

Monthly Deaths Number and Concomitant Environmental Physical Activity: 192 Months Observation (1990-2005)

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Abstract. Human life and health state are dependent on many endogenous and exogenous influence factors. The aim of this study is to check the possible links between monthly deaths distribution and concomitant activity of three groups of cosmophysical factors: solar (SA), geomagnetic (GMA) and cosmic ray (CRA) activities. 192 months death number in years 1990-2005 (n=674004) at the Republic of Lithuania were analyzed. Total and both gender data were considered. In addition to the total death numbers, groups of ischemic heart disease (IHD), stroke (CVA), non-cardiovascular (NCV), accident, traffic accident and suicide-related deaths were studied. Sunspot number and solar radio flux (for SA), A_p , C_p and A_m indices (for GMA) and neutron activity on the Earth's surface (for CRA) were the environmental physical activity parameters used in this study. Yearly and monthly deaths' distributions were also studied. Pearson correlation coefficients (r) and their probabilities (p) were calculated. Multivariate analysis was conducted. Results revealed: 1) significant correlation of monthly deaths number with CRA (total, stroke, NCV and suicides) and inverse with SA and GMA; 2) significant correlation of monthly number of traffic accidents number with SA and GMA, and inverse with CRA; 3) a strong negative relationship between year and IHD/CVA victims number (an evidence for growing role of stroke in cardiovascular mortality); 4) significant links of rising cardiovascular deaths number at the beginning of the year and traffic accidents victims at the end of the year. It is concluded that CRA is related to monthly deaths' distribution.

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"Probably the most powerful single assumption that contributes to the progress of biology is the assumption that everything from animals to the atoms can do, that the things that are seen in the biological world are the results of the behavior of physical and chemical phenomena with no "extra something".

R. Feinmann. *The Character of Physical Law* [1]

Introduction

Human homeostasis is regulated not only by endogenic but also by exogenic influences. In recent years many studies were published describing links between human physiology and pathology, and the level of environmental physical activity. The progress in space exploration, the modern possibilities to monitor and computerize accumulated data in biology and medicine, and concomitant cosmophysical factors measurements justify fresh attempts to analyze the role of cosmophysical activity in the human life, health and death.

The aim of this study was to compare monthly deaths' distribution with accompanying Solar (SA),

Geomagnetic (GMA) and Cosmic Ray (CRA) activity levels at the end of the XX and beginning of the XXI centuries.

Material

Distribution of deaths in 192 consecutive months (1990 - 2005) in the Republic of Lithuania served as the medical background for this study. 674004 deaths were included in this comparative analysis. The data came from the Central Statistical Authority of this country. The physical data was accumulated from the NOAA Geophysical Data and Space Service Centers, USA, IZMIRAN, Russian Academy of Sciences, Oulu University Neutron Monitoring Station at Oulu University, Finland.

We compared the monthly total number of deaths (n=674004, 356419 men), deaths from ischemic heart disease (IHD) (n=240958, 110543 men), stroke (CVA) (n=81162, 30634 men), non-cardiovascular (NCV) deaths - an artificial group describing the number of total deaths and excluding those from IHD and CVA

($n=351884$, 215242 men), deaths related to accidents ($n=60951$, 47360 men) and to traffic accidents ($n=15699$, 11993 men), suicide victims ($n=23682$, 19426 men) and, also, the ratio of deaths from the two big cardiovascular killers - IHD and CVA (IHD/CVA).

For SA the following parameters were used: sunspot number SSN (absolute and smoothed) and solar radio flux at 10.7 cm wavelength F10.7 (absolute and adjusted) [2 - 6]. For GMA, monthly values of Ap, Cp and Am indices were used [2 - 6]. CRA was described by the neutron activity at the Earth's surface (*imp/min*, remains of atoms broken by CRA in the high levels in the surrounding space) [6 - 9].

Statistical Methods

Pearson correlation coefficients r and their probabilities p between the compared death groups and considered physical activity parameters were calculated. Multifactor predictive analysis was also carried out. Probabilities of 95% and higher were described as significant ones meanwhile those of 90-94% - as strong trends to the significance.

Results

Table 1 presents "Part 1" of the results of study for the total deaths as well as for IHD, CVA and IHD/CVA-ratio for both gender together and separately for each (male and female).

Table 2 includes "Part 2" of the results for data for non-cardiovascular deaths, accidents, traffic accidents and suicide (also for total number and for each gender).

Table 3 presents the multivariate analysis of the results of this study as a basis for possible events' prediction according to the level of environmental physical activity.

For the total, non-cardiovascular and some other death groups (i.e., accidents, suicides and stroke) there was found a significant relationship with CRA and, inverse, with SA.

The number of deaths for IHD group was significantly dropped yearly and concentrated at the first months of the year. The relationship with the physical factors did not achieve significant levels. It will be discussed in the next paragraph of this paper. A significant yearly drop was found for IHD/CVA-ratio; this parameter is also related to the monthly level of GMA. Number of traffic accidents' victims showed correlation with SA, GMA and, inverse, with CRA. Also a significant yearly drop of number was evident.

Discussions

Human life from the first steps is affected by external influences [10 - 24]. In recent studies it was shown that such effects are involved in the pathogenesis of chromosome abnormalities-related diseases, congenital anomalies, fetal growth, pathology of pregnancy, number of newborns, hormone secretion, immunologic changes, blood coagulation, inflammation markers, arterial and intraocular pressure, behavioral extremes, like homicide and suicide, a wide spectrum of vascular pathologies, like migraine attacks, angina pectoris, myocardial infarction, stroke in general and their subtypes [25 - 33].

The physical factors discussed in this study are interrelated in different manner. SA and GMA are

connected, and their temporal fluctuations are correlated. In a long term analysis their correlation index was 0.4 (probability $p = 0.001$) [34 - 36].

The CRA was inversely related to SA ($r = -0.74 \pm 0.9$, $p < 0.0001$ in 312 months) and GMA ($r = -0.58$, $p < 0.0001$ in 132 months) in the middle latitudes, and closely connected to high energy ($> 90 - 100$ MeV) space proton flux ($r = 0.93$, $p < 0.0001$ in 107 consecutive months) [34, 36]. The origin of CRA is discussed and its extragalactic occurrence is considered to be one of the possible explanations of the extreme energies measured in some of their fractions that cannot be, partially, explained by the existing physical laws if their origin is accepted as intragalactic one [37, 38].

The account of CRA is measured by neutron monitoring at the Earth's surface in *impulses per minute*. The neutrons are remains of atoms crashed by CRA in the high surroundings of our planet. The SA and GMA are natural shields defending the close surroundings of the Earth from such annihilating effects of CRA [2, 37, 38]. Some medical-biological phenomena are more affected by SA and GMA meanwhile others - by CRA (neutron activity) [25, 26, 28, 31-36, 39-41]. In 1975 a study denying solar activity influence on mortality in the USA was published [42].

In our opinion, a special attention deserves the group of deaths from IHD. This group of deaths' distribution doesn't show significant correlation with most of compared physical parameters. It is a complex group, including many subgroups with different links to GMA, SA and CRA, etc. For instance, sudden cardiac deaths (SCD) with agony time limit of 1 hour and more than 1 to 24 hours have in most cases different pathogenesis and, also, different relationships with the daily levels of GMA [43-49]. Arterial blood pressure, blood coagulation [22, 29, 32, 34], C-reactive protein - an important inflammation marker with strong links to cardiovascular pathology, morbidity and mortality [50] are rising with higher levels of GMA.

Occurrence of acute myocardial infarction (AMI) and all subtypes are related to higher CRA (neutron activity) and also increased at days of extremely high (stormy) levels of GMA [31, 35, 36, 46]. But geomagnetically stormy days take place in the middle latitudes 3-6% days yearly, and, as a consequence, most acute coronary events are occurring in lowest GMA levels and high CRA (neutron activity) and space proton flux periods [34, 36, 40, 44-46, 49].

This multidirectional connection with environmental physical activity of the ingredients of IHD-related deaths, in our opinion, explains the non-significant relationship of IHD-related deaths with each of the compared physical factors.

In the multifactor analysis the picture is different: five parameters (GMA - only for woman) are included in the prediction model that is highly significant ($p < 0.0001$).

The results for other groups of monthly deaths distribution are reflecting different aspects of interaction of external physical factors with physical and psychoneurologic functioning of the human organism (accidents, traffic accidents and suicides).

It is clear that such seasonal and other factors like road conditions, traffic intensity and temperature play

TABLE 1

Monthly Deaths Number and Cosmophysical Activity: Pearson Correlation Coefficients and their Probabilities (shown in brackets); 192 Consecutive Months Data, Lithuania, 1990 - 2005 (Part 1) (M - male, F - female, N.S. - non-significant)

PARAMETERS	Sunspot Number	Smoothed Sunspot Number	Solar Radio Flux (F10.7)	Adjusted Solar Radio Flux	GMA Indices			Cosmic Ray Activity (Neutron Monitoring)	Year (1990 - 2005)	Months (1 - 12)	Deaths Number	
					Ap	Cp	Am					
Total Deaths	All	-0.31 (<0.0001)	-0.29 (<0.0001)	-0.24 (0.0007)	-0.28 (<0.0001)	N.S	N.S	N.S	0.28 (0.0001)	N.S	-0.18 (0.016)	674004
	M	-0.4 (<0.0001)	-0.39 (<0.0001)	-0.36 (<0.0001)	-0.39 (<0.0001)	N.S	N.S	N.S	0.35 (<0.0001)	-0.12 (0.098)	N.S	356419
	F	-0.19 (0.007)	-0.16 (0.02)	N.S	-0.15 (0.04)	N.S	N.S	N.S	0.18 (0.01)	N.S	-0.25 (0.0005)	317585
IHD	All	N.S	N.S	N.S	N.S	N.S	0.15 (0.04)	0.12 (0.09)	N.S	-0.42 (<0.0001)	-0.25 (0.0005)	240958
	M	N.S	N.S	N.S	N.S	0.13 (0.08)	0.18 (0.01)	0.16 (0.02)	N.S	-0.46 (<0.0001)	-0.18 (0.01)	110543
	F	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	-0.37 (<0.0001)	-0.29 (<0.0001)	130415
Stroke (CVA)	All	-0.2 (0.0045)	-0.185 (0.01)	N.S	-0.155 (0.03)	N.S	N.S	N.S	0.19 (0.008)	0.22 (0.003)	-0.24 (0.0007)	81162
	M	-0.17 (0.015)	-0.16 (0.02)	N.S	-0.14 (0.05)	N.S	N.S	N.S	0.14 (0.058)	N.S	-0.22 (0.0024)	30634
	F	-0.19 (0.007)	-0.17 (0.01)	N.S	-0.14 (0.05)	-0.15 (0.03)	N.S	N.S	0.2 (0.006)	0.24 (0.001)	-0.22 (0.0019)	50528
IHD/CVA	All	0.12 (0.09)	0.16 (0.03)	N.S	N.S	0.24 (0.001)	0.27 (0.0002)	0.24 (0.001)	N.S	-0.74 (<0.0001)	N.S	
	M	N.S	0.13 (0.07)	N.S	N.S	0.21 (0.003)	0.24 (0.0006)	0.21 (0.004)	N.S	-0.64 (<0.0001)	N.S	
	F	N.S	0.16 (0.02)	N.S	N.S	0.21 (0.003)	0.24 (0.0009)	0.21 (0.003)	N.S	-0.69 (<0.0001)	-0.13 (0.06)	

also a significant role [13, 14]. Social cataclysms are also serious parts in the whole picture of deaths' distribution.

The annual rhythmicity of all presented here death groups' timing was presented by other authors [12-14] and in our previous publication [51], represented in this study by year and month of the year (1-12). The role of time of the year is different for different death groups and has different weights for men and woman.

The inverse relationship between GMA and suicide (an often consequence of depression) became some practical use: magnetic fields are invented as a treatment of patients with severe forms of depression [52, 53].

Special attention was given to dynamics of deaths from IHD and CVA. As it is shown in Table 1, despite the still leading numbers of death from IHD, their ratio is strongly and inversely related to years of the study. It means that we have a concomitant drop of monthly deaths number from IHD and an inverse dynamics for stroke-related deaths. The progress in prevention and treatment of coronary heart disease in the last years, an accompanying growing age of the population make cerebral stroke a more and more burning medical and social problem.

TABLE 2

Monthly Deaths Number and Cosmophysical Activity: Pearson Correlation Coefficients and their Probabilities (shown in brackets); 192 Consecutive Months Data, Lithuania, 1990 - 2005 (Part 2) (M - male, F - female, N.S. - non-significant)

PARAMETERS		Sunspot Number	Smoothed Sunspot Number	Solar Radio Flux (F10.7)	Adjusted Solar Radio Flux	GMA Indices			Cosmic Ray Activity (Neutron Monitoring)	Year (1990 - 2005)	Months (1 - 12)	Deaths Number
						Ap	Cp	Am				
Non-cardiovascular causes	All	-0.437 (<0.0001)	-0.45 (<0.0001)	-0.378 (<0.0001)	-0.393 (<0.0001)	N.S.	N.S.	N.S.	0.37 (<0.0001)	0.26 (0.0002)	N.S.	351884
	M	-0.535 (<0.0001)	-0.55 (<0.0001)	-0.507 (<0.0001)	-0.52 (<0.0001)	N.S.	N.S.	N.S.	0.47 (<0.0001)	0.17 (0.01)	N.S.	215242
	F	-0.236 (0.014)	-0.24 (0.0013)	-0.152 (0.04)	-0.17 (0.02)	N.S.	N.S.	N.S.	0.18 (0.014)	0.32 (<0.0001)	N.S.	136642
Accidents	All	-0.31 (<0.0001)	-0.234 (0.0016)	-0.23 (0.0015)	-0.23 (0.001)	N.S.	N.S.	N.S.	N.S.	0.5 (<0.0001)	0.16 0.03	60951
	M	-0.2 (0.007)	-0.29 (<0.0001)	-0.22 (0.0018)	-0.15 (0.04)	N.S.	N.S.	N.S.	N.S.	0.48 (<0.0001)	0.17 (0.02)	47360
	F	-0.23 (0.002)	-0.3 (<0.0001)	-0.22 (0.0024)	-0.164 (0.027)	N.S.	N.S.	N.S.	N.S.	0.49 (<0.0001)	0.12 (0.1)	13591
Traffic Accidents	All	0.25 (0.0006)	0.23 (0.0015)	0.17 (0.02)	0.18 (0.01)	0.18 (0.01)	0.16 (0.03)	0.17 (0.02)	-0.16 (0.03)	-0.45 (<0.0001)	0.54 (<0.0001)	15699
	M	0.52 (0.0004)	0.23 (0.0014)	0.18 (0.01)	0.17 (0.02)	0.21 (0.004)	0.18 (0.01)	0.19 (0.009)	-0.17 (0.02)	-0.44 (<0.0001)	0.55 (<0.0001)	11993
	F	0.17 (0.02)	0.17 (0.02)	0.12 (0.1)	0.121 (0.1)	N.S.	N.S.	N.S.	N.S.	-0.36 (<0.0001)	0.47 (<0.0001)	3706
Suicides	All	-0.31 (<0.0001)	-0.4 (0.0001)	-0.38 (<0.0001)	-0.34 (<0.0001)	-0.14 (0.05)	-0.18 (0.01)	-0.19 (0.01)	0.33 (<0.0001)	0.15 (0.039)	N.S.	23682
	M	-0.32 (<0.0001)	-0.4 (<0.0001)	-0.37 (<0.0001)	-0.33 (<0.0001)	-0.12 (0.1)	-0.16 (0.03)	-0.17 (0.02)	0.34 (<0.0001)	0.16 (0.02)	N.S.	19426
	F	-0.22	-0.25	-0.29	-0.25	-0.17	-0.21	-0.21	0.24	N.S.	N.S.	4256

We discussed some explanation for the absence of significant correlation between monthly deaths number from IHD and cosmophysical factors, explaining it by different links with them by separate forms of pathology included in this group. As an additional support for this presumption can be the result of our multivariate analysis for this group of patients within prediction model represented in Table 3 when we obtain results of very high probability for IHD-related deaths considering all physical factors in complex.

Conclusions

Despite the progress in prevention and treatment of diseases, monthly number of deaths is linked (totally and in groups of principal death causes) to environmental physical activity.

In addition to solar and geomagnetic activity, inverse to them monthly cosmic ray (neutron) activity plays a substantial role in these relationships.

Deaths from cerebral stroke (CVA) are rising as one of the leading causes of cardiovascular mortality.

TABLE 3

Prediction of Monthly Deaths Distribution Links with Environmental Physical Activity; 192 Consecutive Months Data, Lithuania, 1990 - 2005 (* - only for female)

Medical Parameters (Deaths)	Statistical variables	Intercept	Year	Month	Sunspot Number	Solar Radio Flux (F10.7)	GMA index Ap	Cosmic Ray Activity
Total	Estimate	2340.837	-	-18.88	-6.465	6.71	10.066	23.51
	Standard error	1060.827	-	7.044	1.967	1.74	4.828	4.609
	p-value	0.0289	-	0.008	0.0013	0.0002	0.0388	<0.0001
IHD	Estimate	71735	-35.395	-14.669	-5.9445	5.375	7.15 *	-
	Standard error	7337.407	3.685	3.745	1.002	0.968	1.497 *	-
	p-value	<0.0001	<0.0001	0.0001	<0.0001	<0.0001	<0.0001 *	-
Stroke	Estimate	-45.567	-	-3.694	-0.685	1.143	-	2.1
	Standard error	134.505	-	1.05	0.294	0.257	-	0.686
	p-value	0.735	-	0.0006	0.02	<0.0001	-	0.0026
Non-cardiovascular	Estimate	-21301	11.01	-	-2.408	1.519	6.57	0.11
	Standard error	7137.415	3.51	-	1.05	0.977	2.506	0.05
	p-value	0.0033	0.002	-	0.023	0.12	0.0096	0.03
Accidents	Estimate	-13667	7.43	3.723	-0.69	-	-	4.476
	Standard error	3330.494	1.698	1.56	0.26	-	-	1.109
	p-value	<0.0001	<0.0001	0.0183	0.0089	-	-	<0.0001
Traffic Accidents	Estimate	6972.289	-3.464	4.33	0.318	-0.189	-	-
	Standard error	868.146	0.436	0.443	0.118	0.114	-	-
	p-value	<0.0001	<0.0001	<0.0001	0.0081	0.1	-	-
Suicide	Estimate	-7595	3.904	-	0.6006	-0.86	-	-
	Standard error	1105	0.55	-	0.15	0.14	-	-
	p-value	<0.0001	<0.0001	-	0.0001	<0.0001	-	-

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