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Cardiovascular mortality in Central and Eastern Europe: differences and similarities

Olga Penina

Department of Social Medicine and Management, Nicolae Testemitanu State University of Medicine and Pharmacy, Chisinau, Republic of Moldova

ABSTRACT

Objective. To identify differences and similarities in trends and patterns of cardiovascular mortality in Central (Romania and Poland) and Eastern (Moldova and Ukraine) European countries before and after the political transition.

Material and methods. The mortality series reconstructed according to ICD-10 since 1970 for Moldova, Ukraine and Poland and since 1980 for Romania were used. Directly standardized death rates by sex, age and detailed cardiovascular disease were computed.

Results. After a long period of stagnation or rise, cardiovascular mortality started declining after 1991 in Poland, 1995 in Moldova, 1997 in Romania and 2005 in Ukraine. The progress in Romania and Poland was associated with both heart diseases and cerebrovascular diseases. In Moldova and Ukraine, the recent improvements were primarily related to cerebrovascular diseases. Compared to Central Europe, the quality of codification of heart diseases was found poor in Eastern Europe.

Conclusions. The lack of effective control of mortality from heart diseases is the major public health problem in Moldova and in pre-war Ukraine. Romania and Poland follow very similar mortality patterns and trends, though with a certain time lag.

Keywords: cardiovascular mortality, Central and Eastern Europe, political transition, heart disease, cerebrovascular disease

INTRODUCTION

Cardiovascular diseases (CVD) are the leading cause of death in the European Union and represent 45% of all deaths at present [1]. Standardized death rates from CVD that eliminate the influence of population ageing are steadily declining worldwide and in regions with reliable data [2]. Disregarding this progress, Central and Eastern Europe (CEE) remains the region with the highest cardiovascular mortality burden in the world [3]. Different studies pointed to the differences in long-term trends in life expectancy at birth between Western countries (Western Europe, USA, Japan) and CEE. The east-west divergence in overall mortality began in the mid-1960s and continued through the early 1990s [4]. In Western countries, there has been a spectacular increase in life expectancy since the 1970s, first and foremost, due to a significant cardiovascular mortality reduction known in the literature as the cardiovascular revolution [5]. At the same time, the health status of the adult population in CEE was deteriorating or stagnating as a result of increased mortality from non-communicable diseases and external causes of death. This divergence in mortality trends, also referred to as the east-west mortality gradient, has a number of explanations such as unhealthy lifestyle, risky patterns of alcohol consumption, inadequate medical care, income inequality, psychosocial stress [6–8]. The Czech Republic and Poland were the first countries in the region to experience steady growth in life expectancy after the collapse of the communist regime at the end of the 1980s. Most life expectancy gains were due to a decrease in mortality from CVD [9]. This population health progress was subse-

Corresponding author:
Olga Penina
E-mail: olga.penina@usmf.md

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quently joined by other Central European countries. Romania, for example, did not see a steady increase in life expectancy until 1997 [10,11]. Among the former Soviet Union (FSU) countries, the first signs of improvement after the break-up of the USSR in 1991 occurred in the Baltic countries, with some differences between them [12]. In other FSU countries, notable amelioration in population health was not seen before 2005 [13,14]. The reasons for these advances are complex and reflect changes in diet, lifestyle, alcohol consumption and modern cardiovascular treatment [15].

OBJECTIVES

The study aims to identify differences and similarities in cardiovascular mortality trends and patterns in four countries from Central (Romania and Poland) and Eastern (Moldova and Ukraine) Europe before and after the political transition. Our research questions are as follows:

What age groups and causes of death account for changes in cardiovascular mortality during a period of deterioration and improvement in these countries?

Are cardiovascular mortality patterns by cause comparable in Central and Eastern Europe?

MATERIAL AND METHODS

We rely on mortality data retrieved from the Human Cause-of-Death (HCD) database [16]. The latter provides coherent death time series, according to the 10th revision of the International Classification of Diseases and Causes of Death (ICD-10) reconstructed by a special method developed by Vallin and Meslé. Continuous mortality series can be compared reliably across time and between countries since the reconstruction method eliminates breaks caused by periodic changes in the classification of causes of death [17]. Data were reconstructed for Moldova, Poland and Ukraine from 1965 and Romania from 1980 [18–21]. The reconstructed time series were prolonged by the author for Moldova and Romania up to 2019 and 2018, respectively. The de-personalized database of medical death certificates provided by the National Agency for Public Health (NAPH) was used for Moldova (since 2015). Romanian time series were prolonged (since 2013) based on the WHO mortality database [22]. The reconstructed series for Poland were completed with raw data (since 2017) from the WHO mortality database. Finally, the reconstructed time series for Ukraine were extended with raw data (since 2014) based on the official statistics [23]. For Ukraine, the period 2014-2019 does not cover the temporarily occupied territories of Crimea and the Donetsk and Luhansk regions, both in terms of mortality and population exposure.

Age-specific death rates were computed based on the list of causes presented in Table 1. Mortality rates were standardized by the direct method using the 2013 European standard population [24]. Data were analysed in R.

RESULTS

The evolution of standardized death rates for CVD by sex since 1970 in Moldova, Ukraine and Poland and since 1980 in Romania is presented in Figure 1. Among males, the level of mortality from CVD was the same in the early 1970s in Moldova, Ukraine and Poland. The subsequent increase was much stronger in Moldova and Ukraine than in Poland or Romania. Among males from the latter two countries, the situation deteriorated continuously until 1991 and 1996, respectively. During this period of deterioration, the standardized death rates increased by 21% in Polish males and by 12% in Romanian males. Since then, the situation has started improving quickly in the two countries. The mortality shrank by 57% in Poland between 1991 and 2019 and by 42% in Romania between 1996 and 2018. However, due to a longer period of deterioration in

TABLE 1. Cardiovascular diseases with corresponding ICD-10 and HCD codes

Disease	ICD-10 code	HCD code
Heart diseases, including:	I00-I51	48-57
Myocardial infarction	I21-I23	51
Other ischaemic heart diseases (IHD)	I20, I24, I25	52
Pulmonary heart disease	I26-I28	53
Other heart diseases	I00-I15, I30-I38, I40-I45, I46-I51	48-50, 54-57
Cerebrovascular diseases, including:	G45, I60-I69	58-61
Stroke (haemorrhage or infarction)	I60-I62, I63, I65, I66	58-59
Other cerebrovascular diseases	G45, I64, I67, I69	60-61
Other cardiovascular diseases	I70-I78, I80-I99	62-63
Cardiovascular diseases	*I00-I99*	*48-63*

Source: The Human Cause-of-Death (HCD) database, https://www.causesofdeath.org
Note: HCD codes refer to the intermediary list

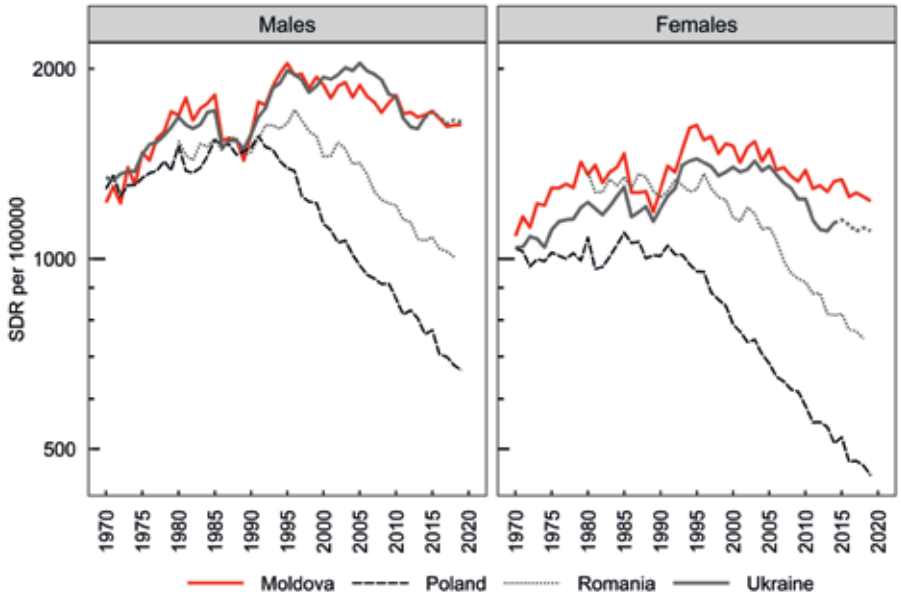

FIGURE 1. Standardized death rates (SDR) from cardiovascular diseases in four European countries, by sex (per 100000)

Source: author's calculations based on data from the Human Cause-of-Death database, the WHO mortality database, the National Agency for Public Health of the Republic of Moldova, the State Statistics Service of Ukraine.
Note: Ukrainian data for 2014-2019 do not cover the temporarily occupied territory of the Autonomous Republic of Crimea, the Donetsk and Luhansk regions

Romania than in Poland and a more rapid subsequent progress in Poland than in Romania, the gap between the two countries remained quite wide since the 1990s (1.5 times in 2018). In the FSU countries, the rapid rise in cardiovascular mortality was abruptly halted in 1985 as a result of the launch of the two-year anti-alcohol campaign. Between 1985 and 1989 alone, when the minimum and maximum values were observed, mortality rates fell by 21% for Moldovan men and 13% for Ukrainian men. However, this improvement was temporary, followed by an immense rise in cardiovascular mortality in the early 1990s caused by the severe socioeconomic crisis that hit the newly independent countries immediately after the collapse of the USSR. Among Moldovan men, this growth continued through 1998 and was followed by a moderate decrease. Among Ukrainian men, the mortality curve continued on the same trajectory as in Moldova until 1998. However, after a slight improvement in the second half of the 1990s, mortality increase resumed in that country and continued through 2005, followed by marked progress. Disregarding the large fluctuations induced by the circumstances of the 1980s and 1990s, the growth of deaths from CVD in males was about 50% in Moldova between 1970 and 1998 and in Ukraine between 1970 and 2005. During the period of improvement, standardized death rates fell by 12% in Moldova and 19% in Ukraine. After 2010, standardized mortality indicators were similar in Moldovan and Ukrainian males and were 2.4 times higher than in Polish males or 1.6 times higher than in Romanian males.

For females, the evolution of cardiovascular mortality was essentially the same as for males. During the period of deterioration, female mortality stagnated in Poland and Romania and increased in Moldova and Ukraine. Unlike men, the situation of Romanian women in the 1980s was much closer to the one in Moldova than in Poland. The 1985 anti-alcohol campaign and the socioeconomic crisis of the 1990s had a more pronounced effect on female mortality in Moldova than in Ukraine.

The evolution of the age-specific mortality profile for CVD among males over a period of deterioration and improvement is illustrated in Figure 2. During the deterioration period, the age group most affected in the four countries was the working-age population aged 30 to 60. The most unfavourable situation was observed in Ukraine, where death rates at these ages more than doubled in 2005 compared to 1970. In Moldova, in contrast to other countries, mortality also rose among the elderly. In Romania and Poland, the period of improvement was characterised by a consistent decline across all ages, including older age groups. At the same time, in Moldova and particularly in Ukraine, recent progress has been mainly associated with declining mortality among middle-aged people.

Changes in cause-specific cardiovascular mortality patterns in males are shown in Figure 3. In the four countries, heart disease was predominant, rep-

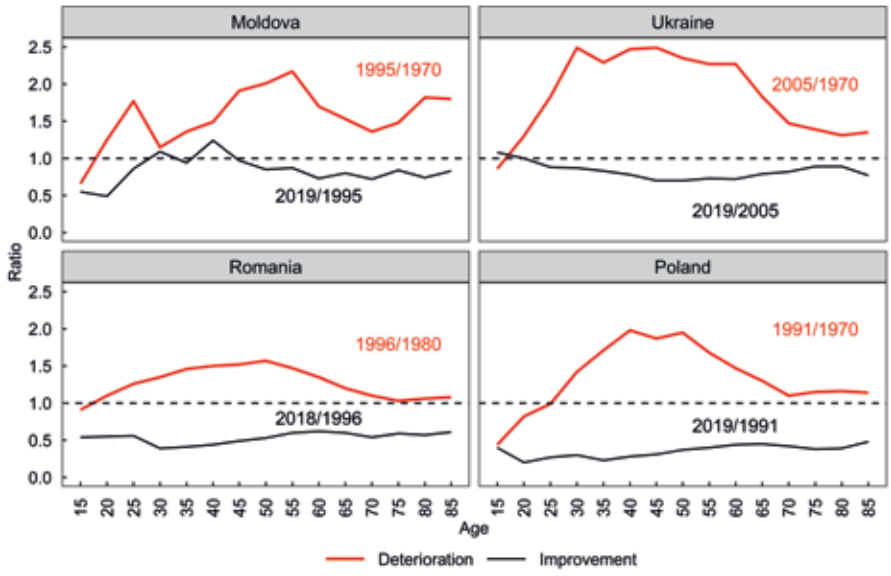

FIGURE 2. Changes in age-specific mortality rates from cardiovascular diseases during a period of deterioration and a period of improvement, males

Source: author's calculations based on data from the Human Cause-of-Death database, the WHO mortality database, the National Agency for Public Health of the Republic of Moldova, the State Statistics Service of Ukraine.
Note: Ukrainian data for 2014-2019 do not cover the temporarily occupied territory of the Autonomous Republic of Crimea, the Donetsk and Luhansk regions

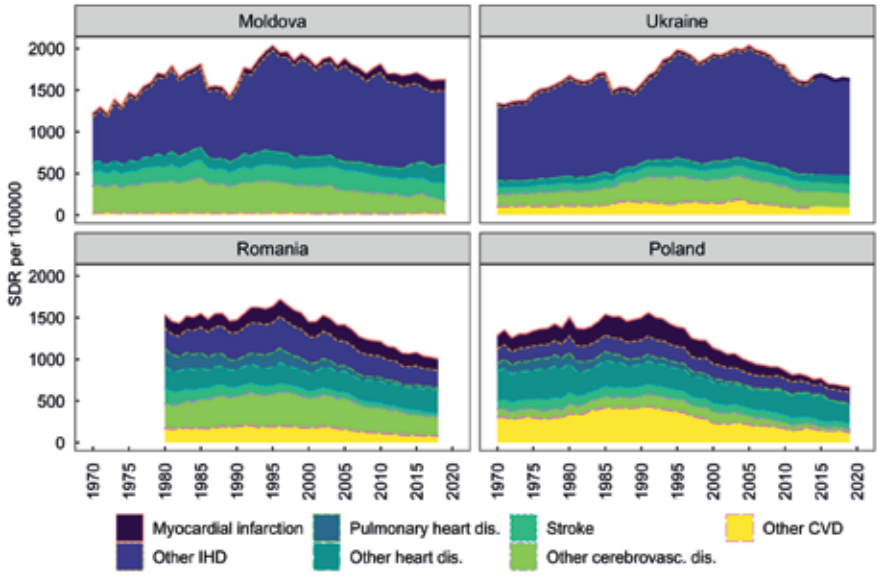

FIGURE 3. Standardized death rates (SDR) from seven cardiovascular diseases in four European countries, males (per 100000)

Source: author's calculations based on data from the Human Cause-of-Death database, the WHO mortality database, the National Agency for Public Health of the Republic of Moldova, the State Statistics Service of Ukraine.
Note: Ukrainian data for 2014-2019 do not cover the temporarily occupied territory of the Autonomous Republic of Crimea, the Donetsk and Luhansk regions

resenting currently 75% of cardiovascular deaths in Moldova and Ukraine and 65% in Romania and Poland. This share was fairly constant over time, with the exception of Moldova where, at the start of the period, it was comparable to that of Poland and Romania (60%). A more detailed analysis of mortality from heart diseases revealed significant differences in codification practices between Eastern and Central European countries. In Moldova and Ukraine, the lion's share of heart diseases was attributed to "other ischaemic heart diseases" with 70% in Moldova and 88% in Ukraine in 2019. At the same time,

the share of this pathology varied between 20% and 30% in Poland and 30% and 40% in Romania depending on the period. In the latter two countries, the contribution of more specific heart diseases such as myocardial infarction, pulmonary heart disease and the residual group of heart diseases was much greater than in Eastern European countries. In Ukraine, for example, the share of myocardial infarction was only 3% compared to 13% in Poland or 22% in Romania. In Moldova, the impact of this type of mortality has been increasing recently (5% in 1990 and 11% in 2019). The same situation in the case of Moldova was observed for the residual group of heart diseases (12% in 1990 and 18% in 2019).

Cerebrovascular diseases are the second largest group of causes of death in Moldova, Ukraine and Romania and the third one in Poland. The contribution of this disease to cardiovascular mortality ranged between 17% in Poland and Ukraine and 20-25% in Moldova and Romania. Intracranial haemorrhage and cerebral infarction merged into the group "stroke" was the most frequent cause of cerebrovascular disease in Poland with the proportion varying from 45% to 65%. On the contrary, in Romania, the impact of this cause was constantly declining over the study period (38% in 1970 and 17% in 2018), while most cerebrovascular deaths were increasingly attributed to "other cerebrovascular diseases". The prevalence of this latter group among cerebrovascular deaths was also observed in Ukraine and Moldova, although to a lesser extent than in Romania. The remaining group of "other CVD" was almost absent in Moldova (under 2%) and accounted for 5%-8% of all cardiovascular deaths in Ukraine and Romania. In Poland, this residual class was as large as cerebrovascular diseases with 18-28%.

Given the differences in the structure of cardiovascular mortality by detailed cause in the four countries, mortality trends for men only for two main causes: heart diseases and other CVD, including cerebrovascular diseases (Figure 4). The overall progress in cardiovascular mortality after 1991 in Poland and 1996 in Romania was due to both components. Mortality from heart disease decreased by 36% in Romania between 1996 and 2018 and by 50% in Poland between 1991 and 2019. Over the same period, standardized death rates from cerebrovascular disorders and other CVD decreased by 50% in Romania and 67% in Poland. In Moldova and Ukraine, sustained improvement occurred only in cases of cerebrovascular and other CVD for which the standardized indicators after the period of long-term growth or stagnation started declining after 2005 (about 30%). Mortality from heart disease in Moldovan males after a brief period of improvement in the second half of the 1990s has remained stagnant to date. In Ukrainian males, mortality from this cause after a 20% reduction between 2005 and 2013 began to stagnate as in Moldova.

DISCUSSION

The paper addressed the changes in long-term trends and patterns in cardiovascular mortality in Central (Romania, Poland) and Eastern (Moldova, Ukraine) European countries. The analysis of mortality trends for any country is complicated by periodic changes in the classification of causes of death.

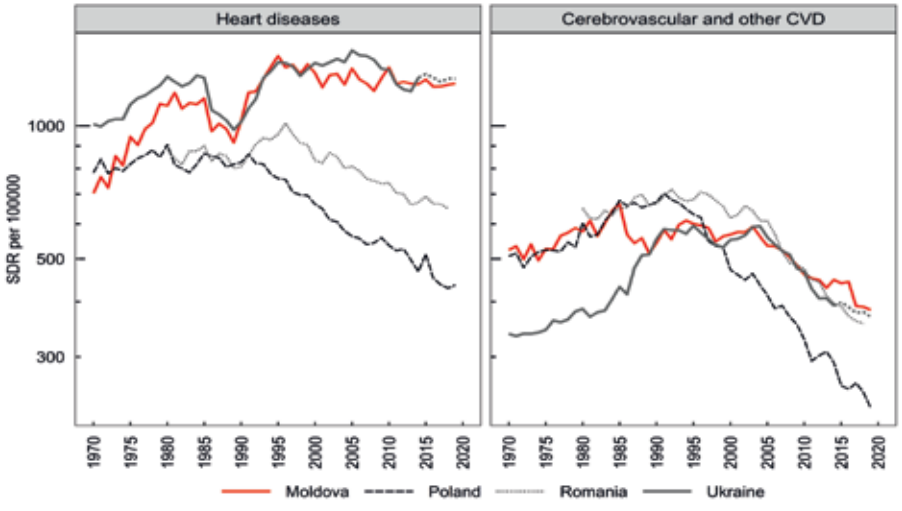

FIGURE 4. Standardized death rates (SDR) from heart diseases and other cardiovascular diseases in four European countries, males (per 100000)

Source: author's calculations based on data from the Human Cause-of-Death database, the WHO mortality database, the National Agency for Public Health of the Republic of Moldova, the State Statistics Service of Ukraine.

Note: Ukrainian data for 2014-2019 do not cover the temporarily occupied territory of the Autonomous Republic of Crimea, the Donetsk and Luhansk regions

To overcome this methodological issue, we relied on the time series of deaths reconstructed under ICD-10 and available for the four countries in the HCD database. The reconstructed data are consistent across time and between countries. In addition, the analysis was carried out following preliminary mortality adjustments resulting from different data quality problems that exist in these countries. Some of these problems are an underestimation of death rates among older adults in the 1960s and an increase in senility-related deaths in the 1990s in the FSU countries [19,25]. Even though the corresponding corrections were applied, we preferred to have the starting point 1970 rather than 1965. Moldovan mortality data for the late 1960s remains somewhat problematic for older age groups.

The results of the study showed low differentiation of CVD mortality in Moldova and Ukraine, especially in the case of heart diseases. However, the similar level of mortality in the 1970s in the four countries, particularly among men, indicates a satisfactory registration of cardiovascular deaths in the countries of Eastern Europe. The very small proportion of deaths attributed to "other CVD" in Moldova and Ukraine, especially relative to Poland, leads to a certain overestimation of mortality for the other two components (heart diseases and cerebrovascular diseases) in these countries. Previous studies showed a wide-ranging practice to attribute ill-defined heart diseases among the elderly to so-called "atherosclerotic cardiosclerosis" in the FSU countries during the Soviet period (I25.1 under ICD-10) [19]. In Ukraine, this practice continues so far, with the proportion of atherosclerotic cardiosclerosis more than 50% of all CVD and 70% of ischaemic heart diseases. In Moldova, after the adoption of ICD-9 in 1991, deaths earlier codified as atherosclerotic cardiosclerosis have been increasingly recorded as unspecified ischaemic heart disease (I25.8 under ICD-8) [25].

In all four countries, cardiovascular mortality was the most common cause of death and reflected the changes in overall mortality. In Romania and Poland, the period of deterioration in population health was accompanied by a rise in mortality from three main components: heart diseases, cerebrovascular diseases and other CVD. The most affected sex and age group was males of working age. The collapse of the communist regime led to a prompt decline in cardiovascular mortality in Poland. At the same time, in Romania, after the 1989 revolution, mortality has accelerated its growth in men and continued to stagnate in women. In 1997, however, standardized death rates started to decline steadily in Romania, more rapidly for cerebrovascular and other CVD, and more slowly for heart disease.

During the period of deterioration, cardiovascular mortality increased more rapidly in Eastern Europe than in Central Europe, for both men and women. The impressive decline in mortality in the late 1980s during the anti-alcohol campaign in Moldova and Ukraine showed a strong dependence of cardiovascular mortality on alcohol consumption in these countries. The reduction in cardiovascular mortality during the 1985 anti-alcohol campaign in the FSU countries was found to be primarily associated with ischaemic heart diseases, except for myocardial infarction [26]. In the case of Moldova, the anti-alcohol effect on cardiovascular mortality was evident not only in males but also in females. Generally, women's health status during the Soviet period was far worse in Moldova than in other FSU countries because of the rapid increase in liver cirrhosis mortality related to the dangerous consumption of homemade wine [27]. The socio-economic crisis of the 1990s led to a dramatic increase in mortality in Moldova and Ukraine, largely due to heart disease. The temporary reduction in mortality recorded in the late 1990s during a persistent socio-economic crisis in these countries was due to the population's adaptation to new social and economic circumstances [19]. In the new millennium, cardiovascular mortality started to rise again among Ukrainian men and stagnated among Moldovan men. Unlike Romania and Poland, stable progress in cardiovascular mortality among Moldovan and Ukrainian men has been observed only in the case of cerebrovascular diseases mainly associated with hypertension. A marked reduction in mortality due to heart diseases observed in Ukraine after 2005 ceased in 2014. Russia's invasion of Ukraine and a full-scale war that began on February 24, 2022, caused devastating and terrible immediate health problems for the Ukrainian population and will have long-term health consequences in the future [28]. After the war, it will take years to restore the positive cardiovascular mortality trend in Ukraine.

CONCLUSIONS

In the Central European countries represented by Poland and Romania, advances in cardiovascular mortality after 1991 and 1996, respectively, were attributable to its three main components (heart diseases, cerebrovascular diseases and other cardiovascular diseases). The pace of progress was more rapid for cerebrovascular diseases than for heart diseases. In Eastern European countries represented by Moldova and Ukraine, the period of improvement in males was mainly associated with cerebrovascular diseases, while mortality from heart diseases continued to maintain at a high level. The practice of codifying heart diseases in Moldova and Ukraine was found to be weak and was characterized by a high share of unspecified ischaemic heart

diseases, a small proportion of other heart diseases and other cardiovascular diseases. Comparing cardiovascular mortality trends by detailed cause between Central Europe and Eastern Europe is problematic even based on the reconstructed time series.

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