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SHORT REPORT

Cyclic patterns of cancer incidence in males by body site: data from the USA for the period 1973-1989

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Summary

Purpose: *A descriptive epidemiological study on the incidence of 5 different cancers in males from the USA over an interval of 17 years was performed in order to analyze patterns of cyclic variations in incidence rates.*

Materials and methods: *Data were taken from the Cancer Statistics Review. Incidence data were presented as time series of annual rates per 100,000 (age-adjusted to the 1970 U.S. standard population).*

Results: *Cyclic patterns of variations in incidence rates were identified and different cycles revealed: cancer of the brain and other nervous system (ICD9, Dx:191) -- period T = 9 years; cancer of the stomach (Dx:151) -- T = 8.75 years; cancer of the colon (Dx:153) -- T = 8 years; cancer of the rectum (Dx:154) -- T = 5.25 years; and cancer of the testis (Dx:186) -- T = 3 years.*

Conclusion: *The results from this study confirm cyclicity in incidence variations for different cancers. A specific pattern of cyclicity in variations of cancer incidence (length of the cycle upon the site of the human body) is speculated at least in males, and a hypothesis for downward dependence of cyclicity upon the particular site of the cancer is presented.*

Key words: body site, cyclicity, downward pattern, US cancer incidence, variations

Introduction

Cancer is a disease of multifactorial origin. It has been suggested that different carcinogenic factors during early ontogenesis might act as either initiators or promoters or both [1] although cancer itself appears later in adult life. This dependence could be called a phenomenon of "fetal impression" [2]. If so, the influence of carcinogens on the organism might be considered dependent upon the particular stage of formation and maturation of tissues and organs during embryogenesis and early life of the infant (early ontogenesis). A particular phenomenon of dependence in health and disease in general [3] and, recently in cancer [4], has been also observed and referred to as "heliogeophysical imprinting" [3].

It is well known that critical periods in the formation and maturation of tissues and organs of the human body are different. Therefore, one side of the hypothesis might be formulated in this way: if a key carcinogenic factor acts regularly over the whole interval of early ontogenesis (from the time of conception up to the age of 12 months), then the factor would selectively affect only particular tissues and organs. It should be noted that the same factor could act also later in life and a "resonance effect" might be observed as suggested for breast

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tumours in females [5]. Clearly, such "selectivity" will be triggered by the regularity of the influence and could result in different patterns of cancer incidence among a defined population (e.g., different annual rates, different age-specific rates, etc.). However, not only the rates as relative values but also patterns of their variations could be considered symptomatic for such impression during early ontogenesis.

The aim of this study was to analyse patterns of cyclic variations in incidence rates for 5 types of cancer in the USA and test the hypothesis for dependence of the above cycles upon the particular cancer site.

Materials and methods

Temporal dynamics of annual incidence for cancer in the USA was described. The SEER data for all new cases with 5 types of cancer (cancer of the brain and other nervous system-ICD9, Dx:191; cancer of the stomach-Dx:151; cancer of the colon-Dx:153; cancer of the rectum-Dx:154; and cancer of the testis-Dx:186), registered over the years 1973-1989 [6], were analysed. The data were taken from the Cancer Statistics Review 1973-1989, presented as time series of incidence rates per 100,000 (age-adjusted to the US 1970 standard population) [6]. A periodogram regression analysis (PRA) with tests for statistical significance of the results was applied [7]. Routine statistical and graphical packages were used as well as another statistical software (6-D Statistics ver. 5.0/98 by B.P. Komitov).

Results

Variations from the trend of incidence rates have represented about 20%-40% of temporal dynamics. The analysis has revealed infrannual cycles of middle to high frequency ($p < 0.06$-0.01). The length of the cycles decreases downward the human body (Figure 1).

Discussion

The incidence rates of cancer over the years are very often considered stable. This could be explained by the fact that most trends correspond very closely to a "straight line". However, variations in cancer incidence either are not being taken into account or are being underestimated as source of information on the appearance of malignant diseases within the present paradigms of cancer epidemiology.

Variations from the trend may be random or regular (cyclic) where the cycle is a pattern in the realisation of a stochastic process that repeats itself at intervals with amplitude and/or phase changing over time. Cyclic variations may be either a definite intrinsic feature of incidence time-series or provoked (modulated) by external influences, or both. In this sense, if any external effect of a regular factor on cancer exists, then incidence variations should exhibit similar cyclicity, as was shown for malignant melanoma of the skin [7,8] and breast cancer [4]. Authors from the USA did make an attempt to reveal cyclic patterns in incidence variations for stomach and colorectal cancers using data from the Connecticut Tumor Registry but found none [8]. However, cyclicity in stomach cancer was previously reported not only for the USA but also for the north-west region in the UK [7]. The present study has clearly indicated cyclicity in variations of incidence rates for 5 cancers in the USA. Also, both facts, that the length of the main infrannual cycle within one and the same sample size ($n = 17$ years) in a defined population is different (period T from 9 to 3 years, i.e., middle to high frequency) and decreases downwards the human body, might imply a specific influence of a key cyclic factor during different ontogenetic periods.

This study has confirmed previous results on cycles in variations of incidence rates for cancer. A hypothesis for a specific pattern in cyclic variations, that is, a downward dependence of the length of the cycle on the particular body site has been suggested. It is very probable that the phenomenon of imprinting during early ontogenesis might play a role in the mechanism of formation of the above pattern. Cyclicity in variations of cancer incidence in the USA could not only allow for better understanding of the aetiology of cancer but also contribute to better forecasting models and preventive measures.

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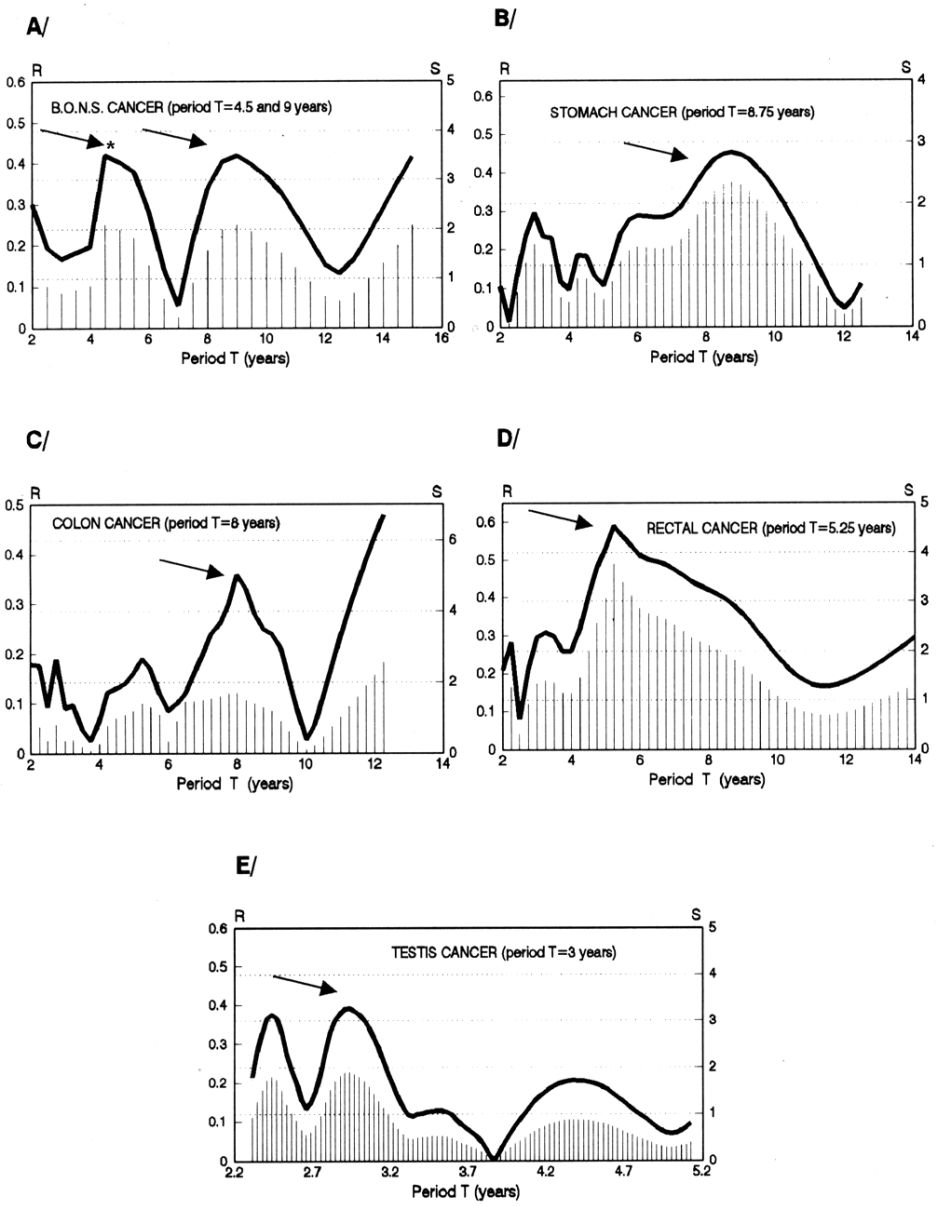

Figure 1. Periodogram regression analysis of variations in incidence rates for 5 cancers by body site in US males (1973-1989). The spectra of coefficients R (curves, left scale) present infrannual cycles in cancer incidence variations for males with a descending length of the period T downwards the body (A - 9 years; B - 8.75 years; C - 8 years; D - 5.25 years and E - 3 years). The significant cycle of 4.5 years in A (*) might be considered a circasemiundecennian cycle, i.e., one-half of the cycle of 9 years. The statistical significance of the coefficients is expressed in number of standard deviations (S, bars, right scale). S is the number z of the standard deviations of R where $z = R/S_R$. The arrows indicate the significant peaks on periodograms ($p = 0.06\text{-}0.01$).

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