May Sunshine Protect Women Against Paroxysms of Atrial Fibrillation?

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Seasonal variation in the occurrence of atrial fibrillation (AF) has been documented, yet precise mechanisms and factors underlying the phenomenon remain unclear. We have previously observed the decrease in the number of AF paroxysms between May and August, when sunshine levels were highest. The objective of the present study was, in turn, to determine whether sunshine affects the incidence of AF episodes. Participants were 1,475 Caucasian subjects (mean age: 68.2 years) diagnosed with AF paroxysms, admitted to the Intensive Cardiac Care Unit (ICCU) between January 1, 2005 and December 31, 2008; 805 were women and 670 were men (mean age: 69.2 and 66.2, respectively). The average incidence of AF episodes was higher among female subjects, with 16.8 cases per month, compared to male subjects with 14.0 cases per month. Pearson’s correlation coefficient (r) was used to find a relationship between monthly sums of sunshine duration and AF paroxysms. This relationship for women was clearly inversely proportional (r = -0.499); namely, most AF episodes were recorded from December to March, when sunshine levels were lowest. In contrast, there was no noticeable association in male patients between the occurrence of AF paroxysms and effective sunshine (r = -0.126). In conclusion, unlike in men, a marked, statistically confirmed relationship between AF episodes and effective sunshine was observed in women. Thus, sunshine may have a protective effect against AF paroxysms for women. Our findings may provide the basic information concerning the influence of environmental factors on human wellbeing and contribute to management of AF. ——— atrial fibrillation; effective sunshine; sex differences; seasonal variation.

Associations between weather and human wellbeing have been known for centuries. In ancient Greece, Hippocrates formulated his theory about the influence of geographical and climatic conditions on physical and mental health status. He stressed that the sun, water and wind may, on the one hand, have an adverse effect on wellbeing, or, on the other, provide health benefits and even promote healing (Kozlowska-Szczesna et al. 1997).

Numerous cardiovascular diseases are known to exhibit seasonal fluctuation. Such a tendency is widely reported in the literature, including, among other things, myocardial infarction (Marshall et al. 1988; The Eurowinter Group 1997; Spencer et al. 1998; Pell and Cobbe 1999; Sheth et al. 1999), cardiac failure (Boulay et al. 1999), brain stroke (The Eurowinter Group 1997; Sheth et al. 1999). Seasonal variation in the occurrence of atrial fibrillation (AF) has also been noted. The study conducted on a large population (32,992) in Denmark revealed a noticeable increase in the incidence of AF episodes in winter, a decrease in summer as well as an association between these episodes and outdoor temperature (Frost et al. 2002). Similarly, two studies on the seasonality of paroxysmal AF, in Israel (Viskin et al. 1999) and Finland (Kupari and Koskinen 1990), found the peak incidence during winter despite the fact that the average temperatures in both countries vary considerably. On the other hand, according to findings from one Japanese study, the incidence of AF paroxysms was the highest in autumn and the lowest in summer (Watanabe et al. 2007). At the same time, the authors of that study stressed the relationship between the incidence of paroxysmal atrial fibrillation and the length of daylight. In our previous study (Gluszak et al. 2008) concerning the relationship between the incidence of atrial fibrillation paroxysms and selected meteorological conditions, we have also observed the decrease in the occurrence of AF episodes between May and August. It should be stressed that this is the period of the highest sunshine for this region of Poland (Gluza 2000).

As all the aforementioned results clearly show, the seasonality of atrial fibrillation has been documented. However, precise mechanisms and factors underlying the phenomenon remain to be clarified. Thus, the aim of the present study was to determine whether effective sunshine...
affects the incidence of AF episodes. Analyses were done with respect to participants’ sex to elucidate a possible role of this aspect in the different response to solar radiation.

**Materials and Methods**

A total of 1,475 cases of AF paroxysms in lightly pigmented Caucasian subjects from a relatively homogenous population, treated in the Intensive Cardiac Care Unit (ICCU) during the period between January 1, 2005 and December 31, 2008 were examined. In this paper, we use the term “AF paroxysm” to emphasize a sudden appearance of this arrhythmia, duration of which did not exceed 48 hours. The episodes of AF stopped spontaneously, were terminated with electrical or pharmacological cardioversion, or turned into the persistent form. Our hospital practice allows all patients with AF paroxysms to be admitted directly to the ICCU.

The data for the present study were collected anonymously, in compliance with the relevant laws and hospital guidelines. The availability and procedures of medical care provided at the hospital where the study was conducted met recognized standards of acceptable professional practice in the EU.

Hospital admissions for AF episodes from the area of 539 km² (51°13´ ± 0.2´ N; 22°44´ ± 0.3´ E) were recorded. This is an undulating terrain with typical plateau topography, located at a height of 200-300 m above sea level. In the study period, there were 77.7 thousand inhabitants in the area, 54.8% in towns and 45.2% in villages, and with women accounting for 52.0% of the population.

The AF etiology remained diverse, including hypertension, ischaemic heart disease, heart defects, and lone atrial fibrillation. All cases of cardiac arrhythmia secondary to acute coronary syndrome, myocardial infarction, pericarditis, myocarditis, hyperthyroidism, acute pulmonary diseases, and atrial fibrillation due to toxicosis (also drug-induced) and electrolyte disturbances were excluded from the analyses. The study sample consisted of 805 (54.6%) females and 670 (45.4%) males. In total, the average age of the sample was 68.2 years, with the average age of 69.2 for female patients (range, 18-93 years) and 66.2 for male patients (range, 20-87 years).

**Data analysis**

In the present study, synchronous correlations between monthly sums of sunshine and monthly sums of cases of AF paroxysms were calculated. The analyses were based on effective sunshine which expresses the number of hours when solar radiation directly reaches the Earth’s surface without being blocked by impeding factors. Pearson’s correlation coefficients ($r$) were computed. A statistical analysis of data was performed using MS Office Professional Excel 2003 (Microsoft, Redmond, WA, USA).

**Results**

In the study period, the average incidence of AF episodes was higher among female subjects, with 16.8 cases per month, compared to male subjects with 14.0 cases per month.

Moreover, the distribution of paroxysms of atrial fibrillation was different in both sexes (Fig. 1). In women, most AF episodes were recorded from December to March, and considerably fewer episodes were noted from May to August. Such a seasonal distribution pattern of the incidence of AF paroxysms in female patients can be attributed to effective sunshine. The relationship between monthly sums of sunshine duration and AF paroxysms for women was clearly inversely proportional and was confirmed statistically by the value of correlation coefficient $r = -0.499$.

In contrast, there was no noticeable association in male

![Fig. 1. Course of monthly sums of effective sunshine and cases of AF paroxysms in women and men in the period of 2005-2008.](image-url)
patients between the occurrence of AF paroxysms and effective sunshine. Unlike in women, there was no significant correlation in men’s reactions to sunshine ($r = -0.126$).

Fig. 2 presents the effect of sex on the response to effective sunshine in respect to AF paroxysms. The figure shows the annual course of mean daily duration of effective sunshine and the number of cases of AF paroxysms in women and men in consecutive months for the period of 2005-2008. Unlike for men, the course of the number of AF cases for women is virtually a mirror image of the course of effective sunshine.

**Discussion**

Solar radiation affects people by ultraviolet A, B, C (wavelengths ranging from 200 to 400 nm), visible light (400-780 nm), and infrared radiation (above 780 nm) (World Meteorological Organisation 1995). There are numerous reports in the literature on the role of vitamin D and its most important source, UV-B radiation with the wavelength of 290-315 nm, in the human organism. It is estimated that 80-100% of vitamin D is produced in the skin as a result of sunshine and only its minor part is ingested from food (Holick 2003). Serum concentration of 25(OH)D is the best indicator of vitamin D status (DeLuca 2004). Our earliest concepts of the association between the AF incidence and sunshine levels were focused on protective effects of vitamin D. This resulted from our general observation of the decrease in AF paroxysms during months having the greatest amounts of sunshine, i.e. in the period between May and August. The analysis of findings from studies conducted in the USA (Jacques et al. 1997), Italy (Carnevale et al. 2001), New Zealand (Rockell et al. 2006) and Great Britain (Hypponen and Power 2007), revealed that levels of 25(OH)D during winter were similar for both sexes. In summer, however, concentrations of 25(OH)D in men were significantly higher than in women, which resulted from considerably lower increases in concentrations of this parameter in the latter. It should be emphasized that there was no difference between women and men with respect to sun exposure (Carnevale et al. 2001), and the use of sunscreen and protective clothing had no effect on vitamin D content (Hypponen and Power 2007).

Taking the aforementioned results (Jacques et al. 1997; Carnevale et al. 2001; Rockell et al. 2006; Hypponen and Power 2007) and our own observations into account, it may be concluded that the incidence of AF episodes in men is not related to 25(OH)D concentrations. By contrast, a statistically significant negative correlation between sunshine levels and the incidence of AF paroxysms was found in women. Therefore, it may be suggested that even lower D vitamin concentrations in women play a role in preventing atrial fibrillation paroxysms. Also, protective effects of products of photodegradation of vitamin D and their derivatives produced as a result of high sun exposure in women cannot be excluded (Chen et al. 2000). Slominski et al. (2004) described the possibility of the conversion of 7-dehydrocholesterol, a parent substance for vitamin D, into 7-dehydropregnenolone in the skin and next, upon stimulation of UV-B radiation, into vitamin D-like derivatives. These derivatives, undergoing further transformations, may also greatly affect physiological processes. The skin endocrine system, in response to UV-A and UV-B stimulation, mounts a progressive, intensity-dependent, highly coordinated response. In the case of high-magnitude stimuli, the generated signals travel through humoral or neural pathways to reach the central nervous system, immune system, and other organs, e.g. the heart (Slominski and Wortsman 2000). Both visible light, with its impact on the neuroendocrine system, and infrared radiation, influencing the metabolism of numerous substances in the skin, may have a different...
effect on the response to sunshine in both sexes. Also, a role of the serotoninergic/melatonergic system with its possible systemic effects should be taken into consideration (Slominski et al. 2005).

In summary, unlike in men, a marked, statistically confirmed relationship between atrial fibrillation paroxysms and effective sunshine was found in women. Thus, sunshine may have a protective effect against AF paroxysms in women. Our observations should be confirmed in further analyses on other patient populations. Nevertheless, the study may provide the basic information concerning the influence of weather conditions on human wellbeing and, in particular, contribute to management of atrial fibrillation.

References


