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Clinical cosmobiology: the Lithuanian study 1990–1992

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Abstract The numbers of deaths from ischaemic heart disease (IHD), stroke (CVA), all accidents except vehicular, vehicular accidents and suicide (overall total, totals for men and women) per month for 36 months (1990–1992) in Lithuania were analysed in relation to: (1) month of the year (1–12); (2) geomagnetic activity; and (3) solar activity. A total of 122227 deaths (64490 men and 57737 women) was studied, and the results compared with those obtained in an earlier study in Israel, differing geographically and climatically from Lithuania. It was shown that the time of year, solar activity, and geomagnetic activity were related to the monthly death distribution, especially regarding death from IHD and suicide. Age and gender differences were apparent in the relationship between death distribution and physical environmental factors. At age >70 years, many of these relationships change. The monthly distribution of deaths from IHD and suicide are adversely correlated with solar activity and with each other. Differences are presumed in serotoninergic effects as caused by environmental influences.

Key words Ischaemic heart disease · Cosmobiology
Stroke · Suicide

Introduction

The new space age technologies have provided further opportunities for the well-studied relationship between the environment and human health. For example computerization, modern diagnostics and progress in medical genetics have enabled us to link external influences to biological changes at the neuroendocrinological, cellular, and subcellular levels.

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Over the past 25 years, experts in the multidisciplinary field of clinical cosmobiology in Israel and other parts of the world have examined the association between solar, geomagnetic and ionospheric changes and the mechanisms, temporal distribution, and outcome of various diseases. In a 180-month study performed in 1991 in Israel, the monthly distribution of in-hospital cardiovascular deaths was correlated with fluctuations in ten cosmophysical parameters (Stoupel and Shimshoni 1991).

In the present work, we have expanded the investigation and collected data on all deaths from ischaemic heart disease and stroke, all accidents excluding vehicular, vehicular accidents, and suicide recorded in the national registry of the Republic of Lithuania over a duration of 36 months.The data were correlated with cosmophysical data on monthly solar and geomagnetic field activity. The results were compared with those obtained earlier in Israel, and differing geographically and climatically from Lithuania.

Methods

Deaths and their description

Data on all deaths registered over a duration of 36 months (1990–1992) were obtained from the Department of Social Medicine of the Kaunas Medical Academy, Lithuania. Deaths were classified according to the accepted codes of the International Classification of Diseases, World Hoalth Organization, Geneva. The total number of deaths and total deaths of men and women respectively were as follows: total deaths, 122227 (64490 men, 57737 women); deaths from ischaemic heart disease (IHD; codes 410–414) 49940 (23019 men, 26921 women); deaths from stroke (codes 430–438) 14259 (5557 men, 8702 women). Figure 1 shows the monthly death ratio for each group of deaths for women and men in 1990–1992.

Cosmophysical data

Cosmophysical data were obtained from the Geomagnetic and Solar Indices Bulletins of the National Geophysical Data Centre, National Oceanic Atmospheric Administration, USA as follows: sun-

spot number (W; monthly data); solar flux (2800 MHz frequency and 10.7 cm wavelength); adjusted solar flux (2800 MHz frequency and 10.7 cm wavelength); smoothed sunspot number (R; i.e. grouping of sunspots); planetary geomagnetic activity index (AP; i.e. an integral of 3-hourly K-indices in nanotesla of geomagnetic activity); mean geomagnetic activity index (AM), as related to differences in the southern and northern hemisphere.

The A-index is graded as follows: 0–7 quiet; 8–15 unsettled; 16–30 active; ≥30 stormy geomagnetic activity index (GMA). The smoothed sunspot number in cycles 21–22 between November 1986 and approximately 1996, fluctuated from 12 (November 1986) to 158 (July 1989). In consideration of the fluctuating nature of the physical parameters studied, the data were analysed monthly. As different kinds of solar energy reach our planet at different speeds, any daily comparison is therefore difficult.

Statistical analysis

The statistical analysis was performed in the Departments of Cardiology and Epidemiology, Beilinson Medical Centre, Israel, where the earlier comparative study and many other cosmobiological investigations have been conducted. Pearson correlation coefficients and their probabilities were used to compare the monthly clinical and cosmophysical parameters. Correlation coefficients with a probability of ≥95% were considered significant; coefficients with a probability of >90–96% (P=0.06–0.1) were considered strong trends.

Results

The data of Table 1 show the correlation coefficients and their probabilities for 18 categories of death (six types: total, male and female) by months of the year and by six solar and geomagnetic activity parameters. Deaths from IHD were negatively correlated with the 1- to 12-month yearly continuity and were concentrated at the beginning of the year. On the other hand, accidental and road accident deaths showed an increase in the summer, autumn and early winter months.

Deaths from IHD were positively correlated with solar activity. This relationship was especially strong in women, but did not achieve significance in men. A strong negative correlation was noted between suicide and solar activity. This relationship was the strongest statistically of all correlations. Thus, deaths from IHD increased with an increase in solar activity, while deaths from suicide decreased. Deaths from road accidents were positively correlated with geomagnetic activity.

In Table 2 are shown the correlation coefficients for deaths from IHD at ages below and above 74 years by gender. For women, practically all significant correlations with month of the year (negative) and monthly solar activity indices were obtained for the older female population (n=20763) and not those aged less than 74 years (n=6158). In men older than 74 years, we noted a stronger and more significant correlation with solar activity than in women (Table 2); this was not true for the group of less than 74 years in age; less than 50% of the men and more than 75% of the women in the population studied were more than 74 years old at death.

A similar analysis for male stroke victims showed a significant negative correlation with geomagnetic activi-

Table 1 Number and causes of monthly deaths (upper panel) and their relation to solar and geomagnetic activity in Lithuania, 1990 and 1992 (36-month data, lower panel). Values in the table indicate Pearson correlation coefficients and their probabilities. *IHD* Ischaemic heart disease, *Acc* Accidents, *Rd. Acc* Road accidents, *M* Male, *F* Female. Note: Empty cells denote non-significant correlations

Cause of death	All causes	All causes M	All causes F	IHD	IHD M	IHD F	Stroke	Stroke M	Stroke F	Acc.	Acc. M	Acc. F	Rd. Acc.	Rd. Acc. M	Rd. Acc. F	Suicide	Suicide M	Suicide F
Number of deaths	122227	64490	57737	49940	23019	26921	14259	5557	8702	9959	7776	2183	3883	2977	906	3400	2720	680
Cosmophysical parameters																		
Month (1–12)			−0.28 0.10	−0.38 0.02	−0.34 0.04	−0.38 0.02				0.35 0.036	0.35 0.03		0.52 0.001	0.53 0.0009	0.36 0.03			
Sunspot number (W)																−0.575 0.0002	−0.38 0.02	−0.56 0.0004
Solar flux 2800 MHz/10.7 cm			0.32 0.05	0.36 0.03		0.43 0.008										−0.46 0.0048	−0.51 0.0017	−0.63 0.0001
Adjusted Solar flux 2800 MHz				0.275 0.10		0.35 0.03										−0.51 0.0014	−0.44 0.0077	−0.60 0.0001
Smoothed sunspot number (R)				0.55 0.06		0.60 0.038									−0.815	−0.78 0.0001	−0.82 0.0027	0.0001
Planetary geomagnetic activity index (AP)							−0.34 0.04	−0.32 0.058	−0.31 0.068					0.29 0.08				
Mean geomagnetic activity index (AM)													0.27 0.10	0.29 0.08				

Table 2 Female and male deaths in Lithuania 1990–1992 (36-month data) from IHD and their relationship: for age groups ≤74 and >74 years (n=26921). Values are of Pearson correlation coefficient with monthly solar and geomagnetic activity (CMA) and their probabilities (*IHD* Ischaemic heart disease, *NS* not significant)

Age (years)	Month of the year	Sunspot no. (W)	Solar radioflux 2800 MHz 10.7 cm	Adjusted solar radioflux 2800 MHz, 10.7 cm	Planetary geomagnetic activity index (AP)	Mean GMA index (AM)	n
≤74 female/ male	NS	NS	NS	NS	NS	NS	6158 females 12753 males
>74 female	–0.44 P=0.007	0.335 P=0.04	0.46 P=0.005	0.385 P=0.02	NS	NS	20763
>74 Male	–0.456 P=0.005	0.281 P=0.09	0.41 P=0.01	0.342 P=0.04	NS	NS	11266

Table 3 Male deaths in Lithuania 1990–1992 (36-month data) from stroke at age 74 years (n=5557) and relationships with monthly solar and geomagnetic activity

Age (years)	Month of the year	Sunspot number (W)	Solar radioflux 2800 MHz 10.7 cm	Adjusted solar radioflux 2800 MHz, 10.7 cm	Planetary geomagnetic activity index (AP)	Geomagnetic activity index (AM)	n
≤74	NS	NS	NS	NS	–0.42, P=0.01	–0.35, P=0.036	3065
>74	NS	NS	NS	NS	NS	NS	2492

Table 4 Significant and strong trend correlation coefficients between monthly deaths from ischaemic heart disease (IHD) and suicide in Lithuania 1990–1992 (36 month data)

	Suicide		
	Total (n=3400)	Males (n=2720)	Females (n=680)
Total IHD (n=49940)	–0.47 P=0.0036	–0.44 P=0.0068	–0.445 P=0.006
Males (n=230.19)	–0.29 P=0.08	–0.273 P=0.10	–0.276 P=0.10
Females (n=26921)	–0.55 P=0.0004	–0.52 P=0.0011	–0.52 P=0.001

ty for all stroke-related deaths. This relationship was significant for men aged ≤74 years at death (n=3065), but not for those older than 74 years (n=2492; Table 3) and not for women. A significant correlation with solar activity indices for stroke-related death distribution was not found in this 36-month study.

Table 4 demonstrates the interrelationship between monthly deaths from IHD and suicide over the 36 consecutive months of the study for the entire group and for each of the sexes. There was a highly significant negative monthly distribution of deaths from IHD and suicide for the entire group and for women; a strong trend was shown for men.

Table 5 Total monthly mortality in lithuania 1990–1992; for women and men below and above age 74: correlation coefficients and their probabilities with month of the year (1–12) and solar and geomagnetic activity (GMA)

Sex	Age (years)	Month of the year	Sunspot number (W)	Smoothed sunspot number (R)	Solar radioflux (2800 MHz, 10.7 cm)	Adjusted solar radioflux (2800 MHz, 10.7 cm)	Planetary geomagnetic activity index (AP)	Mean GMA index (AM)	n
Female	≤74								24345
	>74	–0.374 0.0246			0.378 0.023	0.298 0.077			33368
Male	≤74		–0.40 0.0145	–0.41 0.0127	–0.392 0.0180	–0.405 0.0142			44531
	>74	–0.371 0.0260			0.387 0.0196	0.305 0.07			19959
Total	≤74		–0.284 0.09						68876
	>74	–0.383 0.02			0.392 0.0182	0.309 0.06			53327

The underlined correlation coefficients indicate a strong trend; the non-underlined figures are significant at >95% level. Note: Empty cells denote non-significant correlations

We made an additional calculation for the total deaths studied in Lithuania (in 1990–1992). Using the data showing no significant relationship between the physical environmental factors and the different mortality groups. The principle difference from the calculation of correlation coefficients made in Table 1 was that all victims were differentiated according to age (more and less than 74 years) and gender. The results presented in Table 5 indicate the following. (1) Monthly mortality for men aged less than 74 years was significantly and negatively correlated with solar activity. (2) Monthly mortality for both men and women aged ≥74 years was significantly correlated with solar activity and was concentrated at the beginning of the year. (3) This converse relationship with solar activity of the two age groups resulted in the absence of a significant relationship between the entire population analysed and the solar activity parameters examined.

Discussion

The present study focuses on the relationship between extremes of human behaviour/disease, namely suicide and cardiovascular disease, under different environmental conditions. A correlation was demonstrated between certain causes of death and the time of the year, solar activity, and geomagnetic activity. In an earlier study on in-hospital deaths in Israel (Stoupel and Ashkenazi, data presented at the First International Symposium on Heart Failure Mechanisms and Management, Jerusalem, Israel 1989), a circannual rhythmicity for all deaths and deaths from cardiovascular disease by month was demonstrated, although significance was not achieved for noncardiovascular deaths.

In the above study (Stoupel and Ashkenazi 1989), the maximum number of total cardiovascular deaths and deaths from myocardial infarction, stroke, and congestive heart failure were concentrated in the first 3 months of the year. Entrican and Douglas (1979) have shown a similar distribution in a study conducted in Scotland. Also in the present work, the total and female IHD-related deaths occurred mostly at the beginning of the year. In contrast, the total number of accident and road accident deaths increased with time as the year progressed, and was correlated with the month of the year (Jan–Dec; 1–12). The latter finding may well be related to climatic conditions and school/summer holidays.

In this study there was an adverse correlation to 1–12 months' yearly continuity. This shows that despite well-known differences in the respective climate of Lithuania and Israel, in both countries the highest (acrophase) of circannual IHD-related deaths occurs in the coldest time of the year: at the beginning of the year in Lithuania and at the beginning of February in Israel.

In another pertinent study in Israel (Stoupel and Shimshoni 1991), a significant, negative relationship was revealed between cardiovascular deaths and geomagnetic activity for both men and women. These results are supported by the present work and agree with the findings of a separate study showing that ventricular and supraventricular heart rhythm disturbances and paroxysmal atrial fibrillation, representing precursors of cerebral embolism, are negatively correlated with the daily level of geomagnetic activity (Stoupel et al.). On the other hand, higher diastolic arterial pressure and thrombocyte aggregation have been noted at higher geomagnetic levels (Stoupel 1980; Stoupel et al. 1990).

Mayes et al. (1993), in a study conducted in Belgium, have demonstrated a significant seasonality to certain types uf suicide. In an Israeli study, a strong antagonistic relationship between the incidence of suicide and myocardial infarction and total ischaemic disease has been found with environmental activity (Stoupel et al.). Moreover, in a cooperative European study (Ladvig et al. 1991), a relationship between affective disorders after myocardial infarction and repeated coronary events and cardiac death has been shown. In a short-term observation over 1 week of very strong geomagnetic storms, in March 1989, an increase in affective disorders, emergency medical events, and the need for related ambulance and psychiatric services has been noted, accompanied by a drastic decrease in suicide (E. Stoupel, data presented at the 2nd International Symposium on Serotonin, Houston, Texas, USA, 1992). A strong correlation between solar activity and first admission of psychiatric patients (1991) has also been reported (Rapps et al. 1993). Considered altogether, these findings lead to the hypothesis that the strong negative relationship between deaths from suicide and ischaemic heart events may be the result of different changes in serotoninergic regulation as triggered by environmental physical activity.

A further important result of the present work is that a clear gender difference emerged. For total and IHD-related deaths, mortality among the female population was correlated much more strongly with solar activity than in our earlier study (Stoupel et al. 1993; Stoupel et al., data presented at the Annual Meeting of the Israel Heart Association, Tel Aviv, Israel 1994), and corresponding to the relationship between death from IHD in the total population. For deaths from stroke, however, a significant negative correlation with geomagnetic activity was seen only for males aged less than 74 years. The negative relationship between stroke-related admissions and GMA level is also in accordance with the results of a smaller study (Stoupel et al. 1995) demonstrated for the day of occurrence of stroke. The correlation held only for male patients aged less than 65 years, and applied also to the distribution of episodes of paroxysmal atrial fibrillation, sometimes a precursor of cerebral embolism.

These findings are in agreement with our earlier observation of gender differences in the response to solar and geomagnetic activity levels with regard to epileptic seizures, cerebrovascular events and dizziness (Stoupel et al. 1991). Apparently such differences also exist for deaths from IHD and stroke. This raises the question of whether the gender differences in deaths in general and deaths due to IHD and stroke are a consequence of the differences in male and female longevity.

When all deaths were considered together (n=57737 women and n=64490 men), we found that 57.79% occurred in women aged 74 years or more and 30.94% in men of the same age group. For deaths from ischaemic heart disease (n=26921 women and 23019 men), 77.3% occurred in women more than 74 years old and 48.94% in men; the differences a mounted to 27% and 28% respectively (p<0.001). Regarding stroke (n=8702 women, 5557 men), the corresponding values were 65.34% and 44.93% (20% difference, P<0.001). The age differences between patients (men and women) who died from IHD explains the strong relationship with solar activity of the total female deaths from IHD, most of which occurred after age 75 years. The above explanation also provides for the absence of such strong links in the male group, in which most IHD-related deaths occurred before age 75.

In our previous study we stressed that many physiological parameters tend to fluctuate only slightly (8-10%) in response to changing solar or geomagnetic activity. We believe that patients who are already physically or emotionally ill or elderly tend to react more strongly to physical environmental changes than the rest of the population. Owing to medical advances enabling the possibility of a longer life-span, we now have a growing number of senior citizens who, because of their old age, may be more sensitive to environmental changes. Thus, the stronger and more prominent relationship with changing solar activity for total deaths and deaths from IHD in women may be at least partly explained by the higher life expectancy of women.

However for stroke-related deaths, despite the significantly higher mortality age in women, the relationship with geomagnetic activity was strong and significant for men, but only for the group below the age of 74. Therefore, in this case, other gender-specific factors must be involved (atherosclerosis, arrhythmias, coagulation, arterial pressure, alcohol consumption, etc.). This is yet another confirmation that men and women are different in their reaction to the environment.

In conclusion, the present work indicates the following:

1. Time of the year, solar activity, and geomagnetic activity are significantly related to monthly death distribution, especially regarding deaths from IHD and suicide in Lithuania.

2. Age and gender differences are apparent in the relationship between death distribution and physical environmental factors.

3. The monthly distribution of deaths from IHD and suicide are negatively correlated with solar activity and with each other.

4. Differences in serotoninergic environmental influences may be presumed.

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