

## The circaseptan variation of stroke onset – a hospital-based study

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### Abstract

**Introduction.** Circaseptan or weekly rhythm, despite not belonging to terrestrial rhythms and being a conventional one, influences the incidence of stroke through short-term lifestyle changes.

**Objectives.** To investigate the presence of a weekly variation pattern in the onset of cerebrovascular pathology in patients admitted to Neurology Departments I and II of the County Hospital Cluj-Napoca over the course of 2012.

**Material and method.** The study is based on demographic data, data referring to the day of onset, the type of stroke and the subtype of ischemic stroke, collected retrospectively from the observation sheets of 1083 patients with stroke admitted through the Emergency Room to Neurology Departments I and II of the County Hospital Cluj-Napoca. Diagnosis was defined according to updated World Health Organization criteria and the Trial of ORG 10172 in Acute Stroke Treatment Classification.

**Results and conclusions.** The circaseptan variation of stroke onset reveals two incidence peaks, one over the weekend continuing through Monday, and one in the middle of the week. Age, sex and the type/subtype of stroke enhances one of these peaks.

**Key words:** *Circaseptan variation, stroke occurrence, lifestyle changes,*

### Introduction

The temporal variation of cerebrovascular events includes, in addition to circadian and seasonal variation (more extensively studied), weekly or circaseptan variation, mainly correlated with changes in psychophysiological stress linked to the transition from intense activity periods to relaxation periods and vice versa [1-5].

The weekly cycle does not belong to terrestrial rhythms, but is a conventional rhythm. Circaseptan variation has been little studied, with different results reported by different studies; however, most of them support either a peak over the weekend extending through Monday – the first weekday of the week, the “Blue Monday” phenomenon [5, 6], or a peak in the middle of the week – the maximum activity period of the week [7, 8].

The objective of this study was to investigate a possible weekly cyclicity of stroke incidence, as well as differences depending on stroke types/subtypes and demographic data over the course of 2012 in the Cluj-Napoca city area.

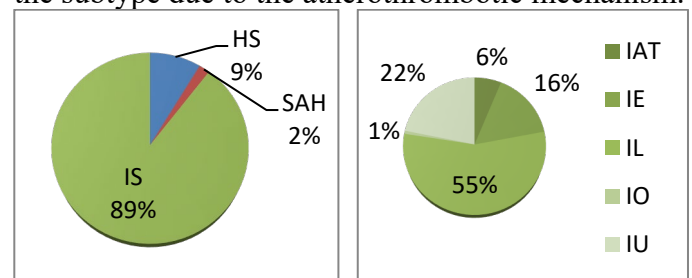
### Material and method

The stroke event data were collected from the patient records of a consecutive series of 1083 patients admitted through the Emergency Room to Neurology Departments I and II of the County Hospital Cluj-Napoca (which serve the population of Cluj-Napoca city and its surroundings), between 1 January 2012 and 31 December 2012. The diagnosis of ischemic

stroke (IS), intraparenchymal hemorrhagic stroke (HS), and subarachnoid hemorrhage (SAH) was confirmed by neurologic examination and neuroimaging, according to updated World Health Organization criteria. The classification of ischemic stroke subtypes was made using the Trial of ORG 10172 in Acute Stroke Treatment or TOAST Classification: 1 - large-artery atherosclerosis (embolus/thrombosis) - IAT; 2 - cardioembolism - IE; 3 - small-vessel occlusion (lacunar) IL; 4 - stroke of other determined etiology - IO; and 5 - stroke of undetermined etiology - IU. The onset time was assigned to one of the seven days of the week. Statistical analysis was performed using Excel Microsoft.

### Results

The proportions of the types of stroke and subtypes of ischemic stroke are represented in Figure 1, with the highest percentage for the type of ischemic stroke and the subtype due to the atherothrombotic mechanism.



**Fig. 1.** Stratification of strokes recorded over the course of 2012 depending on the types of stroke and the subtypes of ischemic stroke

During 2012, the overall frequency of stroke was increased over the weekend (Saturday and Sunday) and lower in the middle of the week (Wednesday), with a new peak on Thursday, a pattern found for both ischemic stroke and hemorrhagic stroke, while for SAH, the situation was reversed (Fig. 2).

However, the study of the weekly variation in ischemic stroke occurrence by age groups reveals some differences (Figs. 3-5), and there are also differences in the weekly frequency of the three types of stroke depending on sex (Fig. 6). IS shows two peaks (over the weekend and in the middle of the week) for men, and one peak, over the weekend, for women; HS exhibits the same two peaks for both sexes, while for SAH, women have an incidence peak at the beginning of the week.

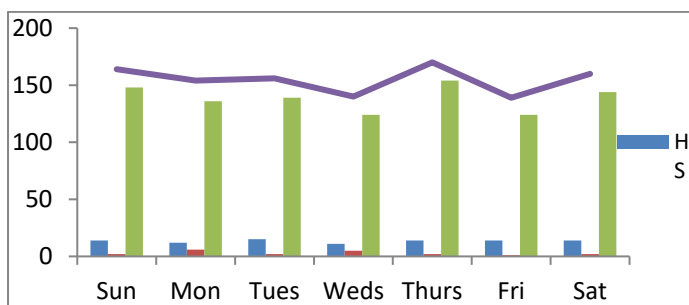


Fig. 2. Weekly variation of the three types of stroke over the course of 2012

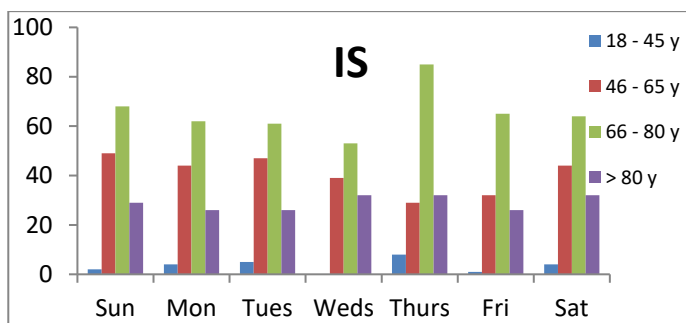


Fig. 3. Weekly variation of IS by age groups over the course of 2012

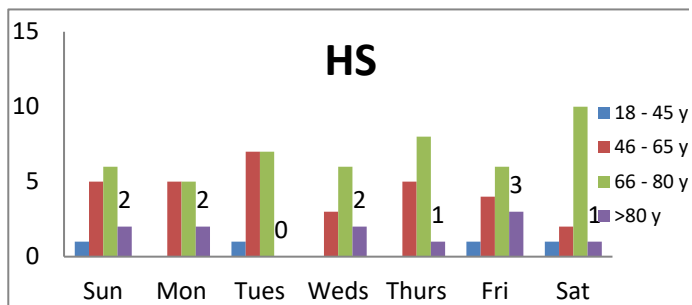


Fig. 4. Weekly variation of HS by age groups over the course of 2012

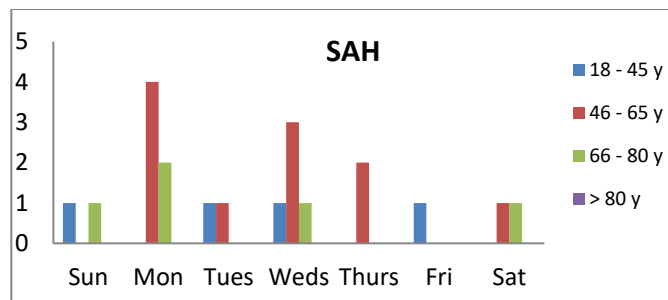


Fig. 5. Weekly variation of SAH by age groups over the course of 2012

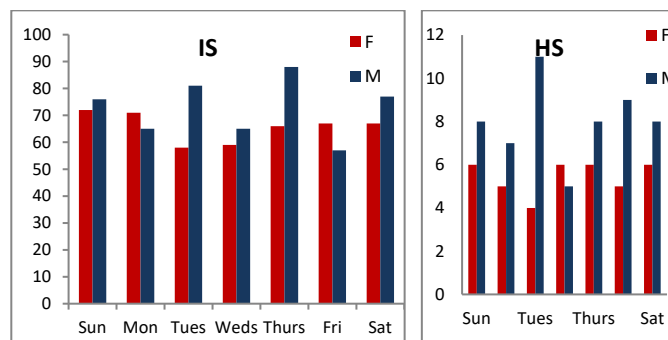


Fig. 6. Weekly variation of IS, HS, SAH depending on sex, over the course of 2012

Ischemic stroke (IS) occurs with the highest frequency over the weekend and in the middle of the week for the lacunar and the undetermined mechanism (IL and IU), over the weekend for the atherothrombotic mechanism (IAT), and in the middle of the week for the cardioembolic mechanism (IE) (Fig. 7).

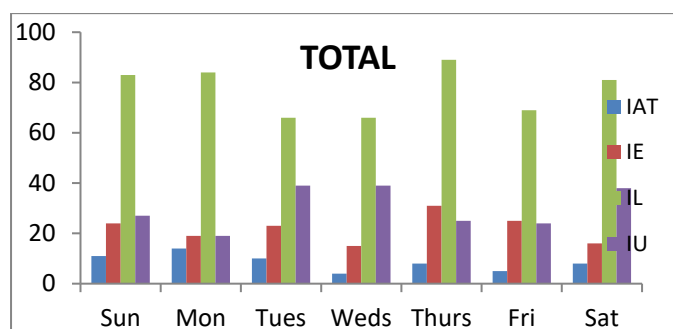


Fig.7. Weekly variation of IS subtypes over the course of 2012

## Discussion

In our study, two general stroke frequency peaks can be seen, over the weekend and in the middle of the week. For the first peak, the implication of short-term lifestyle changes during the weekend is hypothesized, with the sudden transition from an intense activity period to a relaxation period and subsequently the other way around, and this is more obvious for IS, the

IAT, IU and IL subtypes, and for women in general. The second peak can be explained in the context of the weekly peak of sustained work, and is more obvious for IE as part of IS and for men in general. The 46-65 age group is involved in the weekend peak for IS and in the mid-week peak for HS; for the 66-80 age group the situation is reversed, most probably in relation to the mean retirement age of 65 years in Romania.

The socio-professional particularities of women in the Romanian society involve duties and an intense rhythm of work during the weekend as well, which can explain the more pronounced tendency to cerebrovascular events in this time interval, contrary to some literature data, which describe a weekend peak more expressed in men and a Thursday-Friday peak in women, for example in the Japanese society [4, 9]. In the literature, circaseptan variation has been little studied and the results are different. Brackenridge et al. and Hosseininezhad et al. describe the highest stroke occurrence frequency in general in the middle of the week, particularly over the course of Wednesday [10, 11]. Johansson et al. report the presence of a peak in IAT onset from Tuesday to Thursday, and for IL, a weekend peak [8]. On the other hand, Pasqualetti's study on HS reveals a higher incidence over the weekend, raising the hypothesis of the implication of short-term lifestyle changes during the weekend [7]. In the well-known Framingham study, the highest proportion of cerebrovascular events was recorded on Monday (17.2%) compared to any other day, particularly in smokers, alcohol users and hypertensive subjects [5]. The so-called "Blue Monday" phenomenon is also supported by the more recent study of Shigematsu et al., conducted on 13788 subjects over 11 years [9]. According to Wang, SAH seems to present the highest frequency on Sunday and Monday [4]. In a community-based study carried out in Japan (about 10,000 inpatients, a 3-year study), Wang et al. found a significant weekly variation differentiated by sex, with a 26% peak on Monday (the first weekday of the week) for men and with the highest incidence of stroke over the last two weekdays of the week (Thursday and Friday) for women. The explanation provided by the authors is related to the fact that in provincial Japanese society, men are more involved in public life, unlike women, who are responsible for housekeeping. This difference in the weekly variation of stroke onset in general between men and women, more obvious over

the age of 60 years, is linked by the authors to the retirement age in Japan, which is 60 years [4]. In the current study, the limit of 65 years (the mean retirement age in Romania) makes some difference in terms of circaseptan variation, the 46-65 age group having the peak of IS onset over the weekend, in relation to the weekly rest period of working individuals, while the 66-80 age group has the highest frequency in the middle of the week. For HS, the 46-65 age group has the peak in the middle of the week (the most busy period of the week), while the 66-80 age group has two peaks, one in the middle of the week and the other, which is the highest, on Saturday. Regarding ischemic stroke, the most frequent in terms of etiology, two Finnish studies have opposite conclusions: Jakovljevic et al. report the highest frequency on Monday and the lowest frequency on Saturday [12], while Haapaniemi et al. describe the highest incidence during weekends and holidays [13].

## Conclusions

1. Cerebrovascular events occurred with the highest frequency over the weekend (a relaxation period) through Monday (the first weekday of the week), and in the middle of the week (the maximum activity period of the week), most probably reflecting the circaseptan variation of lifestyle and socio-professional factors.
2. The weekend peak continuing through Monday is higher in the case of ischemic etiology (atherothrombotic, lacunar and undetermined) as well as intraparenchymal and subarachnoid hemorrhagic etiology, while the mid-week peak is more pronounced for ischemia of cardioembolic etiology.
3. The weekend and Monday peak is more marked in the case of women, while the mid-week peak is more pronounced in men. Before the age of retirement (65 years), ischemic stroke more frequently occurs over the weekend (the weekly relaxation period for professionally active individuals), and hemorrhagic stroke is more frequent in the middle of the week (the weekly period of maximum activity and stress), while for patients aged over 65 years (retired) the situation is reversed.

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