Seasonal and Monthly Variation in Stroke and its Subtypes–10 Year Hospital-Based Study

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ABSTRACT

Background and Objectives: there is no evidence of long-term studies of seasonal variations in stroke in Iran. Hence, the aim of this study was to determine the seasonal and monthly variation of 28-day mortality in Isfahan, Iran.

Methods: From 2003 to 2013, in a Hospital-based retrospective study, 24186 cases with first-ever stroke were analyzed in Isfahan. Multinomial logistic regression was used to calculate odds ratios (OR) with 95% confidence intervals (CI) for seasonal and monthly 28-day mortality for stroke in general and three subtypes of stroke including intracranial hemorrhage (ICH), ischemic (IS) and subarachnoid hemorrhage (SAH).

Results: In this study, unadjusted and adjusted odds ratios of seasonal 28-day mortality of stroke was highest in the winter and lowest in the summer. Although, differences were not statistically significant. For total stroke, 28-day mortality was significantly lowest in May (0.746, 95% CI 0.575-0.97, p=0.029) as compared to March. Whereas after adjusted, for total stroke, 28-day mortality was significantly lowest in May (0.746, 95% CI 0.575-0.97, p=0.029), June (0.777, 95% CI 0.60-0.99, p=0.49) and July (0.771, 95% CI 0.59-0.99 p=0.049) as compared to March. The AMR between months were not significant in SAE and IS.

Conclusion: Our findings demonstrate clear obvious monthly variation of 28-day mortality of stroke and its subtypes in Isfahan but no seasonal variations were observed.

Keywords: intracranial hemorrhage, ischemic, subarachnoid hemorrhage, mortality.
10-year period in rural and urban areas of Isfahan province, Iran. Isfahan as one of the metropolitan cities is located in the center of Iran and has an arid cool climate with hot summer and cool winter (11).

We also sought to examine seasonal and monthly variability in the incidence and 28-day mortality of the three subtypes of stroke including intracranial hemorrhage (ICH), ischemic (IS) and subarachnoid hemorrhage (SAH).

2. METHODS

Hospital-based retrospective cross-sectional study was conducted in the Neuroscience Research Center in collaboration with the Cardiovascular Research Center, Isfahan University of Medical Sciences from 2003 to 2013. Current study is based on information for 24186 patients who had stroke occurring for the first time and they have admitted to eight hospitals in Isfahan. All the necessary information included age, sex, date of admission, date of death both in and outside of hospital were recorded. Strokes, according to WHO definition, were diagnosed (12) and classified outside of hospital were recorded. Strokes, according to WHO definition, were diagnosed (12) and classified into three subtypes, IS (ischemic), ICH (intracranial hemorrhage) and SAH (subarachnoid hemorrhage) (13). Four seasons including spring (March, April and May), summer (June, July and August), autumn (September, October and November) and winter (December, January and February) were considered in this analysis.

Statistical Methods

Data Characteristics of stroke patients were presented mean ± standard deviation for age and number (percentage) for other variables. Binary logistic regression was used to calculate odds ratios (OR) with 95% confidence intervals (CI) for seasonal and monthly 28-day mortality of stroke in total as well as ICH, SAH and IS separately. OR were estimated for seasonal models with spring as a reference and for monthly models with March as a reference.

A significance level of 0.05 was considered statistically significant. All statistical analysis was performed using SPSS for Windows, version 19.0 (SPSS Inc, Chicago, IL).

3. RESULTS

Demographic Characteristics and risk factor of study patients by stroke subtypes are presented in Table 1. Of the 23311 stroke patients studied (men, 11833; women, 11497), 18413 (80.2%) had IS stroke, 4329 (17.9%) had ICH stroke and 569 (2%) had SAH stroke. The mean ± standard deviation age of all patients were 69.46 ± 14.87 years and above. Among the Cardiovascular risk factors, blood pressure had greater proportion than others risk factor.

The unadjusted and adjusted odds ratios (OR) with 95% confidence intervals (CI) for seasonal and monthly 28-day mortality of stroke in total are presented in Table 2. The unadjusted odds ratios of seasonal 28-day mortality of stroke was highest in the winter (1.089; 95% CI, 0.994-1.194) and lowest in the summer (0.959; 95% CI, 0.879-1.048). After adjusted for age, sex, living area
and Cardiovascular risk factors, the highest OR was observed in the winter (1.150; 95% CI, 0.991-1.334) and lowest in the summer (0.955; 95% CI, 0.827-1.102). However, No significant association was found between seasonality and 28-day mortality of stroke. The OR for the 28-day mortality of SAH stroke was higher in spring than in any other season, whereas in IS and ICH stroke, OR was highest in winter. but the differences was not statistically significant (P>0.05).

The unadjusted Odds Ratio and 95% Confidence Interval of monthly variations for 28-day mortality of total stroke and its subtype with March as a reference are shown in Figure 1.

For total stroke, The unadjusted 28-day mortality ratio (UMR) was only significant in February (1.19, 95% CI 1.00-1.42, P= 0.04) as compared to March. The lowest UMR of total stroke was seen in May (0.92, 95% CI 0.789-1.089, P= 0.357). The UMR of ICH and SAH showed no significant variation by Months (p>0.05). For IS, the UMR was only significantly higher in February (1.28, 95% CI 1.021-1.614, P= 0.03) than in March.

Figure 2 shows adjusted 28-day mortality ratio (AMR) with 95% confidence intervals for monthly incidence of total stroke and its subtype with March as a reference. For total stroke, the AMR was significantly lowest in May (0.77, 95% CI 0.59-0.99, p=0.049) and July (0.771, 95% CI 0.59-0.99 p=0.049) as compared to March. The highest AMR for all strok types was observed in February (1.077, 95% CI 0.821-1.41), although not statistically significant (p=0.59). For ICH, the AMR was significantly lowest in july (0.502, 95% CI 0.283-0.891, p=0.018) and may (0.543, 95% CI 0.30-0.984 p=0.044) as compared to March. The AMR between months were not significant in SAH and IS.

4. DISCUSSION

In this study, we investigated monthly and seasonal variations in the 28-day mortality of stroke and three main subtypes, in more than 20,000 stroke patients registration in Isfahan hospitals between 2003 and 2013. To our knowledge, this is the largest study of monthly and seasonal patterns of stroke so far conducted in Iran.

The present study showed monthly variation in 28-day mortality of all stroke and some its subtypes, but no seasonal variations were observed. Nevertheless, it seems odds of the strokes 28-day mortality were highest in winter and lowest in summer. In accordance with our finding, several studies found that the mortality of stroke was highest in winter and lowest in summer (7, 14-18).

The weather in Isfahan follows distinct seasons. Mean temperatures between 2003 and 2013 in Isfahan for winter were 4.99 °C which was the coldest season of the year. It’s somewhat well documented that cardiovascular diseases rises during winter (9). It is assumed that cold weather played an important role in the occurrence of this phenomenon. A
study in 21 countries showed that Rates of coronary events during winter was increased about 10% (20). Increased blood pressure (6, 21), incidence of influenza and other respiratory disease (16), decreased physical activity (22) and increased cholesterol and triglyceride (23) has been considered to be the likely main reasons for high incidence and mortality of diseases: the official journal of National Stroke Association. 2004; 13(4): 171-7.

5. CONCLUSION

The present study showed monthly variation in 28-day mortality of all stroke and some its subtypes, but no seasonal variations were observed.

REFERENCES

1. Adamson J, Beswick A, Ebrahim S. Is stroke the most common cause of disability? Journal of stroke and cerebrovascular diseases: the official journal of National Stroke Association. 2004; 13(4): 171-7.

2. Arboix A, Cartanyà A, Lowak M, et al. Gender differences and woman-specific trends in acute stroke: Results from a hospital-based registry (1986–2009). Clinical Neurology and Neurosurgery
1. Koifman J, Hall R, Li S, et al. The association between rural residence and stroke care outcomes. Journal of the Neurological Sciences. 2015; 363: 16-20.

2. Shigematsu K, Watanabe Y, Nakano H, et al. Higher ratio of ischemic stroke to hemorrhagic stroke in summer. Acta Neurologica Scandinavica. 2015; 132(6): 423-9.

3. Kumar N, Venkatraman A, Gar B, et al. Seasonality in acute ischemic stroke related hospitalizations and case fatality rate in the United States. International Journal of Cardiology. 2015; 195: 134-5.

4. Gomes J, Damasceno A, Carrilho C, et al. The Effect of Season and Temperature Variation on Hospital Admissions for Incident Stroke Events in Maputo, Mozambique. Journal of Stroke and Cerebrovascular Diseases. 2014; 23(2): 271-7.

5. Raj K, Bhatia R, Prasad K, et al. Seasonal Differences and Circadian Variation in Stroke Occurrence and Stroke Subtypes. Journal of Stroke and Cerebrovascular Diseases. 2014; 24(1): 10-6.

6. Azarpazhooh MR, Etemadi MM, Donnan GA, et al. Excessive incidence of stroke in Iran: evidence from the Mashhad Stroke Incidence Study (MSIS), a population-based study of stroke in the Middle East. 2010; 41(1): 63-910.

7. Shayeghi M, Vatandoost H, Gorouhi A, et al. Biodiversity of Aquatic Insects of Zayandeh Roud River and Its Branches, Isfahan Province, Iran. Journal of Arthropod-Borne Diseases. 2015; 31: 981-6.

8. Turin TC, Kita Y, Murakami Y, et al. Higher stroke incidence in the spring season regardless of conventional risk factors: Takashima Stroke Registry, Japan, 1988-2001. Stroke. 2008; 39(3): 745-52.

9. Gordon DJ, Hyde J, Trost DC, et al. Cyclic seasonal variation in plasma lipid and lipoprotein levels: the Lipid Research Clinics Coronary Primary Prevention Trial Placebo Group. J Clin Epidemiol. 1988; 41(7): 679-89.

10. Lichtman JH, Jones SB, Wang Y, et al. Seasonal Variation in 30-Day Mortality After Stroke: Teaching versus Non-Teaching Hospitals. Stroke; a journal of cerebral circulation. 2013; 44(2): 531-3.

11. Han MH, Yi HJ, Kim YS, et al. Effect of seasonal and monthly variation in weather and air pollution factors on stroke incidence in Seoul, Korea. Stroke. 2015; 46(4): 927-35.

12. Shigematsu K, Watanabe Y, Nakano H. Weekly variations of stroke occurrence: an observational cohort study based on the Kyoto Stroke Registry, Japan. BMJ Open. 2015; 5(3): e006294.

13. McDonald RJ, McDonald JS, Bida JP, et al. Subarachnoid hemorrhage incidence in the United States does not vary with season or temperature. AJNR Am J Neuroradiol. 2012; 33(9): 1663-8.

14. Karagiannis A, Tziomalos K, Mikhailidis DP, et al. Seasonal variation in the occurrence of stroke in Northern Greece: a 10 year study in 8204 patients. Neurrol Res. 2010; 32(3): 326-31.

15. Frohlich M, Sund M, Russ S, et al. Seasonal variations of rheological and hemostatic parameters and acute-phase reactants in young, healthy subjects. Arterioscler Thromb Vasc Biol. 1997; 17(11): 2692-7.

16. Gallerani M, Reversible R, Salmi R, et al. Seasonal variation of platelets in a cohort of Italian blood donors: a preliminary report. European Journal of Medical Research. 2013; 18(1): 31.