Stroke epidemiology and one-month fatality among an urban population in Iran

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Objective Stroke is one of the most common causes of death and disability in Iran. This study evaluated stroke patient profiles with respect to rate, risk factors, and one-month fatality.

Material and method A cross-sectional, hospital-based study on all stroke patients older than 45 years admitted to hospitals in the city of Qom throughout 2001.

Results Four hundred and sixty patients older than 45 years were admitted as stroke. The annual stroke rate was estimated to 338/100 000 (95% confidence interval, 300–360) inhabitants older than 45 years. The annual rate of stroke was 384/100 000 (95% confidence interval, 381–386) when adjusted to the European population. Stroke subtypes were; ischaemic infarction 75%, intracranial haemorrhage 20·7%, subarachnoid haemorrhage 3%, and undetermined 1·3%. Main risk factors were hypertension in 74·6% and diabetes in 55·7%. Mortality rate was 24·6% within the first month.

Conclusion Stroke incidence was higher than in Western countries. Hypertension and diabetes mellitus were considerably more frequent in our studied stroke patients than in other developing countries. Our findings need to be addressed in future health education programmes in Iran identifying patients at risk and focusing on more aggressive prevention programmes to lower stroke incidence.

Key words: fatality, Iran, risk factors, stroke-rate

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Introduction

Globally, stroke is the second leading cause of death (1). Stroke accounts for 5·7 million deaths each year, and is equivalent to 9·9% of all deaths. Over 85% of these deaths occur in low- and middle-income-rated countries (2).

Stroke is a major public health problem in developing countries (3). According to a recent well-designed population-based study in Mashhad, Iran, incidence of stroke in Iran is considerably higher than in most Western countries. The crude annual incidence stroke rate of first-ever stroke was 139 per 100,000 inhabitants, and the rates adjusted to the European population aged 45–84 years are higher than in most western countries: 616 for brain infarction, 94 for intracerebral haemorrhage, and 12 for subarachnoid haemorrhage (4).

Framingham population-based stroke profile studies show an increased knowledge of stroke trends, subtypes, risk factors, and incidence rates in men and women (5). However, these studies were conducted among predominantly white populations in Western countries. Recent studies have focused on differences in stroke incidence between racial/ethnic groups. High rates for African Americans but little data regarding stroke risk in Hispanic and/or Asian people have been available (6). Recent data from Northern Manhattan suggest that black people are not alone in the higher risk category and Hispanics appear to have greater risks than Caucasians (7).

Stroke Incidence studies could provide investigators with gender and race differences; identify the frequency of various stroke risk factors and furnish health authorities with data to be able to quantify the societal stroke burden (8). Both the profile of stroke and medical practice patterns for stroke care vary substantially from country to country, limiting the applicability of many study results with regard to costs and applied resource utilisation estimates. In China, the incidence of ischemic stroke is reported higher than in most western population (9).

Practice pattern variation is evident when examining differences in the average length of stay (LOS) at hospital between countries. The average LOS in the United States for patients with ischaemic stroke ranges from six- to 11 days (10, 11) compared with the much longer LOS of 17–47 days in Canada (12) and some countries in Europe (13, 14), and Asia (15).

The aim of this study was to estimate the incidence of stroke and one-month fatality as well as to describe stroke subtypes and the occurrence of established risk factors of stroke in a city of Iran in order to have a basis for preventive and rehabilitation interventions.

Materials and methods

Study design

This study was a hospital based, cross-sectional study performed on all patients over 45 years with stroke admitted to the five departments of neurology and internal medicine wards from 1 January 2001 to 1 January 2002: Kamkar, Masoumieh, Valieasr, Golpaygani, and Nekoei Hospitals affiliated to Qom Medical University.

This age limit was set due to the more common occurrence of other aetiologies in lower ages and organisational reasons. We organised the study according to the criteria for studies of stroke incidence proposed by Sudlow *et al.* (16). The local Ethics committee of Qom approved the study.

Population

Qom is a religious city in the centre of Iran with a young population estimated to 940 151 of which 136 094 (14·47%) persons were > 45 years in 2001 (17). The Iranian population in general is younger and the overall life expectancy (68·9 years) is lower compared with the European and North American population (18).

Hospitals

Qom has five general hospitals, from where all the patients' medical records were evaluated. These hospitals were admitting and managing all stroke patients in Qom during 2001; there were a total numbers of 872 beds in these hospitals. Stroke patients were hospitalised in departments of neurology, internal medicine, and general intensive care units of these hospitals.

Definition

Stroke diagnosis and stroke classification: stroke was defined as rapidly developed signs of focal (or global) disturbance of cerebral function lasting > 24 h (unless interrupted by surgery or death), with no apparent nonvascular cause based on the World Health Organization (WHO) definition of stroke(19). This definition includes clinical investigation as well as imaging techniques with CT scan, MRI, and thorough duplex ultrasound examination of neck arteries (20). These investigations were used to determine the main type of stroke according to International classification of disease, version 10 (ICD 10) (21): brain infarction (BI) (including thrombotic and embolic subtypes), intracerebral haemorrhage (ICH), subar-

achnoid haemorrhage (SAH), and undetermined stroke main type (UND). Uncertain cases were those with clinical features of stroke or SAH without confirmation from investigations (19).

Case finding

All patients admitted with stroke symptoms and diagnosed as stroke using the definition of ICD 10 classification system were included. Hospital medical wards registers; intensive care units and death certificates were screened with regard to stroke diagnosis; two experienced health care personnel specifically educated before study start performed these evaluations. Patients were identified and medical records summarised. An experienced nurse holding special education and training in this field evaluated these specific checklists. They were assessed under supervision of neurologists who categorised patients with regard to stroke subtype and risk factor profile, and reviewed all data.

Brain imaging was mandatory to differentiate between ischaemic and haemorrhagic strokes, and to rule out differential diagnosis such as tumour, subdural haematoma, or SAH.

Stroke risk factors were recorded, including diabetes mellitus (DM), hypertension (HTN), cardiac disorders, current or past history of smoking, and hyperlipidaemia as well as demographic data, date of admission, and discharge.

The DM was defined as a fasting blood sugar > 126 mg/dl, a nonfasting blood sugar > 200 mg/dl or a documented history of receiving antidiabetic drugs (22); HTN as a self-reported history of HTN or the use of antihypertensive medications, or a measured blood pressure consistently > 140/90 mmHg (23); cardiac disorders were diagnosed by a history and clinical findings of cardiac diseases and/or ECG findings (24); hyperlipidaemia: abnormal fasting lipid profiles as defined by National Cholesterol Education Program criteria (25) constituted hyperlipidaemia or the use of lipid-lowering drugs.

Smokers: categorised as currently smoking, former smoker or nonsmoker (26).

Patient follow-up

All diagnosed stroke patients were followed-up by a trained study nurse for one-month to find case fatality, through information by telephone, mail, medical records, or the patients' relatives.

Statistical methods

Standard descriptive statistics were used to describe the variables, applying means, medians, and standard deviations. Categorical variables were summarised as counts and percentages.

Rates of strokes were adjusted to standard Iranian and European populations by direct method. To enable comparison with other population-based studies, rate was age-adjusted

to 45 years or older based on Iranian and European populations as standards, respectively. We calculated confidence interval (CI) for crude rates and for rates specific for age and gender, assuming normal distribution.

Case fatality was defined as the proportion of events that were fatal within one-month of stroke onset. Statistical analysis was performed using spss-11 software package.

Results

During the one full year, 460 patients >45 years and 37 patients <45 years were admitted and diagnosed as stroke with an equal gender distribution, rendering a crude incidence of 53/100 000/year. Considering that 136 094 of the entire study population of 940 151 were >45 years, the stroke rate in this subpopulation was estimated to 338/100 000 (95% CI, 300–360) (312/100 000 in male and 370/100 000 in female) per year. When adjusted to the Iranian population of 2007, the

annual rate of stroke was 354/100 000 (95% CI, 346–353) (27); and 384/100 000 (95% CI, 381–386) when adjusted to the European population of 2001 (Table 1) (28). Of the 460 patients, 20·4% had a history of previous stroke.

The mean age for all strokes was 69·6 and for the subtypes thrombotic, embolic, ICH, and SAH were 71·6, 67·1, 67·8, and 62·1, respectively. The proportions of main types of stroke were BI 75%, ICH 20·7%, SAH 3%, and UND 1·3% (Table 2). 51·2% of Thrombotic strokes were female and 48·8% were male. Among embolic and ICH subtypes, 39·6% and 52·6% were female as well as 71·4% with SAH.

The one-month fatality rate in patients aged over 45 years was 24·6%. Mean LOS in hospital was 7·8 days (1–40 days). Among subtypes, Thrombotic subtype had the lowest LOS with a mean of 7·17 days and SAH subtype had the highest LOS with a mean of 12·3 days (Table 3).

Hypertension, DM, heart disease, hyperlipidaemia, and smoking were found in 74·6%, 55·7%, 40·4%, 15·2%, and

Table 1 Age- and gender-specific annual rates of stroke per 100 000 population of Qom, Iran 2001

Age group years	Male			Female			Both genders		
	Cases/at risk	Rate	96% CI	Cases/at risk	Rate	96% CI	Cases/at risk	Rate	96% CI
45–54	18/30650	59	31–85	36/24692	146	117–163	54/55342	98	71–122
55–64	44/20734	212	149–274	45/17329	260	213–287	99/38063	260	234–286
65–74	87/16737	520	403–617	74/15021	493	380–600	161/31758	507	461–539
75–84	70/4529	1546	1150–1850	66/3827	1725	1320–2120	136/8356	1628	1482–1758
85+	11/1171	939	659–1219	19/1370	1387	1065–1695	30/2541	1181	761–1599
All ages	230/73821	312	280–340	230/62239	370	336–384	460/136060	338	300–360
ASR 1		321	317–324		380	376–384		354	346–353
ASR 2		343	339–340		414	409–411		384	381–386

ASR, age-standardized rate; ASR 1, adjusted to the 2007 Iranian population (27); ASR 2, adjusted to the 2001 European population (28).

Table 2 Distribution of stroke subtype in age group and gender of stroke patients

Stroke subtype	Age					N	Mean (SD)	Gender	
	45–54	55–64	65–74	75–84	85			Female	Male
Ischaemic stroke									
Thrombotic (55.2%)	14	35	104	84	17	254	71.65 (9.1)	130	124
	5.5%	13.8%	40.9%	33.1%	6.7%			51.2%	48.8%
Embolic (19.8%)	14	25	22	23	7	91	67.07 (11.15)	36	55
	15.4%	27.5%	24.2%	25.3%	7.7%			39.6%	60.4%
Haemorrhagic stroke									
Subarachnoid (3%)	4	4	4	2		14	62.07 (10.22)	10	4
	28.6%	28.6%	28.6%	14.3%				71.4%	28.6%
Intracerebral (20.7%)	11	25	29	24	6	95	67.81 (10.60)	50	45
	11.6%	26.3%	30.5%	25.3%	6.3%			52.6%	47.4%
Undetermined (1.3%)	1		2	3		6	72.00 (10.66)	4	2
	16.7%		33.3%	50.0%				66.7%	33.3%
Total (100%)	44	89	161	136	30	460	69.61 (10.15)	230	230
	9.6%	19.3%	35%	29.6%	6.5%			50%	50%

Table 3 Previous cerebrovascular accident (CVA) status, fatality rate, mean and standard deviation of length of stay (LOS) in hospital in stroke patients

Stroke subtype	Previous CVA		Fatality			LOS		
	CVA−	CVA+	Cure	Death	Others	N	Mean	SD
Ischaemic stroke								
Thrombotic	197	57	200	48	6	254	7.17	4.95
	77.6%	22.4%	78.7%	18.9%	2.4%			
Embolic	69	22	70	19	2	91	7.78	4.87
	75.8%	24.2%	76.9%	20.9%	2.2%			
Haemorrhagic stroke								
Subarachnoid	11	3	9	5		14	12.29	11.62
	78.6%	21.4%	64.3%	35.7				
Intracerebral	84	11	54	35	6	95	9.08	7.08
	88.4%	11.6%	56.8%	36.8%	6.3%			
Undetermined	5	1		6		6	3.00	2.61
	83.3%	16.7%		100%				
Total	366	94	333	113	14	460	7.78	5.81
	79.6%	20.4%	72.4%	24.6%	3.0%			

Table 4 Proportion of risk factors in stroke patients (N = 460)

Risk factor	n	%
Hypertension	343	74·6
Diabetes mellitus	256	55·7
Heart disease	186	40·4
Hyperlipidaemia	70	15·2
Atrial fibrillation	48	10·4
Smoking	25	5·4

5·4%, respectively. The HTN was the main risk factor and significantly different between ischaemic and haemorrhagic strokes, 69·8% and 89·7%, respectively (Table 4).

Discussion

In this hospital-based, epidemiological stroke study, a crude stroke incidence of 53/100 000/year was found; however, 338/100 00/year when calculated on persons > 45 years was observed. When adjusted to the European population, the figure was calculated to 384/100 000. These age standardisation rates are a well-established WHO standard (28). This may be due to differences in risk factors e.g. HTN is not aggressively diagnosed and treated in Iran. The low crude incidence is likely to be attributable to the higher proportion of younger people in the population of Qom (84·5% < 45 years). On an international basis, Sudlow *et al.* (16) have demonstrated variations in the incidence rates in patients aged 45–84 years, ranging from 238/100 000/year in Dijon to 627/100 000/year in Novosibirsk, Russia (16).

In our study, ischaemic stroke was found in 75% of patients, comparable with other studies from Iran with ischaemic strokes ranging from 57·9% to 87% (29–31). These findings are also comparable with European studies (32); however, these are higher than in some developing countries like 70% in Senegal (33) and 66·7% in Zimbabwe (34), lower than the 80% cerebral infarction rate of strokes in the French West Indies (35).

The gender distribution was equal in our study, which contrasted with African studies where men constitute the major group in hospitalised stroke patients (33, 36). However, when looking at subtypes of stroke, there were more females with haemorrhagic stroke although with low absolute numbers.

The mean age of stroke onset in our study was 69·6 years, which is in line with the findings of a Japanese study (37) but older than reported in other studies of developing countries, 58 years in Gambia (36) and 60·4 years in Senegal (33).

In our study, the one-month mortality was 24·6%, which is higher than that reported in developing countries and needs consideration (38). The one-month fatality of stroke in Western Europe has been reported to 22·9% in a meta-analysis (39) and in Australia this figure was reported to be between 23·9% and 35·5% with seasonal variation (40).

Hypertension was the most common risk factor, encountered in three-out-of-four patients in line with the recently published large European study PROFESS (41). In recent decades, the prevalence of HTN and stroke mortality has increased in Iran and southern Asia (42). The HTN prevalence in Qom has been estimated to 53·5% of the population (43). Considering such a common risk factor in our population, this issue must be addressed in future cerebro- and cardiovascular studies with a focus on risk-reducing life-style programmes.

Diabetes mellitus was the second most common risk factor in this study, occurring in more than half of patients, while reported in 14–38·3% in other studies. (35, 44, 45) This discrepancy could be explained by the increased risk factor exposure in the whole population with a DM prevalence estimated to 5·7% vs. worldwide 2·8% (46). The HTN and DM are major health problems in our population and clearly presented in the ample occurrence of these risk factors in the

stroke patients (47). Surprisingly, there were only 5% smokers in contrast to 21% in the PROFESS study (41) possibly due to religious belief and reluctance to inform the researchers.

Our results were hampered by some bias. With the inclusion process attributable to the hospital-based design of the study, it might be that some stroke patients were not identified because they were not admitted to hospital due to minor symptoms especially patients from surrounding suburban regions, or they died before being admitted to hospital. In line with other stroke incidence studies, non-observed strokes have been estimated at 5–10% in European studies (48, 49). If these events were estimated at 10% in our study, a stroke incidence of 372/100 000/year could be calculated. However, our study acknowledges and shares the view of a study from developing countries: 'The choice is therefore to accept hospital data or have no data at all' (50).

The Qom population is young with a mean age of 23·5 years and <4·4% over 65 years and the percentage of patients >45 years is around 15% in Iran. However, stroke incidence is comparable with most developing countries. The stroke morbidity and mortality figures in our study must have consequences and need to be addressed in future research and health care planning. Our observation that HTN and DM were considerably more frequent in our study population than in other developing countries must also be addressed in future research.

The findings of this research suggest that a more aggressive stroke prevention regime with low-cost treatments addressing risk factor reduction should be made widely available both on primary stroke risk prevention and secondary stroke prevention basis. Such intervention programmes must be sanctioned and financed by local as well as national health care authorities and focus on conceptualisation of health and illness so that those involved continue to adhere to ordinations and prescriptions by their medical doctors. From our results, we also strongly advice a shift from the current nonspecified and general care facilities in our general hospitals to the establishment of stroke units and specific stroke rehabilitation centres.

Acknowledgements

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