Did favourable trends in food consumption observed in the 1984-2001 period contribute to the decrease in cardiovascular mortality? – Pol-MONICA Warsaw Project

Anna Waśkiewicz, Walerian Piotrowski, Elżbieta Sygnowska, Stefan Rywik, Bogdan Jasiński

Department of Epidemiology, Cardiovascular Prevention and Health Promotion, National Institute of Cardiology, Warsaw, Poland

Abstract

Aim: To compare food consumption trends (1984-2001) with cardiovascular mortality trends (1984-2002) in an adult population of right-bank Warsaw residents and establish the delay between dietary changes and mortality reduction.

Methods: Cardiovascular mortality rates for the 1984-2002 period, calculated based on the Central Statistical Office data and the results of individual evaluation of nutrition patterns in 4 independent Pol-MONICA cross-sectional studies (1984, 1988, 1993 and 2001) were analysed.

Results: The cardiovascular mortality rate in right-bank Warsaw inhabitants tended to increase until 1991, and then a decline was observed – in 2002 in comparison to 1991 the mortality rate in both genders decreased by over 50%. From 1984 to 2001 a significant decrease in the following dietary factors was found: total energy intake, dietary cholesterol, and Keys score reflecting atherogenicity of the diet and animal fats. In contrast trends of vegetable fats intake increased. The favourable changes in the dietary habits of Warsaw inhabitants were correlated with the reduction of cardiovascular mortality (R^2 within the range of 0.35-0.95), and the strongest relationship between these facts occurred after 7 years.

Conclusions: A positive tendency observed with respect to nutrition patterns of right-bank Warsaw inhabitants contributed to the reduction of cardiovascular mortality.

Key words: cardiovascular mortality, nutrition pattern, consumption trends

Introduction

In the past three decades cardiovascular mortality significantly decreased in many Western countries [1, 2]. In the same time period cardiovascular mortality in Poland continued to increase, and this unfavourable trend was one of the strongest in the world. It was not until 1992 that a decline in CV mortality was observed, and mortality rates for subjects aged 0-64 years decreased by over 30% in the 1991-1999 period [3]. Such a significant reduction in cardiovascular mortality warrants the question of its causes. It does not seem that this reduction is solely attributable to the easier access to cardiovascular care or improvement of its effectiveness in our country. It has been postulated that, at least in part, lifestyle, including rationalisation of nutrition habits [4, 5], is responsible for the favourable changes.

The favourable trends in food consumption and reduction of the atherogenic potential of the common diet [6, 7], that have been observed in Poland within the past two decades, most likely resulted in the reduction in cardiovascular mortality. However, the

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evidence supporting such a hypothesis may be provided only by the analysis of a real, appropriately defined population with long-term follow-up. The Pol-MONICA Programme offers such an opportunity, as it was carried out in 1984, 1988, 1993 and 2001 on representative population sample- inhabitants of right-bank Warsaw. Additionally, the individual assessment of nutrition habits provides information on actual food consumed by the studied subjects.

The aim of the study was to compare trends in food consumption (1984-2001) with cardiovascular mortality trends (1984-2002) in an adult population of right-bank Warsaw residents and to establish the delay between dietary changes and mortality reduction.

Methods

Mortality rates

Cardiovascular mortality rates for right-bank Warsaw inhabitants aged 35-64 years were calculated based on unprocessed data obtained from the Central Statistical Office (number of deaths and size of population). The calculations were performed using the following classification:

- in 1984-1996 according to the IX Revision of the International Classification of Diseases and Causes of Death (cardiovascular deaths + sudden deaths – no. 390-459 and 798);
- in 1997-1996 according to the X Revision of the International Classification of Diseases and Health Problems (cardiovascular deaths + sudden deaths – no. I00-I99 and R96).

For the years 1996-1998, when the cause of death was not stated in some deceased, the number of cardiovascular deaths was estimated as follows: for each population and individual gender and age groups, the product of cardiovascular deaths and the ratio of deaths overall to all deaths with a known cause.

Nutrition patterns

In 1984, 1988, 1993 and 2001, four independent cross-sectional studies in representative population samples of residents of the right-bank of Warsaw aged 35-64 years were carried out as a part of the Pol-MONICA Programme. The sampling frames for the first three screenings were the registers of voters, and for the fourth one the personal ID number (PESEL). The quantitative estimation of individual food consumption was obtained by means of a questionnaire regarding consumption within the last 24 hours: in 1984 for 2571 subjects (1265 males and 1306 females); in 1988 for 1397 (688 and 709 respectively); in 1993 for 1485 (734

and 751 respectively); and in 2001 for 836 subjects (420 and 416 respectively).

The calculation of energy and nutrients intake was performed based on Polish food concumption tables. Due to the changing economic situation of the country, fast-food industry expansion and new products on the market, the same tables were used for calculations from the first three studies (1983-1988), whereas for the fourth screening updated tables from 1998 were used. Such a method enabled better matching of type and quality of foods available on the market at the time of each study to the data included in the tables of caloric content and nutritional values. The details of methodology, data acquisition and measurements were presented in the previous reports from the Pol-MONICA Study [8, 9].

Statistical methods

Mean values of nutritional factors during the study (in 1984, 1988, 1993 and 2001) were determined by means of covariance analysis (general linear model – GLM) after adjustment for age, season, smoking habits and non-occupational physical activity. These values were used for the estimation of measures of nutritional patterns with logarithmic interpolation $y = \exp(a + bx)$ in each year from 1984 to 2001.

For each year, coefficients of determination between nutritional factors and mortality rates were established, using time shift (advancement) of mortality rates by a couple of years, with constant consumption. According to this algorithm maximum matching of the studied phenomena was used. The statistical analyses were performed using SAS 8.2 software.

Results

Cardiovascular mortality rates (number of deaths per 100,000 subjects) among residents of right-bank Warsaw aged 35-64 years are shown in Figure 1. CV mortality continued to increase until 1991, and in the following years a decline was observed – in 2002 in comparison to 1991 mortality rates were lower by over 50% in both genders.

Over the 17-year period significant trends of declining nutritional intake were observed for energy, dietary cholesterol, Keys score reflecting atherogenicity of the diet*, and added animal fats. An increased consumption of added vegetable fats was found.

Keys score $= 1.35 (2 \times SFA - PFA) + 1.5 \sqrt{\dfrac{Choldiet}{1000\ [kcal]}}$

SFA – % of energy from saturated fatty acids
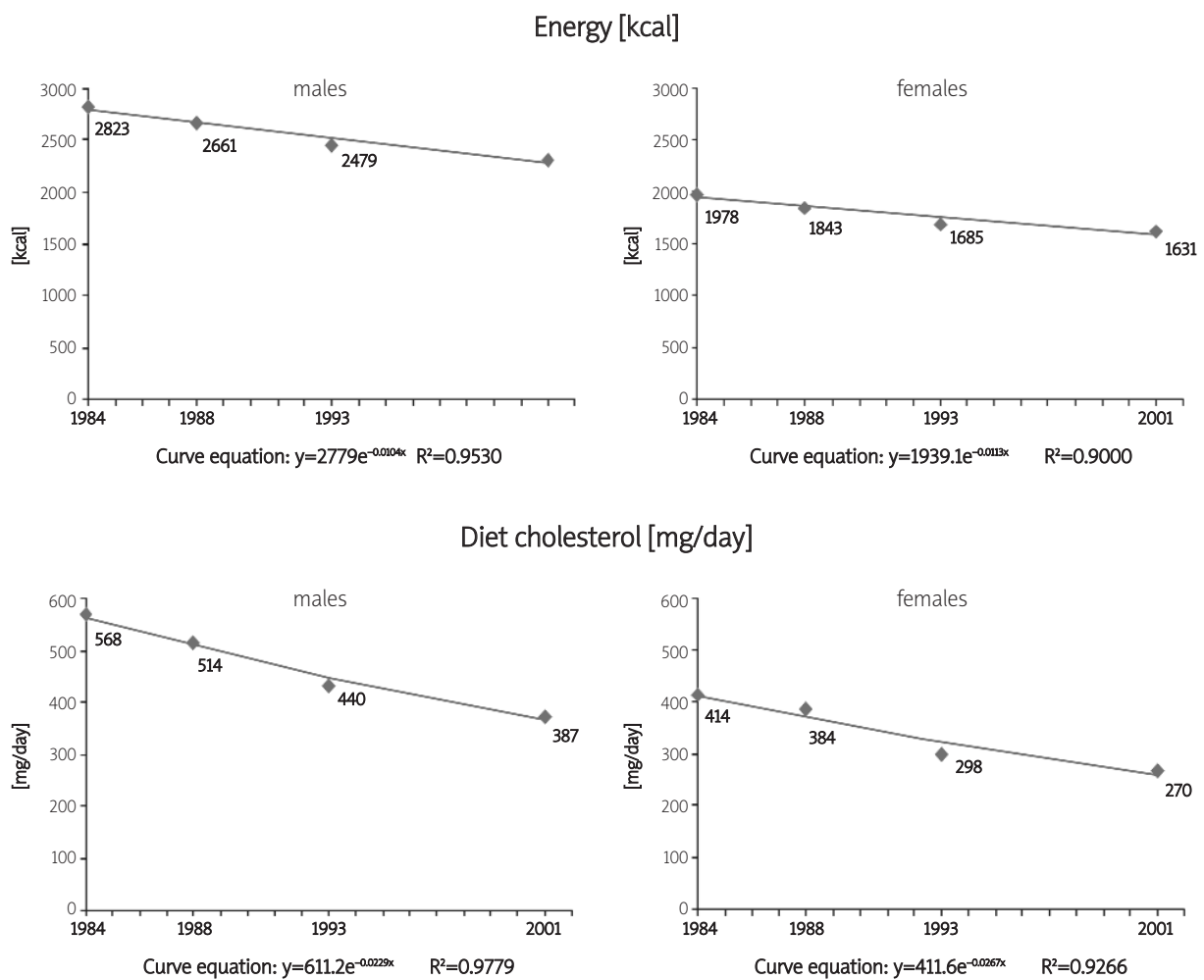*PFA – % of energy from polyunsaturated fatty acids*
Choldiet – dietary cholesterol [mg]
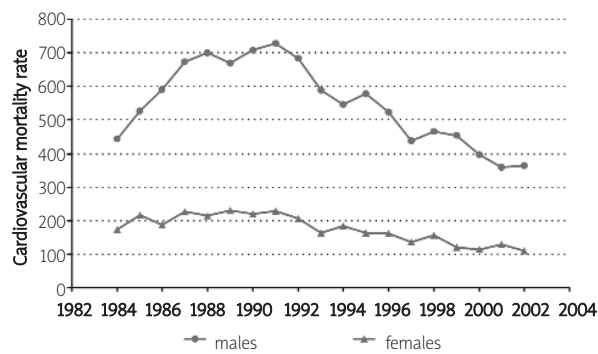
Figure 1. Cardiovascular mortality rates (number of deaths per 100,000 subjects) in the residents of right-bank Warsaw aged 35-64 years from 1984 to 2002
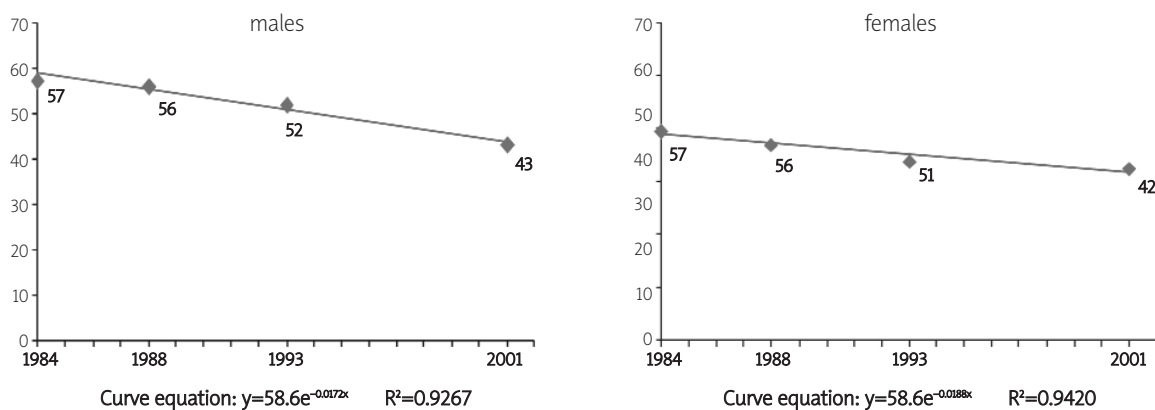
The curves and their mathematical equations are shown in Figures 2-4.

In 2001 as compared to 1984, both genders showed an 18% reduction in energy intake of the diet, and dietary cholesterol decreased by 35%. This is reflected by the atherogenicity index of the diet, which decreased within the study period by approximately 25%. Within 17 years, favourable trends in the consumption of added fats used for the preparation of food and for spreading on bread were noted. This included reduction of animal fat intake (lard, butter) by 53% and an increase in vegetable fat consumption (margarine, oils) by 330% in males and 250% in females. No significant trends in consumption of vegetables and fruit were reported.

Energy [kcal]

Curve equation: $y=2779e^{-0.0104x}$ $R^2=0.9530$

Curve equation: $y=1939.1e^{-0.0113x}$ $R^2=0.9000$

Diet cholesterol [mg/day]

Curve equation: $y=611.2e^{-0.0229x}$ $R^2=0.9779$
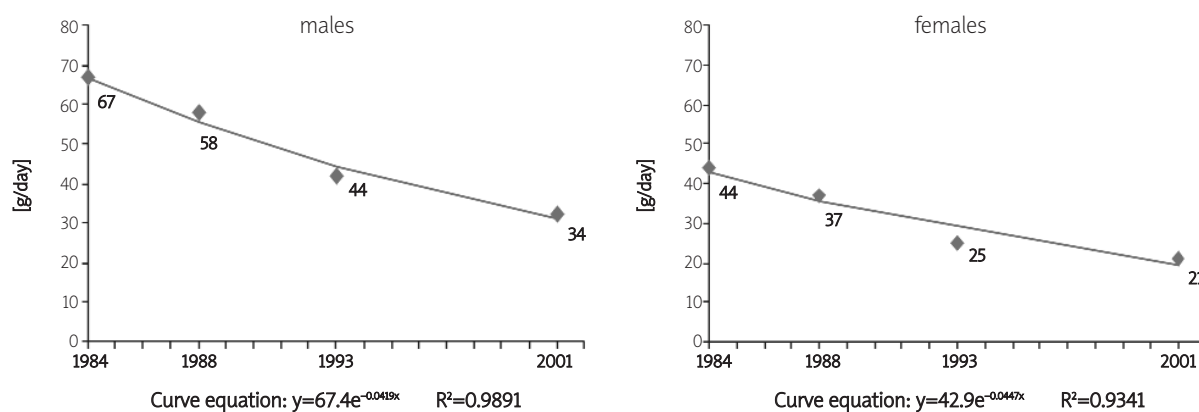
Curve equation: $y=411.6e^{-0.0267x}$ $R^2=0.9266$

Figure 2. The nutritional value of an average diet of residents of right-bank Warsaw over 17-year follow-up

Keys score of diet atherogenicity

males

Curve equation: $y=58.6e^{-0.0172x}$ $R^2=0.9267$

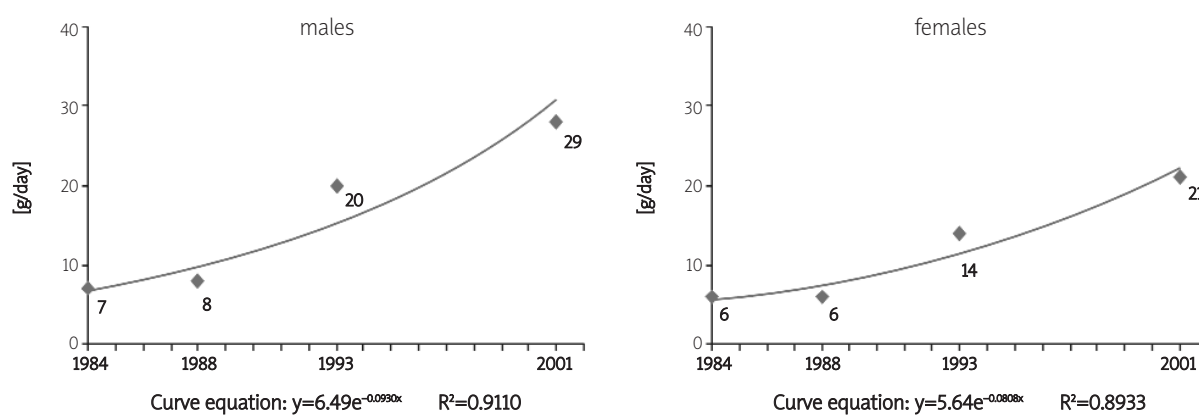females

Curve equation: $y=58.6e^{-0.0188x}$ $R^2=0.9420$

Figure 3. Key scores reflecting atherogenicity of the diet in residents of right-bank Warsaw over 17-year follow-up

Added animal fats [g/day]

males

Curve equation: $y=67.4e^{-0.0419x}$ $R^2=0.9891$

females

Curve equation: $y=42.9e^{-0.0447x}$ $R^2=0.9341$

Added vegetable fats [g/day]

males

Curve equation: $y=6.49e^{-0.0930x}$ $R^2=0.9110$

females

Curve equation: $y=5.64e^{-0.0808x}$ $R^2=0.8933$

Figure 4. Mean added fat consumption by residents of right-bank Warsaw over 17-year follow-up
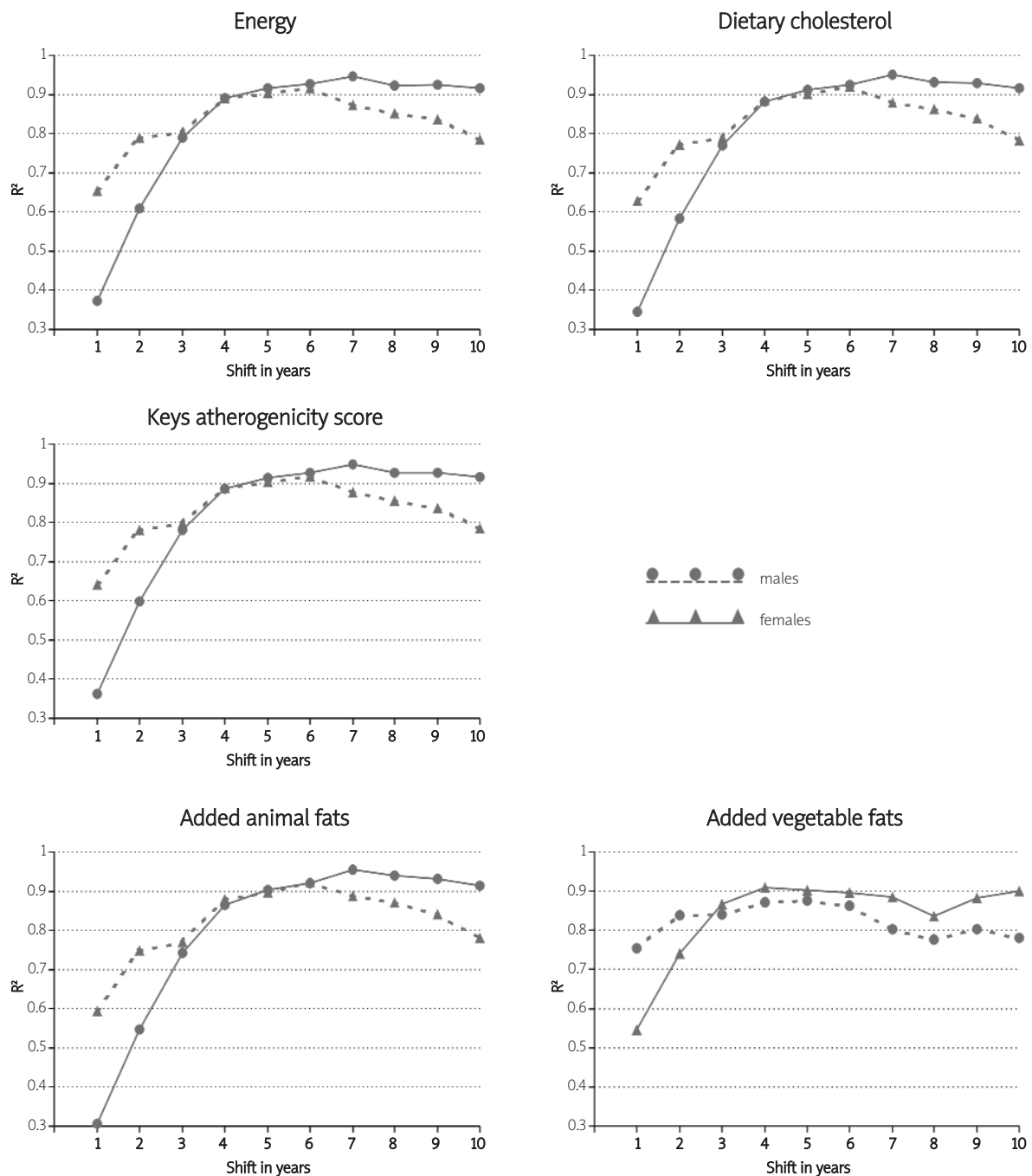
Figure 5. The coefficient of determination R^2 between the mortality rate and nutritional factors in relation to time shift

These favourable tendencies in consumption correlated with cardiovascular mortality reduction (R^2 0.35-0.95). Favourable changes in the energy intake, diet atherogenicity index and exchange of animal fat for vegetable fat had the major impact on mortality rates after 7 years of follow-up (Figure 5).

Discussion

The results show that over 17 years (1984-2001) positive changes in the study population nutrition patterns took place, contributing to the significant reduction in cardiovascular mortality.

With respect to important health risk factors, consumption changes involved mainly the structure of fat intake – an increase of vegetable fat and reduction of animal fat as well as energy intake decrease were noted. This was reflected by the reduction in atherogenicity of the mean food ration. The results of our project are consistent with those of other studies carried out in Poland. Data from food balances and home budgets indicate that in the studied period consumption of atherogenic products significantly decreased, while the consumption of nutrients recommended for the prevention of atherosclerosis increased. The major effect was associated with the change of fat types used for spreading on bread and food processing – consumption of butter decreased from 8.4 kg in 1984 to 4.2 kg in 1999 [6, 7]. Also, as the results of another study presented by Narojek [10] show, in 1984 butter was the most frequently bought type of fat in Warsaw families, followed by soybean oil, sunflower oil and lard, and only in slightly over half of families was margarine bought. However, in 1995 butter and lard were exchanged for oils and margarines. Similar conclusions were also drawn by Szpak et al. [11] from studies performed in north-eastern Poland.

In residents of the right-bank of Warsaw, between 1984 and 2001 the consumption of vegetables was at a similar level, whereas fruit consumption doubled (in 1984, 110 g per day in males and 130 g per day in females; and in 2001, 212 g and 253 g, respectively). However, due to a high decrease in fruit consumption in 1988 followed by an increase in 1993 and 2001, consumption trends of this sort of food scored as statistically insignificant over the 1984-2001 period and have not been correlated with mortality. In other populations of our country an increase in consumption of these products was observed, including mainly southern fruits and juices and deep-frozen foods [12].

The presented study showed that positive tendencies in food consumption contributed to the reduction in cardiovascular mortality in residents of the right-bank of Warsaw. Zatoński et al. also attributed the sudden decrease in mortality in 1991-1994 mostly to the changes in nutrition patterns of Poles [13]. Other studies also provide evidence for an association between the diet and cardiovascular events. The conclusions are strong and coherent, and are supported by metabolic interaction studies [14].

Prospective cohort or interventional studies performed in various cultures demonstrated that diet and smoking are major risk factors for coronary artery disease. Reduction of the atherogenic potential of the mean food ration in the population may significantly contribute to a decrease in cardiovascular mortality. This

was documented in the Finnish studies (The North Karelia Project) [15], where intensive preventive actions and a sudden decrease in fat and cholesterol intake resulted in a reduction in mortality from ischaemic heart disease. Correlations between trends of fat intake and cardiovascular mortality were also observed in the USA [16] and the UK [17]. On the other hand, the cohort trial (The Nurses Health Study), performed in the USA [18] suggested that the most effective way to prevent myocardial infarction is not to reduce total dietary fat intake but to replace saturated and trans unsaturated fats with unhydrogenated monounsaturated and polyunsaturated fats.

The implementation of a specific diet as part of secondary prevention was also shown in the following clinical trials: Indian Study Diet and Reinfarction (DART) [19], Lyon Diet Heart Study [20], GISSI – Preventive Trial [21], and Dietary Approaches to Stop Hypertension (DASH) [22]. The mortality risk was significantly reduced after implementation of low-fat diets enriched in fish or fish oil (GISSI), vegetables, fruit, leguminous seeds, nuts, and also vegetable oils in the Lyon Diet Heart Study. It should be mentioned that comprehensive studies on the influence of diet on cardiovascular events are very expensive and complicated due to the difficulties in demonstrating significant differences in lifestyle and nutritional patterns between study and control groups.

The favourable changes in Warsaw population dietary patterns closely correlated with the decrease in cardiovascular mortality. The strongest relationship between these findings was observed after 7-year follow-up. In the Czech Republic [23] the decrease in cardiovascular mortality rate seen from 1990 occurred soon after favourable changes in the dietary fat structure and rise in fruit and vegetable consumption. In population studies a reduction in mortality following favourable changes in nutritional patterns is usually observed after some delay, because the interval between the effect of a specific factor (here nutritional) on the incidence of a disease may occur after several years to several decades, depending on the presence of other factors [24].

Limitations of the study

Interpretation of the results of an epidemiological study investigating the relationship between nutrition and health is associated with a number of methodological limitations. Cardiovascular mortality trends are modified by many complex and dependent factors which in practice make it extremely difficult to analyse the influence of separate factors. This is also complicated by the fact that changes in the nutrition pattern influence the mortality rate directly but also by

the effect on other risk factors of coronary heart disease such as lipid and homocysteine levels, and body weight.

In the study population significant changes in the rate of smoking and physical activity have been found from 1984 to 2001. The elimination of the consequences of these non-nutritional risk factors on mortality required inclusion of these factors in the model. Improvements in cardiovascular care and better hypertension and hyperlipidaemia control might also result in mortality reduction, but it was impossible to evaluate this problem as part of this study.

Conclusions

Over the 17-year follow-up period (1984-2001) favourable trends have been observed with respect to food consumption in the population of right-bank Warsaw, including, in particular, reduction of animal fat consumption and an increase in vegetable fat intake, which made the common food ration partially similar to the one recommended for the prevention of atherosclerosis.

The positive changes in nutrition patterns contributed to the reduction of cardiovascular mortality, and the strongest relationship was evidenced after the 7-year follow-up.

It may be assumed that further optimisation of diet could result in the reduction of incidence of cardiac diseases and other civilisation diseases, if it is accompanied by other changes in lifestyle.

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Czy korzystne tendencje w spożyciu żywności zaobserwowane w latach 1984–2001 przyczyniły się do spadku umieralności spowodowanej chorobami układu krążenia? Badanie Pol-MONICA Warszawa

Anna Waśkiewicz, Walerian Piotrowski, Elżbieta Sygnowska, Stefan Rywik, Bogdan Jasiński

Zakład Epidemiologii, Prewencji Chorób Układu Krążenia i Promocji Zdrowia, Instytut Kardiologii, Warszawa

Streszczenie

Cel: Porównanie trendów spożycia żywności (1984–2001) z trendami umieralności spowodowanej chorobami układu krążenia (ChUK) (1984–2002) w dorosłej populacji mieszkańców prawobrzeżnej Warszawy oraz ustalenie o ile czasu zmiany w sposobie żywienia poprzedzają spadek umieralności.

Metody: Materiał do analizy stanowiły współczynniki umieralności z powodu ChUK z lat 1984–2002, wyliczone w oparciu o dane z Głównego Urzędu Statystycznego oraz wyniki indywidualnej oceny sposobu żywienia uzyskane w 4 niezależnych badaniach przekrojowych Pol-MONICA (1984, 1988, 1993 i 2001).

Wyniki: Umieralność mieszkańców prawobrzeżnej Warszawy z powodu ChUK wzrastała do 1991 r., a w następnych latach zanotowano jej spadek – w 2002 r. w porównaniu do 1991 r. współczynniki umieralności u obu płci obniżyły się o ponad 50%.

W okresie od 1984 do 2001 r. wśród analizowanych czynników żywieniowych istotne trendy malejące zanotowano dla: energii, cholesterolu pokarmowego, współczynnika aterogenności diety Keysa i tłuszczów zwierzęcych, a rosnące dla tłuszczów roślinnych.

Wystąpienie pozytywnych zmian w sposobie żywienia populacji warszawskiej było skorelowane ze spadkiem umieralności spowodowanej ChUK (R^2 w granicach 0,35–0,95), najsilniejszy związek miedzy tymi zjawiskami wystąpił po 7 latach.

Wnioski: Zaobserwowane pozytywne tendencje w sposobie żywienia mieszkańców prawobrzeżnej Warszawy przyczyniły się do spadku umieralności spowodowanej ChUK.

Słowa kluczowe: umieralność spowodowana ChUK, sposób żywienia, trendy w spożyciu

Adres do korespondencji:

dr Anna Waśkiewicz, Zakład Epidemiologii, Prewencji ChUK i Promocji Zdrowia, Instytut Kardiologii, ul. Alpejska 42, 04-628 Warszawa, tel. +48 22 815-65-56, faks: +48 22 613 38 07, e-mail awaskiew@ikard.waw.pl