

Seasonal variation of stroke occurrence: a hospital based-study

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Abstract

Introduction. Cerebrovascular events are not randomly distributed over time. In addition to the better known circadian variation, a seasonal variation in stroke occurrence is described in different reports. The aim of our study was to investigate whether stroke with its types follows a seasonal occurrence pattern in the Cluj-Napoca area.

Materials and method. The stroke event data were collected from the patient records of a consecutive series of 1083 patients admitted through the Emergency Room to the Neurology Departments I and II of the County Hospital Cluj-Napoca, between 1 January 2012 and 31 December 2012. The diagnosis of ischemic stroke, intracerebral hemorrhage and subarachnoid hemorrhage was confirmed by neurologic examination and neuroimaging, according to updated World Health Organization criteria. The onset time was assigned to one of the four seasons: spring (March to May), summer (June to August), autumn (September to November) and winter (December to February). Statistical analysis was performed using Excel Microsoft.

Results. All three types of stroke (ischemic stroke, intracerebral hemorrhage and subarachnoid hemorrhage) showed a seasonal variation in their occurrence, with two peaks in the winter and in the summer.

Conclusion. The knowledge of the seasonal variation pattern of stroke occurrence could provide a basis for preventive and therapeutic strategies in cerebrovascular pathology.

Key words: *stroke occurrence, seasonal variation, stroke types*

Introduction

The presence of a circadian variation pattern in stroke occurrence, with a morning incidence peak has already been described in the literature [1-4]. Regarding seasonal variation, it is difficult to study the effect of the succession of seasons on health and disease in general, because defining seasons themselves is a challenge. Either the arbitrary division of the year into 3 month periods or its division into seasons by taking the equinox and solstice time as a reference is used. Also, the seasons are opposite in the two hemispheres. Furthermore, seasonal variation may interfere with environmental factors related to the artificial environment in which individuals spend most of their time (for example: air conditioning systems in the summer and artificial heating systems in the winter) [1].

Data derived from the available literature studies regarding the presence of a seasonal variation in stroke occurrence are somewhat contradictory, depending on the climate area where the study concerned has been carried out. In general, studies conducted in temperate zone countries report an increased incidence in the cold months (late autumn, winter and early spring) [5-9]. The winter period is also marked by an increase in BP values by about 5

mmHg, through the increase in arterial wall tone during the process of adaptation to cold consecutive to sympathetic activity, along with an enhancement of blood viscosity (through the increase in the number and volume of red blood cells and platelets), as well as an elevation of the serum level of coagulation factor VIII, favoring thrombotic processes [10]. In addition, during the winter months, there is an increased frequency of seasonal infections (Influenza, Chlamydia pneumonia, Helicobacter pylori) and the occurrence of other inflammatory episodes is favored [10], while the plasma levels of fibrinogen and C reactive protein, considered to be independent risk factors for cardiovascular and cerebrovascular diseases, increase [10, 11, 12].

The aim of our study was to investigate a possible seasonal variation in the occurrence of stroke during 2012 and the differences between the types of stroke in the Cluj-Napoca area.

Material and method

The stroke event data were collected from the patient records of a consecutive series of 1083 patients admitted through the Emergency Room to the Neurology Departments I and II of the County Hospital Cluj-Napoca, serving the Cluj metropolitan area, between 1 January 2012 and 31 December 2012.

For each patient, we recorded demographic data (sex, age), the date of onset and the type of stroke: ischemic stroke (IS), stroke caused by intracerebral hemorrhage (ICH) and stroke caused by subarachnoid hemorrhage (SAH). The diagnosis of IS was defined according to updated World Health Organization criteria as an episode of neurological dysfunction caused by central nervous system (CNS: cerebral, spinal or retinal) infarction. The evidence of CNS infarction was defined as CNS cell death attributable to ischemia, based on imaging or other objective evidence of CNS focal ischemic injury in a defined vascular distribution, or on clinical evidence of CNS focal ischemic injury with symptoms persisting ≥ 24 hours or until death. The diagnosis of ICH was defined as rapidly developing clinical signs of neurological dysfunction attributable to a focal collection of blood within the brain parenchyma or ventricular system which is not caused by trauma. The diagnosis of SAH was defined as rapidly developing clinical signs of neurological dysfunction and/or headache caused by bleeding into the subarachnoid space, which is not secondary to a trauma [13].

The onset time of stroke was assigned to one of the four seasons: winter (December to February), spring (March to May), summer (June to August) and autumn (September to November). Statistical analysis was performed using Excel Microsoft.

Results

The demographic characteristics of the patients included in the study are synthesized in Table 1. Men represent 47.18% (572) and women represent 52.81% (511). The mean age of the women is 72.26 +/-11.09 years compared to that of men, 68.67 +/-11.26 years. Table 1: Demographic characteristics of patients with stroke – percentage by age groups (number of patients)

AGE	M PERCENTAGE (NUMBER)	F PERCENTAGE (NUMBER)
<45 y	1.48% (16)	1.60% (11)
45-64 y	18.10% (196)	9.88% (107)
65-80 y	25.76% (279)	24.01% (260)
>80 y	7.48% (81)	12.28% (133)
Total	47.18 (572)	52.81% (511)

M - male, F – female

All **1083** patients were assigned to one of the three known types of stroke: **969** patients with IS (89.47%), **94** patients with ICH (8.68%) and **20** patients with SAH (1.85%) (Fig. 1).

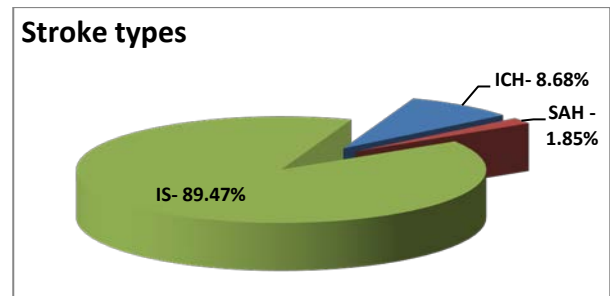


Fig. 1. Percentage distribution of stroke types (IS, ICH and SAH), IS – ischemic stroke, ICH – intracerebral hemorrhage, SAH – subarachnoid hemorrhage

Descriptive statistical analysis evidences a seasonal and monthly variation of IS during the course of 2012 (representing almost 90% of all cases of stroke in our study), with the highest rate of occurrence in December-January, corresponding to the cold season, and a second smaller incidence peak during the hot months of the year (June-August). In the case of ICH, the highest incidence was found during the cold months, while SAH had the highest incidence during the hot months (Figs. 2-4).

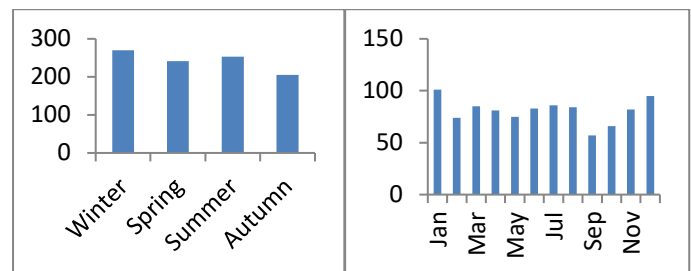


Fig. 2. Monthly and seasonal variation of ischemic stroke (IS) occurrence during 2012

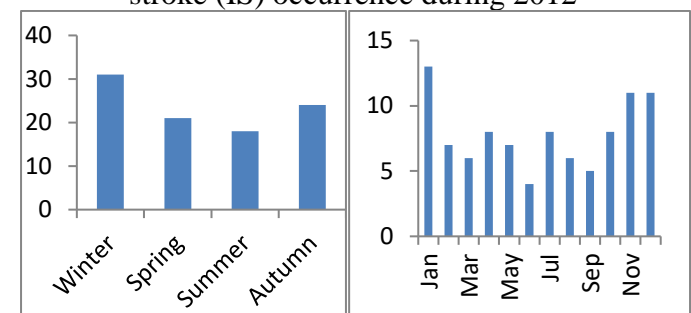


Fig. 3. Monthly and seasonal variation of intracerebral hemorrhage (ICH) occurrence during 2012

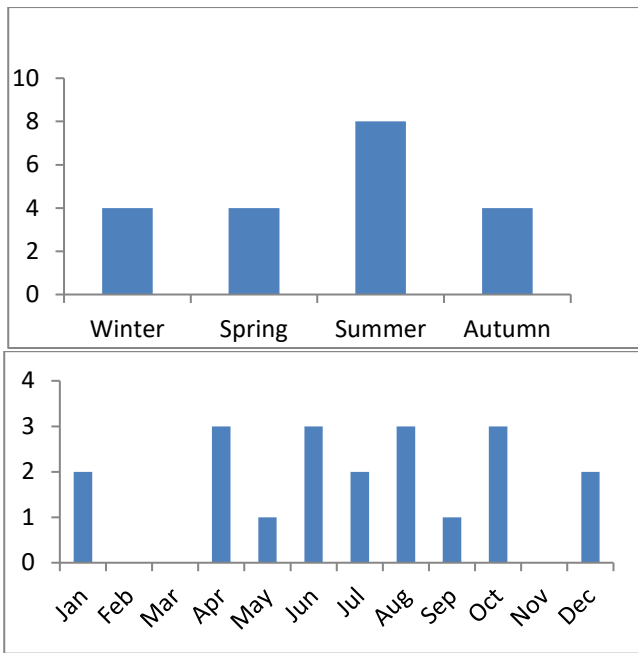


Fig. 4. Monthly and seasonal variation of subarachnoid hemorrhage (SAH) occurrence during 2012

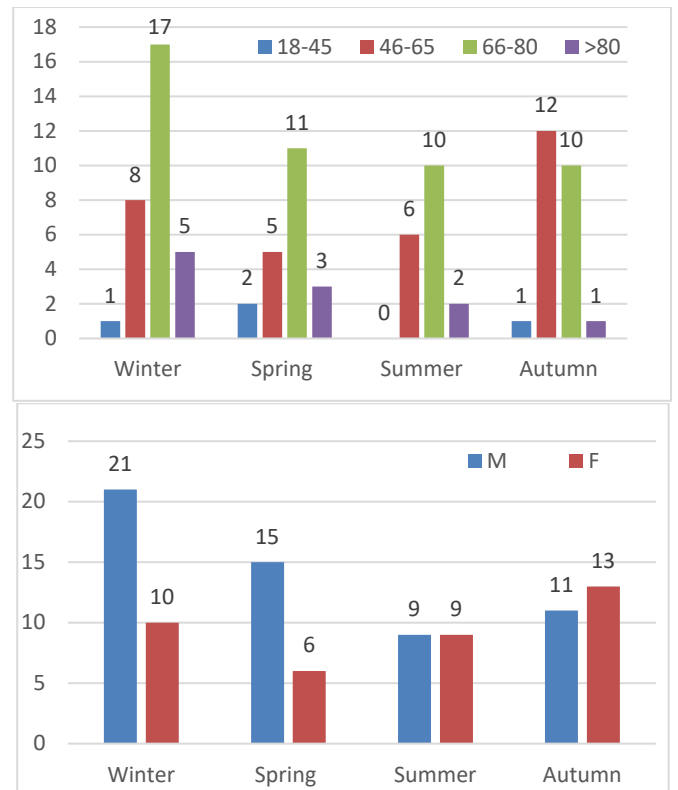


Fig. 6. Seasonal variation of intracerebral hemorrhage (ICH) occurrence according to age and gender

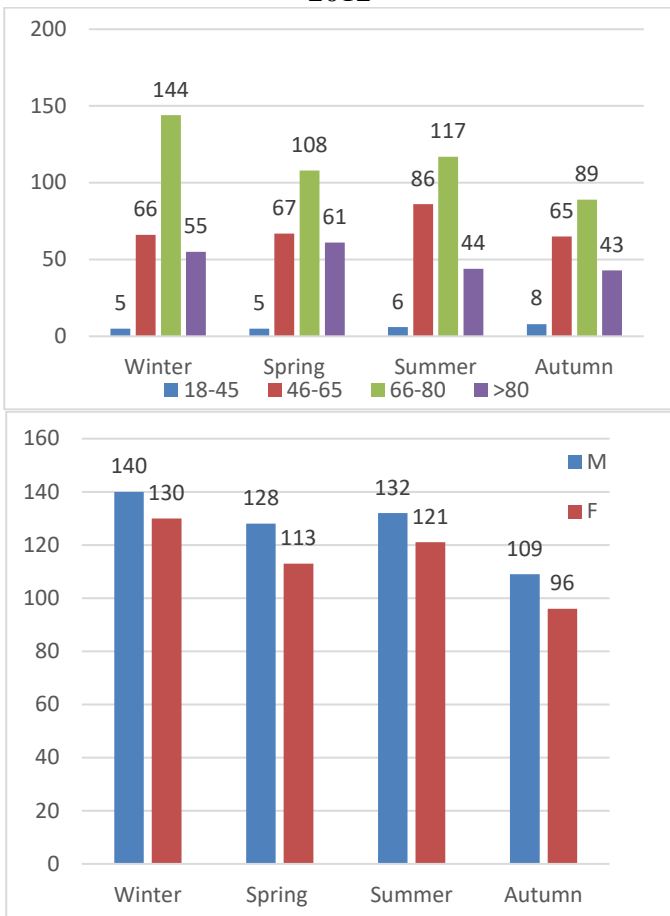


Fig. 5. Seasonal variation of ischemic stroke (IS) occurrence according to age and gender

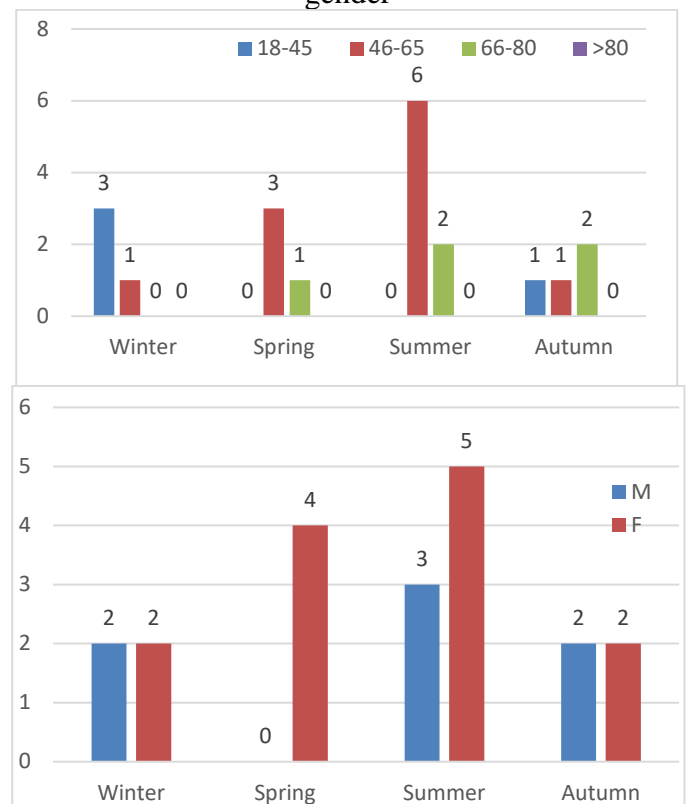


Fig. 7. Seasonal variation of subarachnoid hemorrhage (SAH) occurrence according to age and gender

Both men and women had the same incidence variation pattern with two peaks for IS and a higher incidence of ICH during the cold half of the year (men in winter-spring and women in autumn-winter) (Figs. 4-5). The 66-80 and over 80 years age groups had a higher incidence of both IS and ICH in the cold season, while the 45-65 years age group more frequently had IS in the summer and ICH in the autumn (Figs. 4-5).

Discussions

We found in our study a proportion between the three types of stroke which is relatively close to that reported in the literature [14]. Overall, the age of men is about 3.5 years lower than the age of women. The difference is more obvious in younger age groups, disappearing after 65 years of age (Table 1), which reflects the worsening of vascular risk factors after menopause onset [15].

For the seasonal and monthly variation, the time period included in the study, 1 year, was too short to draw some conclusions; however, we performed an analysis of the data. Thus, for ischemic stroke, the presence of two incidence peaks was detected: one in the winter (December-January), with a higher value, and the second one in the summer (July), correlated with the literature data [9]. This increased incidence of stroke during the cold months is more obvious in elderly people, which has been described in the literature regarding the incidence of myocardial infarction [15]. A study conducted in Japan found that the peak in the occurrence of IS during winter and early spring corresponds to the influenza activity peak among the population [16]. The less impressive incidence peak detected in the summer can be related to exposure to extreme temperatures and consecutive dehydration, which leads to hypercoagulability through an increase of blood viscosity, in hot climate countries [17].

However, some articles report an annual incidence peak in late spring – in the month of May [18], or even during the hot summer months [17], as we also found for young patients (aged 45-65 years).

The majority of the studies conducted for the investigation of a seasonal variation pattern were carried out in temperate zone countries, where temperatures are polarized at two extremes. A similar study performed in Israel (a subtropical country) evidenced a two times higher incidence during hot months compared to cold months [17], which suggests that exposure to extreme temperatures (very

cold or very hot) may increase the risk of cerebrovascular events [9, 17, 18]. In areas without marked temperature differences between the months of the year, there is no significant seasonal variation in the incidence of stroke [19, 20].

In the case of intracerebral hemorrhagic stroke, the highest incidence was found in November-January, the literature data supporting a predominance in the cold season, but there are also different reports due to the different climate conditions of the regions where the studies were conducted [1, 2, 18]. The increase of sympathetic activity leading to hemodynamic changes during the process of seasonal adaptation may underlie the higher incidence in the winter, which is also supported by the results of recent studies [21, 22].

In this study, SAH had the highest incidence in the summer, in June and August, alongside April and October. These results are different from those of the literature, which report the highest incidence in February and the lowest incidence in the hot months, but our analysis was based only on the 20 cases hospitalized during the course of 2012 [23-25].

Conclusions

This study has the already mentioned limitations related to the short duration over which data were collected (1 year). The results largely overlap those of the literature, except for the monthly/seasonal rhythmicity of SAH. The increased incidence of stroke during the cold months of the year indicates the need to prevent/treat the seasonal infectious and inflammatory episodes possibly involved in the high risk of both ischemic and hemorrhagic stroke, to monitor BP values and the other vascular risk factors during the winter months, as well as to strictly comply with antithrombotic or anticoagulant treatment (when indicated) and to avoid dehydration in the summer (which may result in increased blood viscosity with hypercoagulability) by adequate fluid consumption.

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