

## Study on Seasonal Variation in Stroke

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### Abstract

**Introduction:** After coronary artery disease and cancer, stroke is the third commonest cause of death in the developed countries. There have been descriptions of a seasonal variation in the frequency of different types of stroke. This variation may be related to a variation in the frequency of risk factors of stroke. **Objective:** To find out the seasonal variation of different type of strokes. **Materials & methods:** This cross sectional observational study was carried out at the department of medicine, mymensingh medical college hospital, mymensingh over a period of one year between June 2011 to May 2012. A total 292 patients of CT scan proven acute stroke of both sexes who were hospitalized within one weeks of acute stroke were included in this study within this period. data were processed and analyzed by computer software SPSS. Level of significance was considered as p value less than 0.05. **Results:** The frequency of ischaemic stroke during summer (62.4%) was significantly greater than that during winter (37.8%). The frequency of haemorrhagic stroke during winter (62.2%) was significantly greater than that during summer (37.6%). Hypertension was the most important risk factor and other risk factors were smoking, diabetes mellitus, tobacco chewing, ischemic heart disease, dyslipidemia, oral contraceptive pill, alcohol consumption, atrial fibrillation and past history of stroke. **Conclusion:** This study found stroke is influenced by the variation of seasons. The frequency of ischaemic stroke during summer was significantly greater than winter. The frequency of haemorrhagic stroke during winter was significantly greater than summer.

**Keywords:** Stroke, Variation, Haemorrhagic Stroke, Ischaemic Stroke.

**Number of Tables:** 05; **Number of Figure:** 01; **Number of References:** 26; **Number of Correspondence:** 04.

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### Introduction:

Stroke results from either ischemia due to arterial occlusion or stenosis, or haemorrhage due to leakage or rupture of an artery. Cerebral ischemia caused by reduction in the blood flow that lasts longer than few seconds. If the cessation of flow lasts longer than few minutes, than infarction of brain tissue results<sup>1</sup>. After coronary artery disease and cancer, stroke is the third commonest cause of death in the developed countries. Among all neurological diseases of adult life, only stroke clearly ranks first in frequency and importance. At least 50% of neurologic disorders in a general population are of this type<sup>2</sup>. Our hospital statistics also reveals that stroke is the third major cause of death in adult<sup>3</sup>. The incidence of stroke increases with age and affects many elderly people. It is uncommon below the age of 40 years and more common in male. Yearly incidence of stroke is 15 million worldwide. One third of those patients die secondarily to their strokes, and another third experience permanent disability<sup>4</sup>. Worldwide, stroke is also a leading cause of death, the mortality being particularly high in Eastern Europe and Asia<sup>5</sup>.

The morbidity and mortality from cerebrovascular diseases has been diminishing in recent years, due largely to better recognition and treatment of underlying risk factors including hypertension<sup>6</sup>. While the overall incidence of stroke is declining in developed countries, the absolute number of stroke is increasing secondary to overall increase in life expectancy<sup>4</sup>. In the under developed world, with better control of infectious diseases and with increase in life expectancy as well as relative growth of elderly population, the incidence of stroke is likely to increase. Thus stroke remains as a major cause of mortality, morbidity and great burden to the family members, society and hospital manpower. Non

modifiable risk factors of stroke include age, sex, family history, race & ethnicity. Modifiable risk factors are hypertension, diabetes mellitus, cardiac diseases (particularly atrial fibrillation), hyperlipidemia, smoking, transient ischemic attacks, asymptomatic carotid artery stenosis, alcohol abuse and physical inactivity<sup>7</sup>. It is important to find out the etiological factors and to treat them adequately to prevent stroke.

Many studies have found a definite association between season and rate of stroke. Usually there was higher rate in colder months<sup>8</sup>. Christie (1981) found similar seasonal variation of stroke which was likely to be associated with average daily temperature<sup>9</sup>. Pan, Li & Tsai.(1995) opined that observations made by other authors in western countries regarding correlation between temperature and stroke may not be similar in subtropical countries like Taiwan, where 95 percent of temperature lies between 13<sup>o</sup>-30<sup>o</sup>C<sup>10</sup>. These observations may be rather more appropriate in tropical countries like Bangladesh. Owing to its geographical location, very hot and humid climate prevails throughout most of the year. There is significant difference of temperature between summer and winter. This marked temperature difference during summer and winter in our country may affect the haemorrhheological mechanisms and blood pressure which may contribute to the causation of different kinds of stroke. Due to socio economic conditions, a large percentage of population is exposed to extremes of temperature during summer and winter in Bangladesh. They are thus vulnerable to stroke. This variation in prevalence of different type of stroke may be related to a variation in the frequency of risk factors of stroke. So the study was planned to prospectively document the seasonal variation of stroke sub-types and to describe the seasonal variation in the frequency of risk factors among the stroke sub-types.

**Materials and Methods:**

This Cross sectional observational study was carried out at the Department of Medicine, Mymensingh Medical College Hospital, Mymensingh Over a period of one year between June 2011 to May 2012. A total 292 patients were taken by purposive way who were admitted in Medicine ward male or female. Patients were admitted in Medicine wards with acute (<7 days) development of focal or global disturbance of neurological function like hemi-paresis, monoparesis, dys-arthritis, dysaphasia or impaired consciousness with or without previous history of stroke and who also had confirmed changes suggestive of stroke demonstrated by CT scan of brain. Patients admitted with features of stroke but who could not avail CT scan of brain or who died within 24 hours of hospitalization were excluded. Both descriptive and inferential statistics were used. Data were processed and analyzed by Computer software SPSS (Statistical Package for Social Science). Descriptive statistics were used for grouping and organizing of demographic variables and inferential (Chi-square and Fisher exact Test) statistics were used to see the association between seasons and types of stroke Level of significance was considered as p value< 0.05.

**Results & Observations:**

This study intended to observe the seasonal variation in types of stroke and description of the common risk factors included a total of 292 stroke patients admitted during June 2011 to May 2012. CT scan was done to confirm the diagnosis of stroke and its types. The findings of the study obtained from data analysis are documented below:

The age category 70 years or more than 70 years and male patients were predominant in the both groups. Ischemic stroke was found higher in farmer, day labour and other professions and haemorrhagic stroke was higher in housewife, service holder and businessman. There were no significant difference between two groups (p > 0.05) (Table I).

**Table-I: Comparison of demographic variables between groups.**

Demographic variables	Group		P-value
	Ischaemic (n = 158)	Haemorrhagic (n = 134)	
<b>Age (Years)#</b>			
<40	11(7.0)	9(6.7)	0.163
40 – 50	18(11.4)	27(20.1)	
50 – 60	33(20.9)	17(12.7)	
60 – 70	42(26.6)	37(27.6)	
≥70	54(34.2)	44(32.8)	
<b>Sex#</b>			
Male	103(65.2)	80(59.7)	0.334
Female	55(34.8)	54(40.3)	
<b>Occupation#</b>			
Housewife	55(34.8)	54(40.3)	0.614
Farmer	57(36.1)	46(34.3)	
Service	10(6.3)	11(8.2)	
Business	14(8.9)	12(9.0)	
Day labour	1(0.6)	00	
Others	21(13.3)	11(8.2)	

# Data were analyzed using Chi-square Test.

Regarding seasons of occurrence of stroke observed that 194 (66%) of the patients presented in summer (March – November) and 98(34%) in winter season (December – February). Total ischemic stroke was 158 (54.1%) and total haemorrhagic stroke was 134 (45.9%) ( Table II).

**Table-II: Distribution of subjects by Season of occurrence and types of stroke (n = 292).**

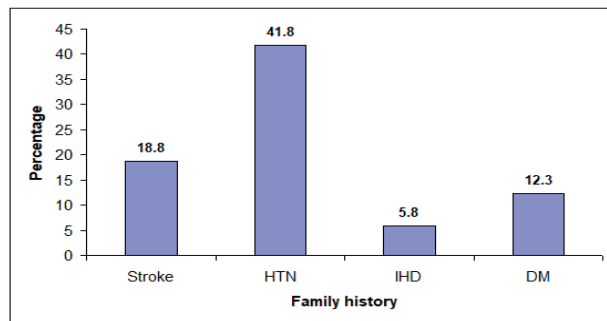
Seasons	Total Stroke	Ischemic Stroke	Haemorrhagic Stroke
Summer	194 (66%)	121(62.4%)	73 (37.6%)
Winter	98 (34%)	37(37.8%)	61(62.2%)
Total	292	158 (54.1%)	134 (45.9%)

The association between type of stroke and seasons depicts that ischaemic stroke was observed to be significantly higher in summer season (62.4%) than that in winter season (37.8%) (P< 0.001). Similarly haemorrhagic stroke was significantly higher (62.2%) in winter season than that of summer season (37.6%)( Table III).

**Table-III: Frequency of ischaemic and haemorrhagic stroke during summer and winter.**

Type of stroke	Season		P-value
	Summer (n = 194)	Winter (n = 98)	
Ischaemic	121(62.4)	37(37.8)	<0.001
Haemorrhagic	73(37.6)	61(62.2)	

# Chi-square (2) Test was employed to analyze the data (Chi-square (2) value = 15.9, df = 1)



**Fig. 1: Distribution of patients by family history (n = 292).** About 20% of patients had family history of stroke, 41.8% hypertension, 5.8% ischaemic heart disease (IHD) and 12.3% diabetes (Figure 1).

Comparison of risk factors between ischemic and haemorrhagic group depicts that all the risk factors except hypertension were homogeneously distributed between two groups. Majority (84.3%) of the patients in haemorrhagic group had hypertension compared to ischemic group (51.3%) ( $p < 0.001$ ) (Table IV).

**Table-IV: Comparison of risk factors between ischaemic and haemorrhagic stroke.**

Risk factors	Group		P-value
	Ischemic (n = 158)	Haemorrhagic (n = 134)	
Hypertension#	81(51.3)	113(84.3)	<0.001
Smoking#	50(31.6)	38(28.4)	0.163
Alcohol*	2(1.3)	2(1.5)	0.625
Tobacco chewing#	22(13.9)	17(12.7)	0.757
Oral contraceptive#	11(7.0)	11(8.2)	0.687
Diabetes#	26(16.5)	13(9.7)	0.091
IHD*	2(1.3)	1(0.7)	0.562
AF*	5(3.2)	1(0.7)	0.150
Past H/O stroke*	3(1.9)	1(0.7)	0.375

# Data were analyzed using Chi-square Test. \* Fisher Exact Test was done to analyze the Data

The risk factors like hypertension, smoking habit, alcohol, oral contraceptive, AF and past history of stroke were homogeneously distributed between summer and winter seasons (67.5% vs. 64.3%,  $p = 0.580$ ; 32.5% vs. 25.5%,  $p = 0.221$ ; 1% vs. 2%,  $p = 0.483$ ; 7.2% vs. 8.2%,  $p = 0.772$ ; 1% vs. 4.1%,  $p = 0.083$  and 1.5% vs. 1%,  $p = 0.715$  respectively). However, habit of tobacco chewing, diabetes and ischemic heart disease (IHD) were statistically significant between summer and winter seasons (5.7% vs. 28.6%,  $p < 0.001$ ; 16% vs. 8.2%,  $p = 0.044$  and 0% vs. 3.1%,  $p = 0.014$  respectively) (Table V).

**Table-V: Comparison of risk factors between summer and winter.**

Risk factors	Season		P-value
	Summer (n = 194)	Winter (n = 98)	
Hypertension#	131(67.5)	63(64.3)	0.580
Smoking#	63(32.5)	25(25.5)	0.221
Alcohol*	2(1.0)	2(2.0)	0.483
Tobacco chewing#	11(5.7)	28(28.6)	<0.001
Oral contraceptive#	14(7.2)	8(8.2)	0.772
Diabetes#	31(16.0)	8(8.2)	0.044
IHD*	00	3(3.1)	0.014
AF*	2(1.0)	4(4.1)	0.083
Past H/O stroke	3(1.5)	1(1.0)	0.715

# Data were analyzed using Chi-square Test. \* Fisher Exact Test was done to analyze the Data

**Discussion:**

This Hospital based descriptive cross sectional study found that the frequency of ischaemic stroke during summer was significantly greater than that during winter. The frequency of haemorrhagic stroke during winter was significantly greater than that during summer. Hypertension was the most important risk factor for both type of stroke and other risk factors were smoking, diabetes mellitus, tobacco chewing, ischemic heart disease, dyslipidemia, oral contraceptive pill, alcohol consumption, atrial fibrillation and past history of stroke. The prevalence of common risk factors of stroke were homogeneously distributed between two seasons and between the two sub-type of stroke except hypertension which was significantly higher in haemorrhagic stroke patients.

Masood, Maqsood & Qadri (2006) demonstrated a higher number of stroke patients in summer (April to September) than that in winter (October to March) bearing consistency with findings of the present study<sup>11</sup>. The seasonal variation of ischaemic and haemorrhagic stroke of the present study is in conformity with that of Rothwell et al. (1996) who found increased incidence of ischaemic stroke in summer and increased incidence of ICH in winter<sup>12</sup>. Pan, Li & Tsai (1995) found that the risk of cerebral infarction at 32°C was 66 percent higher than the risk of at 27.29°C<sup>10</sup>.

Sang-Pil Yun et al. (2008) in a study showed mean age of the patients to be 63.5 ± 11.3 years which was similar to the present study<sup>13</sup>. Anwarullah et al. (1993) found that 34% patients in the sixth decade and 27 percent in the seventh decade, with an age range of 26-84 years<sup>14</sup>. Sarker et al. (1993) observed highest percentage (37.5%) of patients in the sixth decade. The higher percentage above seventh decade in this study may be due to increase in life expectancy over the last decade<sup>15</sup>. Demographic variables were identically distributed between ischemic and haemorrhagic groups in our study.

In a study Sang-Pil Yun et al. (2008) reported that hypertension was the most common (50%) among the risk factors of stroke followed by diabetes (27.9%), IHD (5.3%), hyperlipidemia (3.5%), and AF (0.9%)<sup>13</sup>. Goldstein et al. (2006) also addressed that the stroke incidence is affected by risk factors such as hypertension, diabetes mellitus, cigarette smoking, and alcohol intake<sup>16</sup>. Anwarullah et al. (1993) found hypertension in 65% smoking in 44%, family history of stroke in 26%, diabetes mellitus in 21%, IHD in 27%, past history of stroke in 22%, rheumatic heart disease (RHD) with atrial fibrillation (AF) in 6%, lone AF in 2% and use of OCP in 2% cases<sup>14</sup>. Results were similar with those of the present study. Hypertension accelerates atherogenesis in cerebral arteries. Longstanding hypertension causes formation of small aneurysm (Bouchard's aneurysm) and aneurysm of circle of Willis. Hannan et al. (2001) reported that hypertension was significantly more associated with haemorrhagic stroke than with ischaemic stroke irrespective of season<sup>17</sup>. This is also in conformity with the statement of Liu and Chia (1991) and

Thrift (1996)<sup>18,19</sup>. This finding is also similar with that of present study.

Rozenthal et al. (1996) found smoking (53.6%), hypertension (43.4%), hyperlipidaemia (22%) and diabetes mellitus (21%) as main risk factors for stroke<sup>20</sup>. Liu & Chia (1991) found that cerebral thrombosis was significantly associated with hypertension, diabetes and smoking. Cerebral embolism was associated hypertension, atrial fibrillation and TIA. Cerebral haemorrhage was associated with hypertension only<sup>18</sup>.

In Bangladesh, where average life-expectancy is 67 years, age more than 60 years may be considered as increasing age. Thus, increasing age as risk factor was present in 60.7 percent cases in this study. Carrieri et al. (1994) showed that old age, high diastolic blood pressure and smoking had strong association with stroke. Smoking was the third commonest risk factor (30.1%) in the present study<sup>21</sup>. Silvestrini et al. (1996) stated that there was failure in cerebrovascular regulation after smoking resulting in increased risk of cerebrovascular disease in current smokers. Smoking initiates atherosclerosis<sup>22</sup>. Graffagnino et al (1994) however, reported 47% of the patients with a family history stroke sharply contrasting to the findings of the present study<sup>23</sup>. Liao et al (1997) reported an increased risk of stroke among persons with positive family history of stroke is consistent with the expression of genetic susceptibility, a shared environment or both<sup>24</sup>.

Javanovic (1996) found 77.34 percent ischemic stroke, 20.12 percent intra cerebral haemorrhage (ICH) and 2.54 percent subarachnoid haemorrhage (SAH)<sup>25</sup>. Yano et al. (1994) found 74 percent ischemic stroke, 20 percent ICH, 6 percent SAH and 2 percent unknown type<sup>26</sup>. The cause of increased haemorrhagic stroke in the present study may be explained by hypertension, which was the principal risk factor. On the other hand, stroke patients having severe sign symptoms and unconsciousness were mostly hospitalized in a tertiary level hospital. Severe sign symptoms and unconsciousness were mostly related to haemorrhagic stroke. Comparison of risk factors between summer and winter shows homogenous distribution of hypertension, smoking habit, alcohol, OCP, AF, past history of stroke but habit of tobacco chewing, diabetes mellitus and IHD were significantly different. There is no previous data to compare such difference of risk factors of stroke during summer and winter.

#### Conclusion:

The study demonstrated that the type of stroke is influenced by the variation of seasons. Hypertension was the main risk factor for stroke and other risk factors were smoking, diabetes mellitus, tobacco chewing, ischemic heart disease, dyslipidemia, oral contraceptive pill, alcohol consumption, atrial fibrillation and past history of stroke. Increasing age was also noted as a risk factor (60.7% > 60 years). Ischaemic stroke appears to be predominant during summer, whereas haemorrhagic stroke appears to be predominant during winter. Distribution of the risk factors

during summer and winter did not show significant difference. Also all the risk factors were homogeneously distributed between ischemic and haemorrhagic group except hypertension which was significantly higher in haemorrhagic stroke patients.

**Conflict of Interest:** None.

#### Acknowledgement:

We are thankful to study subjects for their active, sincere and voluntary participation.

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