

## Changes in Stroke Ratio in a Secondary Referral Center of Lahore District – Variations in Different Seasons

Amina Husnain,<sup>1</sup> Saima Nauman,<sup>2</sup> Muhammad Hussain,<sup>3</sup> Khalid Umar Gill,<sup>4</sup> Arif Siddiqi<sup>5</sup>

### Abstract

**Background and Purpose:** Multiple studies suggest that there is a relationship between occurrence of stroke and the climate (ambient temperature and humidity). Exposure to a decrease in temperature has been correlated to the increase in stroke risk especially hemorrhagic stroke. The aim of this study was to find an association between weather and stroke occurrence.

**Method:** It was retrospective cross sectional study in which data of patients admitted in Medical unit II, Jinnah Hospital Lahore, Pakistan in the year 2009 was reviewed retrospectively. Total data of patients with

stroke was separated and analyzed. Climate record for the year 2009 was used to find a correlation between the changes in weather and the types of stroke presenting thereafter. An increase in Stroke ratio has been used a surrogate indicator of change in the proportion of patients presenting hemorrhagic strokes in various parts of the year.

**Results:** Stroke presentation is commoner in cooler days. From the analysis of past records of 403 cases in the year 2009 it was found that hemorrhagic stroke was more frequent (38%) in cool and dry climate as compared to other days i.e 13% – 18%. Occurrence of ischemic stroke was almost uniform in all kind of weather.

**Conclusion:** Hemorrhagic stroke is more common in cooler days but the ischemic stroke occurs almost uniformly in all kind of temperature. Many of our patients presenting with stroke have more than one risk factors for a cerebro vascular accident.

**Key word:** Cerebral Hemorrhage, Temperature, weather.

---

Husnain A.<sup>1</sup>

Assistant Prof. Medical Unit II  
Allama Iqbal Medical College, Lahore

Nauman S.<sup>2</sup>

Senior Registrar, Medical Unit II  
Allama Iqbal Medical College, Lahore

Hussain M.<sup>3</sup>

Medical Unit II  
Allama Iqbal Medical College, Lahore

Gill K.U.<sup>4</sup>

Associate Prof Psychiatry  
Avicenna Medical College, Lahore

Siddiqi A.<sup>5</sup>

Prof. I/C, Medical Unit II  
Allama Iqbal Medical College, Lahore

### Introduction

Usually treating physicians dealing with cases of cerebral concentrate more on the risk factors rather than seasonal variations in presentations. The two major mechanisms causing non traumatic brain damage in stroke are ischemia and hemorrhage. In ischemic stroke, which represents about 80% of all strokes, decreased or absent circulating blood deprives neurons of

necessary substrates. The effects of ischemia are fairly rapid because the brain does not store glucose; the chief energy substrate and is incapable of anaerobic metabolism.<sup>2,4</sup> Non-traumatic intra-cerebral hemorrhage represents approximately 10% to 15% of all strokes. The number of patients presenting with ischemic or hemorrhagic stroke comes in variable frequency in different weather conditions.<sup>7,9-11,13-7</sup>

Researchers analyzing hospital admission patterns among women aged below 50 years in 17 countries found links between lower environmental temperatures and a higher risk of hospitalization.<sup>13-15</sup> Recently various other workers have pointed out similar relationships.<sup>2,5,7</sup> Studies suggest that there is an association between weather patterns and ischemic stroke risk which perhaps should not be taken to be of prognostic significance. Many of these studies, conducted in different countries throughout the world, including those in Europe, Asia, Australia, and North America, report an association of stroke with the climate.<sup>7-9</sup> These studies also show the peak of occurrence of stroke varies in different seasons of the year. A decrease in environmental temperature may increase stroke risk through altering blood viscosity and / or by triggering infections.<sup>4</sup> There has not been a study in Pakistan on this aspect of the problem. A retrospective analysis was done through analysis of the past year's records assuming it convenient and cost effective to make such initial observations.

## Materials and Methods

It was a retrospective, observational study of clinical cases. The admission and inpatient record of patients admitted in medical unit II, Jinnah Hospital Lahore in 2009 (Jan-Dec both inclusive) was reviewed to pick out cases admitted for the investigation/treatment of cerebral stroke. A note was made of the demographic particulars like age/sex etc. The duration of admission, results of investigations especially CT scan were noted to see the cause of stroke (infarct/hemorrhage). Data compilation was done in Word Excel® Windows Office Software and analyzed. Results were tabulated in descriptive statistics and no test of significance was used to study the results. Lahore lies at elevation of 705 feet at a latitude 31° 33'N and a longitude 74° 20'E. The temperatures tend to remain higher during the summers i.e. between April and September (both inclusive) with peak in June every year.<sup>1</sup> The average number of days above 90°F soar highest in the same

months. Average precipitation and the accompanying humidity is usually highest in Jun – Aug peaking in July.<sup>1</sup> Winters and summers are interspersed by spring-February and March (average temp range 52 – 72°F) and autumn – September and October (average temp range 79 – 88°F).<sup>1</sup>

Climate record for the city of Lahore for the year 2009 was taken from website weatherbase.com. Stroke ratio was calculated by finding the number of hemorrhagic events per ischemic stroke.

## Results

A total of 403 patients of stroke were hospitalized in Medical Unit II Jinnah in year 2009. These included 131 (33%) patients with hemorrhagic and 272 (67%) patients with ischemic stroke. Most of the patients presented with ischemic stroke. The mean age of patients with hemorrhagic stroke was 57.39 years (SD 14.36, range 25 – 100) and the mean age of patients with ischemic stroke was 60.93 (SD 13.17, range 41 – 120). Ischemic stroke was a more common reason for stroke in older age group. Most of the patients were from rural areas adjoining Lahore city which is also the provincial headquarter. Female population was more affected as compared to male population. From among those who died in the hospital 39% patients had presented with hemorrhagic and 28% patients had an ischemic stroke.

Risk factors for stroke were also observed in this study. Most common risk factor for stroke was hypertension followed by, diabetes mellitus, smoking, hyperlipidemia and ischemic heart disease. Seventy eight percent of the cases presenting with stroke had a positive history of hypertension in the past during the cool and dry days of the year (Average BP = 195/115) with a concomitant rise in the number of patients presenting with hemorrhagic stroke Table 2.

On the basis of change in weather (temperature and humidity) study period (12 months) was divided into five categories. These were Hot and Dry (Mar – Apr), Very Hot and Dry (May – Jun), Hot and Wet (Jul – Sep), Warm and Dry (Oct – Nov), Cool and Dry (Dec – Feb). When occurrence of stroke with different Temperature and Humidity was calculated maximum cases of stroke 120 (30%) were admitted in cool and dry weather (December to February) Figure 1. During these days minimum temperature was 6°C i.e. lowest temperature of the year. It was also found that 46

**Table 1:** Stroke statistics from the Pakistani literature.<sup>5</sup>

| Study          | HTN % | DM %  | Mean Age Years | Ischemic % | Bleed % | SAH % |
|----------------|-------|-------|----------------|------------|---------|-------|
| Basharat et al | -     | 57    | -              | 25         | 21      | -     |
| Usman et al    | -     | 63.3  | -              | 88.8       | 21      | -     |
| Basharat et al | 61    | 33    | -              | 79         | 21      | -     |
| Fayyaz et al   | 58    | 18    | 65             | 61         | 34      | 5     |
| Alam et al     | 60    | 28    | 59             | 68         | 31      | 1     |
| Syed et al     | 66.2  | 41.5  | 61             | -          | -       | -     |
| Khan et al     | 56.04 | 33    | 60.8           | 71.4       | 28.6    | -     |
| Iqbal et al    | 82    | -     | 60.8           | 70         | 27      | 3     |
| Naseem et al   | 23.07 | 31.73 | -              | 66.4       | 27.9    | 3     |
| Javed et al    | 62    | 32    | -              | -          | -       | -     |
| Khan et al     | 64    | 49.2  | 62             | 70.1       | 29.9    | -     |
| Vohra et al    | 50    | 18    | 58.8           | 70.1       | 29.9    | -     |
| Present study  | 79.40 | 54.83 | 64.14          | 67         | 33      | -     |

(% = percentage  
HTN = hypertension  
DM = Diabetes Mellitus  
SAH = subarachnoid hemorrhage)

(38%) out of total 120 patients (presenting with hemorrhagic stroke) presented in this cool and dry period, which is significantly high as compared to other days. When hemorrhage to Infarct ratio was calculated it was also significantly high (0.62) in cooler weather as compared to hot whether (0.382) as shown in Table 3.

This clearly shows hemorrhagic stroke occurs more frequently as compared to ischemic stroke in cold weather. When only Humidity was correlated with the occurrence of stroke no significant effect was found. So it was mainly temperature which significantly affects the occurrence of stroke.

**Table 2:** Demographic characteristics of cohort.

| Type of Stroke | Hemorrhage    | Infarct       |
|----------------|---------------|---------------|
| Total Patients | 131 (33%)     | 272 (67%)     |
| Age (mean±SD)  | 57.39 ± 14.36 | 60.93 ± 13.17 |
| Sex ratio M/F  | 0.83          | 0.81          |
| Rural          | 56 %          | 71%           |
| Urban          | 44 %          | 29%           |
| Mortality      | 39 %          | 28%           |

**Table 3:** Risk Factors of patients with stroke during various temperatures and humidity conditions.

| Risk Factors                   | Hot and Dry (18 – 32°C) | Very Hot and Dry (43 – 48°C) | Hot and Wet (35 – 41°C) | Warm and Dry (29 – 12°C) | Cool and Dry (6 – 20°C) |
|--------------------------------|-------------------------|------------------------------|-------------------------|--------------------------|-------------------------|
| HTN (%)                        | 60                      | 54                           | 66                      | 62                       | 78                      |
| DM (%)                         | 41                      | 37                           | 43                      | 54                       | 46                      |
| Smoking (%)                    | 23                      | 18                           | 14                      | 32                       | 18                      |
| Hyperlipidemia (%)             | 21                      | 27                           | 19                      | 16                       | 24                      |
| Heart Disease (%)              | 26                      | 31                           | 16                      | 24                       | 36                      |
| Alcoholism (%)                 | 2                       | 0                            | 3                       | 2                        | 2                       |
| More than one (%) risk factors | 54                      | 63                           | 43                      | 52                       | 61                      |

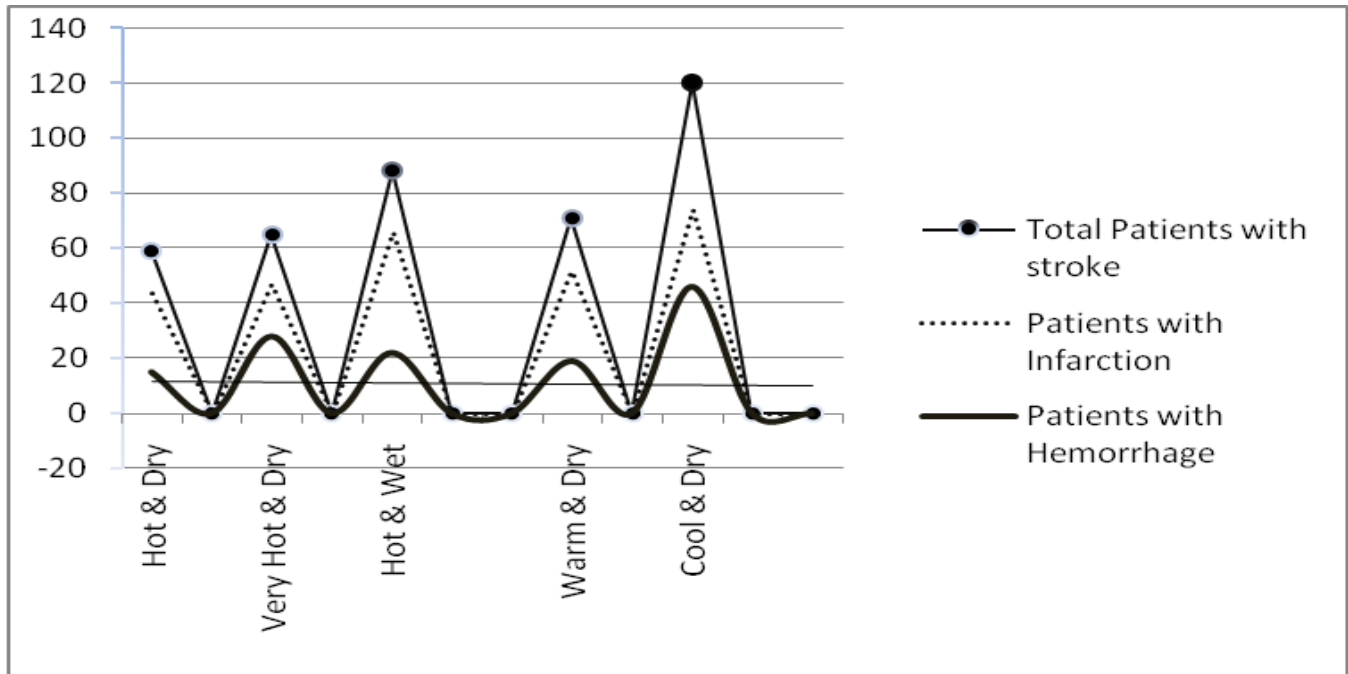


Figure 1: Occurance of Stroke with changes in weather.

### Discussion

Alarming, more than 70% of people with hypertension in Pakistan are unaware of their hypertension, and less than 3% take care to keep it adequately controlled.<sup>17</sup> Our observations are suggestive of lack of health facilities and poor commitment to their health in the rural areas of Pakistan which increase the risk factors. This results in indirectly increased chances of many health problems like Stroke and Ischemic Heart disease. It also pushes patients towards big cities like Lahore. The population presenting to these hospitals is rarely a true representation of the local population. The mean age of patients with hemorrhagic stroke in our cohort was 57.39 years (SD 14.36, range 25 – 100) and the mean age of patients with ischemic stroke was 60.93 (SD 13.17, range 41 – 120) which is close to the figures quoted for Pakistan.<sup>5</sup> If we take a close look at the mean age and the incidence of different etiologies of stroke in the Pakistani population our cohort resembles very closely to the ones seen in other published studies in the country.<sup>5</sup> It may be safe to presume that the inferences that we make from this study can be considered a surrogate of the country’s population.

A lot of work has been done to find associations between cerebral stroke and weather patterns in various settings.<sup>12,15,17</sup> The findings have not been consistent with some studies which have found a positive

association between ischemic stroke events and various weather conditions especially cold temperature,<sup>12,13</sup> while other studies have found no association.<sup>13,16</sup> Some studies have not differentiated between recurrent stroke or stroke type<sup>5,14</sup> hence decreasing their utility in a meta-analysis setting. A change in blood viscosity has been blamed by some.<sup>13</sup> In addition infections, both bacterial and viral are known to be associated with an increased stroke risk.<sup>14</sup> Since a change in weather conditions may trigger the outbreak of infections, it is possible that a sudden change in temperature can be used as a predictor for stroke risk however concrete evidence to support these hypotheses is yet to come. Studies on associations between stroke occurrence and weather conditions have also been mainly environmental studies where data on stroke events have been compared to weather variables in a defined geographical area but no such data has been collected in Pakistan.<sup>5,13</sup> Hong et al. in South Korea found a positive association between ischemic stroke incidence and decreasing temperature on the day before stroke using a case – crossover design.<sup>13</sup> Our observation of a rising Hemorrhagic ischemic ratio in cool dry weather needs to be studied a much larger scale in order to find a significant correlation. Many limitations of such investigations have been pointed out in studies on stroke occurrence and weather patterns including unknown effects of temperature &

humidity changes on human physiology or unknown secondary effects of weather on human behavior. Our work seconds the findings of other workers that most Pakistani patients seem to be presenting with ischemic strokes (61 – 88.8%).<sup>5</sup> Some studies have found a possible biological pathway in which changes in temperature may lead to stroke occurrence through alterations in the blood coagulability and viscosity.<sup>15</sup> Wang Yiou Yu et al demonstrated a seasonal (winter and summer) variation in the occurrence of primary intra-cerebral hemorrhage and ischemic stroke for those aged < 65, ≥ 65 and all ages, after controlling for humidity and air pollutants in Brisbane, Australia.<sup>11</sup> Canadian studies upon 3000 patients on 180 Chinook days (when the weather changes dramatically causing a fall in temperatures) have failed to find an association between a change in temperature and incidence of stroke events.<sup>16</sup> In order to have a better understanding of the accurate mechanism of such changes probably studies of large scale and detail would be justified so that a comprehensive knowledge of the reasons behind these variable findings can be reached especially a tilted referral bias during summer season from areas in close proximity to the hospital for logistic reasons.

## Declaration

No financial or physical source from any funding agency, pharmaceutical company or grant was used for the present study. The authors declare lack of any conflict of interest in any manner. No formal approval of the local ethical committee was sought.

## Acknowledgments

Special thanks to Dr. Faisal Nazeer Hussain, Dr. Farah Javed, Mr. Waqar Awan and Nursing staff of Medical unit II who helped us in this study.

## References

1. Lahore weather:  
<http://www.weatherbase.com/weather/weatherall.php?s=4614&refer=&units=us>
2. Sid Shah: Pathophysiology of Stroke. Foundation for education and research in neurological sciences: 2002: p. 2-14
3. Kammersgaard, L. P., Jorgensen, H. S., Rungby, J. A. Reith, Nakayama, H. MD, Weber, U. J., Houth, J., Olsen, T. S.: Admission Body Temperature Predicts Long – Term Mortality After Acute Stroke: The Copenhagen Stroke Study. *Stroke*. July 2002; 33 (7): 1759-1762.
4. J. Schön, V. Serien, H. Heinze, T. Hanke, M. Bechtel, S. Eleftheriadis, H.-V. Groesdonk, L. Dübener, M. Heringlake: Association between cerebral desaturation and an increased risk of stroke in patients undergoing deep hypothermic circulatory arrest for cardiothoracic surgery *Applied Cardiopulmonary Pathophysiology* 2009; 13: 201-207.
5. Farrukh Shohab Khan, Azra Zafar and Abdul Malik: Stroke in Pakistan: Reality, Challenges and a Call for Action *Pak J Neurol Sci* 2008; 3 (1): 14-19.
6. Kammersgaard, L. P. Jorgensen, H. S.; Rungby, J. A. Reith, J. Nakayama, H. Weber, U. J., Houth, J. Olsen, T. S.: Admission Body Temperature Predicts Long-Term Mortality After Acute Stroke: The Copenhagen Stroke Study. *Original Contributions. Stroke* July 2002; 33 (7): 1759-1762.
7. Zen-Yong Chen, MD; Shu – Feng Chang, MD, MPH Che-Long Su, MD .Weather and Stroke in subtropical area: Ilan, Taiwan, *Stroke*. 1995; 26: 569-572.
8. Giroud M, Beuriat P, Vion P, et al. Stroke in a French prospective population study. *Neuro-epidemiology* 1989; 8: 97–104.
9. Thalia S. Field Michael D. Hill: Weather, Chinook, and Stroke Occurrence, *Stroke*, **Stroke**. 2002; 33: 1751.
10. Haberman S, Capildeo R, Rose FC. The seasonal variation in mortality from cerebrovascular disease. *J Neurol Sci*. 1981; 52: 25-36.
11. Wang, Xiao Yu and Barnett, Adrian G. and Hu, Wenbiao and Tong, Shilu Temperature variation and emergency hospital admissions for stroke in Brisbane, Australia, 1996 – 2005. *International Journal of Biometeorology*: 2009; 53 (6): pp. 535-541.
12. J. Schön<sup>1</sup>, V. Serien<sup>1</sup>, H. Heinze<sup>1</sup>, T. Hanke<sup>2</sup>, M. Bechtel<sup>2</sup>, S. Eleftheriadis<sup>4</sup>, H.-V. Groesdonk<sup>1</sup>, L. Dübener<sup>3</sup>, M. Heringlake<sup>1</sup> Association between cerebral desaturation and an increased risk of stroke in patients undergoing deep hypothermic circulatory arrest for cardiothoracic surgery: *Applied Cardiopulmonary Pathophysiology* 2009; 13: 201-207.
13. M Medina-Ramón, J Schwartz Temperature, temperature extremes, and mortality: a study of acclimatisation and effect modification in 50 US cities. *Occup Environ Med* 2007; 64: 827–833.
14. Kyobutungi, A. Grau, G. Stieglbauer, H. Becher: Absolute temperature, temperature changes and stroke risk: A case – crossover study: *European Journal of Epidemiology* 2005; 20: 693–698.
15. Abergavenny Roger Dobson: Stroke and heart attack admissions are linked to cold weather: *BMJ* 2004; 329: 760 (2 October).

16. American Heart Association (2002, July 15). Clear Outlook: Study Finds No Link Between Weather And Stroke. Science Daily. Retrieved June 13, 2010.
17. Bhojo A. Khealani, Bilal Hameed, Uzma U. Mapari: Stroke in Pakistan; J Pak Med Assoc.: July 2008; Vol. 58, No. 7: p 400-404.