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Cardiovascular mortality and risk factors: Is Poland repeating the US experience of 30 years ago?

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Summary
Background: Cardiovascular diseases (CVD) have been leading causes of death in the United States (US) and Poland. CVD and coronary heart disease (CHD) death rates have changed in both countries in recent decades. We examined these mortality trends in the two countries and considered their relations to contemporaneous changes in risk factor exposures.
Methods: Mortality and population data were obtained from the Polish Main Statistical Office (1970—96), the US Community Structures Project (1962—67), and the US National Center for Health Statistics (1968—2000). Best-fit, age-standardized, mortality rate trend curves for ages 35—64 years were generated with local regression and were quantified with piecewise log-linear regression. Contemporaneous risk factor exposures were obtained from published sources and from Pol-MONICA data.
Results: While mortality rates leveled and declined in the US, they increased in Poland resulting in Polish rates exceeding those of US Caucasians and approaching or

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exceeding those of African Americans. Increasing mortality rate trends in Poland reversed in 1991, and declined thereafter, especially for CHD. US mortality declines were accompanied by reductions in multiple risk factors. Decreased risk factor exposures were noted during CHD declines in Poland, but differed somewhat from the US experience.

Conclusions: The reversal of increasing CVD mortality rate trends in Poland during the 1990s is reminiscent of a similar reversal in the US 30 years earlier and was accompanied by reduced risk factor exposures in both countries. The similarity of experiences comparing the two countries demonstrates the importance of efforts to reduce population exposures to preventable risk factors.

Introduction

Cardiovascular diseases (CVD) have been leading causes of death in both the United States (US) and Poland. However, while the US and western European countries have experienced declines in CVD death rates for at least three decades, rates in Poland and in other Central and Eastern European countries have increased [1—5]. In the early 1990s the free market economy was suddenly introduced into Poland with all its positive and negative features including loss of social support, high inflation rates and high unemployment rates as well as improved availability of food products typically found in the western market [6—9]. These changes have likely influenced health-related behaviors and risk factor exposures in Poland and can be considered a large natural experiment influencing the whole nation, with consequences on the health status of the population. Recent reports have suggested that Poland is experiencing a reversal of its upward CVD mortality trend in a manner reminiscent of that experienced by the United States thirty years earlier [10—12]. We examined trends in CVD and its major constituent, coronary heart disease (CHD), and their risk factors in Poland during this period of social and economic transition and compare them with US trends. Our aim was to examine mortality trends in the two countries and consider their relations with contemporaneous changes in risk factor exposures during periods of leveling and decline in CVD and CHD mortality rates.

Materials and methods

These analyses were conducted as part of the Poland and US Collaborative Study on CVD Epidemiology with the goal of sharing information on CVD epidemiology between the two countries [13]. National mortality and population data were obtained from the Main Statistical Office in Poland [14]. US mortality and population data for 1962—1967 from the Environmental Protection Agency obtained for the Community Structure and Cardiovascular Disease Mortality Trends Project at the University of North Carolina School of Public Health were made available for this study [15]. US data for 1968—2000 were obtained from the US National Center for Health Statistics Compressed Mortality File [16—18]. All-cause, CVD and CHD mortality rates and their trends were calculated for males and females aged 35—64 years. The data were analyzed separately for Caucasians and African Americans in the US. Stratification of the US population by race reflects the different mortality and risk factor exposure experiences of the two groups [19,20]. All rates were age-standardized by the direct method using weights determined previously from Segi's world population [21] and were calculated per 100,000 population. Because reported rates represent population parameters and the study design involves neither sampling nor randomization, we did not perform comparisons using probability values or statistical tests [22].

CVD risk factor measures in the US and Poland were obtained from multiple sources cited as they are presented below. US levels of hypertension, smoking, and serum cholesterol, determined from National Health and Nutrition Examination Survey (NHANES) conducted by the National Center for Health Statistics of the Centers for Disease Control and Prevention, were adapted for graphical display from tabular reports [23,24]. Levels of hypertension, smoking, and serum cholesterol during various time periods in Poland were obtained from the Pol-MONICA Project [25,26].

Underlying cause of death in Poland was classified in accordance with the eighth (1970—1979) and ninth (1980—1996) revisions of the International Classification of Diseases, Traumas and Causes of Death (ICD) [27,28]. Underlying cause

of death in the US was classified in accordance with the seventh (1962—67), eighth (1968—78), ninth (1979—98), and tenth (1999—2000) revisions of the ICD [29—32]. Deaths attributable to CVD were identified as seventh revision rubrics 330—334 and 400—468; eighth and ninth revision rubrics 390—459; and tenth revision rubrics I00—I99. Deaths attributable to CHD were identified as seventh revision rubrics 420 and 422.1; eighth revision rubrics 410—413; ninth revision rubrics 410—414, 402, and 429.2 (US only); and tenth revision rubrics I11, I20—I25. Comparability in the coding rules across ICD revisions was considered in these choices. In Poland, only 3-digit codes were recorded, so ICD 429.2 was not included for CHD in the ninth revision rates. However, due to the relatively few deaths in this category, the comparisons should be affected only minimally.

Age-standardized mortality rates were evaluated graphically within strata of cause, country, sex, and race (US only) for the time periods 1970—1996 for Poland and 1962—2000 for the US. These time periods were chosen to illustrate the reversal of CVD and CHD trends in each country within the limits of available data. Annual rates are presented as points overlaid with a fitted curve determined using SAS PROC LOESS for local regression [33]. Some rates are presented on a log scale to allow visual comparisons of relative rate changes in populations with vastly different rate levels.

Mortality trends were quantified using piecewise log-linear regression for time periods 1962—67, 1968—80, 1981—91, and 1992—2000 in the US; and 1970—80, 1981—91, and 1992—96 in Poland. These time intervals were chosen to reflect apparent changes in CHD mortality rate trends and are not intended to represent best-fit curves. Log-linear regression modeling was performed using the SAS PROC REG procedure [34]. The log-linear model assumes constant proportional or relative change over time and has been used in previous mortality studies [35].

Results

CVD and CHD mortality rates in the US leveled off and began to decline in the late 1960s (Fig. 1). This decline continued through 2000. In contrast, CVD and CHD mortality rates in Poland increased from 1970 to the early 1990s and then began to decline. The reversal of the upward CVD and CHD trends in Poland during the 1990s is reminiscent of a similar reversal occurring in US populations almost 30 years earlier, but the reversal in Poland was more rapid than that in the US. CVD and CHD mortality rates in Poland were lower than in the US until the late 1970s. CHD rates in Poland rose above US rates in the late 1980s, then declined to meet US rates again by the mid-1990s.

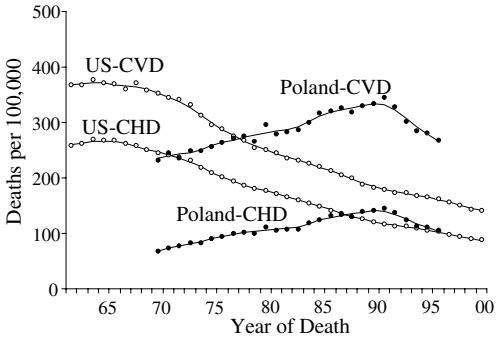


Figure 1 Age-standardized cardiovascular disease (CVD) and coronary heart disease (CHD) mortality rates in the US (1962-2000) and Poland (1970—1996) for ages 35—64 years.

At the beginning of the observation period, all-cause, CVD, and CHD mortality rates were higher for African-American men and women (Fig. 2) compared to men and women in Poland and in the US Caucasian population. Sex-specific all-cause mortality rates for African Americans were about twice those of the US Caucasian and Polish populations in 1970. CHD rates for African-American women were more than eight times those of Polish women during the 1970s. Sex-specific US Caucasian mortality rates also exceeded rates in Poland, especially for CHD, in the early 1970s. Within each country and race group, cause-specific male mortality rates exceeded female rates, typically by a factor of 2—4 in all time intervals. The greatest relative sex differences occurred for CHD mortality.

Mortality rates changed little or increased slightly from 1962 to 1967 for US Caucasians and African-American men (Table 1). But African-American women experienced mortality rate declines during this period, especially in CVD and CHD. CHD mortality rates increased by 1.1% per year for Caucasian men and declined by 3.0% per year for African-American women during the mid 1960s. All-cause mortality increases were greatest for African-American men at that time (3.0% per year).

All-cause, CVD, and CHD mortality rates declined for all race-sex groups in the US from the 1970s to 2000 (Fig. 2 and Table 1). The mean annual percent changes in mortality rates in the 1970s and thereafter ranged from −0.5% (all-cause mortality in African-American men, 1981—91) to −3.5% (CHD mortality in Caucasian men, 1981—91).

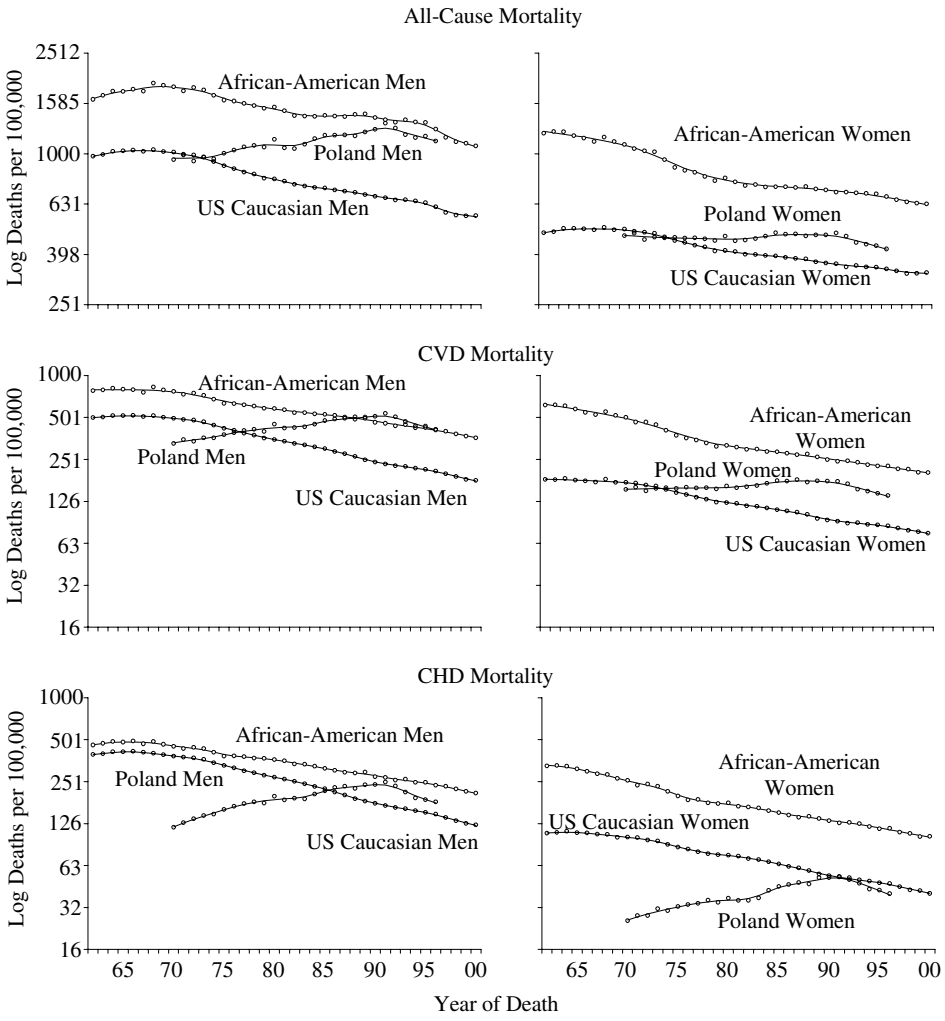


Figure 2 Age-standardized all-cause, cardiovascular disease, and coronary heart disease mortality rates in the US (1962—2000) and Poland (1970—1996) for men and women aged 35—64 years (log scale).

In general, relative declines for CHD mortality were greater than for CVD mortality, and declines for CVD mortality were greater than for total mortality in all US race-sex groups after the 1960s. Mean annual percent change in CHD mortality rates in time periods after 1967 ranged from −2.0 (African-American women, 1981—91) to −3.5 (Caucasian men, 1981—91). Annual CHD and CVD mortality declines were somewhat lower in 1992—2000 for Caucasians compared to declines during 1981—91. In contrast, African-American annual declines in CVD and CHD were greater in 1992—2000 compared to the earlier time period. Rates of decline in CHD mortality for US Caucasian men were greater than for African-American men, resulting in a widening racial gap in CHD mortality rates.

From 1970 to 1991, while US mortality rates were declining, rates in Poland increased for men and women (Fig. 2). This increase occurred for all-cause, CVD, and CHD mortality but was most pronounced for CHD mortality, which increased up to 5.2% annually for Polish men and up to 4.3% annually for Polish women (Table 1). In contrast, all-cause and CVD mortality rates changed little during this period for Polish women. As a result of these trends, cause-specific mortality rates in Poland exceeded rates for US Caucasians and approached or exceeded African-American rates by the early 1990s. The only exception was CHD mortality among women (Fig. 2), where rates in Poland never appreciably exceeded US Caucasian rates. Increasing mortality rates in Poland peaked in the early 1990s and then declined. Stratum-specific rates of mortality decline in Poland exceeded US rates of decline during the 1990s. Average CVD and CHD mortality declines during this period for the men and women in Poland were more than twice those of their US counterparts.

Table 1 Mean annual percent change in age-standardized all-cause, cardiovascular disease (CVD), and coronary heart disease (CHD) mortality rates for ages 35–64 years during the time periods specified in Poland and in the United States (US) from piecewise log-linear regression

	Men			Women		
	All-cause	CVD	CHD	All-cause	CVD	CHD
US Caucasians						
1962–1967	1.7	1.3	1.1	1.2	0.4	−0.3
1968–1980	−2.1	−2.7	−2.8	−1.6	−2.5	−2.5
1981–1991	−1.3	−3.1	−3.5	−1.0	−2.4	−2.8
1992–2000	−1.9	−2.7	−3.0	−1.0	−2.0	−2.6
US African Americans						
1962–1967	3.0	0.7	0.5	−0.8	−2.2	−3.0
1968–1980	−1.8	−2.4	−2.1	−2.7	−3.5	−3.2
1981–1991	−0.5	−1.7	−2.2	−0.6	−1.7	−2.0
1992–2000	−2.7	−2.5	−2.5	−1.4	−2.3	−2.6
Poland						
1970–1980	1.4	2.8	5.2	−0.2	0.5	3.4
1981–1991	1.6	2.0	2.5	0.5	1.0	4.3
1992–1996	−2.8	−5.1	−6.8	−3.1	−5.6	−6.5

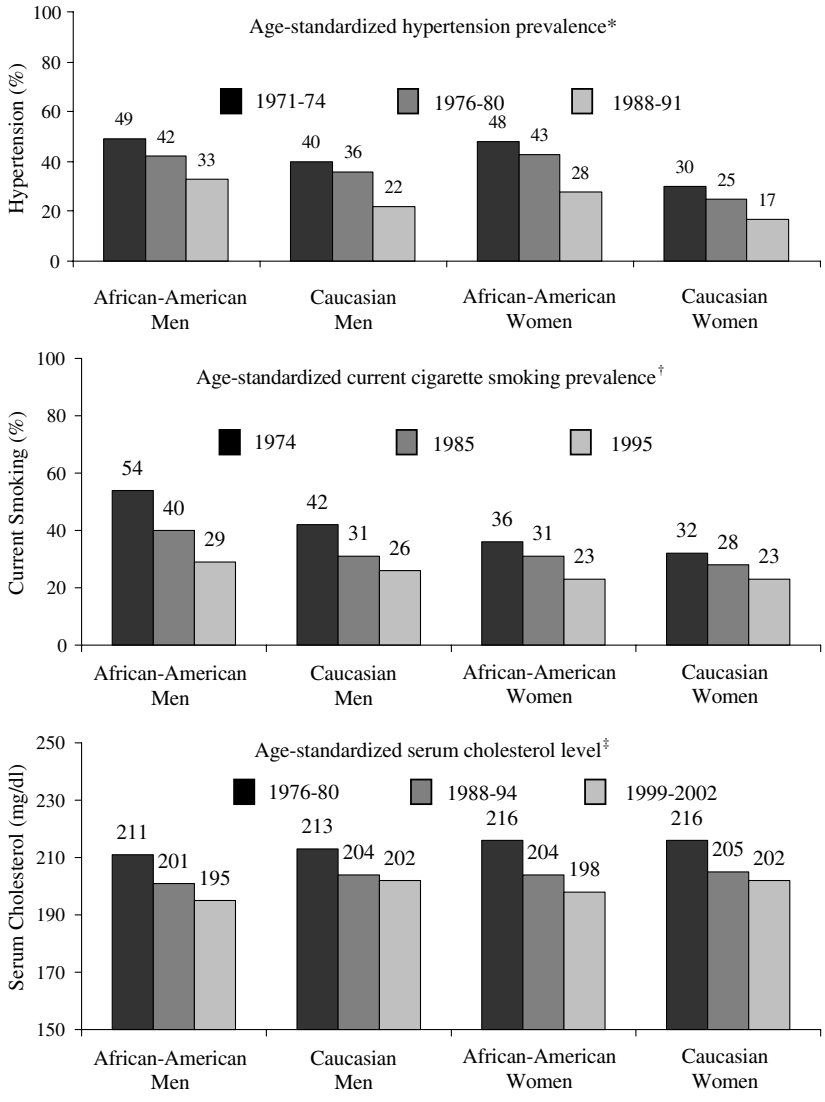
In the early 1970s almost half of African Americans, 40% of US Caucasian men, and 30% of US Caucasian women had hypertension (Fig. 3) [23]. Hypertension prevalence in the US population declined through the early 1990s when less than a third of African Americans and less than a quarter of Caucasians had this condition. Declines in cigarette smoking and serum cholesterol levels were also apparent for each race-sex group in the US, contemporaneously with declines in CVD and CHD mortality [24].

In Pol-MONICA, hypertension prevalence was lower during the period of CVD and CHD mortality decline compared to the period of increase, 10 years earlier for both men and women (Fig. 4) [36]. A slight decline in smoking was noted for men, but not for women [37]. In contrast, serum cholesterol levels increased slightly for men and women during this period of mortality decline in Poland [38].

Discussion

CVD and CHD have been leading causes of death in middle aged and older adults in the majority of developed countries and in many developing countries [1,39]. CHD mortality rates increased in the US from the early 20th century to the 1960s [11]. US CVD and CHD mortality rates began to decrease in the mid-1960s, first in California, and somewhat later in the northeastern states and the Appalachian region of the middle Atlantic states [4,40]. Since the 1970s, decreases in cardiovascular mortality have been observed for each sex, race and socioeconomic group [12,41,42]. Relative declines in CHD mortality have been more rapid for Caucasian men than for African Americans and Caucasian women, resulting in widening disparities [41,43]. Age-standardized all-cause mortality rates have also decreased, providing confirmation that the decline in heart disease deaths (being the major cause of mortality) was both real and important and not an artifact of shifting classification of causes of death. Our results are consistent with these and other reports of population differences in CVD and CHD mortality rates and their trends in the US. Although some have reported a leveling of the downward trend in US cardiovascular mortality during the early 1990s [44], our findings suggest that cardiovascular mortality rates continued to decrease throughout that decade.

All-cause and cardiovascular mortality in Poland presented quite different trends. At the beginning of the US decline in CHD, mortality rates were lower in Poland than in the US, but by the 1990s mortality rates in Poland exceeded those of US Caucasians and approached the rates of African Americans. These upward mortality trends reversed for both men and women in Poland in the early 1990s. The observed decline of Polish mortality rates occurring thereafter is a new phenomenon. Zatonski et al. [10] concluded that these trends were not accompanied by great improvement in effectiveness or delivery of medical services nor by increases in the state health service budget during this period. The reduction in CVD



*Systolic blood pressure ≥ 140 and/or diastolic blood pressure ≥ 90 mm Hg by race and sex for ages 18-74 years. Adapted from: Burt VL, et al., Trends in the prevalence, awareness, treatment, and control of hypertension in the adult US population. Data from the health examination surveys, 1960 to 1991 [23].

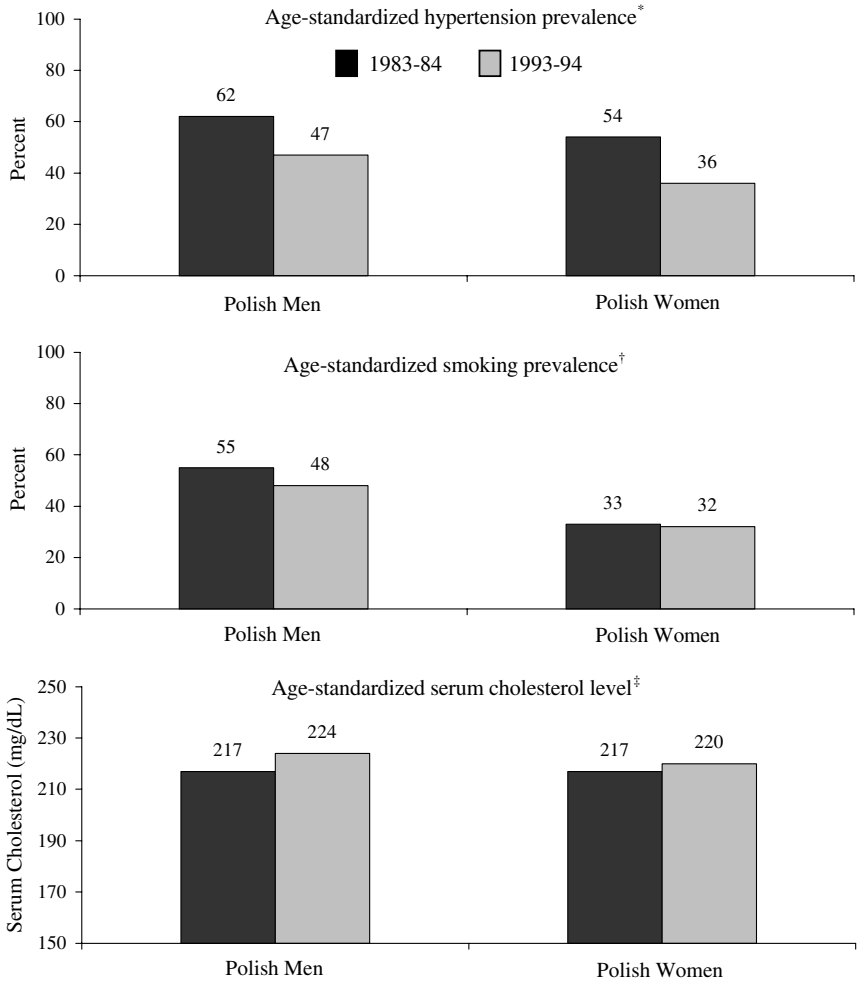
†Among adults ≥ 18 years of age. Adapted from: Health, United States, 2004 With Chartbook on Trends in the Health of Americans, Table 60 [24].

‡Among adults 2-74 years of age. Adapted from: Health, United States, 2004 With Chartbook on Trends in the Health of Americans, Table 68 [24].

Figure 3 Trends of selected cardiovascular disease risk factors in the United States by time period, race, and sex.

and CHD deaths in Poland may thus not be attributable to changes in medical care, so that other causes, such as changes in CVD risk factors and lifestyle, should be examined.

The report of the Task Force of the European Society of Cardiology and Cardiovascular Mortality and Morbidity Statistics in Europe [2] stressed that more recent analysis of mortality data pointed to a substantial increase in cardiovascular diseases in countries of Central and Eastern Europe concomitant with recent nutritional, economic and political changes. Foster and Jozan [45], analyzing the recent poor health record in Eastern Europe, reported that, after the Second World War, the decrease in mortality rates in many Eastern European countries was similar to that in Western Europe. There are several reasons why this improvement in mortality rates was not maintained. One of them might be that in Eastern Europe industrial production and other factors have taken precedence over health. The authors further concluded that less attention has been given to the health of middle aged and older people, and there has been a lack of investment in health care technology.



*Systolic blood pressure ≥ 140 and/or diastolic blood pressure ≥ 90 mm Hg, Ages 35-64 years. Adapted from: Rywik S. Epidemiology of arterial hypertension [36].
†Ages 35-64 years. Adapted from: Broda et al. 10-years trend in cigarette smoking in Polish urban and rural population in the Pol-MONICA Project [37].
‡Ages 35-64 years. Adapted from: Rywik et al. Lipid and lipoprotein profile and its changes during 10-year observation in Warsaw Pol-MONICA population [38].

Figure 4 Trends of selected cardiovascular disease risk factors by time period and sex in Poland.

Hunink et al. [46] have attributed 63% of the decline in CHD mortality in the US in 1968–76 to reduced risk factor exposures, including blood pressure reduction. These authors attributed only 31% of the decline to other medical interventions. Goldman and Cook [47] estimated that 54% of the decline in the death rate from ischemic heart disease was related to changes in lifestyle, while 40% could be attributed to medical interventions. Bots and Grobbee [48] concluded that improvements in medical care contributed only 46% to the observed decline in CHD mortality in the Netherlands, whereas approximately 44% of the decline could be attributed to primary prevention efforts and changes in risk factors.

During much of the period of decline in US cardiovascular mortality, there have been favorable changes in exposure to major risk factors, including reduction of prevalence of smoking, hypertension, and hypercholesterolemia [23,24,46,49–52]. In contrast, the prevalence of diabetes and obesity have increased markedly in the US and there has been little improvement in smoking, physical activity, and hypertension control during the 1990s, prompting some to attribute these factors to the slowing in US mortality declines observed in that decade [53].

Through the mid-1980s in Poland, there were no national community-based programs devoted to cardiovascular disease prevention or health promotion. Such available programs were of local interest

only and of a research character [54]. Furthermore, risk factor levels were higher in Poland than in the US. For 1983–84, the Pol-MONICA Project reported that more than 50% of middle aged men and more than 30% of women were current smokers [26], hypertension prevalence was higher in Polish than in US samples and its control was relatively poorer in Poland [55]; the prevalence of hypercholesterolemia was close to 70% in middle aged adults of both sexes [26]; and lipid lowering treatment was rarely used. It should also be taken into account that the Polish economic situation was much worse than in the US populations, and it is known that lower socioeconomic groups typically experience higher incidence and mortality rates and poorer survival rates for most major chronic diseases. Moreover, the risk of morbidity and mortality typically declines as the socioeconomic situation improves [56].

After the introduction of the free market for food products in Poland in 1989, different low fat milk products, different fruits and vegetables, and other low fat and low calorie products became available. According to Pol-MONICA Warsaw data, this influenced the Polish daily diet; and within the years of 1984–93, a decrease of total energy and saturated fat intake was observed as well as an increase in polyunsaturated fat intake and fruit and vegetable consumption [8]. Furthermore, decreased hypertension prevalence and improved hypertension control, as well as decreased smoking prevalence, particularly in men, were observed. However, no changes in dyslipidemia or obesity prevalences were found [26]. Dobson et al. [57], analyzing the change in overall or global risk in the WHO MONICA populations between the first and second screens (in Warsaw between 1984 and 1988), found that the CHD risk of the Warsaw population decreased between these screens. This improved CHD risk profile preceded the decrease in CVD mortality rates. Rywik et al. [58] confirmed the Dobson results analyzing the Warsaw population from 1984 to 2001 and additionally suggested that modification of the risk factor profile, especially hypertension and smoking, during that time period, decreased the probability of death in the Warsaw population consistent with changes in mortality rates.

Comparisons of absolute mortality rates for populations in different countries should be performed with caution [59]. Medical custom and vital record systems likely differ between the US and Poland. These differences may influence death classifications, limiting comparisons of cause-specific mortality rates. Furthermore, changes across ICD revisions may impact the comparability of cause-specific rates between different time periods in the two countries. To address these issues, we have attempted to ensure comparable ICD rubrics across revisions, and we have simultaneously examined all-cause, CVD, and CHD mortality rate trends. The consistency of these trends within countries suggests that it is unlikely that changes in disease classification over time substantially influenced our conclusions. Comparisons of trends, rather than absolute rate levels, were the major focus of this study.

In an earlier report [35] comparing mortality trends between the US and Poland, we concluded that the increasing stroke and CVD mortality rates, especially in middle aged Polish men, may be the result of different susceptibilities and determinants compared with US populations. It was further concluded that inequalities between nations in CVD mortality might be related to different exposures to avoidable CVD risk factors, although more complex, socioeconomic and community socioenvironmental factors may also be important. Differences in risk factor levels and trends in the two countries during their respective declines in CHD mortality support a conclusion that trends in CHD mortality, like stroke mortality, are the result of susceptibilities and determinants that differ between the US and Poland. The relatively abrupt reversal and rapid decline of CHD mortality in Poland compared to the US also suggest that the two countries may differ in their life style and socio-environmental risk profiles.

Rates of all-cause, CVD, and CHD mortality have been rising in many Central and Eastern European countries since 1970, in the face of substantial declines in other developed countries such as the US. A reversal of this trend since 1991 appears to be occurring in Poland, despite lack of evidence of improved treatment or access to medical care, which is often credited with causing these declines in the US. Improvements in lifestyle factors, such as a decline in smoking, improvement in hypertension control, and increased availability of heart healthy diets, have clearly been demonstrated in Poland to have preceded the CVD mortality declines observed from 1991 and beyond and have been associated with US declines in CVD mortality since the 1970s. These data are consistent with evidence from intervention trials of substantial potential for reduction in morbidity and mortality from simple changes in lifestyle. They should provide increased impetus for efforts at improving these factors in all countries with mortality rates above the projected minimum, regardless of whether these rates are rising, declining, or leveling off.

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