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INCREASE IN STROKE DEATHS AFTER 1997 IN THE CZECH REPUBLIC

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A b s t r a c t

Yearly mortality data on stroke in the Czech Republic, recorded from 1950 to 1999, were analysed. About 50- and 21-year cycles were suggested, regardless of whether all data were considered or whether they were analysed for men and women separately. After detrending, a self-starting cumulative sum (CUSUM) control chart showed an increase in stroke deaths that took place around 1997. These results are in keeping with similar findings in four other geographic locations. They warrant a renewed effort toward stroke prevention. Ambulatory monitoring of blood pressure and heart rate in the general population is a useful tool to detect and correct certain abnormalities of the circadian pattern of these variables which have been associated with large increases in stroke risk, even in conventionally normotensive subjects.

K e y w o r d s

Stroke, Yearly mortality, Czech Republic

INTRODUCTION

Morbidity and mortality from stroke and other cardiovascular events have long been shown to follow non-random circadian and circannual patterns (*1–12*). Most of the epidemiological studies reveal a morning peak at the onset of stroke and its higher occurrence in winter than in summer in temperate regions. About-weekly and half-weekly patterns in stroke incidence have also been documented (*11, 13–21*). Differences in timing have been reported in relation to different disease aetiologies (*14*). For instance, the incidence of strokes associated with subarachnoidal haemorrhage differs in its circadian and circaseptan timing from that of lacunar infarctions and other kinds of strokes (*14*). The incidence of strokes associated with a cardiac embolus also differs in its circannual timing from that of strokes associated with large vessel disease (*14*). In general, strokes tend to occur preferentially on Mondays (*13*).

Mortality from myocardial infarction in Minnesota has also been shown to undergo an about 10.5-year cycle, similar to the solar activity cycle (*22, 23*).

During years of maximal solar activity, there is an excess of 220 myocardial infarction deaths per year as compared to years of minimal solar activity, representing a 5% change in mortality (*22, 23*). This study investigates whether long-term changes also characterise stroke deaths in the Czech Republic.

MATERIALS AND METHODS

Yearly mortality from stroke in the Czech Republic was recorded from 1950 to 1999. Only total mortality data were analysed, in view of changes in disease classification during the span covered, and not deaths in subcategories such as subarachnoid *vs*. intracerebral haemorrhage or occlusion of cerebral arteries. The data on overall mortality and for each gender separately were analysed by least-squares spectra (*24*), with frequencies in the range of one to 11 cycles per 52.5 years. The choice of the fundamental period, slightly longer than the observation span, stems from the desirability to include a trial period of 10.5 years, the average solar cycle length for the span under study. In view of a prominent about 50-year cycle, analyses were repeated on the residuals from this long-term trend and from a third-order polynomial. Components corresponding to spectral peaks were further assessed by nonlinear rhythmometry (*24,25,26*).

RESULTS

The time course of stroke deaths is illustrated in *Fig. 1*. A prominent about 50-year cycle was validated nonlinearly (*Table 1)*. After removing this major component, an about 21-year cycle was suggested, but reached only borderline statistical significance (*Table 1*). In view of the non-sinusoidal waveform of the about 50-year cycle, a third-order polynomial was fitted to the data. Residuals, shown in *Fig. 2*, were analysed by self-starting CUSUM, a control chart procedure (*27*). When the last 8 years were considered, an increase in stroke deaths was detected in 1999. From these data it is derived that stroke mortality increased from 1997 to 1999.

DISCUSSION

With the qualification that there have been changes in the classification of mortality from stroke, a non-monotonic trend over the past 50 years has been documented both in the Czech Republic and in Minnesota (*23, 28*). This result raises the question whether the decline in stroke during the past two decades cannot be accounted for, at least in part, by a natural about 50-year cycle. Of course, one should not use 50 years of data to discuss an about 50-year periodicity (*29*), unless there is collateral evidence. The historical case of Mark Beaufoy, an artillery colonel who provided data for one cycle before Samuel Heinrich Schwabe's discovery of the sunspot cycle, is illustrative. Beaufoy's data permitted the documentation in geomagnetics of the same cycle length that was found subsequently in sunspots (*30, 31*) and was further confirmed for the Schwabe cycle (*32*) in a perspective of centuries.

In the case of a recent increasing trend in stroke deaths, there is corroborating evidence from other studies. An upward trend in stroke mortality has been

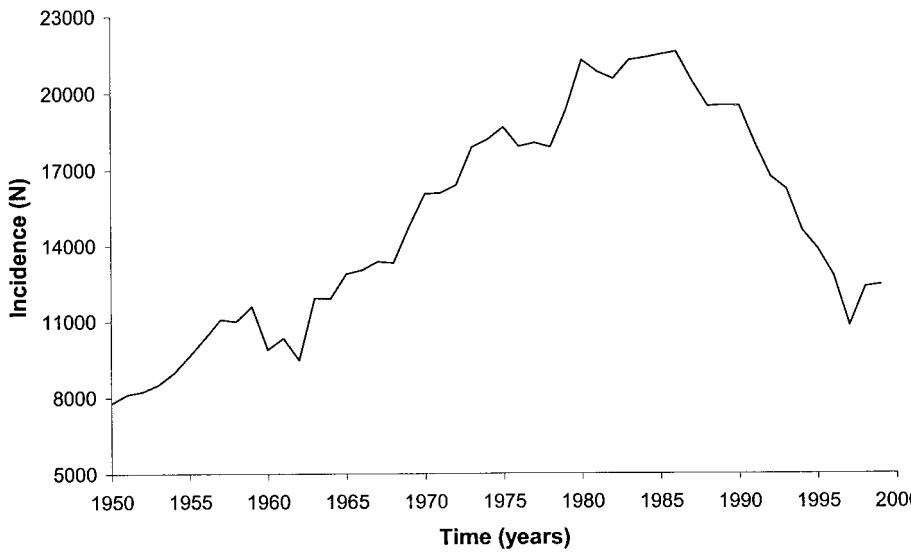

Fig. 1
Incidence of strokes in the Czech Republic (1950–1999).

Table 1

Nonlinear estimation of about 50- and 21-year cycles in stroke mortality

Data set	Period (years) (95% confidence interval)	Double amplitude (N)
Original data:		
Men	53.3 (49.4; 57.9)	46.1 (39.9; 52.3)
Women	55.0 (51.3; 59.4)	71.3 (62.9; 79.8)
All	54.3 (50.6; 58.7)	117.3 (102.9; 131.8)
Residuals from about 50-year cycle:		
Men	21.3 (17.1; 27.4)	15.1 (1.7; 28.4)*
Women	21.4 (16.8; 27.9)	22.5 (1.7; 43.2)*
All	21.4 (17.0; 27.7)	37.5 (3.5; 71.5)*

*One-parameter limits (lower limit of nonlinear interval overlaps zero).

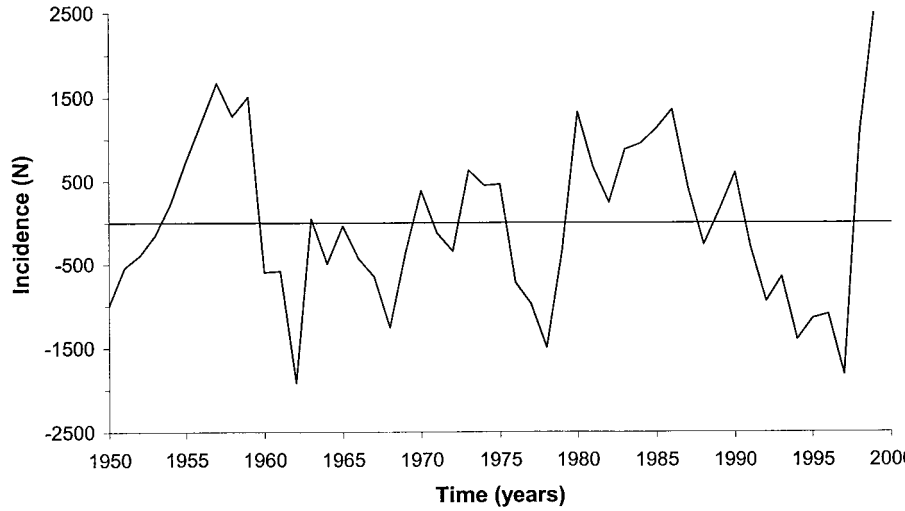

Fig. 2
Stroke incidence in the Czech Republic. Residuals from the third order of a polymonial.

observed in most recent years not only in the Czech Republic and in Minnesota, but also in Slovakia (*33*), Lund, Sweden (*34*), and Arkansas (*28*).

While treatment and public education are very important to limit the incidence of strokes, the decrease seen after 1985 may not only be a response to changes in patient management but may also, at least in part, represent a response to environmental influences characterised by very-low-frequency components, such as a circasemicentennial cycle that needs replications not only in different geographic locations but also over several longitudinal cycles before qualifying as a rhythm. The recent identification of an excessive circadian blood pressure amplitude, as well as of a deficit in heart rate variability, as independent additive features of a risk syndrome for stroke and other vascular morbidity (*22, 35*), should prompt systematic monitoring of the population. Since conditions of altered variability can be transient (*36*), a minimal 7-day monitoring is recommended for screening. The implementation of this task is facilitated by an offer, made by the industry, of a 90% decrease in the cost of ambulatory blood pressure monitors for participants in the BIOCOS project that aims at stroke prevention. The Ministry of Health of the Czech Republic fully endorses this goal that is now implemented, as the routine 7-day monitoring of blood pressure and heart rate, at St. Anne's Teaching Hospital of Masaryk University in Brno.

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ZVÝŠENÍ POČTU ÚMRTÍ NA CÉVNÍ MOZKOVOU PŘÍHODU PO ROCE 1997 V ČESKÉ REPUBLICE

S o u h r n

Byly analyzovány údaje o roční mortalitě v důsledku mrtvice v České republice zaznamenávané od roku 1950 do roku 1999. Uvádějí se cykly v délce trvání asi 50 a 21 let, ať jsou uvažovány všechny údaje nebo jsou analyzovány samostatně pro muže a ženy. Kolem roku 1997 došlo ke zvýšení počtu úmrtí na mrtvici. Tyto výsledky jsou v souladu s podobnými nálezy ve čtyřech jiných zeměpisných lokalitách a zdůvodňují obnovenou snahu o prevenci mrtvice. Ambulantní monitorování krevního tlaku a srdeční frekvence u široké veřejnosti je užitečné pro zjišťování a nápravu určitých abnormalit cirkadiánního průběhu těchto proměnných, které byly spojovány s výrazným zvýšením rizika mrtvice i u normotenzivních osob.

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