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CIRCANNUAL AND CIRCADECENNIAN CHANGES IN MORTALITY FROM CARDIOVASCULAR CAUSES IN TBILISI, REPUBLIC OF GEORGIA (1980–1992)

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A b s t r a c t

The time structure (chronome) of mortality from cardiopathology in Tbilisi, Republic of Georgia, was assessed and examined for any influence by natural environmental factors, including geomagnetic activity. Monthly and daily mortality data, covering the span from January 1, 1980, to December 31, 1992, were analysed chronobiologically. In addition to an anticipated weekly variation and a prominent circannual variation, an about 10.5-year cycle was found to characterise cardiovascular mortality. The results were similar to those obtained for mortality from myocardial infarction in Minnesota from 1968 to 1996.

K e y w o r d s

Circannual rhythm, Circadecennian rhythm, Cardiovascular mortality, Asian population, Geomagnetic activity

INTRODUCTION

As the sampling rate and duration of biological records broaden the scale of possible investigations, more and more chronome (*1, 2*) components can be mapped. Chronomics is focused on deterministic (and other) chaos, multi-frequency periodicities and trends characterising both endpoints of rhythms and chaos. Multidisciplinary research has also revealed the presence of ubiquitous chronomes, not only in biology but also in natural physical variables. New evidence has accumulated showing that non-photic solar, galactic or other cosmic effects, such as those related to geomagnetic disturbances, affect biota in a way similar to influences by photic solar effects, such as light intensity and environmental temperature. This study investigates any association of natural environmental factors with mortality from cardiovascular causes in Tbilisi, Republic of Georgia, between 1980 and 1992.

MATERIALS AND METHODS

Mortality due to cardiopathology in Tbilisi was recorded daily from January 1, 1980, to December 31, 1992. A number of environmental variables were recorded concomitantly, including the equivalent-effective temperature and different indices of geomagnetic disturbance and solar activity. The data were analysed by the Halberg cosinor rhythmometry (*3, 4*).

RESULTS

Cardiovascular mortality correlated with the equivalent-effective temperature. This is a measure of perceived temperature related to air temperature, humidity and wind speed. Both variables (cardiovascular mortality and equivalent-effective temperature) were characterised by a prominent circannual variation. In addition to the circannual component, monthly values were characterised by an about 10.5-year cycle, validated by non-linear least-square analysis (*5–7*), as illustrated in *Fig. 1*. Its 95% confidence interval was similar to that characterising solar activity, gauged by Wolf's relative sunspot number (*Table 1*).

In the data on cardiovascular mortality, a weekly component was demonstrated with statistical significance ($P<0.001$). The 7-day component had a relative amplitude of 4.4% (95% CI: 2.9; 5.9) and an acrophase of -123° (95% CI: 103; 143) (Tue AM). A second harmonic, with a period of 3.5 days contributing to the waveform of the weekly rhythm ($P=0.058$), had a relative amplitude of 1.8% and an acrophase of -194° (Mon PM and Fri AM).

Table 1

Time structure of cardiovascular mortality in Tbilisi (1980–1992) related to natural environmental variables (magnetic disturbance and solar activity)

Variable	Period (years) (95%CI)	Amplitude (95% CI)	Acrophase (95%CI)
CVD (N)	9.4 (6.0; 12.8)	7.56 (1.43; 13.69)	
	3.4 (3.0; 3.8)	7.25 (1.17; 13.33)	
	1.0 (fixed)	18.99 (13.03; 24.96)	-22° (-0; -45) Jan 23
Number	11.1 (6.8; 15.4)	0.81 (0.05; 1.58)	
of MD (A)	0.5 (fixed)	0.69 (-0.04; 1.42)	-135° (-90; -225) 10 Mar & 10 Sep
Duration	10.8 (7.7; 13.8)	51.37 (13.16; 89.57)	
of MD (days)	0.5 (fixed)	33.50 (-2.74; 69.75)	-135° (-90; -225) 10 Mar & 10 Sep
Solar activity	9.5 (9.1; 9.9)	74.32 (66.64; 82.01)	
(Wolf numbers)			

CVD, cardiovascular disease mortality; MD, magnetic disturbances; CI, confidence interval.

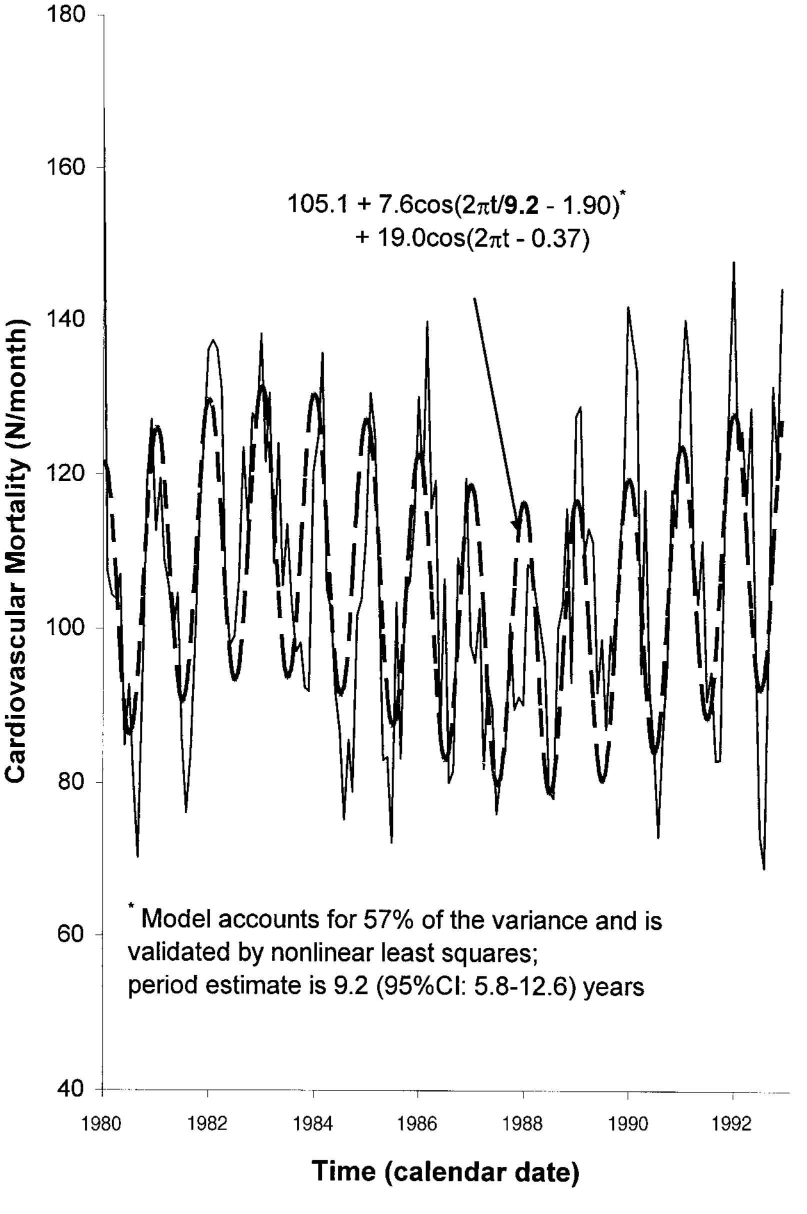

Fig. 1

Circannual and circadecennian changes in mortality from cardiovascular causes in Tbilisi, Republic of Georgia, from 1980 to 1992.

DISCUSSION

The time structure of mortality from cardiopathology in Tbilisi, as reported in this study, was similar to that of mortality from myocardial infarction in Minnesota investigated over 29 years (1968–1996) (*8*). The major components characterising mortality from myocardial infarction in Minnesota include an about 10.5-year cycle in addition to prominent about-yearly and about-weekly variations. In Tbilisi, the relative prominence of the weekly component was found to be modulated by the solar activity cycle, in agreement with papers published previously (*9, 10*). A corresponding finding has also been reported for self-measurements of heart rate in the USA (*11*).

Generally, in this computer era, the proper monitoring of natality, morbidity and mortality and other data, such as homicide records, is relatively cheap and highly informative, when done as densely as possible and certainly on an hourly basis, and should be the law of the land worldwide. Specifically, remove-and-replace approaches are mandatory to examine the prominence and other characteristics at shared or near-matching frequencies of circadecadal and other biospheric and environmental cycles.

A c k n o w l e d g e m e n t s

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CIRKANUÁLNÍ A CIRKADECENIANNÍ ZMĚNY V ÚMRTNOSTI NA KARDIOVASKULÁRNÍ CHOROBY V TBILISI, GRUZIE (1980–1992)

S o u h r n

Časové struktury (chronomy) kardiovaskulární mortality v Tbilisi, Grizie, byly stanoveny a byly zjišťovány vlivy přirozených faktorů zevního prostředí, včetně geomagnetické activity. Měsíční a denní údaje o mortalitě, za období od 1.1. 1980 do 31. 12. 1992, byly chronobiologicky analyzovány. Kromě týdenního a ročního kolísání byl nalezen cyklus deseti a půl let, který charakterizuje kardiovaskulární mortalitu. Naše výsledky byly podobné údajům o mortalitě na infarct myokardu v Minnesotě v období 1968 až 1996.

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