45 years who hospitalized with ischemic stroke in the Department of Neurology of Imam Reza Hospital in Kermanshah between 2007 and 2014. Data, including age, gender, history of hypertension, smoking status, the history of heart disease, taking high-risk medications, the history of internal diseases, hyperlipidemia, diabetes mellitus and causes of stroke were recorded in the designed a checklist.

Results: The incidence of ischemic stroke had been growing in individuals under the age of 45 years in Kermanshah during 2007 - 2014. The mean and standard deviation of age was 37.33 ± 7.05 years among participants. They included 57 female (46.7%) and 65 males (53.3%). The most prevalent risk factors in the study patients respectively comprised the history of hypertension (30.3%), smoking status (28.7%), the history of heart disease (26.2%), taking high-risk medications (23.8%), the history of internal diseases (22.9%), hyperlipidemia (20.5%) and diabetes mellitus (18.8%). Early atherosclerosis (23.8%) was also found to be the most common cause of ischemic stroke in these patients.

Conclusions: There is a considerable increase in the incidence of ischemic stroke in young people. Control of the risk factors, raising public awareness, and changing lifestyle are crucial for preventing cerebrovascular accidents and their associated complications and death.

Keywords: Ischemic Stroke, Risk Factors, Hypertension, Heart Diseases, Smoking

1. Background

Stroke is the most prevalent life-threatening and most important debilitating neurological disorder. According to WHO estimates, by 2020, strokes will turn into the second leading cause of death after ischemic heart disease in developed and developing countries (1). Moreover, preventing this complication as a major cause of physical and brain disabilities is crucial given the high cost of maintaining and taking care of the patients (2, 3). From a clinical perspective, stroke is caused by the disruption of the blood supply to the brain as a result of the thromboembolism-associated blockage of the main vessels or rupture of the arteries. Approximately 85% of all strokes are ischemic in origin, as they are mainly caused by the thrombotic or em-

bolic blockage of brain arteries (4). The incidence of stroke significantly grows with age. Given the increased human longevity, this incidence has therefore become exceptionally important in different communities. Research suggests that the incidence of this complication nearly doubles with every ten years after the age of 55 (5).

Although strokes are mainly associated with middle and old ages, young adults may also be affected by cerebrovascular incidents. The annual incidence of ischemic stroke has been reported as 5% - 10% of all types of stroke in young adults (6). Clinical evidence and unofficial national statistics also suggest an increase in the incidence of strokes in young Iranian adults, which is particularly important given the potential increase in the number of lost years caused by the disease and the higher costs of main-

taining, taking care and rehabilitating this group of patients. According to previously - conducted studies, age, male gender, family history, race and ethnicity are among the uncontrollable factors contributing to the incidence of strokes, and hypertension, heart diseases, diabetes mellitus, hyperlipidemia, non-sclerotic causes, smoking, excessive alcohol drinking, lack of mobility and cerebrovascular ischemic incidents, including traumas, fibromuscular dysplasia and migraine, are the controllable risk factors with the same role (7). Research also attributes different causes to strokes in adults compared to in older adults. Cervical arterial dissection and non-arrhythmic cardiac disorders are the common causes of stroke in young adults, whereas well-known risk factors are more common in older adults (8).

Despite the increasing prevalence of strokes in young adults and numerous consequences of this disorder for this age group, few studies have been conducted to determine stroke - associated risk factors in young Iranian adults. Finding the risk factors associated with cerebrovascular incidents helps to not only determine the likelihood of developing stroke, but also to predict the disease duration, the mortality and disabilities associated with these incidents and their probability of recurrence. Correcting the risk factors early can reduce the incidence and recurrence of strokes (9).

2. Objectives

The present study was therefore conducted to investigate the risk factors associated with ischemic stroke in young adults hospitalized with this disease in Imam Reza Hospital in Kermanshah. The present study results can introduce more important risk factors in this region of the country.

3. Methods

The study population comprised all 15 - 45-year-old patients diagnosed with stroke and hospitalized in Imam Reza Hospital in Kermanshah during 2007 - 2014. Stroke is defined as a focal neurological defect lasting over 24 hours, which is associated with cerebral infarction evidence. Stroke was diagnosed through examinations by a neurologist based on clinical symptoms and brain CT scan or MRI.

The stroke - associated risk factors determined according to previous studies (10) included hypertension, angina, diabetes mellitus, hyperlipidemia, smoking and a history of cardiovascular and cerebrovascular diseases. The reasons for developing stroke were also investigated. The

data extracted from the patients' were documented into checklist. The eligible candidates comprised patients with ischemic stroke, whereas the excluded ones consisted of those with hemorrhagic strokes or a history of head traumas as well as those with neurological defects that had been caused by other reasons, including metabolic diseases, or other lesions, including tumors, or had been relieved within 24 hours. All the data collected were investigated and eventually analyzed in SPSS V. 16 after being entered into the computer.

4. Results

The present study investigated 122 patients aged 15 - 45 years with ischemic stroke and a mean age of 37.33 ± 7.05 years, including 57 (46.7%) females and 65 (53.3%) males.

According to the frequency distribution, the highest frequency of the study patients was 27% associated with 2014, and the lowest 5.7% associated with 2008. This figure shows a growing trend in the incidence of ischemic stroke in young adults. Comparing the final year of the study with seven years before shows a significant increase in the incidence of ischemic stroke in this age group (Figure 1).

The results showed age-associated increases in both the risk of stroke and the number of ischemic stroke patients (Table 1).

According to Table 2, the most important clinical risk factors associated with ischemic stroke in the study subjects comprised a history of hypertension, heart diseases, angina and internal and rheumatic diseases, smoking, taking high-risk medications, diabetes mellitus and hyperlipidemia. Table 2 also suggests that "history of hypertension" is the most-frequent risk factor observed in 37 (30.33%) of the patients, and "history of rheumatism" the least - frequent risk factor observed in 11 (9.02%).

According to Figure 2, the most common causes of ischemic stroke in the study patients were early atherosclerosis (23.8%) and cardiac embolism (14.07%).

Table 1. Frequency Distribution of 15 - 45-Year-Old Patients with Ischemic Stroke by Age and Gender^a

Age Group	Female	Male	Total
15 - 20	2 (1.60)	6 (4.90)	8 (6.50)
21 - 25	3 (2.50)	4 (3.30)	7 (5.80)
26 - 30	5 (4.10)	8 (6.60)	13 (10.70)
31 - 35	12 (9.80)	9 (7.40)	21 (17.20)
36 - 40	16 (13.10)	24 (19.70)	40 (32.80)
41 - 45	19 (15.60)	14 (11.40)	33 (27.00)
Total	57 (46.70)	65 (53.30)	122 (100.00)

^aValues are expressed as No. (%).

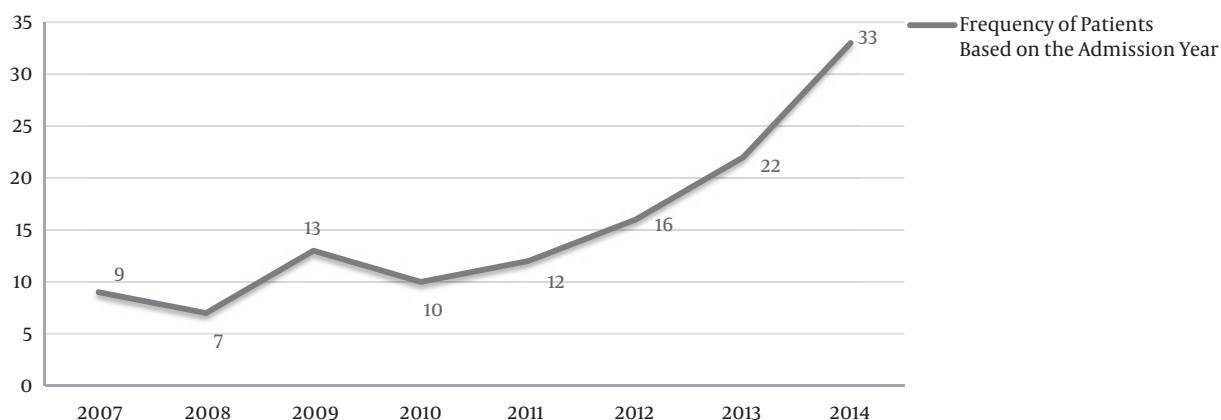


Figure 1. The incidence of strokes in 15 - 45-year-old patients during 2007 - 2014

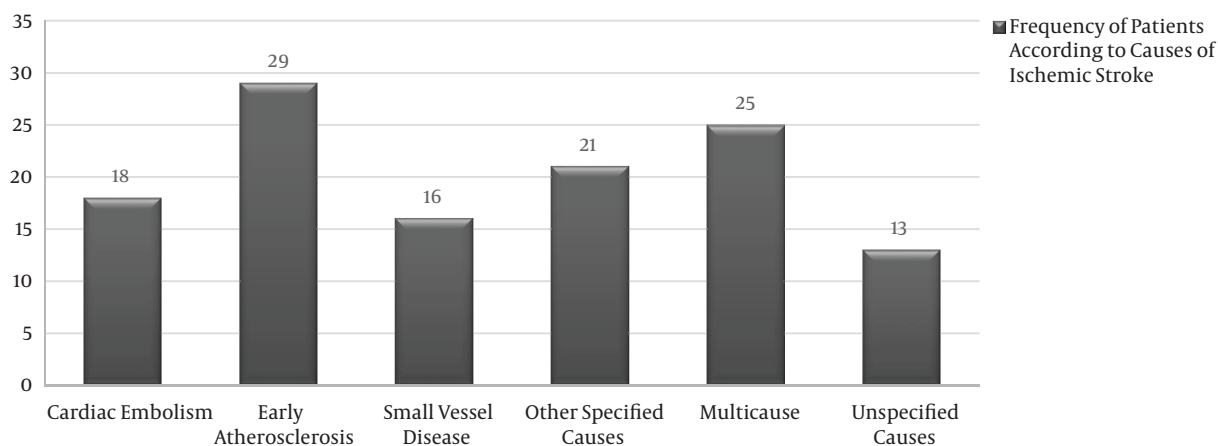


Figure 2. Frequency of causes of stroke in 15 - 45-year-old patients

5. Discussion

According to the present results, the incidence of ischemic stroke had been growing in 15 - 45-year-old patients during 2007 - 2014, especially since 2011. Although raising public awareness, improving the process of emergency deployment and developing the Neurology Department of the study hospital can affect the number of these patients, the significant increase in the incidence of ischemic stroke in young adults, especially during 2011 - 2014, must be addressed by researchers and health policy-makers in this part of Iran.

The present study found the incidence of stroke to increase with age. The highest frequency of ischemic stroke was associated with the 35 - 45-year-old patients, and the mean age of the patients was 37.33 ± 7.05 years. The incidence of stroke increases so sharply with age that aging

constitutes the most important risk factor for stroke (4, 10, 11). The present study found the prevalence of stroke to be higher in the men than in the women, which is consistent with the results obtained by Jovanovic et al. (12), Ji et al. (13) and Shahbazi and Zareiy (14). In contrast, a similar study conducted in the city of Ardabil, Iran found 71% of patients with stroke to be female (15). Racial, cultural and lifestyle differences are important factors affecting the incidence of stroke. Given that the race of people in Ardabil is Turk, and that in Kermanshah is Kurd, racial differences can explain the differences in the prevalence of stroke between women and men. Given the physiological differences between men and women, neither gender can be definitely said to be more vulnerable; nevertheless, previous studies have shown that men are generally more vulnerable to hemorrhagic stroke and women to ischemic stroke (16, 17).

Table 2. Frequency Distribution of 15 - 45-Year-Old Patients with Ischemic Stroke by the Risk Factor

Variable, Present	Frequency ^a
History of hypertension	
Yes	37 (30.33)
No	85 (69.67)
Smoking	
Yes	35 (28.69)
No	87 (71.31)
History of heart diseases	
Yes	32 (26.23)
No	90 (73.77)
Taking high-risk medications	
Yes	29 (23.77)
No	93 (76.22)
Diabetes mellitus	
Yes	23 (18.85)
No	99 (81.14)
History of hyperlipidemia	
Yes	25 (20.49)
No	97 (79.51)
History of angina	
Yes	13 (10.66)
No	109 (89.34)
History of other internal diseases	
Yes	29 (23.77)
No	94 (76.23)
History of rheumatism	
Yes	11 (9.02)
No	111 (90.98)

^aValues are expressed as No. (%).

The present study found the history of hypertension to be the most common risk factor (30.3%) in the study patients, which is consistent with the majority of studies conducted on the subject (10, 18, 19). A study conducted on five thousand 30 - 60-year-old asymptomatic men and women who were followed-up for 18 years found the likelihood of stroke to be seven times larger in patients with hypertension compared to in those with a normal blood pressure. Moreover, review of 45 prospective cohort studies from around the world showed a significant relationship between diastolic blood pressure and the risk of stroke, in a way that the risk of stroke increased by 80% for every 10 mmHg increase in diastolic blood pressure (20, 21). The present study found smoking with a frequency of 28.7% to be the second leading risk factor in the patients. Research suggests that smoking independently increases the risk of stroke. With cardiovascular risk factors being controlled, the relative risk of developing stroke is 1.7 times larger in smokers (22). Jovanovic et al. also found smoking, hyper-

tension and lipid disorder to be among the risk factors associated with developing stroke, which is consistent with the present study results (12).

The present research found cardiovascular diseases to be the third major risk factor. These diseases, especially congestive heart failure and coronary artery arteriosclerosis, significantly increase the risk of stroke. The most important predisposing risk factors for ambulatory strokes are cardiac structural diseases and arrhythmia, especially atrial fibrillation. Heart diseases double the risk of stroke in men and triple it in women (9). The studies conducted in other countries also found heart diseases to be the most common risk factors for stroke. Furthermore, brain embolism caused by congenital heart disorders was found to be the main cause of stroke in Greece (23). A report in Switzerland also found heart diseases to be the most common risk factors for stroke (24). The present study showed that the history of angina (10.6%) and rheumatism (9%) are important risk factors for ischemic stroke. Early atherosclerosis (23.8%) and cardiac embolism (14.7%) were also found to be the most common causes of ischemic stroke in the study patients. Other studies have reported the prevalence of embolism as 5.2% - 28.3%. The results of investigations showed that the main cardiac factors in these patients are heart valve disease followed by arrhythmia AF (13.8%) (9, 25).

Hyperlipidemia is another common risk factor for ischemic stroke in young age. A study conducted in Greece on strokes in young adults found lipid disorders to be a major risk factor (23). A study by Oslen et al. on 652 patients showed that high cholesterol levels are approximately linearly correlated with the severity of strokes, and that the likelihood of strokes increases with cholesterol levels (26). Hypolipidemic medications were also found to reduce the severity of strokes (27). The present study identified hyperlipidemia in 20.5% of the patients. The majorities of studies conducted suggest that diabetes is a risk factor for strokes in young ages (5, 28). The present study also found diabetes to be the sixth major risk factor (18.8%). Ji et al. reported diabetes as a risk factor for developing strokes in young ages in 11% of the cases (13). The incidence of strokes has been reported to be 1.5 - 2 times higher in diabetics compared to in normal populations (19, 29).

5.1. Conclusions

According to the present results, the incidence of ischemic stroke has been growing in young adults. Numerous risk factors have been introduced for this problem, including hypertension with the highest frequency in the present study age group. Given the importance of hypertension for the incidence of different types of stroke, especially for hemorrhagic and fatal types, effective measures,

including the establishment of hypertension diagnostic and treatment clinics across urban and rural communities, are recommended to be taken to identify the patients and detect and prevent the progression of hypertension, especially the asymptomatic type. Other major risk factors that are also required to be simultaneously considered include smoking, cardiovascular factors, high-risk medications and diabetes.

Footnotes

Authors' Contribution: Study design, writing and critically review the manuscript: Payam Sari-Aslani, Hiwa Mohamad, and Fatemeh Hosseini; study execution: Hiwa Mohamadi, Reza Sultanabadi, and Payam Sari-Aslani; data collection and review the manuscript: Reza Sultanabadi.

Conflict of Interests: It is not declared by the authors.

Ethical Approval: The study was approved by Ethic Committee of KUMS.

Funding/Support: This study was financially supported by Kermanshah University of Medical Sciences.

References

- Adams RD, Victor M, Ropper AH. *Principle of neurology*. 10th ed. McGrawhill; 2014.
- Sacco RL. Risk factors, outcomes, and stroke subtypes for ischemic stroke. *Neurology*. 1997;**49**(5 Suppl 4):S39-44. doi: [10.1212/wnl.49.5_suppl_4.S39](#). [PubMed: [9371148](#)].
- Roth EJ, Lovell L, Harvey RL, Heinemann AW, Semik P, Diaz S. Incidence of and risk factors for medical complications during stroke rehabilitation. *Stroke*. 2001;**32**(2):523-9. [PubMed: [11157192](#)].
- Alam I, Haider I, Wahab F, Khan W, Taqweem A. Risk factors stratification in 100 patients of acute stroke. *J Postgrad Med Inst (Peshawar-Pakistan)*. 2011;**18**(4):123-35.
- Ropper AH. *Adams and Victor's principles of neurology*. New York: McGraw-Hill Medical; 2009.
- Gold AP, Patterson MC, Nordli DR Jr. Stroke in children. In: Rowland LP, Pedley TP, editors. *Merritt's neurology*. 12th ed. USA: Lippincott Williams Wilkins; 2010. p. 295-301.
- Azin H, Ashjazadeh N. Cerebral venous sinus thrombosis-clinical features, predisposing and prognostic factors. *Acta Neurol Taiwan*. 2008;**17**(2):82-7. [PubMed: [18686646](#)].
- Fromm A, Waje-Andreassen U, Thomassen L, Naess H. Comparison between ischemic stroke patients <50 years and ≥50 years admitted to a single centre: The bergen stroke study. *Stroke Res Treat*. 2011;**2011**:183256. doi: [10.4061/2011/183256](#). [PubMed: [21318148](#)]. [PubMed Central: [PMC3034967](#)].
- Merritt HH, Rowland LP, Pedley TA. *Merritt's neurology*. Lippincott Williams & Wilkins; 2010.
- Ahmadi Ahangar A, Khafri S, Mostafazadeh M, Akbarian M, Motavalli M. [Risk factors for strokes in patients 15-45 years old admitted at Ayatollah Roohani Hospital in Babol, Iran (2009-2010)]. *J Babol Univ Med Sci*. 2013;**15**(6):95-103. Persian. doi: [10.18869/acadpub.jbums.15.6.95](#).
- Zetola VH, Novak EM, Camargo CH, Carraro HJ, Coral P, Muzzio JA, et al. [Stroke in young adults: Analysis of 164 patients]. *Arq Neuropsiquiatr*. 2001;**59**(3-B):740-5. Portuguese. [PubMed: [11593276](#)].
- Jovanovic DR, Beslac-Bumbasirevic L, Raicevic R, Zidverc-Trajkovic J, Ercegovic MD. Etiology of ischemic stroke among young adults of Serbia. *Vojnosanit Pregl*. 2008;**65**(11):803-9. [PubMed: [19069709](#)].
- Ji R, Schwamm LH, Pervez MA, Singhal AB. Ischemic stroke and transient ischemic attack in young adults: Risk factors, diagnostic yield, neuroimaging, and thrombolysis. *JAMA Neurol*. 2013;**70**(1):51-7. doi: [10.1001/jamaneurol.2013.575](#). [PubMed: [23108720](#)].
- Shahbazi MH, Zareiy S. [Assessment of risk factors in Cerebrovascular accident patients: Beasat Hospital between 2000 and 2001]. *Ebn-e-Sina*. 2007;**10**(3):10-4. Persian.
- Hashemilar M, Savadi Oskoue D, Jafariyani M, Amini Sani N. [An etiologic study of cerebrovascular ischemic events in young adults referring to Alavi Hospital in Ardabil, 2004-2005]. *J Ardabil Uni Med Sci*. 2006;**6**(1):83-7. Persian.
- Inagawa T. Trends in incidence and case fatality rates of aneurysmal subarachnoid hemorrhage in Izumo City, Japan, between 1980-1989 and 1990-1998. *Stroke*. 2001;**32**(7):1499-507. [PubMed: [11441192](#)].
- Putala J, Yesilot N, Waje-Andreassen U, Pitkanen J, Vassilopoulos S, Nardi K, et al. Demographic and geographic vascular risk factor differences in European young adults with ischemic stroke: The 15 cities young stroke study. *Stroke*. 2012;**43**(10):2624-30. doi: [10.1161/STROKEAHA.112.662866](#). [PubMed: [22798330](#)].
- Banerjee TK, Das SK. Epidemiology of stroke in India. *Neurology Asia*. 2006;**11**:1-4.
- Biderafsh A, Karami M, Faradmal J, Poorolajal J, Esmailnasab N. [The pattern of hypertension and the population attributable proportion of hypertension-related stroke in Hamadan province from 2005 to 2009]. *Iran J Epidemiol*. 2014;**10**(3):54-64. Persian.
- Beckett NS. Prevention of stroke. *J Cardiovasc Risk*. 2001;**8**(5):257-64. [PubMed: [11702030](#)].
- Aminoff MJ. *Aminoff's electrodiagnosis in clinical neurology*. Elsevier Health Sciences; 2012.
- Malani PN. Harrison's principles of internal medicine. *Jama*. 2012;**308**(17):1813. doi: [10.1001/jama.308.17.1813-b](#).
- Spengos K, Vemmos KN. Etiology and outcome of cardioembolic stroke in young adults in Greece. *Hellenic J Cardiol*. 2010;**51**(2):127-32. [PubMed: [20378514](#)].
- Nedelchev K, der Maur TA, Georgiadis D, Arnold M, Caso V, Matthe HP, et al. Ischaemic stroke in young adults: Predictors of outcome and recurrence. *J Neurol Neurosurg Psychiatry*. 2005;**76**(2):191-5. doi: [10.1136/jnnp.2004.040543](#). [PubMed: [15654030](#)]. [PubMed Central: [PMC1739502](#)].
- Ezzati M, Lopez AD, Rodgers A, Vander Hoorn S, Murray CJ; Comparative Risk Assessment Collaborating Group. Selected major risk factors and global and regional burden of disease. *Lancet*. 2002;**360**(9343):1347-60. doi: [10.1016/S0140-6736\(02\)11403-6](#). [PubMed: [12423980](#)].
- Olsen TS, Christensen RH, Kammersgaard LP, Andersen KK. Higher total serum cholesterol levels are associated with less severe strokes and lower all-cause mortality: Ten-year follow-up of ischemic strokes in the Copenhagen Stroke Study. *Stroke*. 2007;**38**(10):2646-51. doi: [10.1161/STROKEAHA.107.490292](#). [PubMed: [17761907](#)].
- Deplanque D, Masse I, Lefebvre C, Libersa C, Leys D, Bordet R. Prior TIA, lipid-lowering drug use, and physical activity decrease ischemic stroke severity. *Neurology*. 2006;**67**(8):1403-10. doi: [10.1212/01.wnl.0000240057.71766.71](#). [PubMed: [17060566](#)].
- Shah NR. *Epidemiology of stroke*. American Health & Drug Benefits; 2009.
- Katzan IL. Epidemiology of stroke. *Handbook of clinical nutrition and stroke*. Springer; 2013. p. 3-14. doi: [10.1007/978-1-62703-380-0_1](#).