The Recent Mortality Decline in Russia: Beginning of the Cardiovascular Revolution?

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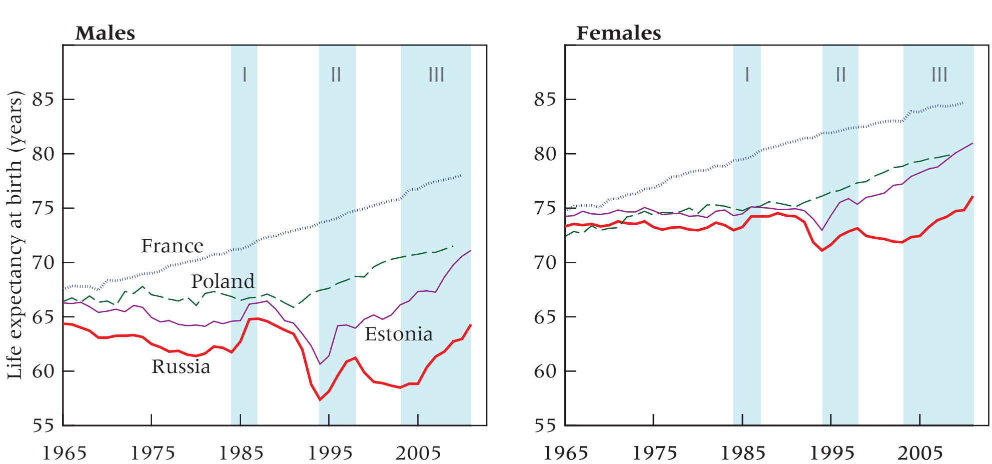
Researchers have offered a number of explanations for the Soviet and post-Soviet mortality crises in Russia. It has been suggested that the poor performance of the Soviet health care system (in particular, its ineffectiveness in lowering cardiovascular mortality), the neglect by Soviet authorities of the population's social and material needs, and the prevalence of unhealthy lifestyles (rising alcohol consumption, poor diet, the lack of health-promoting activities, and the general lack of attention to personal health) are mainly responsible for the health crisis in Soviet Russia (Eberstadt 1981; Feshbach 1984; Blum and Monnier 1989; Meslé, Vallin, and Shkolnikov 1998; Field 1995; Cockerham 1997; Shkolnikov et al. 2004a; Shkolnikov and Leon 2006). A number of factors are thought to have been responsible for the sharp deterioration in the health situation in Russia in the early 1990s. It has been widely accepted that the further rapid spread of unhealthy lifestyles (in particular, alcohol consumption) and psychological stress caused by abrupt and poorly executed social and economic reforms were mainly responsible for reductions in life expectancy (Cornia and Paniccia 2000; Brainerd and Cutler 2005, Shkolnikov et al. 2004a).

The most prominent features of the Russian mortality crisis have been high rates of death from accidents and violence among men at working ages and high and rising cardiovascular mortality rates at middle and older ages. Both causes of death are also considered to be largely responsible for the predominantly adverse mortality trends of the last three decades of the twentieth century (Shkolnikov et al. 2004a). The first substantial interruption of these downward trends occurred in the mid-1980s (Figure 1), as a result of Gorbachev's anti-alcohol campaign (Shkolnikov and Nemtsov 1997). The second interruption occurred in 1995–97, but, unlike the previous break, it was a "rebound" effect following the sharp mortality rise associated with the socioeconomic crisis and a resurgence of alcohol consumption in the early 1990s (Shkolnikov, McKee, and Leon 2001). In both instances, life expectancy soon resumed its long-term negative trajectory. After 2003, a third mortality decline started in Russia that has lasted for the past decade.

A recent study (Shkolnikov et al. 2013) analyzed changes in mortality and life expectancy in Russia over 2004–2010, including decreases in cardiovascular mortality. The authors concluded by asking whether Russia has joined the cardiovascular revolution, a major health development that began in advanced economies during the 1970s. The present study seeks to answer this question by conducting a comparative analysis of age- and cause-of-death patterns in mortality change in Russia and in several countries in Eastern and Western Europe.

To assess the plausibility of achieving a sustainable positive trend in Russian life expectancy, we analyze the driving forces behind this new development. We start by summarizing the evidence on the health progress made in Western countries. We highlight the major stages of mortality change, discuss-

FIGURE 1 Trends in life expectancy at birth in Russia and selected European countries, showing the three periods of substantial improvement in Russia, 1965–2011



NOTE: Data for 2011 - official estimates (Goskomstat).
SOURCE: Human Mortality Database.

ing them in light of established theories of epidemiologic and health transitions (Omran 1971; Frenk et al. 1991). We identify the main demographic features of Russia's health advances and compare them with the characteristics accompanying the improvements observed at different times and in different countries. We focus on France as a Western European reference country; Poland as an Eastern European country where the reversal in unfavorable mortality trends began in 1990, shortly after the collapse of the communist system; and Estonia as a former Soviet Republic that has seen sustained improvements since the mid-1990s. Finally, we assess whether the features of the improvements in these countries are similar to those of the progress made in Russia and speculate about the determinants of the observed changes.

What is the cardiovascular revolution?

In the twentieth century, the rapid increase in human longevity accompanied socio-demographic development throughout the industrialized world. The concept of demographic transition emerged as a general theory providing an initial overview of the determinants of mortality reduction (Landry 1934; Kirk 1944, 1996). According to the theory, the decline in mortality was attributable to factors such as better food supply, the development of vaccinations, improvements in personal hygiene, educational progress, and scientific advancements in medicine.

The theory of epidemiologic transition (Omran 1971) provided a more detailed explanation of mortality decline within the same framework. Based on the notion of three epidemiologic ages (age of pestilence and famine, age of receding pandemics, and age of degenerative and man-made diseases), Omran's theory sought to explain the mechanisms that prompted the shift from one pathological structure to another. The theory postulated that, during the final stage of the transition, infectious diseases almost disappeared, while degenerative and man-made diseases (Meslé and Vallin 2011) became the biggest killers. As a result, increases in life expectancy slow down. However, the evolution of mortality decline in Western countries casts doubt on the validity of Omran's model. From the 1970s onward, mortality started decreasing very rapidly, and these improvements were mainly driven by declining mortality from cardiovascular diseases (CVD) and by halting and then reversing the rise of man-made diseases. From the point of view of the existing theory, it was indeed a revolutionary change, which some scholars called the fourth stage of epidemiologic transition (Olshansky and Ault 1986; Rogers and Hackenberg 1987). Frenk and colleagues (1991) proposed the notion of the health transition, which explains the evolution of the factors responsible for long-term improvements in life expectancy. The concept of the health transition was subsequently reformulated as a broader and more flexible model that accommodated epidemiological changes at earlier (reduction in infectious diseases) and later (decline in cardiovascular mortality) stages, with the option of incorporating any new phases that might emerge in the future (Meslé and Vallin 2006).

Our study is based on the concept of the cardiovascular revolution (Vallin and Meslé 2004), the major epidemiological change that accompanied the second (modern) phase of the health transition. The term emphasizes the unexpected phenomenon of a steady reduction in mortality from cardiovascular diseases. Compared with earlier transitions, it is much more difficult to quantify the cardiovascular revolution and provide a precise definition that can be universally applicable to any population. The cardiovascular revolution is an evolving process shaped not only by general conditions, but also by country-specific contexts. Many factors, including a country's initial mortality level, mortality structure, population composition, and health policies, can affect the timing and the speed of the improvements.

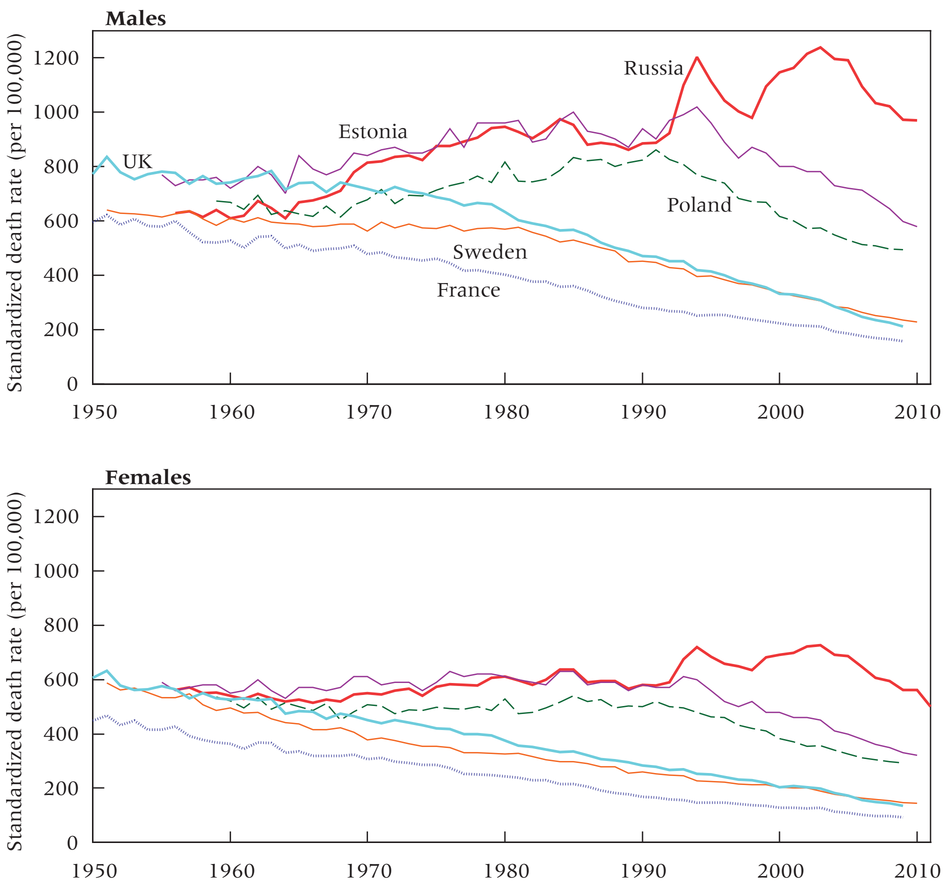
Figure 2 shows several examples of the reduction in CVD mortality between 1950 and 2011. France, the United Kingdom, and Sweden represent the "pioneers"—industrialized countries of Western Europe where the cardiovascular revolution occurred in the late 1970s for men and in the 1950s and 1960s for women. Poland and Estonia belong to a group of "followers"—post-communist countries where improvements began in the 1990s. (France and the UK have respectively the lowest and highest levels of CVD mortality among the Western countries; Poland and Russia represent these two extremes among the Eastern countries.)

In the three Western countries, female CVD mortality decreased steadily throughout the whole period at similar speeds. With the exception of France, male CVD mortality did not exhibit the same sort of linear decrease. In the UK, male mortality fell slowly until the early 1970s, when it started decreasing quickly. In Sweden, male mortality did not begin to decline rapidly until the early 1980s. Poland and Estonia exhibited different patterns of CVD mortality reduction. In both Poland (the early 1990s) and Estonia (the mid-1990s), the cardiovascular revolution emerged abruptly after periods of long-term mortality deterioration among men and mortality stagnation among women. Because of the previous unfavorable trends, the reversal is particularly impressive in these two countries.

It is noteworthy that the declines in cardiovascular mortality occurred in different socioeconomic and political contexts. In the Western countries, it was associated with post-industrial development, improvements in living standards, and the spread of higher education. These were all prerequisites for the development of medical technology and the adoption of healthier behaviors—two factors identified with the cardiovascular revolution in the West (Meslé and Vallin 2006).

Many of the former communist countries experienced significant health improvements in the 1990s, largely due to the reduction in cardiovascular

FIGURE 2 Trends in mortality from cardiovascular diseases in Russia compared to selected European countries, 1950–2011



NOTE: Computed on the basis of the European population standard.
SOURCE: Reconstructed series by cause (see text).

mortality. In the Czech Republic, progress was more rapid than elsewhere. Some scholars have suggested that a rapid reduction in CVD mortality in that country is more likely to be attributable to technical progress in medical treatment (increases in the use of modern cardiovascular drugs and in the number of cardiac surgery operations performed) than to changes in lifestyle (Rychtarikova 2004).

Health improvements in Poland began shortly after the collapse of communism, which represented a profound socioeconomic and political transformation. Changes in dietary habits, such as a decrease in the consumption of animal fats and an increase in the consumption of fruits and vegetables, are believed to be among the main determinants of the significant reduction in CVD mortality in Poland (Zatonski, McMichael, and Powles 1998). Researchers have suggested that more than half of the recent decline in mortality from coronary heart diseases in Poland can be attributed to a reduction in levels of cholesterol and an increase in physical activity, while another third can be attributed to improvements in the quality of medical interventions, including coronary bypass, coronary angioplasty, and stenting (Bandosz et al. 2012).

In Estonia, unlike Poland or the Czech Republic, the political and socioeconomic changes associated with the collapse of communism led to a significant increase in mortality that was not reversed until the mid-1990s. Some studies have suggested that successful reforms of the health sector implemented in the early 1990s (supported by substantial foreign investment) were a major reason for the health improvements (Koppel et al. 2008; Jasilionis et al. 2011). Changes in alcohol marketing as well as stricter penalties for drunk driving may have contributed to the progress of the late 1990s and 2000s (Vails 2008, Lai and Habicht 2011).

These are just a few of the countries in which a marked reduction in CVD mortality was achieved. Each of these countries can be said to have experienced the cardiovascular revolution, because despite their differing socioeconomic, cultural, and political contexts, the shift toward a new epidemiologic profile was in each case accompanied by an impressive (and, to some extent, unexpected) decrease in CVD mortality. Thus, the cardiovascular revolution can be defined as a continuous and irreversible reduction in cardiovascular mortality driven by both fundamental changes in behavioral risk factors and advancements in medical technology and disease prevention. Since 2003, there has been a steady decline in CVD mortality in Russia. However, it is not yet clear whether this phenomenon is sustainable and irreversible.

Data and methods

To avoid problems caused by changes in the classification of causes of death, we rely on the reconstructed mortality series by sex, five-year age group, and cause of death for Russia, Estonia, Poland, and France. These data were previously harmonized using the uniform method of *a posteriori* reconstruction of continuous mortality series (Vallin and Meslé 1988; Meslé and Vallin 1996). Mortality series for Russia, which were reconstructed in accordance with the last Soviet classification system (176 items), are available for the period 1965–1998 (Meslé et al. 1996). To extend the Russian series to 2011, we used the original statistical tables by causes of death classified in accordance with the abridged version of the ICD-10. Updated population estimates (adjusted in accordance with the results of the 2011 population census) were used in the calculation of mortality rates. For Estonia, the series, grouped into 191 items from the ICD-10, are available for the period 1955–2010 (Meslé, Vallin, and Hertrich 2012). Mortality series for Poland are available for the period 1970–

TABLE 1 Causes of death used in the analysis and their correspondence to different classification systems

	Russia		Estonia, France, Poland	
Cause of death	Soviet classification of 1988	Specific abridged version of ICD-10	ICD-9 (detailed list)	ICD-10 (detailed list)
Heart diseases	84–97	115–132	390–429	I00–I159, I20–I259
Cerebrovascular diseases and other cardiovascular diseases	98–102	133–147	430–459	I60–I999, G45–G459
Injury and poisoning	160–175	239–256, 272–274	E800–E999	V01–Z999
Other causes of death	1–83, 103–159	1–114, 148–228	Rest	Rest
All causes of death	1–175, 206	1–228, 239–274	1–799, E800–E999	A00–R999

2009 at the four-digit level of the ICD-10 (Fihel, Meslé, and Vallin 2010). For France, deaths grouped into 114 items from the ICD-9 (from 1950 to 1999) and the ICD-10 (from 2000 to 2009) are available (Pechholdova 2010). The reconstructed data for all of the countries included are available in the form of age-and-cause-specific mortality rates. As supplementary data sources, we relied upon mortality data extracted from the WHO mortality database and the Human Mortality Database.

For each country and period, causes of death were aggregated into four broad groups: heart diseases, cerebrovascular and other cardiovascular diseases (CVD), injury and poisoning, and other (residual) causes of death (Table 1). To compare mortality trends over time, we computed age-standardized death rates on the basis of the European population standard. We used a method for decomposition of a difference between two life table quantities by ages and causes of death (Andreev 1982, Andreev, Shkolnikov, and Begun 2002; Andreev and Shkolnikov 2012). The method allows us to determine the particular age groups and causes of death responsible for changes in life expectancy over time. The required abridged life tables were constructed on the basis of the reconstructed data.

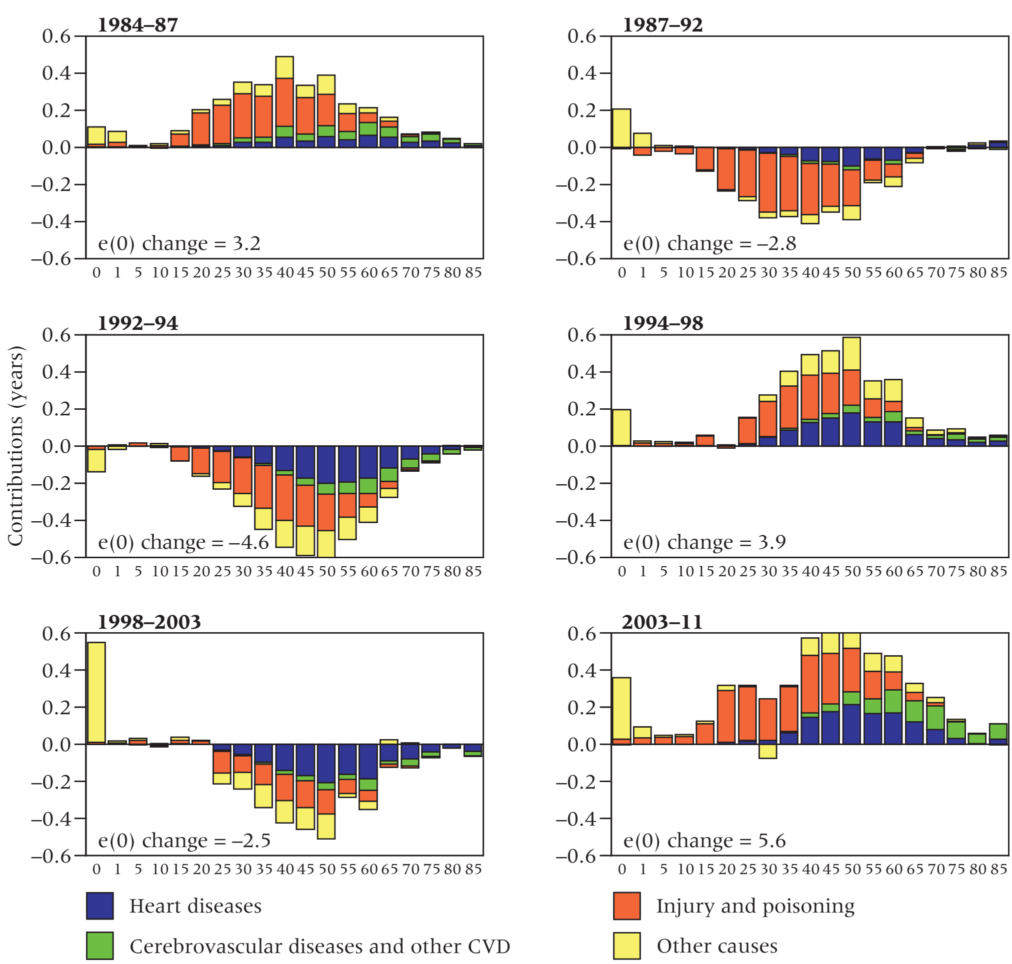
Results

Age-and-cause-specific components of mortality fluctuations in Russia

The evolution of life expectancy trends in Russia over the last three decades can be described as one of large fluctuations. The first two periods of improvement that occurred since the mid-1960s (see Figure 1) were each followed by a period of deterioration. What are the age and cause components responsible for the Russian mortality fluctuations, and how do their effects change over time? More specifically, to what extent is the third period of improvement, between 2003 and 2011, different from the two previous ones?

Age-and-cause-specific contributions to the change in male life expectancy in Russia by periods of improvement/deterioration are shown in Figure 3. The increase in male life expectancy during 1984–87 and the subsequent decrease during 1987–92 are clearly attributable to changes in mortality from injury and poisoning. Over the period 1992–94, the peak of the mortality cri-

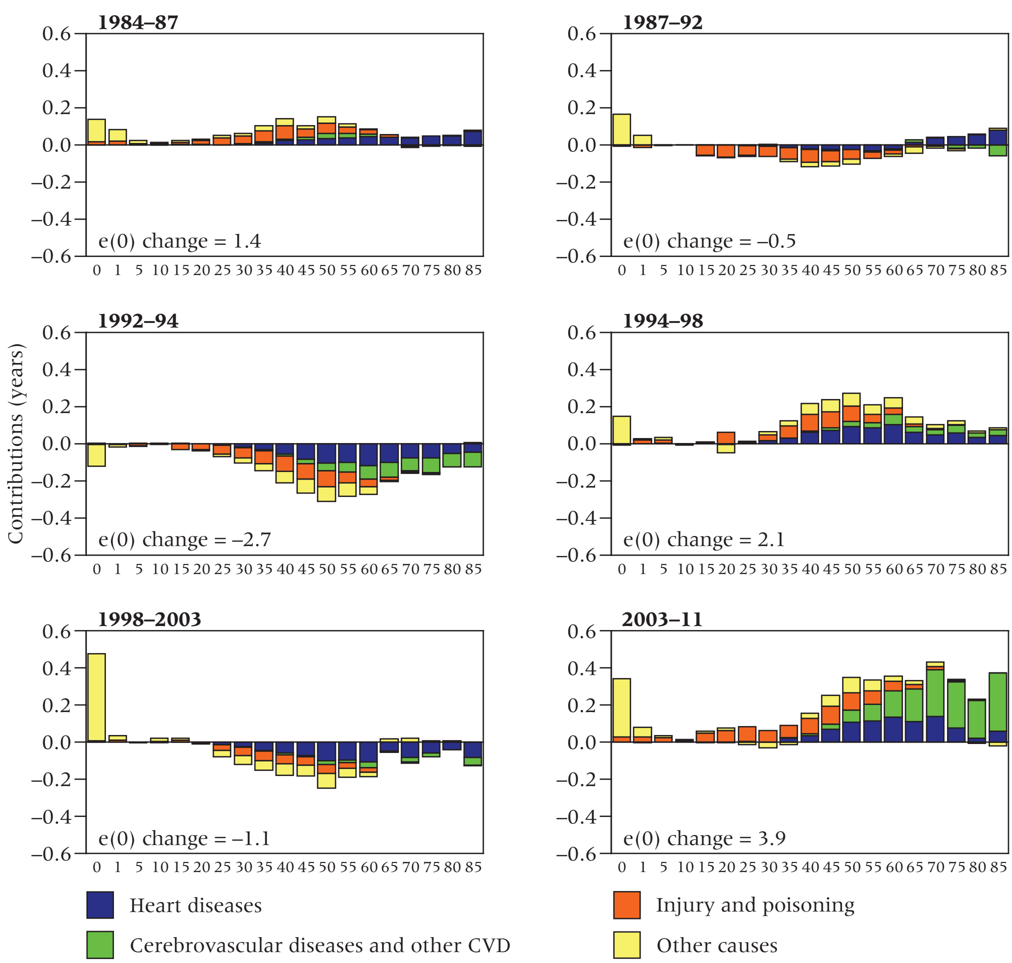
FIGURE 3 Age-and-cause-specific contributions to the change in male life expectancy at birth in Russia by periods



SOURCE: As for Figure 2.

sis in Russia, the role of cardiovascular mortality (particularly heart diseases) became important and almost equal to the influence of mortality from external causes of death. Lower rates of mortality from both causes are responsible for the subsequent short-term improvement over the period 1994–98. Generally, the changes in the life expectancy patterns during the first two "improvement/deterioration" cycles appear to be almost symmetrical. The positive/negative age-and-cause-specific contributions to the change in life expectancy in one period correspond to the negative/positive contributions in the subsequent period. Thus, the 1987–92 deterioration was most likely a rebound effect of the preceding improvement, and the 1994–98 improve-

FIGURE 4 Age-and-cause-specific contributions to the change in female life expectancy at birth in Russia by periods



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ment appears to have been a rebound effect of the dramatic deterioration of the health situation in Russia in the early 1990s.

Some researchers have attributed the decrease in life expectancy at the end of the 1990s to the second wave of the economic crisis in Russia (Gavrilova et al. 2000). The pattern of the decrease in life expectancy between 1998 and 2003, which looks very similar to that observed in 1992–94, is consistent with this hypothesis.

As was the case earlier, the 2003–11 increase in male life expectancy in Russia has been attributable to a reduction in mortality from external causes and in CVD mortality at working ages. However, the pattern of the latest improvement looks different. First, the gains in male life expectancy during 2003–11 (+5.6 years) were larger than the declines during 1998–2003 (–2.5 years). Second, the role of cardiovascular mortality at older ages, though still not large, has been more significant than in the previous periods.

This trend is particularly clear among women (Figure 4). Between 2003 and 2011, around one-half of the 3.9-year gain in female life expectancy came from the reduction in CVD mortality, especially cerebrovascular diseases, at older ages. This recent change in female life expectancy represents a new pattern, since at least a portion of this improvement seems to have been driven by some newly emerging factors. These findings suggest that the recent increase in life expectancy in Russia is not just a temporary fluctuation.

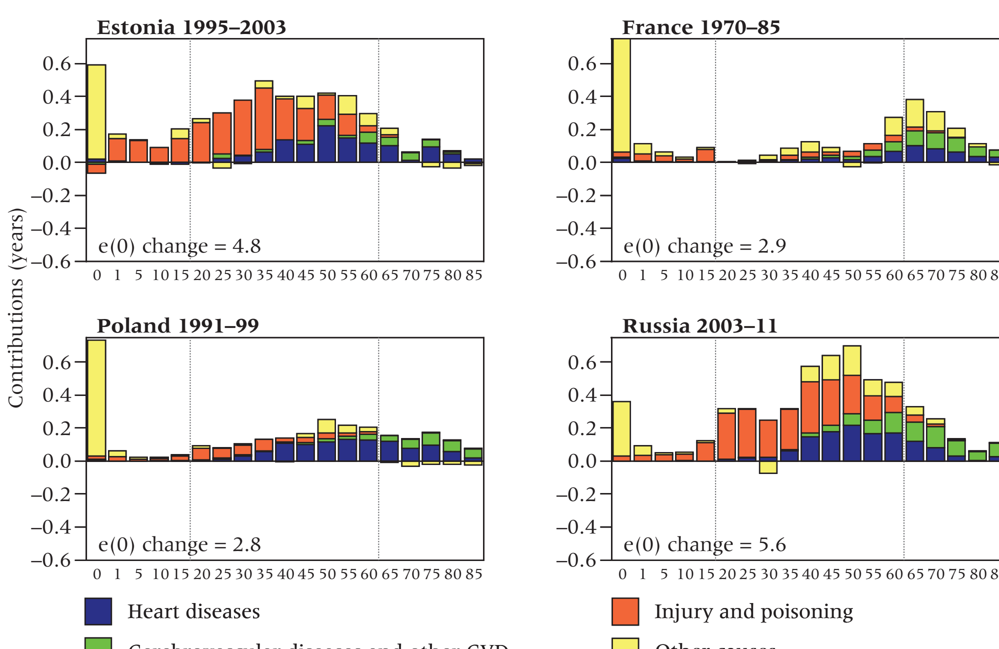
Current health improvements in Russia: Comparison with other countries

To what extent are the features of the current health improvements in Russia similar to those observed in other countries at different times? We first compare the recent shift in life expectancy in Russia (2003–11) with the changes observed in Estonia (1995–2003), Poland (1991–99), and France (1970–85). Our choices of the reference periods to which the changes in Russian life expectancy are compared are partly arbitrary. Indeed, the initial points in time selected for Estonia (1995) and Poland (1991) are also the turning points in mortality trends (see Figures 1 and 2). The end points, the years 2003 for Estonia and 1999 for Poland, were chosen to make the time intervals comparable to the recent period of improvement in Russia. In the case of France, however, selecting the reference period was more difficult. Unlike in the cases of Estonia and Poland, the initial mortality level in France in the 1960s and 1970s was much lower than the levels for Russia, Poland, and Estonia in the 1990s and 2000s. We chose 1970 as our starting point, since it was from that year onward that the reduction in cardiovascular mortality became the leading cause of life expectancy increase. By ending the observation in 1985, we were able to observe about the same gain in life expectancy as the increase recently seen in Russia (for both sexes).

Figure 5 shows the results of the decomposition of male life expectancy in Russia, Estonia, Poland, and France by the defined periods of improvement. A notable gain in life expectancy attributable to the reduction in infant mortality is found in all four countries. At other ages, the Russian pattern of male life expectancy improvement is very similar to that of Estonia. In both countries, the biggest share of the gains can be seen at the mid-adult ages (the area between the two dotted vertical lines in the figure). In both countries as well, cardiovascular mortality played an important role, but its influence was smaller than that of mortality from external causes of death, especially among young adults. If the initial level of the latter type of mortality in both Russia and Estonia had not been so high, then the pattern of the shift in life expectancy might have been more similar to the pattern seen in Poland. The progress in male mortality in Poland was indeed driven by a reduction in cardiovascular mortality. The Russian pattern has even less in common with France's. The main characteristics of the French pattern are the shift in the contributions to life expectancy gains toward older ages and the negligible role of external causes of mortality.

Unlike in males, the patterns of female life expectancy gains in Russia are much more similar to gains in other countries (Figure 6). As was the case

FIGURE 5 Age-and-cause-specific contributions to the change in male life expectancy in Estonia, France, Poland, and Russia by period of improvement



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elsewhere, the reduction in CVD mortality at older ages played the decisive role in these improvements. As in the case of males, the Russian female pattern was closer to the Estonian one because of the role played by mortality from injury and poisoning. In both countries, this cause contributed substantially to the change in life expectancy, whereas in Poland and France the impact of this cause was much smaller. The main feature of Russian progress in female life expectancy is that it has been mostly driven by the reduction in mortality from cerebrovascular diseases and other forms of CVD. Mortality from this cause of death has been considerably higher in Russia than in Poland, France, and Estonia (Figures 7 and 8).

Russia's higher initial mortality level could be the reason why much more substantial progress was seen there. For both men and women, the recent decline in mortality from cerebrovascular and other CVD in Russia is unprecedented. In terms of magnitude, it cannot be compared to the previous mortality fluctuations. The recent improvements have also been longer lasting. Unlike many other causes of death, cerebrovascular mortality is now lower in Russia than it was in the 1970s and 1980s, and it has reached a historic low among women (Shkolnikov et al. 2013).

FIGURE 6 Age-and-cause-specific contributions to the change in female life expectancy in Estonia, France, Poland, and Russia by period of improvement

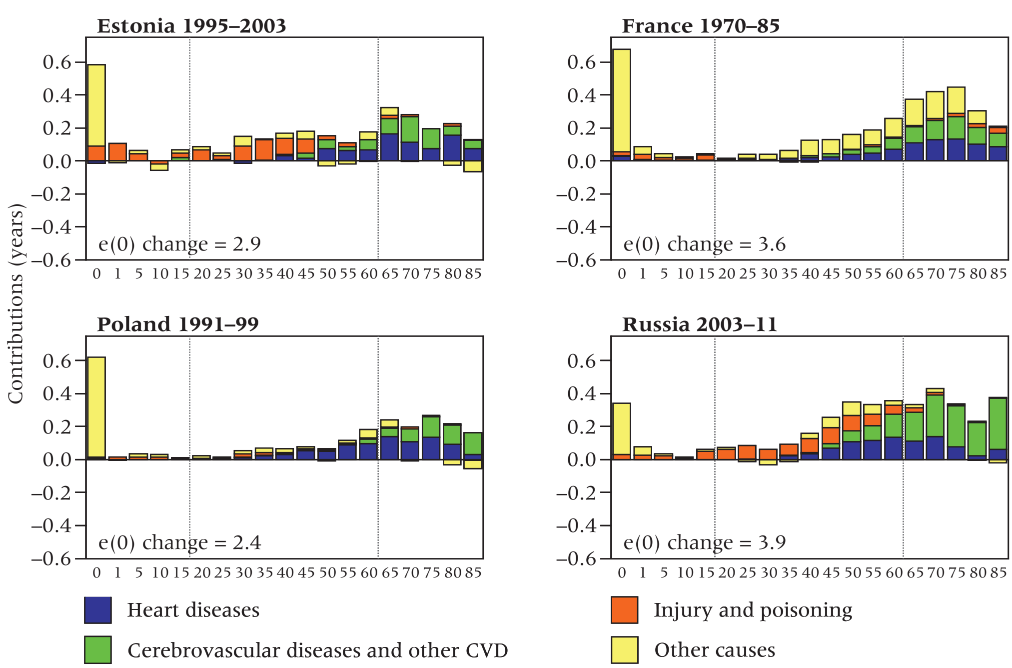

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FIGURE 7 Trends in mortality from selected causes of death in Estonia, France, Poland, and Russia, males, 1965–2011

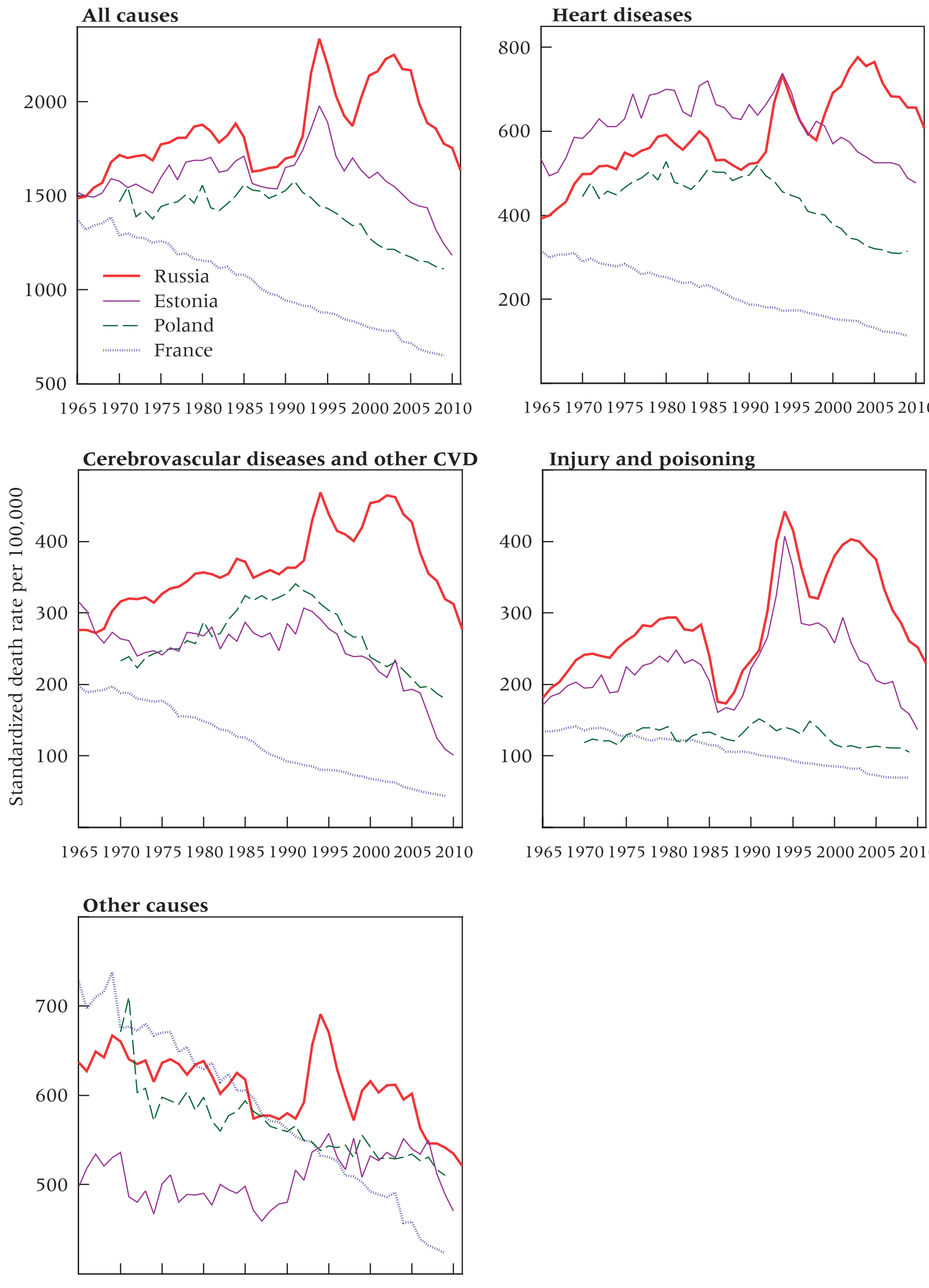

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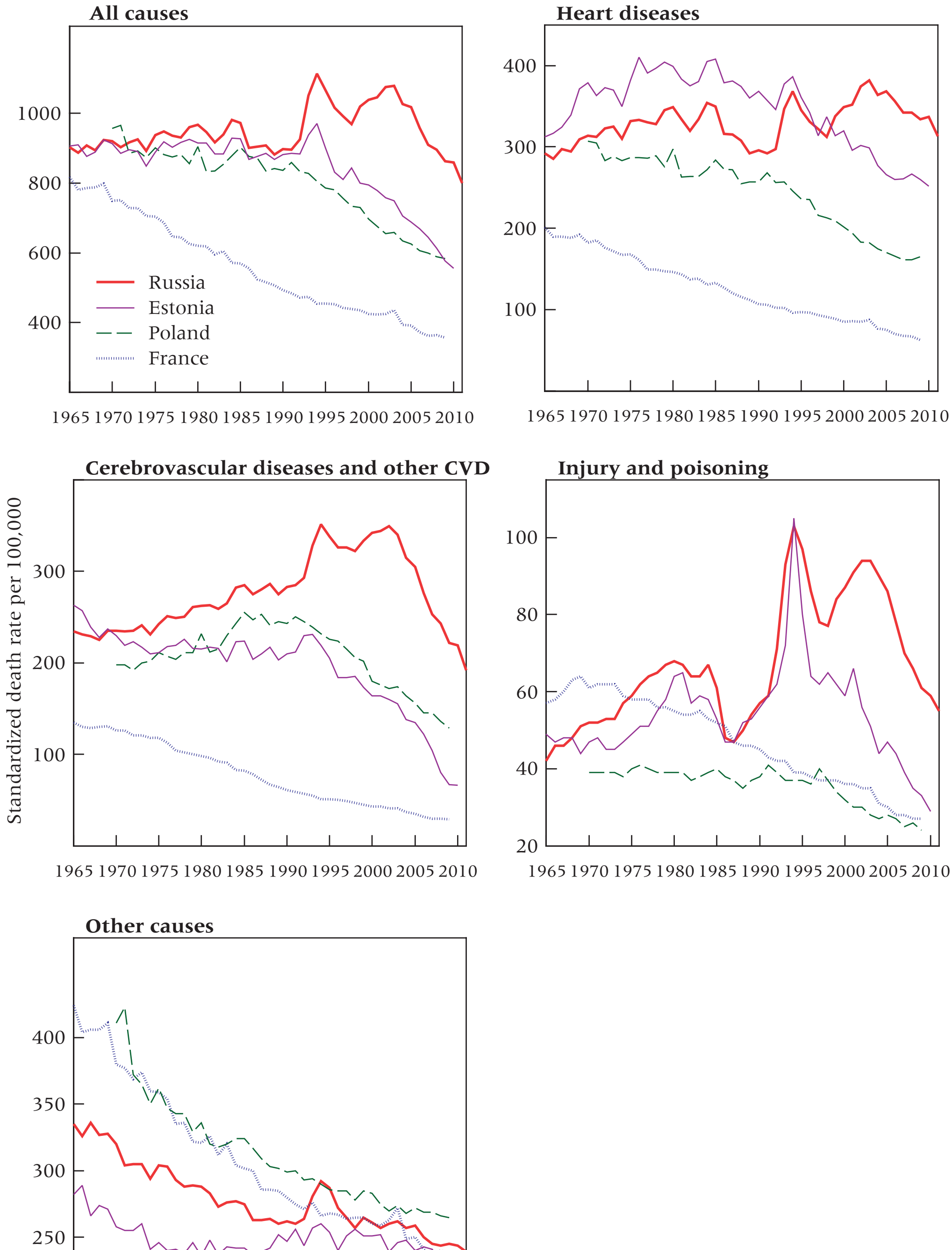
FIGURE 8 Trends in mortality from selected causes of death in Estonia, France, Poland, and Russia, females, 1965–2011



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Recent trends in heart disease mortality in Russia, though not as impressive, have also been positive. For both men and women, the recent improvements have been modest, especially compared to those made in Estonia. Until the beginning of the 1990s, levels of heart disease mortality were lower in Russia than in Estonia. Today, however, Estonia's advantage is apparent. The mortality gap between Russia and Poland is huge: the Russian standardized death rate attributable to heart diseases is roughly twice as high as that of Poland.

In comparison to France, the situation in Russia looks particularly unfavorable for both heart and cerebrovascular diseases. The two countries represent sharply contrasting cases. CVD mortality in France is very low and has already reached a threshold below which further improvements become very difficult. In Russia, by contrast, there is considerable potential for additional progress.

Mortality from injury and poisoning has been a crucial factor in Russia. Again, the Russian trends are similar to those in Estonia, but only until the mid-1990s. Afterward, Russia experienced another phase of fluctuations, while Estonia saw a reduction in external-cause mortality that brought its level closer to those of France and Poland. Russia now appears to be moving in the same direction.

Discussion

Mortality trends

Our detailed analysis of age-and-cause-specific mortality changes shows that several distinct features accompanied the life expectancy increase in Russia over the past decade. First, compared to the two short-term increases observed previously, the recent one has been larger and longer lasting. Second, the current pattern of increase in female life expectancy is quite different from those observed before. The recent reduction in mortality from cerebrovascular diseases at older ages has been responsible for most of the progress, whereas previously gains were more evenly distributed among other causes (heart diseases, injury and poisoning, and remaining causes of death) and were more concentrated at working ages. Third, the female pattern of life expectancy improvement is similar to patterns observed in France, Estonia, and Poland at comparable periods of time. As in the West, the decline in cerebrovascular mortality in Russia started earlier than the decrease in mortality from heart diseases. The important difference in the Russian pattern is the larger role played by the reduction in mortality from cerebrovascular diseases than in mortality from heart diseases. The relatively high initial level of cerebrovascular diseases might explain why the subsequent reduction was more pronounced. Fourth, unlike for women, the pattern of life expectancy improvement among men differed less noticeably when compared to the previous mortality fluctuations. As in the past, the progress in male mortality has been largely attributable to the reduction in mortality from external causes at working ages. A similar development was earlier observed in Estonia, where the initial gain in life expectancy resulted from the marked reduction in mortality from external causes among working-age men. The analysis of long-term trends showed that while male mortality from both heart diseases and cerebrovascular diseases declined, the reduction in the latter was particularly pronounced: today, the level of cerebrovascular mortality among Russian men is close to its historic low.

Examination of Russian data for 2012 demonstrates that mortality from the entire class of circulatory diseases has decreased further and approaches the historically lowest levels of the mid-1960s even for men. In fact, these past mortality levels are likely to be underestimated because of the general understatement of old-age mortality in Russia before the 1970s (Anderson and Silver 1997; Meslé et al. 2003).

Explanations for the observed improvement

What are the potential determinants of the decline in CVD mortality in Russia? When explaining the recent mortality changes in Russia, one should keep in mind that a shift can be driven by both short- and long-term effects. In other words, we may assume that in addition to explanations for the recent changes in mortality, other factors might also be important, such as the exposure to different risk factors in the past and the differences between cohorts in terms of lifestyles, health behaviors, and access to medical care.

Our selection of factors is based on accumulated evidence on mortality determinants in Russia, as well as the experience of the other countries (Estonia and Poland in particular). The potential determinants of the current reduction in Russia's CVD mortality can be divided into two broad groups: behavioral changes (alcohol consumption, smoking, and dietary habits), and changes in health care access and supply. It is also important to assess changes in the socioeconomic context as related to changes in individual behavior and in health care provision. Table 2 summarizes some available indicators that could identify the recent changes in these factors in Russia. Because of the scarcity of reliable data, the following discussion is speculative.

Alcohol has historically been a crucial determinant of Russian mortality. Whenever there was a rapid change in mortality trends, a change in alcohol consumption was the most likely explanation (Leon et al. 1997; Shkolnikov et al. 2004a, Brainerd and Cutler 2005). The recent mortality reduction does not appear to be an exception. According to Neufeld and Rehm (2013), the real alcohol consumption (of pure ethanol) including its unrecorded part has been decreasing in Russia, with a clear acceleration of the decrease in 2006–07. The decline in consumption of spirits in these years has been even steeper. Another indicator of alcohol abuse, namely mortality from accidental poisonings by alcohol, also illustrates the changes in Russian drinking pat-

TABLE 2 Selected indicators reflecting changes in lifestyles, health care resources and expenditures, and socioeconomic development in Russia, 1995–2010

	1995	2000	2005	2010
Alcohol				
Consumption of pure alcohol (including unrecorded consumption), liters per capita[a]				
All beverages	14[b]	16	16	14
Spirits	—	14	12	8
Mortality from accidental poisonings by alcohol per 100,000 population				
Male	52	42	47	22
Female	12	11	11	5
Smoking				
Percent regular daily smokers[c]				
Male	62 (1998)	62	61 (2004)	—
Female	11 (1998)	13	15 (2004)	—
Diet				
Average amount of fruits and vegetables available per person per year (in kg)[c]	110	125	166	187 (2009)
Health care				
Total health expenditure (WHO estimates)[c]				
As percentage of GDP	5.4	5.4	5.2	5.1
PPP$ per capita	300	369	615	998
Number of cardiac surgeries (per 100,000 population at age 35 plus)[d]	—	21.7 (2003)	41.2 (2006)	97.5
High-tech interventions (in thousands)[d]	—	—	128 (2006)	290
Income				
Real GDP, PPP$ per capita[c]	5,613	6,833	11,853	19,971
Population with income below subsistence-level budget (percent)[e]	24.8	29.0	17.8	12.6
Ratio of average pension to subsistence-level budget of pensioners (percent)[e]	101	76	98	165
Social strain				
Unemployment rate (percent)[c]	8.9	9.8	7.2	7.5
Crime rate (number of registered crimes per 10,000 population)[e]	186	201	248	184
Severe offenses	110	120	75	48
Murder or attempted murder	2.2	2.2	2.2	1.1
Assault causing serious bodily harm	4.2	3.4	4.0	2.8

SOURCES: [a]Neufeld and Rehm (2013); [b]Nemtsov (2011); [c]HFA–DB; [d]Minzdravsocrazvitiya; [e]Rosstat (2012).

terns. Between 2000 and 2010, mortality from this cause declined by half. The notable changes in alcohol consumption can be viewed as a critical behavioral component of the cardiovascular revolution.

It is highly likely that a decline in alcohol consumption is largely responsible for the recent reduction in premature mortality. Previous studies demonstrated a close link between rapid changes in alcohol consumption and CVD mortality in Russia (Shkolnikov and Nemtsov 1997; Shkolnikov et al. 2004b; Neufeld and Rehm 2013). Similar changes in CVD mortality were observed in Estonia in 1985–87 and in 1992–94. The CVD decrease in Estonia after 1995 was accompanied by a substantial reduction in alcohol abuse (Lai and Habicht 2011). However, the decline in alcohol consumption does not appear to have played a major role in the significant reduction in cerebrovascular mortality at older ages, since the prevalence of heavy drinking is low among the elderly. Furthermore, during Gorbachev's anti-alcohol campaign, old-age mortality from this cause of death did not respond to the sudden changes in alcohol consumption, and there is no reason to believe that it would do so now.

In Russia as elsewhere, smoking is a major contributor to mortality from cancers, CVD, and other chronic conditions (Gilmore et al. 2004, Peto et al. 2006). Over the last three decades, prevalence of smoking has remained high among men and has increased from initially very low levels among women (Prokhorov 1997; Perlman et al. 2007; Global Adult Tobacco Survey 2009). The observed trends in smoking are of minor importance for explaining the steep declines in mortality. For example, the gradual decrease in mortality from lung cancer since the early 1990s is mostly related to the largely undocumented lifetime exposure to tobacco tar and other toxic substances in the Russian cohorts born between the 1920s and the early 1950s. Such slow tobacco-related changes in the death toll are of minor importance for the steep mortality decreases of the 2000s.

The experience of Poland has shown that changes in dietary habits might contribute to the reduction in CVD mortality (Zatonski, McMichael, and Powles 1998). The evidence points to a substantial increase in the per capita availability of fruits and vegetables in Russia, and the higher consumption of fruits and vegetables is believed to be associated with a reduced risk of stroke (He, Nowson, and MacGregor 2006). Levels of awareness among Russians about what constitutes a healthy or unhealthy diet have likely increased. Therefore, although we are unable to confirm that dietary habits have changed in Russia, this factor cannot be excluded from the list of potential determinants of the recent CVD decline.

The share of national income allocated to health has decreased slightly between 1995 and 2010. However, because of the substantial absolute increase in GDP per capita, health expenditures have risen sharply. This might imply that more resources could be allocated to detection and treatment of cardiovascular conditions in Russia. There has been a sharp rise in the number of cardiac surgeries (a fivefold increase between 2003 and 2010) and in high-tech cardiac interventions performed. These achievements can be attributed to the large-scale national priority project "Health," initiated by Russian authorities in 2006. The aim of the project was to improve the infrastructure for primary and emergency care, to promote high-tech medical care, and to construct new federal medical centers (Shkolnikov et al. 2013). Furthermore, during the period studied, the federal target program "Prevention and treatment of arterial hypertension in the Russian Federation" was launched. The effectiveness of the program was monitored, the results suggesting that the prevalence of arterial hypertension did not change over the period 2003–10. However, the proportion of Russians who were taking medication to reduce their blood pressure, and the share of women who were receiving the recommended treatments, have increased. Moreover, there is recent evidence that the control of hypertension in Russia is improving (Oganov et al. 2011). Research has also suggested that access to medical care among all socioeconomic groups in Russia has improved over the past decade (Balabanova et al. 2012). These changes have likely contributed to the significant reduction in cerebrovascular mortality in Russia.

In addition, standard indicators suggest that the economic circumstances of most Russians have improved: per capita income has risen around 3.5-fold between 1995 and 2010, the share of individuals living below the poverty line has halved, and the financial circumstances of pensioners appear to have recently improved. Indicators of social strain such as unemployment, on the other hand, show less significant improvement. Crime levels in Russia appear to be declining, as demonstrated by substantial reductions in the rates of severe offenses, murders, and assaults. Finally, changes in psychosocial factors might have played a role in the recent improvements in Russia, especially given their importance in the past (Cornia and Paniccia 2000; Cockerham, Hinote, and Abbott 2006). Studies have shown that between 2001 and 2010, levels of acute psychological distress in eight countries of the former Soviet Union, including Russia, have decreased substantially (Roberts, Abbott, and McKee 2012). This positive trend could have contributed to the reduction in CVD mortality, either directly through the reduced incidence of fatalities associated with elevated stress, or indirectly through the reduced level of alcohol consumption as a "stress-reliever" (Cornia and Paniccia 2000).

In sum, the recent decline in Russian mortality can be attributed to a combination of factors, including changes in behavior (decreases in alcohol consumption, improvements in diet), the implementation of health policies (use of drugs to lower blood pressure, increased access to and use of high-tech medical and surgical interventions), and improvements in economic conditions. Even if some of these factors have had only a temporary effect, the decline may be more sustainable than the two previous downward trends. It is likely that contemporary Russia is now in the initial stage of the cardiovascular revolution and could be on a path to a new mortality regime.

Future developments are hard to predict, however, and Russia has a long legacy of neglecting and under-financing health care. Unlike in Estonia and Poland, recent mortality reductions in Russia were not accompanied by fundamental societal changes. The sustainability of the current positive trends depends on the willingness of Russian leaders and Russian society to devote adequate attention and resources to the health care system and to broader public health issues.

From this perspective, recent developments are disconcerting. In 2013, federal health care expenditures were reduced. Because the resulting deficit has to be filled by regional budgets, local authorities will be expected to allocate more financial resources to health care than they did previously. Given that 50 out of 81 Russian regions are subsidized by the federal budget, it is not clear how this gap can be closed in practice. There is a danger that funding for the health sector in less affluent regions will decline. Major and widespread reductions in funding levels will almost certainly adversely affect mortality trends in Russia. Preliminary data for 2012 suggest further mortality reduction at a somewhat slower pace, with life expectancy at birth among males and females increasing by 0.5 and 0.2 years, respectively, between 2011 and 2012 (Rosstat). Although the recent improvements in Russia have features in common with initial stages of prior mortality declines in other countries and may support optimism about the future, a return to mortality stagnation cannot be ruled out.

Note

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References

Anderson, Barbara A. and Brian D. Silver 1997. "Issues of data quality in assessing mortality trends and levels in the New Independent States," in José Luis Bobadilla, Christine A. Costello, and Faith Mitchell (eds.), *Premature death in the New Independent States*. Washington, DC: National Academy Press, pp. 120–155.

Andreev, Evgueni M. 1982. "Method komponent v analize prodoljitelnosty zjizni [The method of components in the analysis of length of life]," *Vestnik Statistiki* 9: 42–47.

Andreev, Evgueni M. and Vladimir M. Shkolnikov. 2012. "An Excel spreadsheet for the decomposition of a difference between two values of an aggregate demographic measure by stepwise replacement running from young to old ages," *MPIDR Technical Report* 2012-2.

Andreev, Evgueni M., Vladimir M. Shkolnikov, and Alexander Z. Begun. 2002. "Algorithm for decomposition of differences between aggregate demographic measures and its application to life expectancies, healthy life expectancies, parity-progression ratios and total fertility rates," *Demographic Research* 7(14): 499–522.

Balabanova, Dina, Bayard Roberts, Erica Richardson, Christian Haerpfer, and Martin McKee. 2012. "Health care reform in the former Soviet Union: Beyond the transition," *Health Services Research* 47(2): 840–864.

Bandosz, Piotr et al. 2012. "Decline in mortality from coronary heart disease in Poland after socioeconomic transformation: Modeling study," *British Medical Journal* 344: d8136.

Blum, Alain and Alain Monnier. 1989. "Recent mortality trends in the USSR: New evidence," *Population Studies* 43(2): 211–241.

Brainerd, Elizabeth and David M. Cutler. 2005. "Autopsy on an empire: Understanding mortality in Russia and the former Soviet Union," *Journal of Economic Perspectives* 19: 107–130.

Cockerham, William C. 1997. "The social determinants of the decline of life expectancy in Russia and Eastern Europe: A lifestyle explanation," *Journal of Health and Social Behavior* 38(2): 117–130.

Cockerham, William C., Brian P. Hinote, and Pamela Abbott. 2006. "Psychological distress, gender, and health lifestyles in Belarus, Kazakhstan, Russia, and Ukraine," *Social Science and Medicine* 63: 2381–2394.

Cornia, Giovanni Andrea and Renato Paniccia. 2000. "The transition mortality crisis: evidence, interpretation, and policy responses," in Giovanni Andrea Cornia and Renato Paniccia (eds.), *The Mortality Crisis in Transitional Economies*. Oxford University Press, pp. 3–37.

Eberstadt, Nicholas. 1981. "The health crisis in the USSR," in *The New York Review*, February 19. (Reprinted *International Journal of Epidemiology* 2006, 35: 1384–1394).

Feshbach, Murray. 1984. "Soviet health problems," *Proceedings of the Academy of Political Science* 35(3): 81–97.

Field, Mark G. 1995. "The health crisis in the former Soviet Union: A report from the 'post-war' zone," *Social Science and Medicine* 41(11): 1469–1478.

Fihel, Agnieszka, France Meslé, and Jacques Vallin. 2010. "Mortality by causes of death in Poland 1970–2007: Preliminary findings," paper presented at the third Human Mortality Database Symposium, Paris 17–19 June.

Frenk, Julio, José Luis Bobadilla, Claudio Stern, Tomas Frejka, and Rafael Lozano. 1991. "Elements for a theory of the health transition," *Health Transition Review* 1(1): 21–38.

Gavrilova, Natalia S., Victoria G. Semyonova, Galina N. Evdokushkina, and Leonid A. Gavrilov. 2000. "The response of violent mortality to economic crisis in Russia," *Population Research and Policy Review* 19: 397–419.

Gilmore, Anna et al. 2004. "Prevalence of smoking in 8 countries of the former Soviet Union: Results from the Living Conditions, Lifestyles and Health Study," *American Journal of Public Health* 94(12): 2177–2187.

Global Adult Tobacco Survey (GATS). 2009. "Russian Federation 2009. Country Report," Ministry of Health and Social Development of the Russian Federation, World Health Organization, Centers for Disease Control and Prevention.

He, Feng J., Caryl A. Nowson, and Graham A. MacGregor. 2006. "Fruit and vegetable consumption and stroke: meta-analysis of cohort studies," *Lancet* 367: 320–326.

Health for All Database (HFA-DB). www.euro.who.int . Accessed 21 February 2013.

Human Mortality Database (HMD). www.mortality.org. Accessed 21 February 2013.

Jasilionis, Domantas, France Meslé, Vladimir M. Shkolnikov, and Jacques Vallin. 2011. "Recent life expectancy divergence in Baltic countries," *European Journal of Population* 27(4): 403–431.

Kirk, Dudley. 1944. "Population change and the postwar world," *American Sociological Review* 9: 28–35.

———. 1996. "Demographic transition theory," *Population Studies* 50(3): 61–87.

Koppel, Agris et al. 2008. "Estonia: Health system review," *Health Systems in Transition* 10(1): 1–230.

Lai, Taavi and Jarno Habicht. 2011. "Decline in alcohol consumption in Estonia: Combined effects of strengthened alcohol policy and economic downturn," *Alcohol and Alcoholism* 46 (2): 200–203.

Landry, Adolphe. 1934. *La révolution démographique: Etudes et essais sur les problèmes de la population.* Paris: Librairie Sirey.

Leon, David A. et al. 1997. "Huge variation in Russian mortality rates 1984–1994: Artifact, alcohol, or what?" *Lancet* 350: 383–388.

Meslé, France, Vladimir M. Shkolnikov, Véronique Hertrich, and Jacques Vallin. 1996. "Recent trends in mortality by causes of death in Russia during 1965–1994." [In French and Russian]. Paris–Moscow.

Meslé, France and Jacques Vallin. 1996. "Reconstructing long-term series of causes of death," *Historical methods* 29(2): 72–87.

———. 2006. "The health transition: Trends and prospects," in Graziella Caselli, Jacques Vallin, and Guillaume Wunsch (eds.), *Demography: Analysis and synthesis. A Treatise in Population Studies*: New York: Academic Press, vol. II, pp. 247–259.

———. 2011. "Historical trends in mortality," in Richard G. Rogers and Eileen M. Crimmins (eds.), *International Handbook of Adult Mortality*. Dordrecht: Springer, pp. 9–47.

Meslé, France, Jacques Vallin, and Véronique Hertrich. 2012. "The Baltic countries: A delayed entrance in the cardiovascular revolution," paper presented at the workshop of the EAPS Health, Morbidity and Mortality Working Group, Tallinn, 5–7 April.

Meslé, France, Jacques Vallin, Véronique Hertrich, Evgueni Andreev, and Vladimir M. Shkolnikov. 2003. "Causes of death in Russia: Assessing trends since the 1950s," in Irena E. Kotowska and Janina Józwiak (eds.), *Population of Central and Eastern Europe. Challenges and Opportunities*. Warsaw: Statistical Publishing Establishment, pp. 389–414.

Meslé, France, Jacques Vallin, and Vladimir M. Shkolnikov. 1998. "Reversal of mortality decline: The case of contemporary Russia," *World Health Statistics Quarterly/Rapport trimestriel de* statistiques *sanitaires* 51(2–4): 191–206.

Ministry of Health and Social Development of Russian Federation (Minzdravsocrazvitiya). Official web-site. http://www.minzdravsoc.ru. Accessed 11 April 2013.

Nemtsov, Alexandr. 2011. *A Contemporary History of Alcohol in Russia*. Huddinge: Södertörn högskola.

Neufeld, Maria and Jürgen Rehm. 2013. "Alcohol consumption and mortality in Russia since 2000: Are there any changes following the alcohol policy changes starting in 2006?" *Alcohol and Alcoholism* 48(2): 222–230.

Oganov, R.G. et al. 2011. "Arterial hypertension epidemiology in Russia: The results of 2003–2010 federal monitoring," [in Russian] *Cardiovascular Therapy and Prevention* 10(1): 8–12.

Olshansky, S. Jay and Brian A. Ault. 1986. "The fourth stage of the epidemiologic transition: The age of delayed degenerative diseases," *The Milbank Quarterly* 64(3): 355–391.

Omran, Abdel R. 1971. "The epidemiologic transition: a theory of the epidemiology of population change," *Milbank Memorial Fund Quarterly* 49: 509–538.

Pechholdova, Marketa. 2010. "Four decades of cause-specific mortality in the Czech Republic, West Germany and France," Ph.D. thesis, Charles University, Prague.

Perlman, Francesca, Martin Bobak, Anna Gilmore, and Martin McKee. 2007. "Trends in the prevalence of smoking in Russia during the transition to a market economy," *Tobacco Control* 16: 299-305.

Peto, Richard, Alan D. Lopez, Jullian Boreham, and Michael Thun. 2006. *Mortality from Smoking in Developed Countries 1950–2000*, 2nd ed. International Union Against Cancer (UICC), Geneva (www.deathsfromsmoking.net).

Prokhorov, A.V. 1997. "Getting on smokin' route 66: Tobacco promotion via Russian mass media," *Tobacco Control* 6(2): 145–146.

Roberts, Bayard, Pamela Abbott, and Martin McKee. 2012. "Changes in the levels of psychological distress in eight countries of the former Soviet Union," *Journal of Public Mental Health* 11(3): 141–152.

Rogers, Richard G. and Robert Hackenberg. 1987. "Extending epidemiologic transition theory," *Social Biology* 34: 234–243.

Russian Federation State Statistics Service (Rosstat). 2012. "Statistical Yearbook of Russia 2012," *Statistical Yearbook*, Moscow–Rosstat.

———. Official web-site. www.gks.ru. Accessed 28 November 2013.

Rychtarikova, Jitka. 2004. "The case of the Czech Republic: Determinants of the recent favorable turnover in mortality," *Demographic Research*, Special Collection 2, Article 5, 105–138.

Shkolnikov, Vladimir M., Evgueni M. Andreev, Martin McKee, and David A. Leon. 2013. "Components and possible determinants of decrease in Russian mortality in 2004–2010," *Demographic Research* 28(32): 917–950.

Shkolnikov, Vladimir M. et al. 2004a. "Mortality reversal: the story so far," *Hygiea Internationals: An Interdisciplinary Journal for the History of Public Health* 4(1): 29–80.

Shkolnikov, Vladimir M., Valeriy V. Chervyakov, Martin McKee, and David A. Leon. 2004b. "Russian mortality beyond vital statistics: Effects of social status and behaviors on deaths from circulatory disease and external causes—A case-control study of men aged 20–55 years in Udmurtia, 1998–99," *Demographic Research*, Special Collection 2, Article 4.

Shkolnikov, Vladimir M. and David A. Leon. 2006. "Commentary: N. Eberstadt's 'Health crisis in the USSR' and sustainable mortality reversal in the post Soviet space during communism and after," *International Journal of Epidemiology* 35: 1398–1399.

Shkolnikov, Vladimir M., Martin McKee, and David A. Leon. 2001. "Changes in life expectancy in Russia in the mid-1990s," *Lancet* 357: 917–921.

Shkolnikov, Vladimir M. and Alexander Nemtsov. 1997. "The anti-alcohol campaign and variations in Russian mortality," in José Luis Bobadilla, Christine A. Costello, and Faith Mitchell (eds.), *Premature Death in the New Independent States.* Washington, DC: National Academy Press, pp. 239–261.

Vails, Kaire. 2008. "Alcohol and drug policies and prevention strategies in Estonia," in Richard Muscat and members of the Pompidou research platform (eds.), From a Policy on Illegal Drugs to a Policy on Psychoactive Substances. Strasbourg: Council of Europe Publishing.

Vallin, Jacques and France Meslé. 1988. *Les causes de décès en France de 1925 à 1978*. Paris: INED, PUF, Travaux et Documents, Cahier 115.

———. 2004. "Convergences and divergences in mortality: A new approach of health transition," *Demographic Research*. Special collection 2, Article 2, 11–44.

Zatonski, Witold A., Anthony J. McMichael, and John W. Powles. 1998. "Ecological study of reasons for sharp decline in mortality from ischaemic heart disease in Poland since 1991," *British Medical Journal* 316: 1047–1051.