

Is there any seasonal influence in spontaneous bleeding of intracranial aneurysms and/or arteriovenous malformations in Istanbul?

A hospital based study

Tayfun Hakan^a, Osman Kizilkilic^b, Ibrahim Adaletli^b, Hakan Karabagli^c, Naci Kocer^b, Civan Islak^b

^a Neurosurgery Department, Kartal Teaching and Research Hospital, Istanbul, Turkey

^b Neuroradiology Department, Istanbul University Cerrahpasa Medical School, Istanbul, Turkey

^c Neurosurgery Department, Haydarpasa Numune Research Hospital, Istanbul, Turkey

Summary

Principles: Despite many reports investigating the relationship of subarachnoid haemorrhage and seasonal variation in different parts of the world, there is no clear correlation. As far as we know this subject has not been reported from Istanbul yet. The purpose of this study is to determine if there is any correlation between season and spontaneous subarachnoid haemorrhage (SAH) caused by intracranial aneurysms and/or arteriovenous malformations (AVM) in Istanbul.

Methods: Data were collected retrospectively from the medical reports of patients having intracranial haemorrhage due to aneurysm and/or arteriovenous malformation. The data were analysed with univariate and chi-square tests for all haemorrhages, for haemorrhages of aneurysms and arteriovenous malformations separately per month and per season respectively for all the patients together and according to gender separately. The ANOVA test was used for testing the monthly distribution of SAH cases with regard to age.

Results: There were 761 cases (417 female, 344 male) of intracranial haemorrhage cases (683 intracranial aneurysms, 78 arteriovenous malforma-

tions) from 1994–2000. In this study, a seasonal peak in winter and a nadir in autumn for all subarachnoid haemorrhages were observed but the findings were not significant statistically. The peak season was winter for bleeding due to both aneurysms and AVM's. While the nadir season for aneurysmal bleeding was autumn and was summer for the AVM's.

Conclusions: We did not find any significant statistical relation between seasonal variation and intracranial haemorrhage in the Istanbul province. But the peak of bleeding in winter and the nadir in autumn were noticeable for all intracranial haemorrhages. In Istanbul, beside the individual risk factors such as hypertension, alcohol consumption, lifestyle, and environmental factors like weather, season and other possible factors of which we are not yet aware, the relative increase of population in winter season due to social reasons may have a small contribution to these findings.

Key words: aneurysm; arteriovenous malformation; seasonal variation; subarachnoidal haemorrhage

Introduction

Intracranial haemorrhage due to rupture of intracranial aneurysms or AVM's are instantaneous and devastating events. As it is life-threatening, we seek not only optimum treatment strategies but also to discover and understand the predisposing factors. Any detected possible relationship between the onset of intracranial haemorrhage and meteorological variables may provide valuable knowledge for the prevention of this disease entity.

Although there are many reports examining a

correlation between meteorological events and intracranial haemorrhages such as intraparenchymal, intraventricular and spontaneous SAH [1–6]; a consensus has not been reached [5–8]. The effects of other risk factors including hypertension, smoking, alcohol consumption and strenuous physical activities may limit the determination and accuracy of any correlation. Some of the reports found high incidences of SAH in winter [1, 6, 7, 9], spring [5, 7, 10] and autumn [1, 9, 10]; others in

April [8] and September [8, 10]; whereas some of the reports found no statistically seasonal variation of SAH [4, 11, 12]. It was also different for men (high incidence in late autumn) and women (high incidence in late spring) [1] and some of them found possible relationships [13]. It is clear that more detailed studies are required before reaching any conclusion.

In this paper; we studied a large group of spontaneous SAH including two main causes, aneurysm

and AVM, together and separately. Our study group includes 683 intracranial aneurysms and 78 arteriovenous malformations. The aim of this study is to determine whether there is any correlation between season and primary SAH due to the angiographically proven intracranial aneurysm and /or AVM in Istanbul as it was studied in Connecticut [1], Siberia [11], Izumo City [12], France [8], Canada [9] and Denmark [5].

Materials and methods

Data were obtained from the clinical and radiological database of the Neuroradiology Department of Istanbul University Cerrahpasa Medical School over the 6 years from 1994 to 2000. The patients were selected from those with a proven ruptured intracranial aneurysm and/or AVM after examination with digital subtraction angiography (DSA) with a primary diagnosis of SAH.

Data analysed for each patient included patient's sex, age, date of bleeding, date of examining with DSA, cause of SAH (aneurysm or AVM by site and number) and concomitant lesions.

An analysis was conducted to see whether there were any monthly or seasonal variations in the occurrence of all SAH, for aneurysms and AVM's alone, as well as with respect to gender together and separately. The Pearson chi-square test, univariate and ANOVA statistical analyses were used. The chi-square test was used for investigating any seasonal and monthly variation. Univariate testing was used for both females and males for each month and each season separately. The ANOVA test was used also for testing the monthly distribution of SAH cases with respect to age.

Results

Patient distribution: The total number of patients was 761 (417 female, 344 male) of which 683 had intracranial aneurysms and 78 AVM's. The female-male ratio was 1.27/1 (383/300) for aneurysms and 1/1.29 (34/44) for AVM's.

Age: The range of age was 8 to 82 years (mean 48.1 years) in the whole group of patients (761 patients), the range for aneurysms was between 10-82 years (mean 50.1), and 8-61 years (mean 30.6) for AVM's. No significant difference was found between the distribution of SAH cases and months with respect to age according to the ANOVA test ($p = 0.566$).

The peak and nadir per month: The occurrence of SAH according to month showed a peak in January

(9.7%) and a decline in September (7.3%) for all cases. The distribution of SAH showed a peak haemorrhage in January (11.9%) and nadir in July (5.2%) for males. The distribution for females was March (10.3%) and September (5.7%) respectively (Fig. 1).

For the aneurysms, the peak was in January (11.6%) the nadir in July (5.6%) for males, and in March (10.1%) and September (6%) respectively for females (Fig. 2).

For AVM's the peak was in November (16.6%) and the nadir was in May, June and July (5.1%) (Fig. 3).

1. In all cases of SAH (aneurysm + AVM); for both sexes, there was no significant difference between months ($p = 0.105$; $p > 0.05$).

Figure 1
The distribution of all SAH cases according to sex and months ($p = 0.105$; $p > 0.05$).

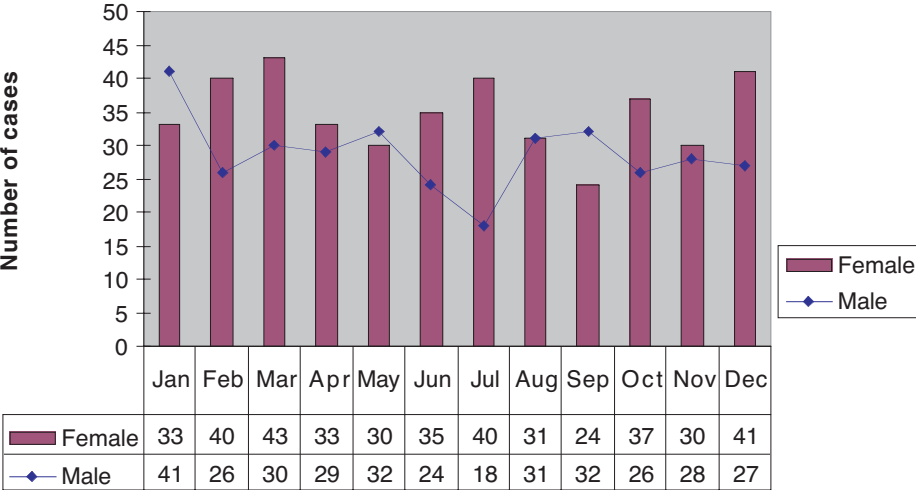
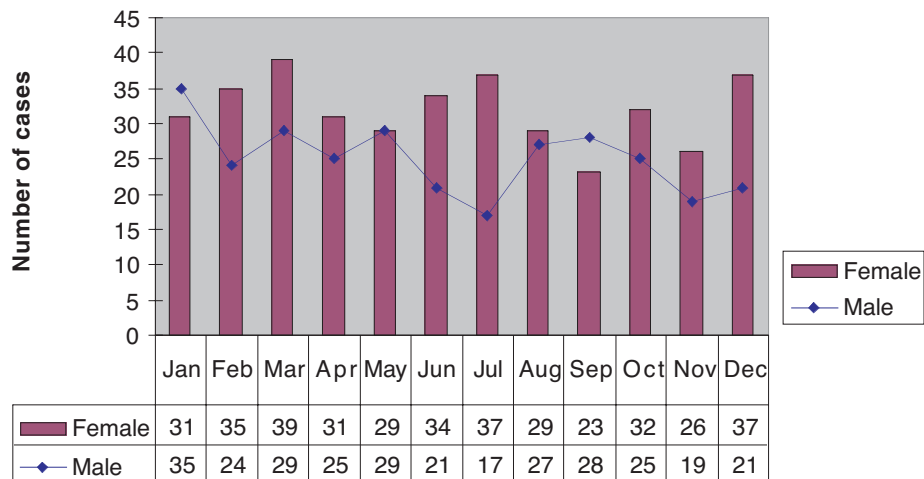
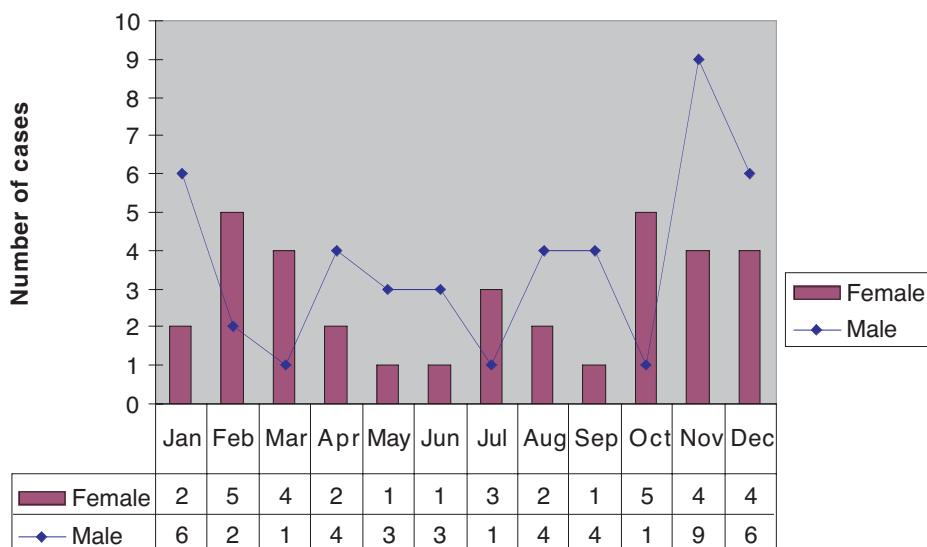


Figure 2

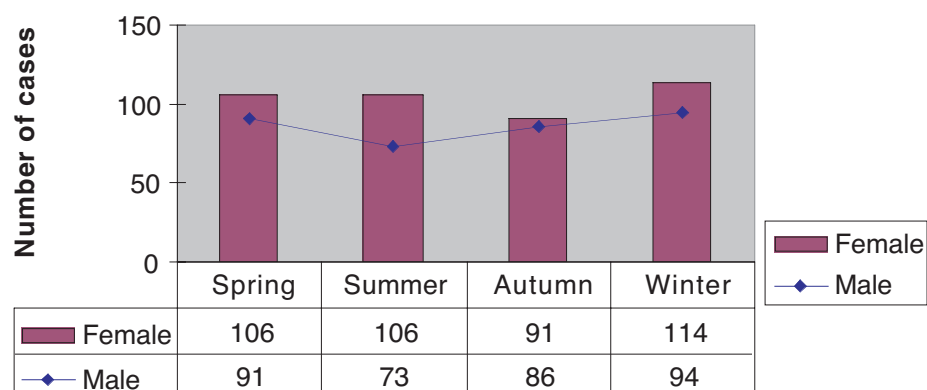
The distribution of aneurysm cases according to sex and months ($p = 0.371$; $p > 0.05$).


Figure 3

The distribution of AVM cases according to sex and months ($p = 0.175$; $p > 0.05$).


Figure 4

Distribution of all cases according to the seasons ($p = 0.511$; $p > 0.05$).



- In cases of aneurysmal SAH; for both sexes, there is no significant difference between months ($p = 0.371$; $p > 0.05$).
- In cases of AVM related SAH; for both sexes, there is no significant difference between months ($p = 0.175$; $p > 0.05$).

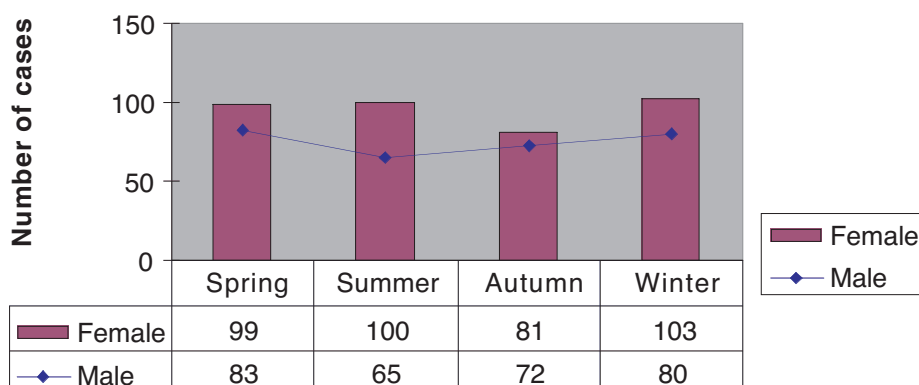
The peak occurrence month of AVM related SAH was in November for males. This finding was the only one demonstrating statistical significance (on

univariate analysis of sex and month distribution), albeit of limited robustness ($p = 0.049$; $p < 0.05$). Since the number of AVM cases was not big enough it is not realistic to make any conclusion about this finding.

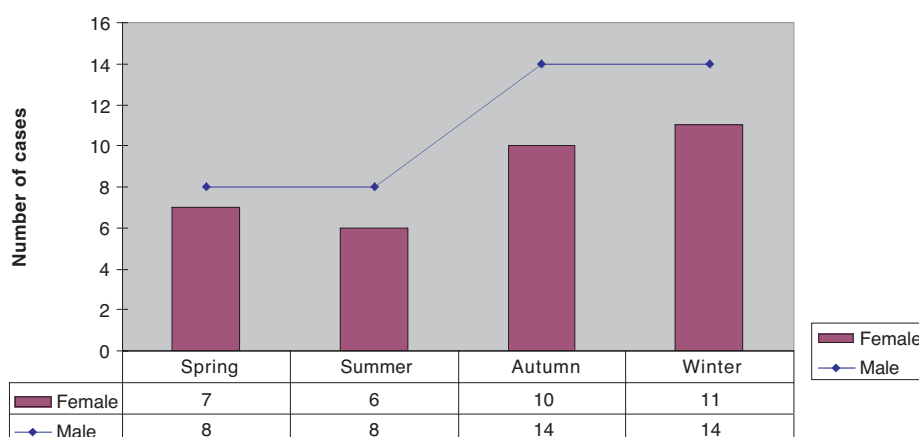
The peak and nadir per season: The peak ratio of SAH according to season was in winter (27.3%) and nadir was in autumn (23.2%). The peak for haemorrhage was winter for both males (12.3%) and was females (14.9%). The nadir was summer

Figure 5

Distribution of aneurysm cases according to the seasons ($p = 0.533$; $p > 0.05$).

**Figure 6**

Distribution of AVM cases according to the seasons ($p = 0.992$; $p > 0.05$).



(9.5%) for males and autumn (11.9) for females (Fig. 4).

In the aneurysm cases the peak was in winter (26.7%) and the nadir was in autumn (22.4%). For aneurysms affecting males only the peak ratio was seen in spring and the nadir was seen in summer. In females the nadir was in autumn and peak in winter (Fig. 5).

The peak ratio was in winter (32%) and nadir was in summer (17.9%) for AVM's. While the peak seasons were autumn and winter for AVM related haemorrhages for males, it was winter for females.

The nadirs were spring and summer for males, and summer for females (Fig. 6).

1. In all cases of SAH (aneurysm + AVM); for both sexes, there is no significant difference between seasons ($p = 0.511$; $p > 0.05$).
2. In cases of aneurysmal related SAH; for sexes, there is no significant difference between seasons ($p = 0.533$; $p > 0.05$).
3. In cases of AVM related SAH; for sexes, there is no significant difference between seasons ($p = 0.992$; $p > 0.05$).

Discussion

Although there are many reports trying to determine whether the occurrence of cerebrovascular disorders is affected by atmospheric and seasonal variations, the findings are conflicting. Some of these reports include SAH and intracerebral haemorrhages [6, 11, 12, 14], others aneurysm rupture [1, 3, 5, 15], and some others including spontaneous SAH [16]. The studies investigating the seasonal variations in the incidence of haemorrhages due to aneurysm rupture are rare [2]. Our study aimed to determine if there is any correlation between season and spontaneous SAH caused by intracranial aneurysm and/or AVM.

Previous papers not only researched the sea-

sonal relationship with bleeding, but also possible correlations with daily climatic changes in different geographical parts of the world. They examined the northern hemisphere [9, 17], southern hemisphere [3, 7] and also subtropical regions of the world [4]. Istanbul is situated in northern hemisphere, in north-western Turkey, north of the Sea of Marmara. The climate in Istanbul is generally moderate (winter $\approx 4^\circ\text{C}$ and summer $\approx 27^\circ\text{C}$) and humid. The months, December, January and February are regarded as winter; March, April and May as spring; June, July and August as summer and finally September, October and November as autumn in Turkey.

The hypothesis of aneurysmal SAH related to weather was first proposed by TM Stundt Jr in 1983 [1]. The affects of changes in meteorological factors in the incidence of strokes was published by Madzhidow for the first time in 1991 [14]. Following this paper, reports were published pointing to a relationship between SAH incidence and meteorological parameters such as relative humidity, atmospheric pressure fluctuations and temperature [3, 8, 14, 16, 17], whilst other authors reported no relation between them [4, 11, 15].

Some of the previous studies found seasonal peaks occurring in spring [7, 10], autumn [1, 10] and winter [6, 7, 9, 10, 16] and monthly peaks in February [18], March [10], April [8] and September [8,10]. Some of these studies observed maximum incidence of bleeding with regard to sex; for men in spring [9], in late fall [1,9] and for women in winter [6, 9].

In a recently reported investigation of both hospital-based and community-based patient populations, Inegawa showed that there is no significant seasonal variation; but he found a significant seasonal trend making peak in winter and nadir in summer in both series [2]. Similarly, we did not find any significant relationship between the onset of SAH and seasonal variation with respect to sex. But the peak in winter and nadir in autumn for both sexes was also determined in our study. When we investigated the cases in two groups as aneurysms and AVM's; the peak season was winter for both, the nadir was autumn in aneurysm group, and the nadir was summer in AVM group.

A peak incidence in winter months is also found ("detected" in studies) for intracerebral haemorrhages [12, 18]. The tendency for bleeding to occur in winter has been postulated to be due to cold-induced hypertension [1, 3, 8, 10, 17] or diurnal changes in blood pressure [2]. These changes in blood pressure may play an important role in seasonal fluctuations in SAH. Some diurnal tendencies in the onset of SAH were found and it was postulated to be due to the changes of in blood pressure during day time, especially in the morning [2]. However, some studies within similar areas reached different conclusions for seasonal variations. While one of the studies detected a seasonal variation [1], another was not able to show any seasonal influence [19]. Schvienk found that climatic factors might trigger aneurysmal bleeding [19]. Some of the writers speculated that possible seasonal relationships might be correlated with increasing physical activities [5, 20]; and that these strenuous activities may mask any effect of climate [13]. Thus, Komatsu *et al.* found aneurysmal bleeding to be frequent in winter but could not find any relationship between bleeding onset and meteorological fronts, but that patients' activities could influence rupturing [15].

Possible conflicting effects of both physiological and biochemical factors in arterial hypertension leading to SAH, either due to raised atmospheric pressure, or due to alteration of individuals' behavioural patterns in different climatic conditions, were stressed by Chayett *et al* [1]. They thought that some factors might affect men but not women. The general tendency for men to spend more time outdoors may be one of these factors [2].

However, there are still some contradictions. While one author found significant seasonal fluctuations for the group of patients younger than 59 years old [2], another concluded that elderly people are affected by climatic conditions more than young ones [4].

Our study did not reveal any seasonal influence on spontaneous bleeding of intracranial aneurysms and/or AVM's for either sex. The small size of the AVM group has limited us in reaching a strict conclusion. For aneurysmal bleeding, winter and autumn are conspicuous as the peak and nadir seasons respectively. Istanbul is the biggest metropolis of Turkey. Seasonal changes in population might make a small contribution to the other possible causes: the city is full of people as a centre for living-purposes, education, trade, industry, health, tourism, congresses etc. during winter months. Rupture of aneurysms and/or AVM's may be due to a number of cumulative effects originating from the patient, including amount of activity, lifestyle, environment, weather, season, and other factors that we are yet not aware of.

In conclusion, although it was suggested that there may be a correlation between SAH and seasonal variation in some of previous studies, we did not find a statistically significant relationship to substantiate this claim in the Istanbul. But the peak of bleeding in winter and the nadir in autumn were noticeable. Besides the well-known individual risk factors such as hypertension and alcohol consumption, others like lifestyle and environmental factors such as weather, seasonal factors and factors that we are yet not aware of, the relative increase of Istanbul's population during the winter season due to social reasons, may make a small contribution to these findings.

Correspondence:

Tayfun Hakan

Haydarpaşa Numune Hastanesi

Beyin Cerrahisi Kliniği

Kadıköy, 81020

Istanbul

Turkey

E-Mail: tayfunhakan@yahoo.com

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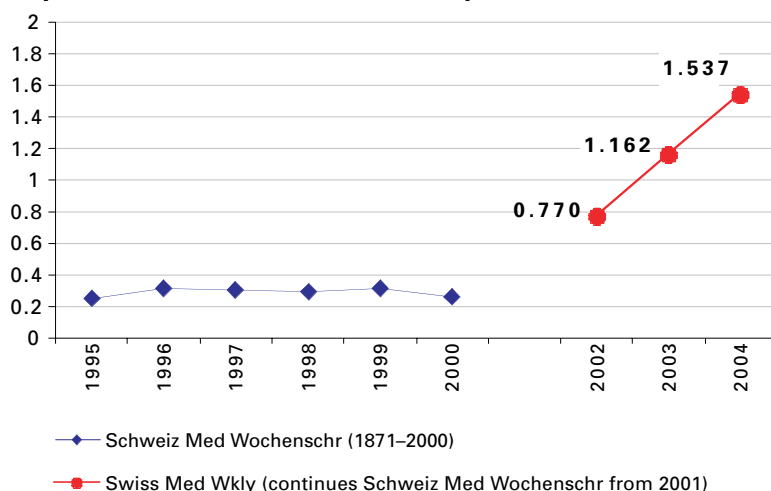
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