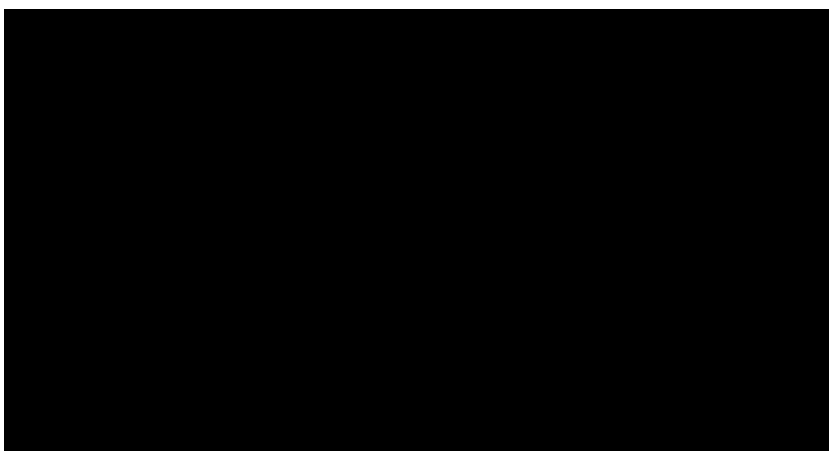


Correlation between the mortality from cancer of the breast, prostate, lung, colon and pancreas and pro capite food consumption...

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Correlation between the mortality from cancer of the breast, prostate, lung, colon and pancreas and *pro capite* food consumption in Serbia, 1991-2010

Milena Ilic¹, Sladjana Vasiljevic², Zeljko Vlasisavljevic³, Slavica Konevic⁴

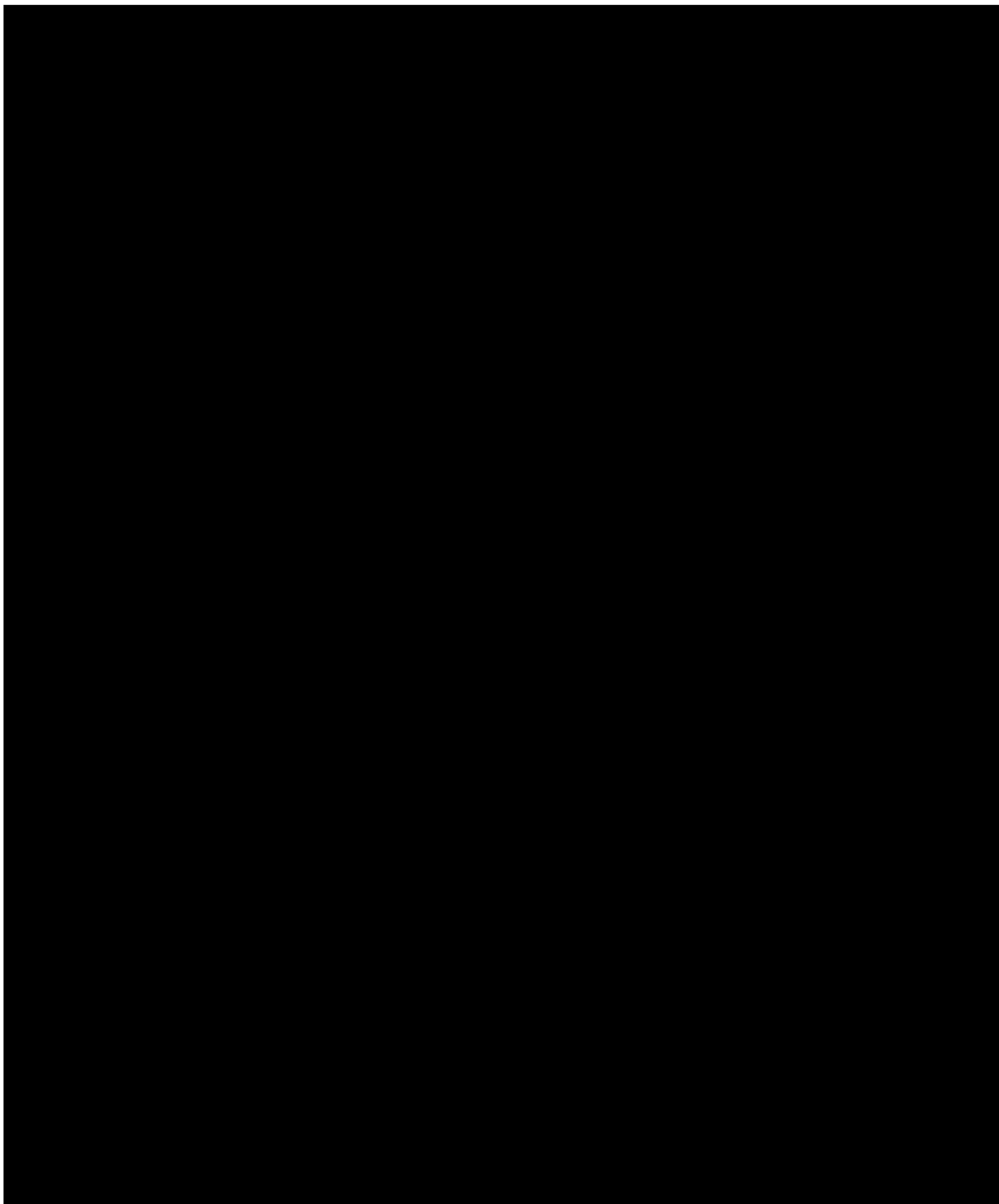
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Summary. *Aim:* The purpose of this study was to investigate the association between *pro capite* food consumption and mortality rates of the five commonest cancers in Serbia. *Materials and methods:* The correlation between the age-adjusted mortality rates of breast, prostate, lung, colon and pancreatic cancer and *pro capite* food consumption was calculated by Pearson's correlation coefficient. *Results:* The coefficients of correlation indicate that *pro capite* consumption of animal fat ($r=-0.67$), beef ($r=-0.80$), milk ($r=-0.47$), wine ($r=-0.72$) and hard drinks ($r=-0.81$) were significantly negatively correlated with female breast cancer mortality rates, while consumption of poultry ($r=0.61$), dried and processed meat ($r=0.57$), fish ($r=0.53$), eggs ($r=0.71$), and yogurt ($r=0.66$) were positively correlated. A positive correlation was apparent in the four cancers (prostate, lung, colon and pancreatic cancer) mortality rates with *pro capite* consumption of vegetable oil, poultry, dried and processed meat, fish, eggs, yogurt and other dairy products, and coffee. Consumption of beer was correlated only with pancreatic cancer mortality rates ($r=0.52$). *Conclusions:* Striking changes in mortality rates of breast, prostate, lung, colon and pancreatic cancers have been shown, which may be at least in part attributable to the concurrent nutrition transition.

Key words: mortality, cancer, *pro capite* food consumption, correlation

«CORRELAZIONE TRA LA MORTALITÀ PER CANCRO DEL SENO, DELLA PROSTATA, DEL POLMONE, DEL COLON E DEL PANCREAS E CONSUMO ALIMENTARE *PRO CAPITE* IN SERBIA, 1991-2010»

Riassunto. *Scopo:* Lo scopo di questo studio era di valutare l'associazione tra il consumo *pro capite* di cibo e i tassi di mortalità dei cinque tumori più comuni in Serbia. *Materiali e metodi:* La correlazione tra i tassi aggiustati per età e mortalità per cancro del seno, della prostata, del polmone, del colon e del pancreas e il consumo alimentare *pro capite* è stata misurata mediante l'indice di correlazione di Pearson. *Risultati:* I coefficienti di correlazione indicano che il consumo *pro capite* di grassi animali ($r=-0,67$), carne bovina ($r=-0,80$), latte ($r=-0,47$), vino ($r=-0,72$) e superalcolici ($r=-0,81$) erano in modo significativo correlati negativamente con i tassi di mortalità per cancro al seno femminile, mentre il consumo di pollame ($r=0,61$), salumi e insaccati ($r=0,57$), pesce ($r=0,53$), uova ($r=0,71$), e yogurt ($r=0,66$) erano correlati positivamente. Una correlazione positiva si è resa evidente per i tassi di mortalità nei quattro tipi di cancro (prostata, polmone, colon e pancreas) con il consumo *pro capite* di olio vegetale, pollame, salumi e insaccati, pesce, uova, yogurt e altri pro-



Consumption was harmonized with the international standards and recommendations of Eurostat and United Nations, which provide international comparison of data.

The unit of observation in the survey is every household selected according to the sampling plan. The Survey used a two-stage, stratified, rotating sample, with enumeration areas as the primary and households as the secondary units of selection. Sample selection was performed by choosing the first-stage units (enumeration areas) proportionally to the number of households within them, while the second-stage units (households) were chosen with equal chances (randomly). The Survey used a diary method (a household keeps a diary of food consumption per fifteen or sixteen days) to record the amount of food and drink consumed, and oral examination method (interview method) of the selected household, where the reference period was twelve months. This data served as a basis to determine the *pro capite* food consumption in a household.

The dietary components chosen for analysis are primarily those linked to observed cancers in other studies, such as fat, meat, fish, eggs, milk, and drinks. Since the literature suggests that meat and milk play

an important rôle in the etiology of cancer, the various components of meat and milk were separately treated.

The correlation among the five cancers mortality rates and *pro capite* food consumption was calculated by Pearson's correlation coefficient. Correlation coefficients were calculated while comparing food consumption rates to cancer mortality rates for the same year. Two-sided *P* values are reported and are considered to indicate statistical significance when they are less than 0.05. All statistical analyses were carried out using the Statistical Package for Social Sciences software (SPSS Inc., version 19.0, Chicago, IL).

Results

Over the 20-year observation period, a significant increase in five cancer mortality rates in the Republic of Serbia (without Autonomous Province Kosovo and Metohia) was observed (Figure 1). The increase for all observed cancer mortality rates was significant for: female breast cancer ($y=0.14x + 18.83$, $p=0.000$, $R^2=0.65$), prostate cancer ($y=0.23x + 7.55$, $p=0.000$, $R^2=0.77$), lung cancer ($y=0.59x + 24.07$, $p=0.000$,

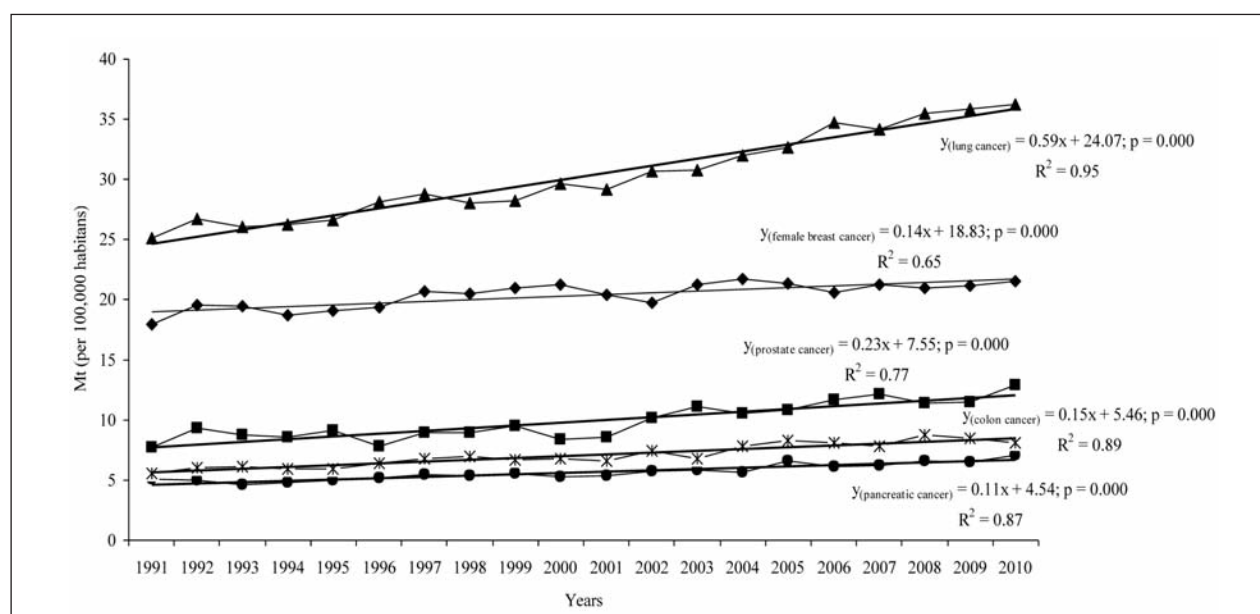
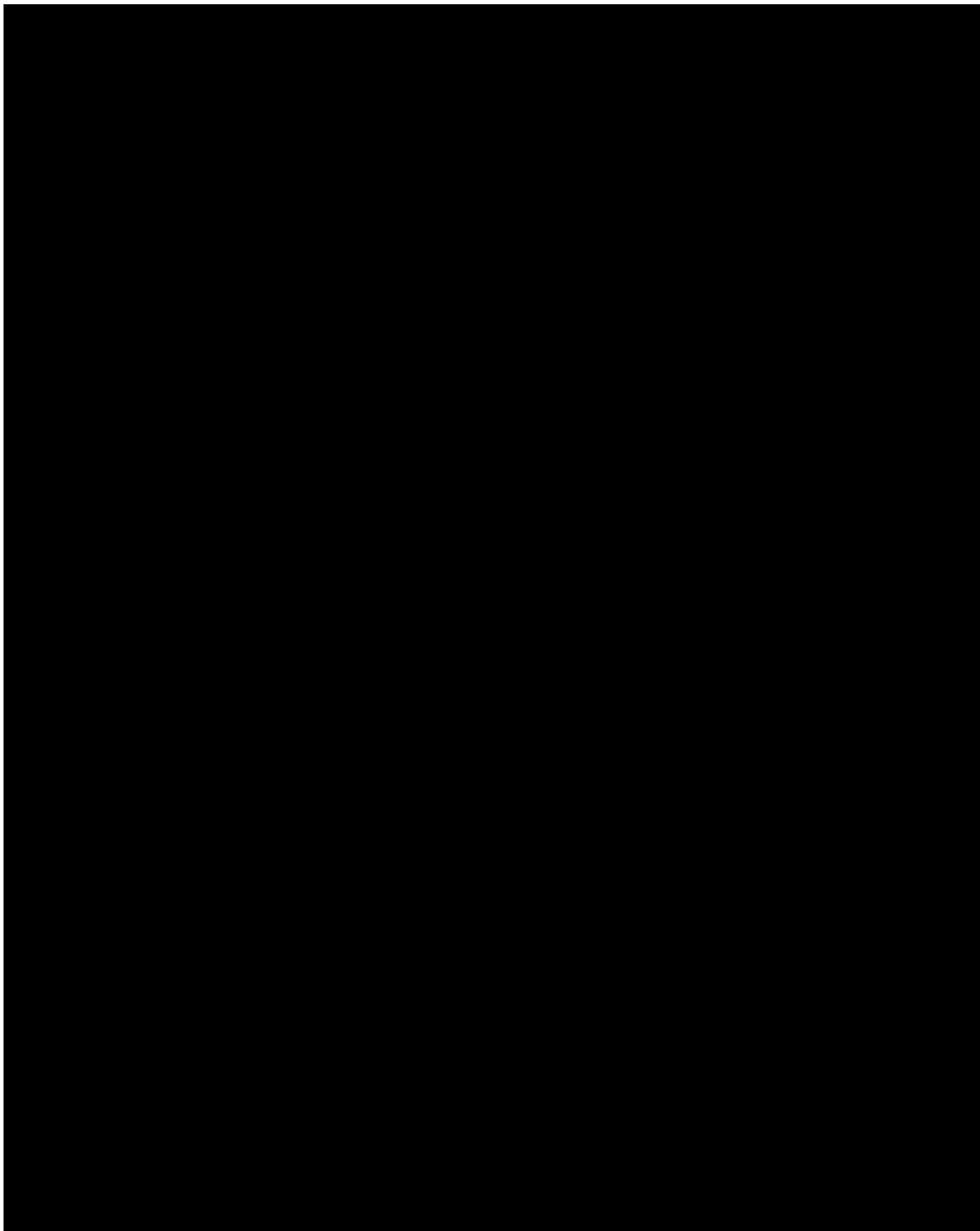


Figure 1. Cancer mortality rates age-adjusted to the World standard population per 100,000 inhabitants in the Republic of Serbia (without Autonomous Province Kosovo and Metohia), 1991-2010.



correlated with female breast cancer mortality rates, while consumption of poultry ($r=0.61$), dried and processed meat ($r=0.57$), fish ($r=0.53$), eggs ($r=0.71$), and yogurt ($r=0.66$) were positively correlated.

A positive correlation was apparent in the four cancers (prostate, lung, colon and pancreatic cancer) mortality rates with *pro capite* consumption of vegetable oil, poultry, dried and processed meat, fish, eggs, yogurt and other dairy products, and coffee. The lung and colon cancer mortality rates were negatively correlated with consumption of animal fat, beef, milk, wine and hard drinks. Animal fat, beef, milk and hard drinks consumption showed a highly significant negative relationship with the prostate and pancreatic cancer mortality rates.

Pro capite consumption of pork and cheese was not correlated with any cancer mortality rates. Consumption of beer was correlated only with pancreatic cancer mortality rates ($r=0.52$).

Discussion

This descriptive epidemiological study presents an assessment of diet influence on mortality from 5 selected malignant tumors in Serbia.

A remarkable increase in mortality rates of breast, prostate, lung, colon and pancreatic cancers have been observed in Serbia (without Autonomous Province Kosovo and Metohia) during the 20-year observation period. Our data on cancer mortality are similar to data from developing countries, in contrast to data from developed countries where last years recorded a downward trend in mortality from malignant tumors (1-5). An increasing trend of the mortality of five cancers in Serbia may be partially explained by the difficult conditions of functioning of health care system, especially during the economic sanctions against Serbia, during the war and the 1999 NATO bombing of the FR Yugoslavia, and due to the larger number of internally displaced persons and refugees (4, 5). In support of this, in the observed period there have been significant changes in the living standard of the population, which could have contributed to some changes in the consumption structure in Serbia. International differences in mortality from the observed

cancers could partially be explained by the differences in quality of death certificate data between individual countries (3-5). The proportion of cases with uncertain death cause (revision 9 codes 780-799 and revision 10 codes R00-R99) in the period observed was on an average of 6.8% with non-significant decreasing trend ($p=0.137$) (5).

A significant positive correlation between observed cancer mortality rates may indicate their reciprocal etiology. In the period observed, the increasing trend of mortality rates of all common cancers was significantly positively correlated with *pro capite* consumption of dried meat and processed meat products, poultry, fish, eggs and dairy products. In contrast, the use of animal fat in the preparation of food, beef, milk and the use of hard drinks decreased cancer mortality. This findings support the associations reported in the correlation studies in southern Mediterranean countries (30), China (31), Japan (32), Brazil (33), Iran (34), and some East Asian countries (7). Our results stand in contrast to the pattern seen in developed countries, such as some comparisons in United States and most Western European countries (10, 16, 35-37).

Some potential explanations for these apparent differences among the countries may lie in discrepancies in quality of food consumption data, primarily due to differences in data collection methodology. Also, the changes in the patterns of smoking and alcohol use in recent decades, obesity, lifestyle and other factors, such as diet, have been attributed to changes in cancer mortality (2, 3). Also, studies of migrants suggest that cancer mortality trend is positively associated with a Western-style diet (38).

Strengths and limitations of the study

Our study could potentially be more informative than international correlation study because that composition of the population and national food data likely vary less than at the international level. Our results are based on the statistical cancer mortality data and food consumption data in Serbia, which in turn enabled us to exclude the differences in international correlation studies stemming from the differences in medical procedures and methods of providing data on the food consumption in various countries.

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