August 2006

Death and the Market*

Elizabeth Brainerd
Economics Department
Williams College
and CEPR, IZA and WDI
Elizabeth.Brainerd@williams.edu

Elena A. Varavikova
Central Research Institute on Organization and
Information in Public Health
Ministry of Health, Moscow, Russian Federation
evaravikova@mtu-net.ru

Abstract: The death rate among working age men in Russia increased by over 70 percent between 1990 and 1994, and similar increases in male death rates occurred in many other former Soviet republics during the same period. The timing of this extraordinary increase in mortality is coincident with the introduction of market reforms in these countries, suggesting that the economic instability had a severe adverse impact on the health of the population. Did the transition to a market economy cause Russia's mortality crisis? This paper analyzes a unique data set on age- and cause-specific mortality across Russia's regions, as well as deaths reported in micro-level data between 1994-2004, to answer this question. The evidence indicates that rising mortality is related to the recent economic and social changes, particularly the steep decline in per capita income in the early 1990s. The consumption of alcohol, and becoming unemployed, increase the probability of accidental death for men but have no effect on deaths due to cardiovascular disease. The evidence also suggests that government policy exacerbated the mortality crisis by failing to provide an adequate social safety net for the population.

*Prepared for the WHO Commission on Macroeconomics and Health. The authors thank David Cutler, Douglas Gollin, Lawrence Katz, Peter Montiel, Jeffrey Sachs, and Lara Shore-Sheppard for comments on earlier drafts of this paper, as well as seminar participants at Berkeley, Dartmouth, the Federal Reserve Bank of New York, Harvard, Rutgers, Williams, the World Bank, and the WDI/CEPR Conference on Transition Economics in Portoroz, Slovenia. Galya Evdokushkina and Viktoria Semionova provided expert research assistance. E. Brainerd gratefully acknowledges the financial support of the German Marshall Fund of the United States.

Between 1990 and 1994 the death rate among working age men in Russia increased by 70 percent, from 759.2 to 1323.7 deaths per 100,000 population. Male life expectancy at birth fell from 63.7 years to 57.5 years during that period, while female life expectancy at birth fell from 74.3 years to 71.1 years. A similar increase in mortality rates occurred in many other countries of the former Soviet Union in the early 1990s, in particular in Belarus, Ukraine, and the three Baltic countries. Although some of the declines in life expectancy were reversed in Russia and many of its neighbors in the late 1990s, the magnitude of the declines and the large and erratic swings of this usually slowly-evolving indicator are unprecedented in the twentieth century for countries at peace and in the absence of major famines or epidemics.

The timing of this demographic crisis coincides with the introduction of market reforms in Russia, suggesting that rising mortality may be linked with the transition to a market economy. On the other hand, the Russian population experienced declining life expectancy for much of the postwar era, indicating that high mortality may be rooted in the low standard of living and environmental neglect that characterized life under communism. Was the dramatic increase in mortality rates in the early 1990s linked to the economic reforms implemented at the same time in Russia? Did the social policy of the Russian government exacerbate the mortality crisis? What explains the large decline in mortality rates between 1994 and 1998?

This paper attempts to answer these questions by analyzing a unique data set on regional mortality rates in Russia which comprises standardized mortality rates by sex and detailed cause of death, as well as age-specific death rates by five-year age group, across Russia's regions for the 1989-1999 period. These data are well-suited to exploring the impact of the changing macroeconomic and social environment on mortality, because some specific types of mortality and age groups appear to be more sensitive to cyclical changes in the macroeonomy than are

others. For example, because cancer often evolves over a long period of time, cancer-related deaths are unlikely to be influenced by the state of the macroeconomy. In contrast, deaths due to accidents, homicides, suicides, and even cardiovascular disease may be strongly influenced by short-run macroeconomic fluctuations.

This regional analysis is supplemented by a study of individual-level data on mortality in Russia from 1994-2004 using the Russian Longitudinal Monitoring Survey. While the timing of this survey precludes an analysis of the early years of Russia's mortality crisis, these data do allow one to assess the impact of behavioral changes on the probability of death – such as smoking and drinking – that are difficult to infer from the regional data, and to test hypotheses suggested by the regional analysis. The individual and regional analyses tell a consistent story in some respects, with both types of data indicating that declining incomes played a role in the rising mortality in Russia in the early 1990s. Alcohol consumption is strongly correlated with the probability of accidental death but appears to be unrelated to cardiovascular mortality, contradicting the hypothesis that alcohol consumption is harmful to cardiovascular health in Russia. Unemployment is also strongly correlated with accidental deaths. Finally, government social policy may have exacerbated the mortality crisis due to the failure to provide an adequate social safety net for those unable to adapt to the new economic circumstances.

I. Russian mortality in the 1990s: an overview[1]

In contrast to most developed countries, stagnant or declining life expectancies are a well-

[1]The Russian mortality data in this section and in the regional analysis are from the computerized system FAISS developed by S. Ermakov, N. Gavrilova and G. Evdokushkina which is registered as state data base N 0229601029 and owned by the Central Research Institute of Organization and Information, Ministry of Health, Russia; all data in this system originate from Goskomstat state statistic forms PH and C51. Some of these data are published in Ministerstvo Zdravookhranie (1998) and in the journal *Zdravookhranie Rossiiskoi Federatsii* (1999, 2000).

established characteristic of Russia's postwar demographic history. After a decade of progress in the 1950s during which life expectancy in Russia converged rapidly with that of western countries, in the mid-1960s female life expectancy began to stagnate and male life expectancy entered a period of long-term decline that continued until 1984 (Figure 1). The post-1984 period is marked by large swings in life expectancy, with dramatic improvements during Mikhail Gorbachev's anti-alcohol campaign (1985-1987) followed by a sharp deterioration that began in 1991 and lasted until the mid-1990s, the latter coinciding with Russia's most erratic attempts at economic reform and period of greatest macroeconomic instability. Life expectancy reached its nadir in 1994 and improved significantly for several years before reversing again after the August 1998 financial crisis, further underscoring the apparent sensitivity of mortality to macroeconomic developments in Russia.

Age- and cause-specific mortality in Russia

Table 1 provides a detailed accounting of the changes in standardized death rates by cause for men in Russia from 1989 to 1999; Table 2 provides the same accounting for women. The first column in each table lists the standardized death rate for the European Union in 1995 for comparison. The first point to note from these tables is that the death rates for most causes of death in Russia are extraordinarily high; this was true even in 1989 before mortality began to increase. Death rates due to infectious diseases, circulatory diseases (heart disease and strokes)[2] and trauma are all three to five times higher than in Europe for men, and the differences are almost as large for women. Between 1989 and 1994 the overall death rate increased by over 40

[2]Throughout this paper the term 'circulatory disease' is used interchangeably with 'cardiovascular disease.'

percent for men and over 25 percent for women.

Deaths due to circulatory diseases are the most important cause of death in Russia, accounting for 49 percent of all male deaths in 1994 and 61 percent for women; the second leading cause of death for men is trauma and poisoning, accounting for 18 percent of all deaths for men and 9 percent for women. Deaths from all causes except cancer increased sharply over the 1989-1994 period, with the largest increases occurring in deaths due to pneumonia, tuberculosis, cirrhosis of the liver, and trauma and poisoning (particularly accidental alcohol poisoning, homicide, and unspecified violent deaths). Deaths due to circulatory diseases, however, explain the largest share of the *increase* in deaths over this period, accounting for 42 percent of the increase in death rates among men, followed by deaths due to trauma and poisoning which contributed 33 percent of the increase. The trends are similar for women, with nearly 47 percent of the increase in female deaths due to circulatory diseases, and 20 percent due to trauma and poisoning. The large increase in deaths due to undetermined causes is likely due to the lack of resources and over-burdened staff in many regions, a loosening of state controls over the medical reporting system, and possibly misreported criminal activity.

Turning to the improvement in mortality rates between 1994 and 1998, roughly half of the deterioration of the 1989-1994 period was reclaimed in those years, with mortality rates declining 19 percent and 13 percent for men and women, respectively, in that period. The changes in death rates by cause mostly mirror those of the earlier period, with declining deaths due to circulatory diseases and trauma accounting for most of the improvement. Deaths due to most types of cancer continued to decline, with the exception of prostate cancer in men and breast cancer in women which increased consistently throughout the 1990s. The increase in mortality in 1999 was due primarily to increased deaths due to circulatory diseases and trauma.

Even more striking patterns characterize the change in age-specific death rates over the two periods; these are illustrated in Figure 2 which shows the percentage change in death rates by five-year age group for 1989-1994 and 1994-1998. The first point to note from Figure 2 is that the 40 percent increase in all male death rates between 1989 and 1994 masks tremendous differences in the changes in age-specific death rates. Most prominently, the death rate for men age 40 to 44 increased by 112 percent in that period, from 710 to 1507 deaths per 100,000 population in that age group; death rates also increased dramatically among men age 30 to 39 and 45 to 54. In contrast, death rates among men age 70 to 74 increased by 19 percent, and death rates among infants and children actually declined throughout the 1990s. The trends are similar for women, with women age 40 to 44 also experiencing the largest increase in death rates. It is striking that the working age population rather than the most vulnerable groups – children and the elderly – has borne the burden of excess mortality. Note also that the decline in age-specific death rates in the late 1990s largely parallels the increase in age-specific death rates in the early 1990s, with the exception of death rates for young adults (age 20 to 24) for whom death rates increased continually throughout the decade.

Figure 2 also decomposes the change in age-specific death rates into their most important causes; this decomposition illustrates that – as one would expect – the changes in death rates by cause vary considerably by age group. For teenagers and young adults most of the increase in death rates was due to increased deaths from violent causes. For men and women age 30 to 39 most of the increase in death rates was also due to violent causes, but deaths due to circulatory diseases accounted for an increasing share of the change in deaths. For the older age groups increased deaths due to circulatory diseases are most important in explaining rising death rates.

In an array of data that are shocking in the story they tell, perhaps the most astonishing

and troubling data from the Russian mortality crisis of the 1990s are the data describing the magnitude and trends in deaths from suicide and homicide among men. These data are shown in Table 3, along with similar data for the United States from 1997 for comparison. In 1989 the level of suicide and homicide rates in Russia already exceeded those of the U.S. by a substantial margin; by 1994 the levels of male suicide and homicide were as much as six times those in the United States. For example, for men age 50 to 54 in Russia the death rate from suicide rose from 72.6 per 100,000 population in 1989 to 138.9 in 1994; for U.S. men age 45 to 64 the suicide rate was 22.5 per 100,000 population in 1997. The male death rate from suicide in Russia is now one of the highest in the world (along with those of the Baltic republics, Ukraine and Belarus), and has an unusual pattern compared to western countries: in many countries the highest suicide rates occur among the elderly (as in Japan) or among youth (as in the U.K.). Even so, the suicide rate among young adults in Russia is extremely high and accounted for over 20 percent of the increase in deaths among men age 15-24 between 1989 and 1994. Homicide rates are also extraordinarily high across all age groups.

As might be expected in a country that spans eleven time zones, mortality rates also vary widely across Russia's regions. The regions which experienced the largest declines in life expectancy in the early 1990s were those in the North, Northwest, Siberia, and the Far East; the smallest declines in life expectancy occurred in the warmer and more agricultural regions such as the Central Chernozem and North Caucasus regions, as well as in the regions of European Russia which have the most developed infrastructure and best medical services in the country. However, no regions escaped the Russian mortality crisis of the 1990s; large declines in life expectancy occurred throughout the entire country between 1989 and 1994 (see Appendix Table 1).

Data quality issues

Despite the extreme fluctuations in mortality rates in Russia, the quality of the country's vital statistics appears to be relatively high in the sense that the registration of vital events is nearly complete and the mortality data are internally consistent (Anderson and Silver 1997). However, it is possible that improvements in the vital registration system did lead to an artefactual increase in registered deaths, in part explaining the increase in mortality in the 1990s.

Two notable changes occurred in the death registration system in Russia in recent years: the definition of infant mortality was revised in 1993 to match the WHO definition of infant mortality;[3] and in 1989 the Ministry of Health directed that, in deaths in which both cancer and circulatory disorders co-existed, cancer was to be indicated as the primary cause of death. Estimates indicate that the former change led to a 25 percent increase in infant mortality rates; however correcting for this underreporting decreases life expectancy for men and women only slightly (e.g. 0.3 year in 1992) and has little effect on the trends over time (Shkolnikov et al. 1997). The Ministry of Health's directive primarily affected the registration of cancer deaths among the elderly in rural areas – which were likely underregistered in the 1980s – but there is little evidence that these coding changes affected the trends in cancer or cardiovascular mortality in Russia in the 1990s (Shkolnikov et al. 1999). Therefore changes in coding practices are unlikely to account for the erratic swings in Russian mortality.

Several other pieces of evidence support the conclusion that the mortality data in Russia are reasonably reliable, at least at the level of broad categories of death. An examination of violent deaths concluded that these data are credible (Wasserman and Värnik 1998), and a study

[3]The previous definition of infant mortality in Russia excluded children born before 28 weeks, or weighing less than 1000 grams or less than 35 centimeters in height. These infants were not counted as live births or infant deaths if the infant died within the first seven days of life. The new definition of infant mortality includes these births and deaths in accordance with the WHO definition.

of coding practices concluded that deaths due to cardiovascular disease are not overregistered, although diagnosis and coding errors occur with some frequency (Shkolnikov et al. 1997). Moreover, as pointed out by other analysts (Leon et al. 1997; Shkolnikov et al. 2001a), the contrary trends in some types of deaths over the 1990s – the decline in cancer-related deaths, or the continued increase in death rates among young adults, for example – are inconsistent with the notion that the mortality trends in Russia resulted from a change or breakdown in vital event reporting: if this were the case, one would expect similar trends across all types of mortality.

The final piece of evidence on data quality is provided by a medical study of all strokes that occurred in Novosibirsk, Russia between 1987 and 1994 which was conducted as part of the WHO MONICA project (Stegmayr et al. 2000). This study found that stroke attack rates increased by over 50 percent for both men and women in Novosibirsk in this period; because the Novosibirsk MONICA center was subject to extensive data quality controls, the dramatic increase in strokes cannot be explained by changes in reporting procedures. This suggests that the large increase in deaths from cerebrovascular disease reported in Novosibirsk – and, by extension, in Russia as a whole – really did in fact occur.

To summarize, Russia experienced a tremendous increase in mortality rates in the early 1990s. Increased deaths were concentrated among men and women in the working ages and were largely due to cardiovascular diseases and violent deaths. Male homicide and suicide rates are extraordinarily high across all age groups and are now among the highest in the world. While many types of death declined between 1995 and 1998, the trend reversed again in 1999 due to rising cardiovascular and violent deaths. Despite some problems in reporting and coding in the Russian mortality data, these erratic swings in mortality rates appear to be real.

II. Recent research on mortality in Russia

Recent literature examines a variety of possible causes for the increase in mortality rates in the former Soviet Union in the 1990s, but to date a convincing explanation remains elusive.[4] Several studies identify stress related to the economic reforms as an important explanatory factor (Shapiro (1995); Cornia and Paniccià (1995, 2000)).[5] Ivaschenko (2005) demonstrates a positive correlation between government expenditures on health care and life expectancy, and a negative correlation between poverty and life expectancy, in the later years of the mortality crisis in Russia (1994 - 2000). Brainerd and Cutler (2005) analyze the cross-country differences in mortality in Eastern Europe and the former Soviet Union, and identify stress, alcohol consumption and possibly diet as contributing factors. This study, like many others in this area of research, concludes that a significant share of the change in mortality in the former Soviet Union remains unexplained.

Further insights into the peculiarities of mortality in Russia are provided by medical studies of the physiological mechanisms behind the extremely high mortality rates due to cardiovascular disease in the countries of the former Soviet Union. The primary question these studies address is whether the principal risk factors for cardiovascular disease (CVD) – smoking, hypertension and high cholesterol levels – are higher in Russia than in western countries. The consistent conclusion of this research is that the prevalence of most conventional CVD risk

[4]For an insightful summary of hypotheses and evidence on the causes of Russia's mortality crisis, see Chen et al. (1996). Edited collections of papers on various aspects of mortality in transition economies include Bobadilla, Costello and Mitchell (1997), Becker and Bloom (1998), and Cornia and Paniccià (2000). Stillman (2006) provides a comprehensive survey of the literature on health and mortality in Eastern Europe and the former Soviet Union.

[5]"Stress" arises when individuals perceive a discrepancy between the demands of a situation and their physical or psychological capacity to respond to these demands (see Shapiro 1995). Besides promoting the development of cardiovascular disease, increased stress may induce behavior with adverse health consequences, such as reckless driving and increased alcohol consumption.

factors in former Soviet countries is if anything *lower* than in the western countries that have much lower rates of cardiovascular disease, and that trends in these risk factors have been mildly favorable over the 1990s ((Puska et al. 1993; Kristenson et al. 1997; Stegmayr et al. 2000; Averina et al. 2003, 2004).

Given this evidence it seems clear that conventional CVD risk factors fail to explain the high levels and dramatic increases in cardiovascular mortality in Russia. This has led some observers to suggest that non-traditional risk factors account for high CVD mortality in Russia, in particular that the style of drinking (binge drinking) negates the protective effect of alcohol on the heart and leads to increased arrhythmias and heart attacks (McKee and Britton 1998). Recent research provides supportive evidence of this idea; for example a small case-control study of adult male deaths in Udmurtia confirmed that cardiovascular deaths are strongly associated with heavy drinking (Shkolnikov et al. 2001b). Other studies, however, have disputed the relationship (e.g. Bobak and Marmot 1999; Malyutina et al. 2000), and the claim that alcohol consumption has a different effect on cardiovascular health in Russia than in other countries remains controversial.

It is also possible that the high cardiovascular disease mortality in Russia of the 1990s is linked with the socioeconomic changes in Russia during that period, particularly with the stress of living through a societal upheaval of the magnitude experienced in Russia. While the physiological mechanisms for the link between stress and cardiovascular disease remain unclear, it has been reasonably well-established that a high level of stress is related to the development of cardiovascular disease (Labarthe 1998). Some of the economic and social changes in Russia in the last decade and their possible impact on the nation's health are discussed below.

III. Economic reform and mortality change

In most industrialized countries even a prolonged economic downturn has little impact on mortality rates; in the United States during the Great Depression, for example, life expectancy continued its upward trend throughout the period. The slowly evolving changes in life expectancy which usually characterize modern populations are consistent with the idea, originating with Grossman (1972a, 1972b), that health is a form of human capital: an individual inherits an initial stock of health and invests in health over the lifetime to produce a durable stock of health which depreciates with age. Conceptualizing health as a stock implies that economic shocks will usually fail to generate large discontinuous changes in mortality rates, since economic policies largely affect current health flows rather than the stock of health itself. Only in cases in which the population is already vulnerable – in the sense that the population's stock of health has already been subject to a sustained erosion – would an economic shock create a large discontinuous change in the mortality trend (Anand and Chen 1996). This may be the best approach to understanding the extreme fluctuations in mortality rates in Russia and its neighbors, because the long-term decline in life expectancy that occurred in these countries indicates that these populations were already vulnerable on the eve of the economic reforms.

Given an already fragile population, economic reforms can adversely affect the health status of a population through a number of routes. Perhaps most importantly for Russia, the early years of the country's transition were marked by a massive decline in GDP and income per capita; real GDP per capita fell by over one-quarter between 1990 and 1994 (EBRD 1999), and official statistics indicate that nearly a quarter of the population earned incomes below the subsistence level in 1995 (Goskomstat 2000). While the effect of income on mortality is disputed, with recent research raising questions regarding a direct causal link between income

and the long-term decline in mortality rates in western countries (Cutler et al. 2006), it is possible that large adverse income shocks in low-income countries are associated with short-term increases in mortality rates.[6] In Mexico, for example, the debt crises of the 1980s and 1990s were followed by an increase in mortality rates among the elderly and young children (Cutler et al. 2002). The decline in life expectancy in Russia in 1999, following an estimated 4.6 percent decline in GDP that occurred after the August 1998 financial crisis, is itself evidence that mortality in Russia is highly sensitive to changes in the absolute level of income.

A related issue is the increase in stress that accompanied the transition, noted above, which is likely at least in part responsible for the upsurge in mortality in Russia. Any number of changes in the Russian economy may have increased stress among the population, from the decline in income to the rapid increase in inequality to the macroeconomic instability of the early 1990s. Regarding the latter issue, the Russian population experienced near-hyperinflation in 1992 and annual rates of inflation well in excess of 100 percent until 1996, and unemployment rose from close to zero to nearly 10 percent between 1991 and 1996. In a country in which prices had remained stable (somewhat artificially) for decades and in which unemployment was virtually unknown, such developments were undoubtedly traumatic for much of the population. The group most affected by the mortality crisis – working-age men – also experienced a substantial loss in wages, both real and relative, since the beginning of the reforms in Russia, reflecting a significant devaluation of the human capital of these workers (Brainerd 1998).

A third means by which economic reforms may affect health is through the changing relative prices that can result from price liberalization. Most significantly for Russia, the price of

[6]Most empirical work has found that higher income levels across countries are associated with longer life expectancy, but this effect diminishes significantly at higher income levels (roughly $4,000 to $5,000 per capita), a point originally made by Preston (1975).

alcohol relative to the price of food fell dramatically in the early years of transition: the price index for food (excluding alcohol) increased by 2236 times between December 1990 and December 1994, while the price index for alcohol increased by only 639 times during the same period (Goskomstat 1994, 1996).[7] The price of medical services has also increased dramatically; for example in 1992 only 6 percent of hospital patients reported paying for their medical care, compared with 45 percent in 1998 (see Brainerd and Varavikova 2001).

A final link between health and economic reforms operates through changes in public investment in health, which may result from declining government revenues that force reduced public expenditures. The capacity and effectiveness of the public health infrastructure are important in maintaining the public's health, but more broadly public investment in health comprises other state functions that preserve or enhance the health of a country. These include, for example, the provision of an adequate social safety net that enables the poor to maintain a minimal standard of living, environmental protection rules that provide a relatively clean environment, and maintenance of an effective criminal justice system.

On each of these issues the Russian government has performed poorly in protecting the nation's health. State funding of the public health infrastructure has always been low (about 3 percent of GDP) and declined slightly during the transition. The effectiveness of the public health service appears to have deteriorated, although a system-wide breakdown has been avoided: while the maternal mortality rate – a marker of the effectiveness of the health care system – is extremely high by international standards, it remained roughly stable at about 50 deaths per 100,000 births in the early 1990s. Most observers agree that the extra deaths due to problems in

[7]However the shadow price of alcohol in 1990-91 was higher, since prior to price liberalization in January 1992 it was necessary to wait in long lines to purchase alcohol.

the health care system account for only a small fraction of the excess deaths in Russia in the 1990s (Shapiro 1995; Chen et al. 1996; Leon et al. 1997); indeed the Novosibirsk stroke study found that case fatality rates remained unchanged between 1987 and 1994: the dramatic increase in stroke mortality in Novosibirsk was due to an increase in attacks rather than to higher fatality rates (Stegmayr et al. 2000).

Government expenditures on social protection appear to have fallen dramatically, although this is uncertain because some social expenditures formerly paid at the federal level have been offloaded to regional or local levels. It is clear, however, that the number of people suffering economic hardship is substantial and that the social safety net for the poor is inadequate, particularly because Russia lacks a national means-tested benefit program for those living below the poverty line. The inadequate social safety net not only increases the financial hardship of the working poor and the unemployed, but may also exacerbate the stress and uncertainty among people of working age, who are unable to rely on government support in times of financial difficulties.

The government also invests in public health by providing a clean environment in which to live and work. For decades the Soviet leadership ignored the environmental cost of heavy industrial production and allowed highly polluted areas to develop around major industrial centers. While environmental neglect likely contributes to the high mortality levels in Russia and may be one of the reasons the population seems to be more vulnerable to economic shocks than other populations, it is unlikely to be linked with the recent rise in mortality rates since declining industrial production led to sharp declines in airborne emissions in the 1990s.

Finally, the tremendous increase in crime rates in Russia reflects the breakdown of the state's ability to ensure public safety. Registered crime rates – surely underreported – increased

from 1240 to 1775 per 100,000 population between 1990 and 1994, and as noted above the murder rate more than doubled in the early 1990s. Crime directly affects mortality rates through homicides and drug abuse, but may also indirectly affect mortality through the health consequences of stress from high or increasing crime rates.

IV. Empirical analysis: mortality across Russia's regions

The statistical significance of some of the these socioeconomic determinants of mortality can be tested using data for Russia's regions. The regional mortality data comprise age-specific death rates by five-year age group for men and women and age-standardized death rates by specific cause of death for 1989-1999. Consistent data are available for 72 regions in Russia; the regions of Chechnya and Ingushetia are excluded due to the civil unrest and war that affected these areas in much of the period.[8]

The primary empirical strategy is to estimate fixed effects regressions of the form:

$$S_{jt} = \alpha_j + \beta_t + E_{jt}\gamma + X_{jt}\delta + \varepsilon_{jt}$$

where *j* and *t* index region and year, respectively; S_{jt} is the natural logarithm of the death rate per 100,000 population from specific causes or for a specific age group; E_{jt} are measures of economic conditions such as income per capita and unemployment; X_{jt} is a vector of regressors capturing social correlates of mortality rates such as crime rates; and ε_{jt} is the error term. The fixed effects specification is appealing because it eliminates the impact of any (relatively) time-invariant factors such as climate, culture, education level and urbanization that are usually correlated with mortality levels but which are unlikely to explain the large annual fluctuations in mortality rates

[8]The migration data are from Goskomstat, *Demograficheskii ezhegodnik Rossii (The Demographic Yearbook of Russia*), various issues, 1993-2000. Other data are from Goskomstat (1992, 1996, 1997, 1998a, 1998b, 1999a, 1999b, 1999c, 2000a, 2000b, 2000c).

in Russia. These unchanging regional attributes are absorbed into the regional fixed effect α_j's, while β_t controls for time trends. All regressions are weighted by population and standard errors are heteroskedasticity-consistent. The analysis focuses on the two causes of death that explain most of the fluctuations in mortality in Russia in the 1990s – circulatory disease and trauma deaths – and also examines suicide deaths because of their extraordinary levels in Russia. Ideally the independent variables would include all of the factors discussed previously, but because of data limitations some factors cannot be tested, such as the price of medical services. Means and standard deviations of the variables used in the analysis are given in Table 4.

Income and mortality in Russia

The first set of regressions tests the relationship between income and mortality in the absence of other covariates, aside from time effects. The results for broad causes of death are shown in Figure 3, which illustrates the standardized coefficients from fixed effects regressions with the log mortality rate as the dependent variable and real income per capita as the independent variable.[9] The lightly shaded areas in Figure 3 represent ± one (standardized) standard error around the coefficient estimate, which is given by the middle line between the two shaded areas. For example, the coefficient on income for male mortality for all causes of death is -.063, with a standard error of .031. The results in Figure 3 indicate that income and mortality are negatively correlated for many of the principal causes of death, and that the magnitude of the relationship is slightly greater for women than for men. The one significant exception is for deaths due to trauma and poisoning, which are unrelated to income levels. Disaggregating the

[9]Standardized coefficients are presented to enable comparison across all specifications. The standardized coefficient is the estimated coefficient multiplied by (standard deviation of the independent variable / standard deviation of the dependent variable).

trauma deaths into some of the major components, suicide is negatively and significantly related to income for men, while some other types of violent death (e.g., motor vehicle accidents) may be positively related to income levels for men, although these coefficients are imprecisely estimated (results not shown).

Figures 4a (men) and 4b (women) illustrate the results of similar regressions that examine the relationship between income and mortality by major causes and five-year age group. For young and middle-aged men, higher income appears to be hazardous to cardiovascular health: there is a strong positive relationship between the death rate due to circulatory diseases and income for men aged 15-49; the coefficient is particularly large for men aged 15 to 34.[10] The relationship turns negative and significant at about age 50, with the largest effect for men aged 65 and over. These findings are consistent with research on the U.S. which shows that higher income is generally protective of health, except for young adults (particularly men) for whom higher incomes may lead to higher mortality rates (Deaton and Paxson 1999; Ruhm 2000). One interpretation of the changing sign on income by age group is that it reflects the theoretically ambiguous relationship between income and health: since health is a normal good, higher income induces more investment in health; however higher incomes also enable individuals to increase purchases of unhealthy goods, such as tobacco and high-fat foods. In other words, young adults may use higher incomes to consume more goods that are detrimental to health, while higher incomes allow the older population to invest more resources to protect their health. In contrast to men, for women there is no systematic relationship between income and circulatory disease mortality by five-year age group.

---

[10]Deaths due to circulatory diseases for individuals age 15-34 in Russia are by no means negligible as they are in most other countries. For example, in 1994 the death rate due to circulatory diseases for men aged 30-34 exceeded 100 per 100,000 population.

For both men and women, however, violent deaths are negatively and significantly related to real per capita income for most age groups. The relationship is especially strong for male suicide deaths, where the income coefficient is quite large and strongly correlated with suicide rates for all men aged 15 to 74.

Other covariates

Adding other independent variables to the regressions, the coefficient on per capita income remains negative and statistically significant for CVD and suicide deaths for both men and women in most specifications (Tables 5a and 5b). Other covariates produce mixed results. The registered crime rate in a region is a significant predictor of male and female trauma mortality in most specifications. It is also positive and significantly related to CVD mortality for men in the base specification (Table 5a, column 1), suggesting that high levels of crime may increase stress levels and thus cardiovascular deaths. The number of doctors in a region is statistically insignificant in most regressions, suggesting that the deterioration of the health care system is largely unrelated to the mortality crisis.[11]

The net migration rate is included as a control for population movements across regions, which appear to disproportionately comprise the migration of young people out of the high-mortality regions of the North, Siberia and the Far East in response to the elimination of government subsidies to these regions and the subsequent deterioration of supplies (Heleniak 1999). The statistically significant negative sign on this measure in most regressions indicates that positive migration inflows have occurred in regions with lower mortality rates, as expected.

[11]This indicator is problematic, however, because it is endogenous (there may be more doctors in regions with high death rates, thus leading to a positive coefficient in some regressions) and because it does not measure the quality of the medical care.

Turning to other variables, the unemployment rate is unrelated to CVD and overall trauma deaths, but is strongly and positively related to suicide deaths for both men and women (Tables 5a and 5b, column 10).[12] The regional inflation rate is included as a measure of macroeconomic instability and is positively related to male death rates due to circulatory diseases (Table 5a, column 3). Although one could argue that this correlation simply reflects the similar trends in mortality and inflation in Russia in the 1990s – both increased dramatically in the first half of the decade and improved in the second half of the decade – that inflation is unrelated to female mortality suggests that it is not simply similar time trends driving this correlation.

Finally, the ratio of the (national) minimum wage to the regional average wage is included in the regressions as a measure of the state's capacity to provide for the working poor. The minimum wage is also used as the base for calculation of many social benefits in Russia, such as child benefits and student stipends, underscoring the value of the minimum wage as an indicator of government social support. As indicated in Table 4, this measure was extremely low in most years, averaging just 13% of the average wage across regions. For both men and women, this variable is negatively and significantly related to CVD mortality, and is also negatively related to trauma mortality for men. Because an income control is already included in these regressions, the negative sign on this coefficient is unlikely to reflect an effect of material deprivation on mortality. An alternative interpretation is that a very low level of the minimum wage creates stress, and stress-related mortality, due to the perceived failure of the government to provide an adequate safety net for those unable to adapt to the new economic environment.

Given the controversy surrounding the role of alcohol in the Russian mortality crisis, it is

[12]Regional average wages, inflation rates and unemployment rates are available beginning in 1990, 1991 and 1992, respectively, so there are fewer observations in these regressions.

important to establish the relationship between alcohol consumption and mortality in Russia in the 1990s. Unfortunately this is difficult to do given the poor quality of available measures of alcohol consumption. Russia's national statistical agency, Goskomstat, published estimates of per capita alcohol sales by region from 1989 through 1992, but then ceased to publish these estimates until 1997 due to the flood of unrecorded imports of alcohol into the country which complicated the estimates. Due to this lack of data, an investigation of the relationship between alcohol consumption and mortality is deferred to the analysis of micro-level data below.

Table 6 examines how some of the relationships explored in Table 5a differ by time period, focusing on male mortality. For both cardiovascular and trauma mortality, the relationship between income and mortality is statistically insignificant in both periods. The effect of the crime rate on both types of mortality is strongest is the early 1990s, while the effect of migration is strongest in the late 1990s. The inflation rate remains positively related to CVD mortality in the 1994 - 1999 period but is statistically significant at only the 22 percent level. The ratio of the minimum wage to the average wage is negatively and significantly related to CVD and trauma deaths in the 1994 - 1999 period only. Given these results, it is difficult to draw clear conclusions regarding the causes of the improvement in mortality between 1994 and 1999. Contributing factors likely included the reduction in reported crime rates and the stabilization of inflation and the real minimum wage in the second half of the decade.

Finally, it is worth noting that several other measures of economic disruption or state capacity showed no correlation with mortality rates during this period. Other indicators of the capacity of the health care infrastructure – the number of nurses, hospital beds, and clinics per capita – were also uncorrelated with mortality rates. The share of expenditures on social services in regional budgets failed to predict mortality. Changes in the composition of the diet, such as

per capita consumption of fruits and vegetables, meat, and dairy products, were also insignificantly related to all types of mortality. Finally, measures of the change in the structure of employment in a region, such as the share of industrial employment, were also unrelated to mortality rates.

Individual-level data

Although these cross-region regressions provide clues to the factors related to changing mortality rates in Russia, ideally one would like to test whether these relationships hold at the individual level. For example, is there any evidence at the individual level that a region's inflation rate or crime rate affects the probability of dying? How is income related to mortality at the individual level? This section attempts to answer these questions using data from the second panel of the Russian Longitudinal Monitoring Survey (RLMS), a nationally representative survey of Russian households conducted in the fall of 1994, 1995, 1996, 1998, and 2000 - 2004.[13] The RLMS provides detailed information on income, employment, and demographic characteristics of individuals and families, as well as on individual behavior such smoking and drinking. While the number of deaths in the survey is small, at least some of the coefficients are estimated with sufficient precision to draw conclusions regarding the impact of individual characteristics and behavior on mortality. In addition, in 2000 - 2004 the survey asked surviving household members to provide information on cause of death, enabling one to explore whether factors such as alcohol consumption and unemployment have differing effects on the probability of dying by these causes.

[13]A detailed description of the sampling design and implementation of the RLMS is available at the RLMS website at http://www.cpc.unc.edu/rlms.

Given the small sample size and the short time period for which data are available, the analysis here takes a straightforward approach to identifying correlates of the deaths that occurred during the period: logistic regressions are estimated with the dependent variable equal to one if the individual died between 1995 and 2004, zero if not. The analysis is based on multiple-person households with at least one member surviving; multiple-person households comprise approximately 85 percent of the population in Russia. The sample thus omits individuals who lived alone and died during the survey, as no information is available on the reasons for household attrition during the panel. If the correlates of deaths for individuals living alone differ systematically from those for individuals living in multiple-person households, the results of this analysis will be biased. For example, it is possible that individuals living alone consume more alcohol than those living with families, so that the effect of alcohol consumption on the probability of dying is underestimated.

In regressions using these data, each round of the survey is stacked so that each regression uses all rounds of the survey and includes multiple observations on individuals. Standard errors are clustered by individual to correct for these multiple observations. Independent variables relate to the previous round of the survey, e.g. whether a person was reported to have died in the 1995 round is regressed on their real per capita household income in 1994. Other independent variables include the individual's age, marital status, education level, whether they smoke cigarettes, and the average amount of alcohol they drank in a day over the last 30 days.[14] Controls are also included for past medical events or conditions such as heart attack, stroke, and diabetes, as well as the year of the survey and region of the country. The analysis focuses on

[14]Alcohol consumption is measured in grams of ethanol consumed, which is calculated based on the amount of ethanol in each type of drink. Specifically, vodka, samogon and other alcohol has 40% ethanol; fortified wine 20%; wine 12% and beer 5% ethanol.

individuals age 18 to 75 because this is the group most affected by the mortality crisis and whose mortality experience has been most puzzling.

The first column of Tables 7a (men) and 7b (women) uses a parsimonious specification to explore the relationship between per capita income and an individual's probability of dying. For both men and women, a higher per capita income is associated with a lower probability of dying; this effect is statistically significant at less than the 1 percent level.[15] Age is strongly positively related to the probability of dying, as expected; alternative specifications indicate that age is linearly related to the probability of dying in the age group examined here. An indicator for self-reported poor health status is included in the second column of each panel; as others have argued (e.g., Attanasio and Emmerson 2003) this acts as a crude control for the 'reverse causality' problem, i.e. that higher income may lead to better health, but better health also enhances one's capacity to work and thus may increase income.[16] If the direction of causality is primarily dominated by the latter mechanism, one would expect that including poor health status in these regressions will significantly reduce the relationship between income and the probability of dying. As indicated in Tables 7a and 7b, however, poor health status (and other indicators of health, such as body mass index (BMI), previous heart attack and stroke) is strongly related to the probability of dying in all specifications but has a relatively small effect on the income variable. Based on these results and in combination with the results of the fixed effects regressions, it appears that declining income did increase the probability of death in Russia in the 1990s. Whether this income effect is directly causal or is a proxy for the capacity to purchase health-

[15]The coefficients in the RLMS regressions are presented as odds ratios, i.e. the coefficient represents the chance of death for those with this factor divided by the chance of death for those without it. For example, a coefficient of 1.5 means that an individual's odds of dying are 50 percent greater if they have this factor.

[16]See Smith (1999) for a comprehensive discussion of this issue.

enhancing goods (or something else) remains an open question.

A related issue is whether it is an absolute or relative measure of income that matters for mortality, or perhaps even inequality in the income distribution that most affects health. The latter issue has been an area of active research in recent years and remains controversial (see Deaton 2001 for an overview). Given the extraordinarily rapid increase in inequality that occurred in Russia in the early 1990s (see Brainerd 1998), Russia's experience provides a unique opportunity to examine the relationship between inequality and mortality during a time of sharply increasing inequality. However, measures of regional income inequality included in either the fixed effects regressions or the logistic regressions attract insignificant coefficients. This is consistent with Deaton's (2001) conclusion that inequality does not, in fact, matter for adult mortality (although it may affect infant mortality); however these results are subject to the caveat that the regional inequality measures for Russia are limited and of questionable quality. A measure of relative income – the individual's rank in the income distribution – is negatively related to the log odds of dying, but becomes insignificant once one adds the per capita income measure (which remains statistically significant). This suggests that, for Russia at least, it is the absolute level of income that matters for mortality, as one would expect given that income per capita is well below the $4,000 - $5,000 threshold noted previously.

The individual-level data can also be used to examine the role of alcohol consumption in Russia's mortality crisis. One caveat is that the measure of alcohol consumption in the RLMS is self-reported and is likely to be underreported; however the trends in overall alcohol consumption in the RLMS track other indicators of alcohol consumption trends from independent sources (Pridemore 2002). As shown in Tables 7a and 7b, alcohol consumption is positively and significantly related to the log odds of dying for both men and women (column 3).

Decomposing alcohol consumption into vodka and other 'hard' liquors versus beer and wine consumption, the evidence suggests that vodka consumption is related to a higher probability of dying for men but not for women; for women consumption of wine is protective of health while consumption of samogon (home-brewed alcohol) is harmful to health (column 4).

The remaining columns of Tables 7a and 7b add additional covariates to test other factors, suggested by the regional analysis, that may be associated with a higher probability of dying. Whether a person was unemployed in the previous round virtually doubles the probability of dying for both men and women (column 5). Unlike the regional regressions, however, there is no relationship between the inflation rate and the probability of dying, or between the minimum wage and the probability of dying (columns 6 and 7). In addition, in contrast to the fixed effects regressions, the regional crime rate is not related to a higher probability of dying (not shown). Other plausible factors in Russia's mortality crisis are also unrelated to a higher probability of dying in this period; these factors include measures of urbanization, pollution, access to a plot of land, access to a hospital, per capita expenditures on fruits and vegetables, and whether an individual had health insurance (results not shown).

The final set of regressions uses the information on cause of death to relate these individual variables to the probability of dying due to cardiovascular disease or due to accidental death. It should be noted that since the information on cause of death is provided by a surviving household member and is not certified by medical personnel, some of these causes of death may be misreported. The results for these deaths are reported in Table 8 (for men only). For both cardiovascular and accidental deaths, a higher per capita income is associated with a lower probability of dying, which is largely consistent with the regional regressions. Alcohol consumption appears to be somewhat protective of cardiovascular health, as one would expect if

the well-established positive effect of alcohol consumption on cardiovascular disease also holds for Russia (although this relationship is imprecisely estimated). In contrast, alcohol consumption increases the likelihood of accidental death and this effect is statistically significant at less than the 1 percent level. At least in this small sample, these results are inconsistent with the argument that the effects of alcohol consumption in Russia are different than elsewhere, i.e. that higher alcohol consumption increases the likelihood of dying due to cardiovascular disease. Unemployment is also unrelated to CVD mortality, but increases the probability of accidental death by nearly four times (columns 2 and 6). This is also consistent with the regional regressions, which showed no relationship between unemployment and circulatory disease mortality, but a strong, positive relationship between unemployment and suicide rates across regions.

V. Concluding remarks

The past decade, much like the past century, has been a time of extraordinary upheaval for Russians. The reforms intended to improve the country's standard of living have instead, at least initially, impoverished part of the population and led to continuing economic instability. Rarely in modern history has a population experienced such a massive loss of income in such a short period of time, and such a massive – and tragic – premature loss of life across broad portions of the population and across the country.

The evidence presented in this study indicates that the decline in income likely did play an important role in the increasing odds of dying in Russia in the 1990s; the health status of Russians – much like that of their former Soviet neighbors – seems to be extremely sensitive to economic fluctuations, possibly because their health status was already fragile on the eve of the

economic reforms. The erratic economic policies pursued by the government and its failure to maintain employment and provide a reliable safety net also appear to have contributed to rising mortality, at least in part by increasing stress among the population which led to rising cardiovascular deaths. This conclusion underscores the crucial role of the government in providing a stable environment for its citizens to prevent premature mortality in Russia. It also appears that alcohol consumption contributed to increased mortality for men in this period, but the effect worked primarily by increasing violent deaths rather than cardiovascular deaths.

References

Anand, Sudhir and Lincoln Chen, *Health Implications of Economic Policies: A Framework of Analysis* United Nations Development Programme, Office of Development Studies, Discussion Paper Series (1996).

Anderson, Barbara A. and Brian D. Silver, "Issues of Data Quality in Assessing Mortality Trends and Levels in the New Independent States," in J.-L. Bobadilla, C. Costello and F. Mitchell, eds., *Premature Death in the New Independent States* (National Academy Press, Washington, D.C., 1997), 120-55.

Attanasio, Orazio P. and Carl Emmerson, "Mortality, Health Status and Wealth," *Journal of the European Economic Association*, Vol. 1, no. 4, June 2003, 821 - 50.

Averina, Maria, Odd Nilssen, Tormod Brenn, Jan Brox, Alexei G. Kalinin and Vadim L. Arkhipovsky, "High Cardiovascular Mortality in Russia Cannot Be Explained by the Classical Risk Factors. The Arkhangelsk Study 2000," *European Journal of Epidemiology* 18, 2003, 871 - 878.

Averina, Maria, Odd Nilssen, Tormod Brenn, Jan Brox, Vadim L. Arkhipovsky, and Alexei G. Kalinin, "Factors Behind the Increase in Cardiovascular Mortality in Russia: Apolipoprotein AI and B Distribution in the Arkhangelsk Study 2000," *Clinical Chemistry* 50 (2), 2004, 346 - 354.

Becker, Charles M. and David Bloom, guest editors, Special Issue: The Demographic Crisis in the Former Soviet Union, *World Development* 26 (11), November 1998.

Bobadilla, José Luis, Christine A. Costello, and Faith Mitchell, editors, *Premature Death in the New Independent States* (Washington, D.C.: National Academy Press, 1997).

Bobak, Martin and Michael Marmot, "Alcohol and Mortality in Russia: Is It Different Than Elsewhere?" *Annals of Epidemiology* Vol. 9 (6), 1999, 335 - 38.

Brainerd, Elizabeth, "Winners and Losers in Russia's Economic Transition," *American Economic Review*, 88 (5) 1998, 1094-1116.

Brainerd, Elizabeth and Elena A. Varavikova, "Policy Implications of the Russian Mortality Crisis," paper prepared for the WHO Commission on Macroeconomics and Health, August 2001.

Chen, Lincoln C.; Friederike Wittgenstein; and Elizabeth McKeon, "The Upsurge of Mortality in Russia: Causes and Policy Implications," *Population and Development Review* 22 (3), September 1996, 517-530.

Cornia, Giovanni Andrea and Renato Paniccià, "The Demographic Impact of Sudden Impoverishment: Eastern Europe During the 1989-94 Transition," Innocenti Occasional Paper, Economic Policy Series, No. 49 (UNICEF), 1995.

Cornia, Giovanni Andrea and Renato Paniccià, "The Transition Mortality Crisis: Evidence, Interpretation and Policy Responses," in Cornia, Giovanni Andrea and Renato Paniccià, eds., *The Mortality Crisis in Transitional Economies* (Oxford, UK: Oxford University Press, 2000), 3-37.

Cornia, Giovanni Andrea and Renato Paniccià, editors, *The Mortality Crisis in Transitional Economies*

(Oxford, UK: Oxford University Press, 2000).

Cutler, David M., Felicia Knaul, Rafael Lozano, Oscar Méndez, and Beatriz Zurita, "Financial Crisis, Health Outcomes and Ageing: Mexico in the 1980s and 1990s," *Journal of Public Economics* 84 (2), May 2002, 279 - 303.

Cutler, David M., Angus S. Deaton and Adriana Lleras-Muney, "The Determinants of Mortality," NBER Working Paper 11963, January 2006.

Deaton, Angus, and Christina Paxson, "Mortality, Education, Income and Inequality Among American Cohorts," in *Themes in the Economics of Aging, 2001*, NBER Conference Report series (Chicago and London: University of Chicago Press), 129 - 65.

Deaton, Angus, "Health, Inequality, and Economic Development," *Journal of Economic Literature*, Vol 41 (1), March 2003, 113 - 58.

European Bank for Reconstruction and Development, *Transition Report 1999* (London: EBRD, 1999).

Goskomstat of Russia, *Demograficheskii ezhegodnik rossii (The demographic yearbook of Russia)*. Moscow, various issues 1993-2000.

Goskomstat of Russia, *Pokazateli sotsial'nogo razvitya respublik, kraev i oblastei Rossiiskoi Federatsii (Indicators of the Social Development of the Republics, Krais and Oblasts of the Russian Federation)* (Moscow 1992).

Goskomstat of Russia, *Regiony Rossii (Regions of Russia)*, Vol. 2 (Moscow 1998a).

Goskomstat of Russia, *Rossiiskii statisticheskii ezhegodnik 2000 (Russian Statistical Yearbook 2000)* (Moscow), 2000a.

Goskomstat of Russia, *Sotsial'noe polozhenie i uroven' zhizni naseleniya Rossii (Social Conditions and Living Standards of the Population of Russia)* (Moscow), 1997, 1999a, 2000b.

Goskomstat of Russia, *Torgovlia v Rossii (Trade in Russia)*, (Moscow), 1999b.

Goskomstat of Russia, *Trud i zanyatost' v Rossii (Labor and Employment in Russia)* (Moscow), 1999c.

Goskomstat of Russia, *Tseny v Rossii (Prices in Russia)*, (Moscow), 1994, 1996, 1998b, 2000c.

Grossman, Michael, "The Demand for Health: A Theoretical and Empirical Investigation," National Bureau of Economic Research Occasional Paper no. 119 (1972a).

Grossman, Michael, "On the Concept of Health Capital and the Demand for Health," *Journal of Political Economy* 10:3 (1972b), 223 - 255.

Heleniak, Timothy, "Out-Migration and Depopulation of the Russian North During the 1990s," *Post-Soviet Geography and Economics* 40 (3), 1999, 155-205.

Ivaschenko, Oleksiy, "The Patterns and Determinants of Longevity in Russia's Regions: Evidence from Panel Data," *Journal of Comparative Economics*, 33 (4), December 2005, 788 - 813.

Labarthe, Darwin R., *Epidemiology and Prevention of Cardiovascular Diseases: A Global Challenge* (Aspen: Gaithersburg, MD, 1998).

Leon, David A., Laurent Chenet, Vladimir M. Shkolnikov, S. Zakharov, J. Shapiro, G. Rakhmanova, S. Vassin and M. McKee, "Huge variation in Russian mortality rates in 1984-1994. Artefact, alcohol or what?" *Lancet* 350 (1997), 383-388.

Malyutina, Sofia, Martin Bobak, Svetlana Kurilovitch, Valery Gafarov, Galina Simonova, Yuri Nikitin and Michael Marmot, "Relation Between Heavy and Binge Drinking and All-Cause and Cardiovascular Mortality in Novosibirsk, Russia: A Prospective Cohort Study," *Lancet* Vol. 360 (9344), 2002, 1448 - 54.

McKee, M. and Annie Britton, "The Positive Relationship Between Alcohol and Heart Disease in Eastern Europe: Potential Physiological Mechanisms," *Journal of the Royal Society of Medicine*, Vol. 91 (August 1998), pp. 402 - 407.

McKee, Martin, Sándor Süzcs, Attila Sárváry, Roza Ádany, Nikolay Kiryanov, Ludmila Saburova, Susannah Tomkins, Evgeny Andreev and David A. Leon, "The Composition of Surrogate Alcohols Consumed in Russia," *Alcoholism: Clinical and Experimental Research* 29 (10), October 2005, 1884 - 1888.

Ministerstvo Zdravookhranenie Rossiiskoi Federatsii, *Smertnost' naseleniya Rossiiskoi Federatsii 1997 god* (Ministry of Health of the Russian Federation, *Mortality of the Russian Population in 1997*) (Moscow, 1998).

Preston, Samuel H., "The Changing Relation Between Mortality and Level of Economic Development," *Population Studies* 29 (1975), 231-48.

Pridemore, William Alex, "Vodka and Violence: Alcohol Consumption and Homicide Rates in Russia," *American Journal of Public Health*," 92 (12), December 2002, 1921 - 1930.

Ruhm, Christopher J., "Are Recessions Good for Your Health?" *Quarterly Journal of Economics* CXV (May 2000), 617 - 50.

Shapiro, Judith, "The Russian Mortality Crisis and Its Causes," in Anders Aslund, editor, *Russian Economic Reform in Jeopardy?* (London and New York: Pinter Publishers, 1995), 149 - 178.

Shkolnikov, Vladimir M., France Meslé, and Jacques Vallin, "Recent Trends in Life Expectancy and Causes of Death in Russia, 1970-1993," in J.-L. Bobadilla, C. Costello and F. Mitchell, eds., *Premature Death in the New Independent States* (National Academy Press, Washington, D.C., 1997), 34-65.

Shkolnikov, Vladimir, Martin McKee, and David A. Leon, "Changes in Life Expectancy in Russia in the Mid-1990s," *The Lancet* 357, March 24, 2001a, 917-921.

Shkolnikov, Vladimir, Meslé, France and David A. Leon, "Premature Circulatory Disease Mortality in Light of Population- and Individual-level Evidence," in Weidner, G., Kopp S.M. and Kristenson, M., editors, *Heart Disease: Environment, Stress and Gender* (NATO Science Series, Series I: Life and Behavioural Sciences, Vol. 327, 2001b).

Shkolnikov, Vladimir M., Evgueni M. Andreev, David A. Leon, Martin McKee, France Meslé and Jacques Vallin, "Mortality Reversal in Russia: The Story So Far," *Hygiea Internationalis* 4 (4), December 2004, 29 - 80.

Smith, James P., "Healthy Bodies and Thick Wallets: The Dual Relation Between Health and Economic Status," *Journal of Economic Perspectives* 13 (2), Spring 1999, 145-166.

Stegmayr, Birgitta; Tatyana Vinogradova; Malyutina, Sofia; Peltonen, Markku; Nikitin, Yuri; Asplund, Kjell, "Widening Gap of Stroke Between East and West: Eight-Year Trends in Occurrence and Risk Factors in Russia and Sweden," *Stroke* January 2000, 2-8.

Stillman, Steven, "Health and Nutrition in Eastern Europe and the Former Soviet Union During the Decade of Transition: A Review of the Literature," *Economics and Human Biology* 4 (2006), 104 - 146.

U.S. Census Bureau, *Statistical Abstract of the United States 2000* (Washington, D.C.).

Wasserman, D. and A. Värnik, "Reliability of statistics on violent death and suicide in the former USSR, 1970-1990," *Acta Psychiatrica Scandinavica* 98 (Suppl. 394) (1998), 34-41.

World Health Organization, *Health for All* database (www.who.dk/country/country.htm), June 2000 version.

Zdravookhranie Rossiiksoi Federatsii (*Public Health in the Russian Federation*), various issues, 1999, 2000.

Figure 1. Male and female life expectancy at birth, Russian Federation and the United States, 1958-2004

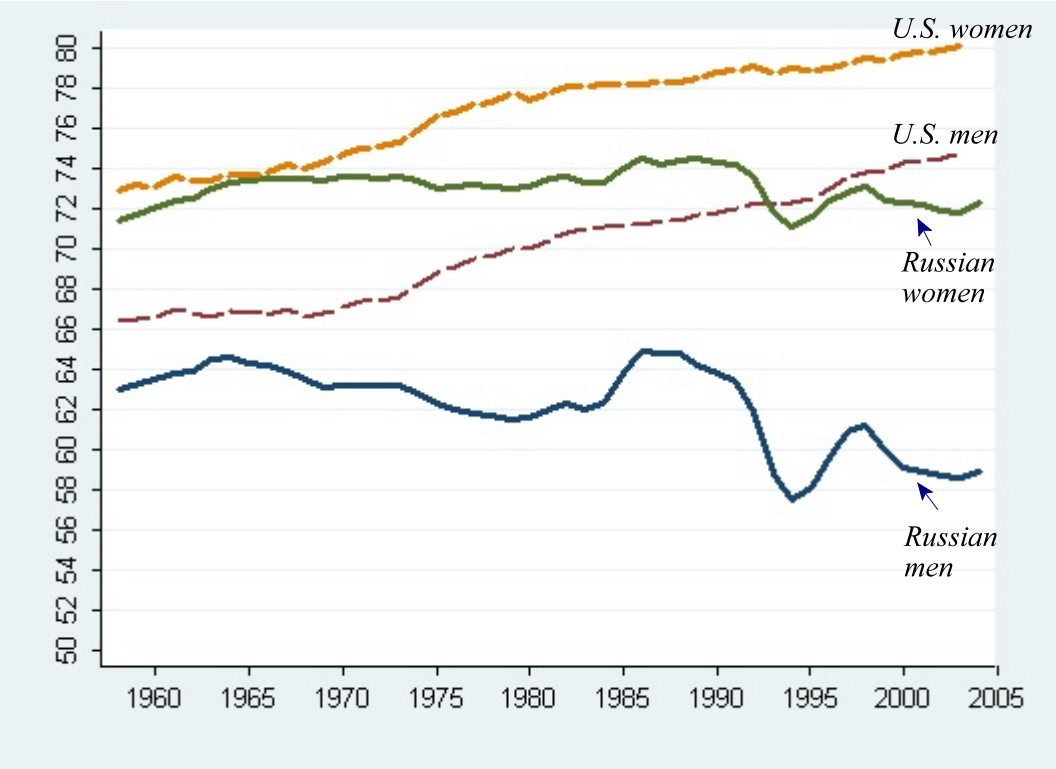


Table 1. Levels and changes in standardized death rates by cause, all ages, men

	EU avg. 1995	Death rate per 100,000 population				1989-1994			1994-1998		
		1989	1994	1998	1999	Change	% increase	Share of increase in all deaths	Change	% increase	Share of increase in all deaths
All causes	944.0	1629.5	2290.5	1847.0	1991.5	661.0	40.6	100.0	-443.5	-19.4	-100.0
Infectious diseases	8.0	22.8	36.8	34.5	44.3	14.0	61.4	2.1	-2.3	-6.3	-0.5
Tuberculosis	1.8	16.5	28.9	29.1	37.7	12.4	75.2	1.9	0.2	0.7	0.0
All neoplasms	262.0	316.2	316.7	291.2	292.2	0.5	0.2	0.1	-25.5	-8.1	-5.7
Stomach	na	61.2	53.9	46.4	45.9	-7.3	-11.9	-1.1	-7.5	-13.9	-1.7
Bronchus and lung	69.9	103.2	101.7	89.5	88.2	-1.5	-1.5	-0.2	-12.2	-12.0	-2.8
Prostate	na	10.6	11.4	12.7	12.8	0.8	7.5	0.1	1.3	11.4	0.3
Leukemia	na	7.2	6.6	6.2	7.1	-0.6	-8.3	-0.1	-0.4	-6.1	-0.1
Diseases of the circulatory sys.	364.0	854.3	1130.7	924.7	1002.7	276.4	32.4	41.8	-206.0	-18.2	-46.4
Ischemic heart disease	168.0	457.9	598.6	476.0	516.4	140.7	30.7	21.3	-122.6	-20.5	-27.6
Of which, heart attacks	na	66.2	64.9	58.5	62.9	-1.3	-2.0	-0.2	-6.4	-9.9	-1.4
Cerebrovascular disease	83.0	286.9	355.8	317.9	332.5	68.9	24.0	10.4	-37.9	-10.7	-8.5
Diseases of the respiratory sys.	85.9	115.0	156.0	105.8	118.1	41.0	35.7	6.2	-50.2	-32.2	-11.3
Pneumonia	na	15.1	36.7	25.1	34.8	21.6	143.0	3.3	-11.6	-31.6	-2.6
Chronic bronchitis	na	55.0	71.9	53.2	na	16.9	30.7	2.6	-18.7	-26.0	-4.2
Diseases of the digestive sys.	43.7	43.3	65.3	54.5	59.8	22.0	50.8	3.3	-10.8	-16.5	-2.4
Stomach ulcer	na	5.0	6.7	6.4	6.8	1.7	34.0	0.3	-0.3	-4.5	-0.1
Cirrhosis of the liver	21.4	14.2	27.1	20.6	22.4	12.9	90.8	2.0	-6.5	-24.0	-1.5
Diabetes mellitus	14.8	4.7	7.7	6.6	6.2	3.0	63.8	0.5	-1.1	-14.3	-0.2
Trauma and poisoning	62.9	200.3	416.2	305.1	335.0	215.9	107.8	32.7	-111.1	-26.7	-25.1
Motor vehicle accidents	18.1	46.8	45.3	34.6	39.7	-1.5	-3.2	-0.2	-10.7	-23.6	-2.4
Accidental alcohol poisoning	na	15.8	62.0	29.3	33.3	46.2	292.4	7.0	-32.7	-52.7	-7.4
Other accidental poisonings	na	13.2	21.1	20.1	20.5	7.9	59.8	1.2	-1.0	-4.7	-0.2
Accidental drowning	na	14.7	21.1	18.8	19.9	6.4	43.5	1.0	-2.3	-10.9	-0.5
Suicide	18.1	46.6	76.4	62.2	68.7	29.8	63.9	4.5	-14.2	-18.6	-3.2
Homicide	1.6	19.5	50.3	34.6	39.3	30.8	157.9	4.7	-15.7	-31.2	-3.5
Unspecified violent death	na	16.1	57.9	46.3	48.3	41.8	259.6	6.3	-11.6	-20.0	-2.6
Other accidents and violence	na	20.9	44.2	32.1	na	23.3	111.5	3.5	-12.1	-27.4	-2.7
Ill-defined conditions	23.2	13.6	79.5	64.9	71.9	65.9	484.6	10.0	-14.6	-18.4	-3.3

Note: Death rates for Russia and the European Union are standardized using the European population. Source for EU data: WHO Health for All database.

Table 2. Levels and changes in standardized death rates by cause, all ages, women

	EU avg. 1995	Death rate per 100,000 population				1989-1994			1994-1998		
		1989	1994	1998	1999	Change	% increase	Share of increase in all deaths	Change	% increase	Share of increase in all deaths
All causes	554.0	875.0	1098.4	957.4	1008.8	223.4	25.5	100.0	-141.0	-12.8	-100.0
Infectious diseases	4.8	6.1	8.1	6.9	8.3	2.0	32.8	0.9	-1.2	-14.8	-0.9
Tuberculosis	0.6	1.8	2.9	3.4	4.1	1.1	61.1	0.5	0.5	17.2	0.4
All neoplasms	145.0	141.7	143.8	138.3	139.4	2.1	1.5	0.9	-5.5	-3.8	-3.9
Stomach	na	26.8	22.7	19.6	19.1	-4.1	-15.3	-1.8	-3.1	-13.7	-2.2
Bronchus and lung	15.1	10.6	10.4	9.1	8.7	-0.2	-1.9	-0.1	-1.3	-12.5	-0.9
Breast	30.4	18.8	22.1	23.6	23.8	3.3	17.6	1.5	1.5	6.8	1.1
Leukemia	na	4.3	4.2	4.0	4.4	-0.1	-2.3	-0.0	-0.2	-4.8	-0.1
Diseases of the circulatory sys.	230.0	562.5	666.7	583.2	619.4	104.2	18.5	46.6	-83.5	-12.5	-59.2
Ischemic heart disease	79.4	256.6	291.3	247.2	263.1	34.7	13.5	15.5	-44.1	-15.1	-31.3
Of which, heart attacks	na	24.0	23.2	23.5	24.4	-0.8	-3.3	-0.4	0.3	1.3	0.2
Cerebrovascular disease	67.5	225.5	262.9	251.7	259.0	37.4	16.6	16.7	-11.2	- 4.3	-7.9
Diseases of the respiratory sys.	40.6	38.8	40.2	28.6	31.2	1.4	3.6	0.6	-11.6	-28.9	- 8.2
Pneumonia	na	6.7	9.8	7.6	10.2	3.1	46.3	1.4	- 2.2	-22.4	-1.6
Chronic bronchitis	na	15.8	15.9	11.4	na	0.1	0.6	0.0	- 4.5	-28.3	-3.2
Diseases of the digestive sys.	24.7	21.1	29.6	24.7	26.5	8.5	40.3	3.8	- 4.9	-16.6	-3.5
Stomach ulcer	na	1.2	1.3	1.3	1.4	0.1	8.3	0.0	0.0	0.0	0.0
Cirrhosis of the liver	8.9	6.4	12.8	9.7	10.3	6.4	100.0	2.9	-3.1	-24.2	-2.2
Diabetes mellitus	13.4	6.3	10.8	9.7	8.9	4.5	71.4	2.0	-1.1	-10.2	-0.8
Trauma and poisoning	24.8	53.2	98.2	74.4	80.6	45.0	84.6	20.1	- 23.8	-24.2	-16.9
Motor vehicle accidents	5.7	11.4	12.1	10.9	11.8	0.7	6.1	0.3	-1.2	- 9.9	-0.9
Accidental alcohol poisoning	na	3.5	16.3	7.3	8.6	12.8	365.7	5.7	- 9.0	-55.2	-6.4
Other accidental poisonings	na	4.1	6.0	5.0	5.0	1.9	46.3	0.9	-1.0	-16.7	-0.7
Accidental drowning	na	2.4	3.4	3.6	3.6	1.0	41.7	0.4	0.2	5.9	0.1
Suicide	5.8	10.3	12.5	10.4	11.5	2.2	21.4	1.0	-2.1	-16.8	-1.5
Homicide	0.7	5.8	13.9	10.3	12.0	8.1	139.7	3.6	-3.6	-25.9	-2.6
Unspecified violent death	na	4.0	13.4	11.1	11.2	9.4	235.0	4.2	-2.3	-17.2	-1.6
Other accidents and violence	na	4.9	10.7	8.2	na	5.8	118.4	2.6	-2.5	-23.4	-1.8
Ill-defined conditions	13.1	6.5	53.4	52.8	55.0	46.9	721.5	21.0	-0.6	-1.1	-0.4

Note: Death rates for Russia and the European Union are standardized using the European population. Source for EU data: WHO Health for All database.

Figure 2. Percentage change in age-specific death rates, 1989-1994 and 1994-1998

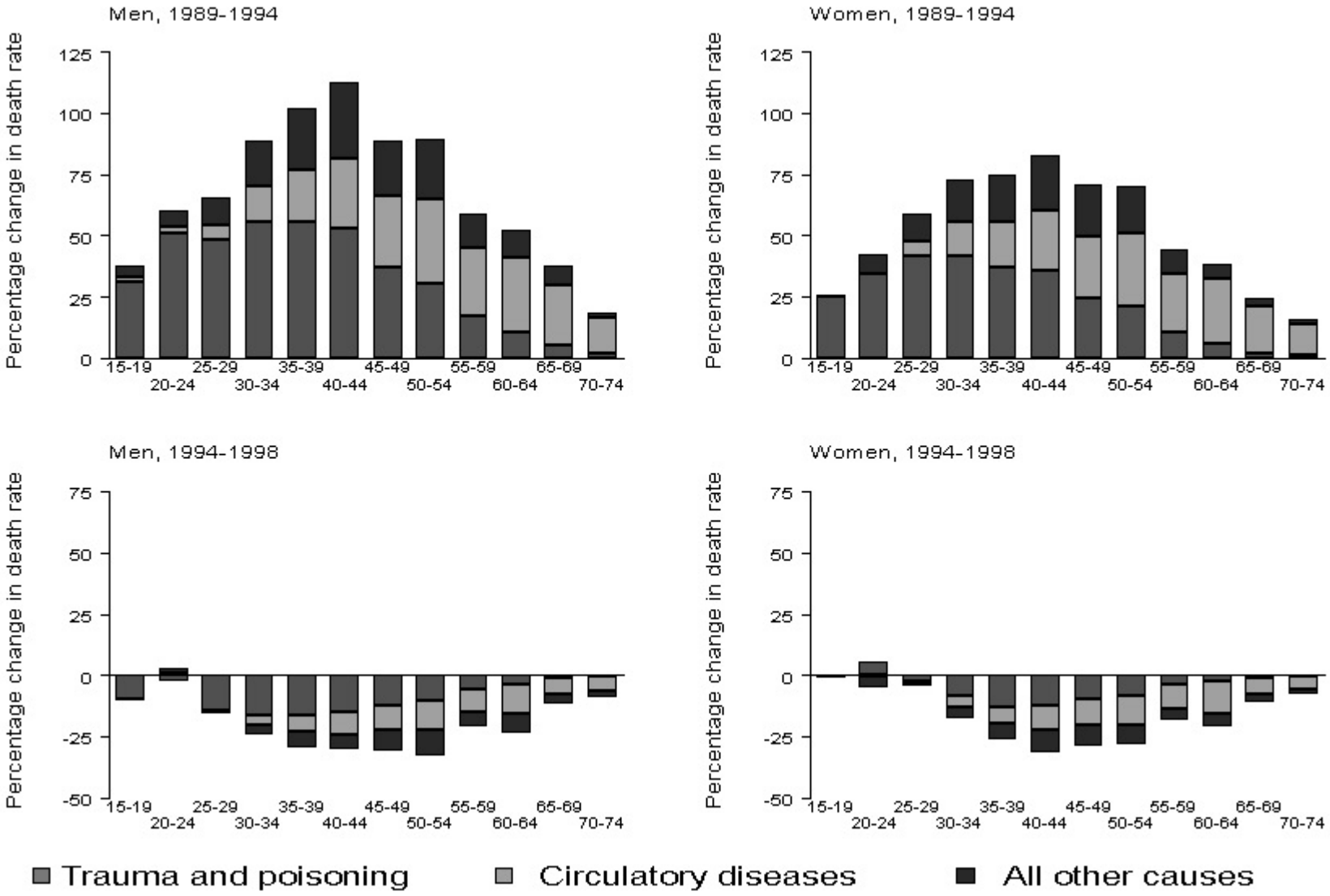


Table 3. Death rates due to suicide and homicide, men

	Death rate per 100,000 population in each age group			
	U.S.	Russia		Share of increase in all deaths
	1997	1989	1994	
Suicide				
15-24	18.9			
15-19		18.5	34.9	28.3
20-24		33.1	63.4	20.1
25-44	23.8			
25-29		49.2	84.4	16.3
30-34		58.2	100.7	11.9
35-39		61.7	106.9	8.5
40-44		62.2	114.6	6.6
45-64	22.5			
45-49		72.3	117.4	4.6
50-54		72.6	138.9	4.9
55-59		72.6	115.5	3.2
60-64		60.9	101.4	2.4
Homicide				
15-24	28.2			
15-19		11.2	26.3	25.9
20-24		28.8	61.4	21.6
25-44	16.3			
25-29		35.5	78.0	19.7
30-34		39.0	81.9	12.0
35-39		35.0	84.4	9.2
40-44		30.7	87.6	7.1
45-64	na			
45-49		27.9	85.1	5.9
50-54		22.2	75.4	3.9
55-59		18.5	61.6	3.2
60-64		14.3	47.7	2.0

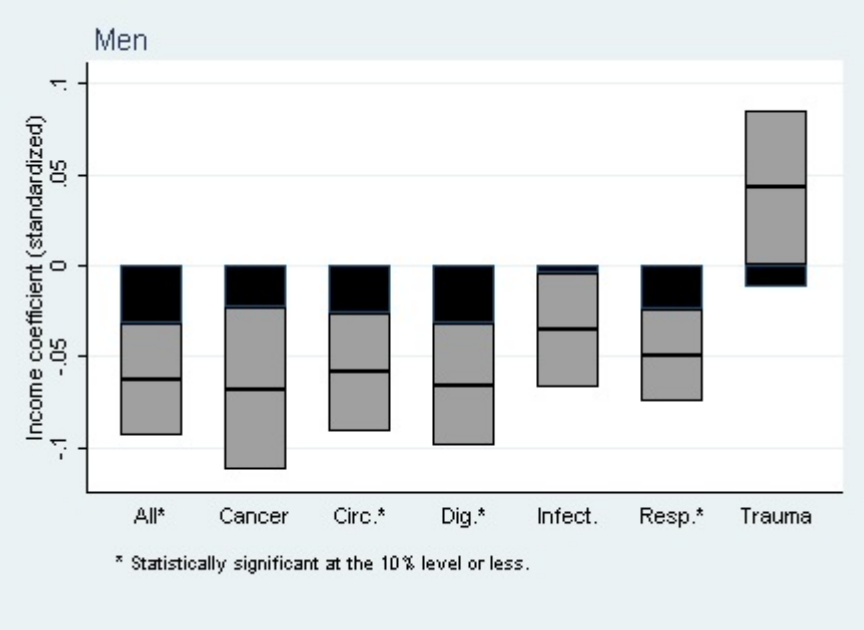
Source for U.S. data: *Statistical Abstract of the United States 2000.*

Table 4. Means and standard deviations of variables

	Mean	Standard deviation
Dependent variables:		
Log standardized death rate, men:		
All causes	7.56	.139
Infectious diseases	3.38	.440
Neoplasms	5.73	.136
Diseases of the circulatory system	6.86	.145
Diseases of the respiratory system	4.78	.343
Diseases of the digestive system	3.99	.249
Trauma and poisoning	5.72	.293
Suicide	4.08	.486
Log standardized death rate, women:		
All causes	6.88	.116
Infectious diseases	1.83	.436
Neoplasms	4.94	.157
Diseases of the circulatory system	6.39	.135
Diseases of the respiratory system	3.5	.385
Diseases of the digestive system	3.22	.270
Trauma and poisoning	4.28	.332
Suicide	2.34	.487
Independent variables:		
Real monthly income per cap., 1000s of 1989 rb.	.175	.087
Registered crime rate per 100 pop.	1.62	.565
Doctors per 100 pop.	.450	.124
Annual net migration rate per 10 pop.	.024	.068
Unemployment rate	9.41	4.31
Inflation rate/1000	.490	.674
Minimum wage/average wage	.128	.070

Figure 3. Relationship between income and mortality by cause

Coefficient on fixed effects regressions for 1989-1999, with log(death rate by cause)
as the dependent variable and real per capita income (in 1989 rb) as the independent variable.
All regressions include year dummies and are weighted by population.



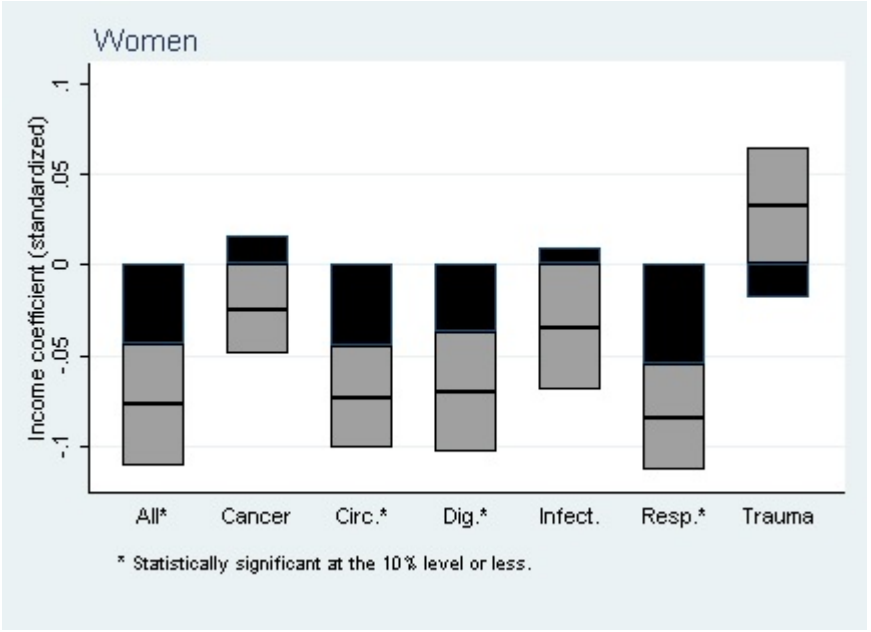
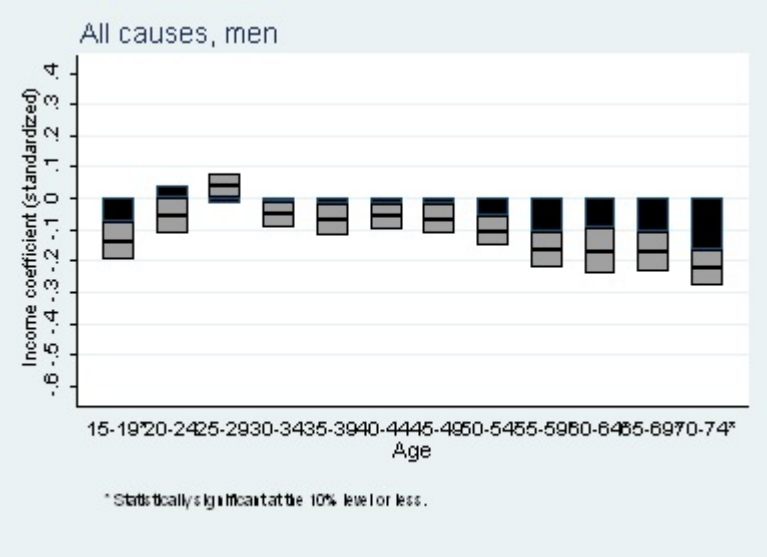
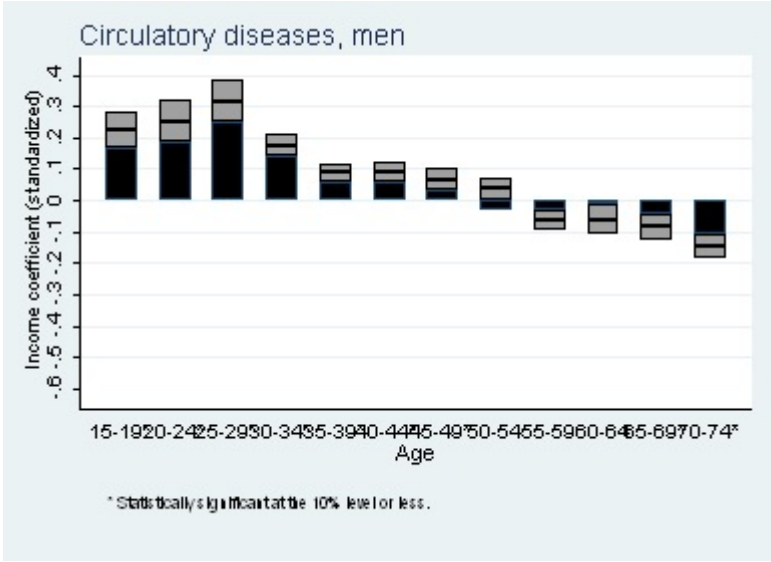
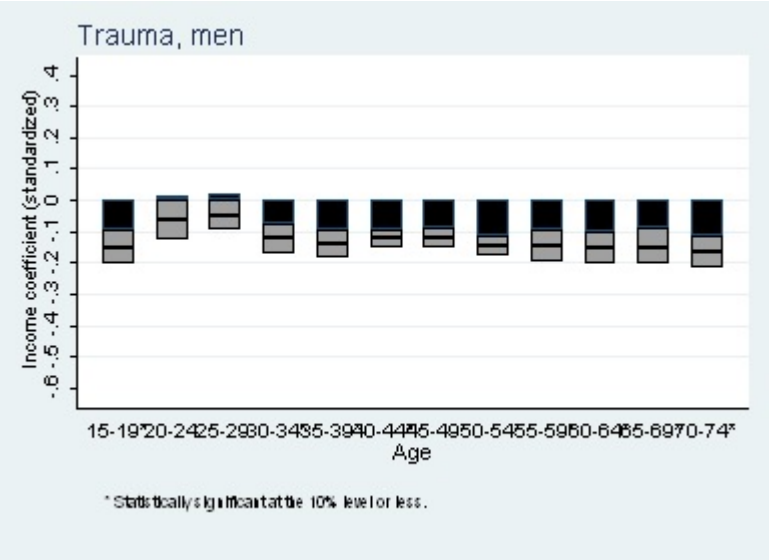


Figure 4a. Relationship between income and mortality rates by cause and 5-year age group, men

Coefficient on fixed effects regressions for 1989-1999, with log(age-specific death rate) as the dependent variable and real per capita income (in 1989 rb) as the independent variable. All regressions include year dummies and are weighted by population.







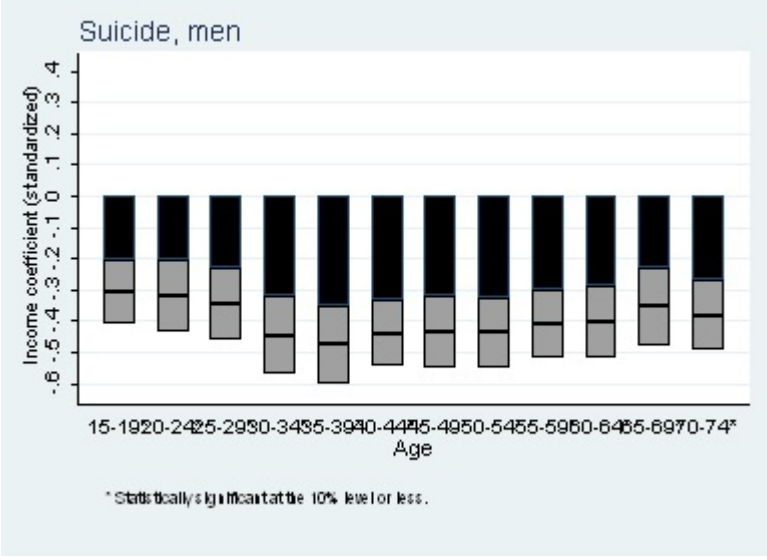
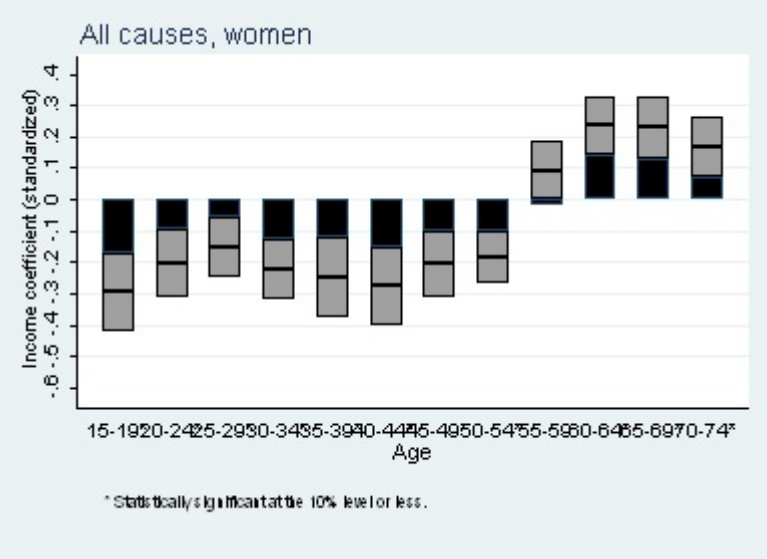
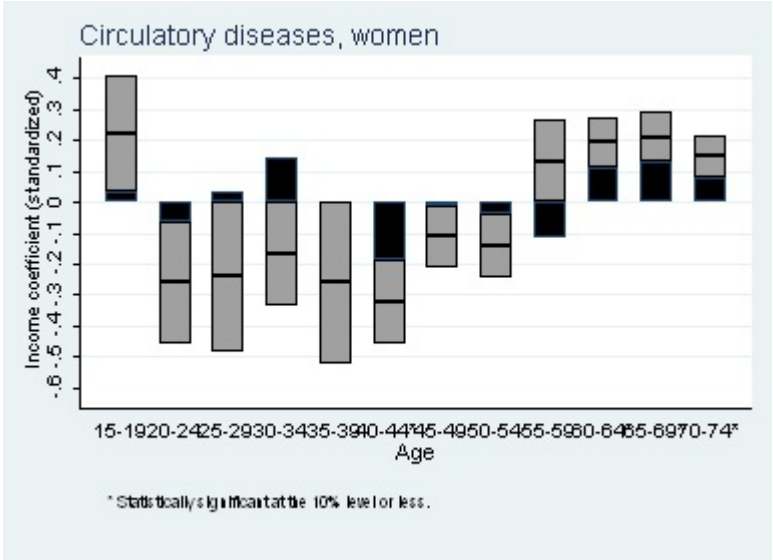
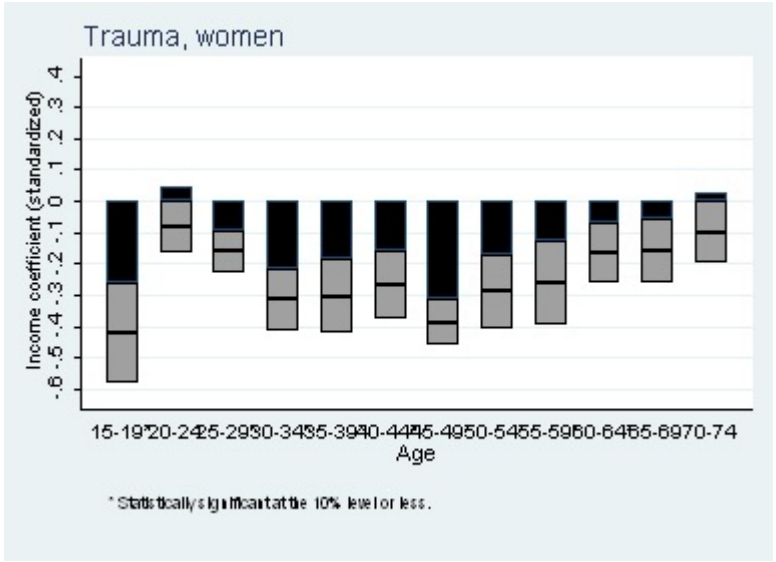


Figure 4b. Relationship between income and mortality rates by cause and 5-year age group, women

Coefficient on fixed effects regressions for 1989-1999, with log(age-specific death rate) as the dependent variable and real per capita income (in 1989 rb) as the independent variable. All regressions include year dummies and are weighted by population.







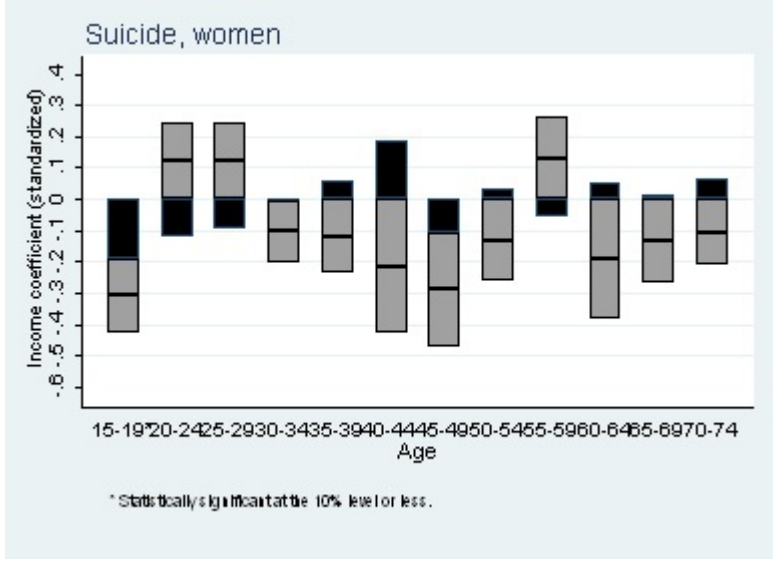


Table 5a. Fixed effects regressions, men, 1989-1999
Dependent variable: log(standardized death rate by cause)

	Circulatory disease				Trauma and poisoning				Suicide			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Income per capita, 1989 rb	-.099 (.071)	-.117** (.048)	-.129** (.051)	-.155** (.069)	.177 (.172)	.022 (.085)	.135 (.125)	.096 (.152)	-.726** (.316)	-.632*** (.155)	-.812*** (.276)	-.777** (.312)
Crime rate	.031* (.016)	.022 (.024)	.037 (.023)	.038** (.019)	.102*** (.034)	.065** (.033)	.076** (.034)	.097*** (.035)	.130*** (.044)	.037 (.033)	.076* (.044)	.118*** (.045)
Doctors per 100 pop.	-.125 (.099)	-.391* (.233)	-.311 (.223)	-.141 (.099)	-.619 (.387)	-.207 (.340)	-.133 (.419)	-.613 (.453)	.753** (.336)	.289 (.444)	.217 (.664)	.793** (.327)
Net migration rate	-.139** (.062)	-.350*** (.098)	-.181** (.088)	-.189** (.081)	-.232** (.095)	-.402*** (.121)	-.205** (.106)	-.254** (.106)	.082 (.205)	-.005 (.238)	.085 (.247)	.072 (.231)
Unemploy-men rate	–	-.0004 (.002)	–	–	–	-.003 (.002)	–	–	–	.016*** (.005)	–	–
Inflation rate	–	–	.021* (.011)	–	–	–	.008 (.018)	–	–	–	.012 (.023)	–
Minimum wage/avg. wage	–	–	–	-.527** (.265)	–	–	–	-1.44** (.578)	–	–	–	-.138 (.722)
R2	.907	.914	.911	.913	.933	.940	.931	.932	.945	.968	.956	.949
N	791	573	648	720	791	573	648	720	791	573	648	720

Robust standard errors in parentheses. Regressions are weighted by population and include year effects.

Table 5b. Fixed effects regressions, women, 1989-1999
Dependent variable: log(standardized death rate by cause)

	Circulatory disease				Trauma and poisoning				Suicide			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Income per capita, 1989 rb	-.138** (.061)	-.134*** (.050)	-.131*** (.051)	-.176*** (.069)	.112 (.161)	.036 (.095)	.102 (.119)	.075 (.144)	-.722** (.366)	-.724*** (.173)	-.833*** (.300)	-.814** (.363)
Crime rate	.016 (.016)	.009 (.024)	.017 (.021)	.019 (.017)	.107*** (.033)	.041 (.039)	.063* (.035)	.092*** (.032)	.106** (.053)	.032 (.048)	.056 (.054)	.111** (.054)
Doctors per 100 pop.	-.079 (.126)	-.264 (.210)	-.188 (.205)	-.075 (.121)	-.218 (.281)	-.390 (.541)	-.252 (.530)	-.278 (.281)	.407 (.319)	.332 (.546)	-.475 (.612)	.335 (.286)
Net migration rate	-.085* (.050)	-.237*** (.082)	-.128** (.065)	-.123** (.056)	-.163 (.120)	-.304* (.179)	-.160 (.133)	-.175 (.124)	.096 (.173)	-.140 (.279)	-.118 (.222)	-.014 (.195)
Unemploy-men rate	–	-.001 (.001)	–	–	–	-.002 (.003)	–	–	–	.014*** (.005)	–	–
Inflation rate	–	–	.011 (.010)	–	–	–	.005 (.020)	–	–	–	-.001 (.033)	–
Minimum wage/avg. wage	–	–	–	-.471* (.249)	–	–	–	-.973 (.609)	–	–	–	-1.19 (.768)
R2	.884	.911	.906	.902	.935	.940	.936	.937	.903	.929	.920	.910
N	791	573	648	720	791	573	648	720	791	573	648	720

Robust standard errors in parentheses. Regressions are weighted by population and include year effects.

Table 6. Fixed effects regressions for men, 1989-1994 and 1994-1999

	DV: Log standardized death rate, circulatory diseases						DV: Log standardized death rate, trauma and poisoning					
	1989-1994			1994-1999			1989-1994			1994-1999		
Income per capita, 1989 rb	.011 (.090)	.035 (.103)	-.020 (.094)	-.016 (.064)	.006 (.063)	-.020 (.066)	.063 (.265)	.099 (.270)	-.012 (.318)	-.140 (.167)	-.140 (.181)	-.147 (.160)
Crime rate	.051*** (.018)	.088*** (.024)	.063*** (.017)	.008 (.024)	.008 (.024)	.010 (.024)	.162*** (.049)	.178*** (.055)	.174*** (.052)	.029 (.031)	.029 (.031)	.032 (.031)
Doctors per 100 pop.	-.155* (.082)	-.058 (.267)	-.121 (.084)	-.492 (.368)	-.474 (.353)	-.502 (.351)	-.912* (.459)	.623 (1.25)	-.930 (.573)	.079 (.353)	.079 (.359)	.061 (.340)
Net migration rate	-.062 (.038)	-.050 (.049)	-.083* (.050)	-.372*** (.140)	-.371*** (.137)	-.409*** (.116)	-.350*** (.131)	-.232* (.138)	-.309 (.143)	-.483*** (.143)	-.483*** (.144)	-.553*** (.180)
Inflation rate	–	.008 (.011)	–	–	.167 (.135)	–	–	.002 (.012)	–	–	.0003 (.254)	–
Minimum wage/avg. wage	–	–	-.109 (.268)	–	–	-.881* (.530)	–	–	-.546 (1.19)	–	–	-1.65** (.742)
R2	.940	.957	.952	.928	.928	.929	.952	.950	.949	.951	.951	.953
N	431	288	360	432	432	432	431	288	360	432	431	432

Robust standard errors in parentheses. Regressions are weighted by population and include year effects.

Table 7a. Logistic Regressions for Men Age 18 - 75 Dying in the Russian Longitudinal Monitoring Survey, 1994-2004
[dependent variable: dummy variable for whether the person died]

Independent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Age	1.07*** (17.6)	1.06*** (13.1)	1.06*** (13.1)	1.06*** (13.0)	1.06*** (13.6)	1.06*** (13.6)	1.06*** (13.6)
Log(real income per capita)	-.834*** (3.75)	-.870*** (2.61)	-.871*** (2.60)	-.874*** (2.50)	-.893** (2.07)	-.895** (2.01)	-.896** (2.00)
Poor health (1=yes)	–	2.42*** (7.14)	2.43*** (7.19)	2.44*** (7.20)	2.46*** (7.27)	2.44*** (7.20)	2.46*** (7.27)
BMI	–	-.846*** (4.78)	-.849*** (4.64)	-.850*** (4.54)	-.849*** (4.63)	-.850*** (4.62)	-.850*** (4.62)
BMI squared	–	1.002*** (4.60)	1.002*** (4.41)	1.002*** (4.20)	1.002*** (3.46)	1.002*** (4.45)	1.002*** (4.44)
Ever had a heart attack	–	1.62*** (2.87)	1.62*** (2.89)	1.62*** (2.88)	1.65*** (2.98)	1.62*** (2.87)	1.65*** (2.98)
Diabetic	–	1.86*** (2.67)	1.89*** (2.73)	1.89*** (2.73)	1.89*** (2.72)	1.90*** (2.74)	1.89*** (2.73)
Ever had a stroke	–	1.52* (1.69)	1.54** (1.73)	1.53* (1.72)	1.55* (1.76)	1.56* (1.79)	1.56* (2.79)
Smoker	1.60*** (4.33)	1.58*** (3.91)	1.55*** (3.72)	1.54*** (3.67)	1.53*** (3.55)	1.54*** (3.60)	1.53*** (3.56)
Alcohol consumption	–	–	1.001** (2.48)	–	1.001** (2.34)	1.001** (2.39)	1.001** (2.33)
Vodka consumption	–	–	–	1.002** (2.00)	–	–	–
Samogon consumption	–	–	–	1.001 (1.16)	–	–	–
Beer consumption	–	–	–	1.001 (0.10)	–	–	–
Wine consumption	–	–	–	-.951 (1.27)	–	–	–
Fortified wine consumption	–	–	–	1.001 (0.32)	–	–	–
Other alcohol consumption	–	–	–	-.998 (0.53)	–	–	–

Unemployed	–	–	–	–	1.91*** (3.79)	1.91*** (3.77)	1.91*** (3.78)
Regional inflation rate	–	–	–	–	–	1.00 (.005)	–
Min. wage as % of average wage	–	–	–	–	–	–	1.013 (0.56)
No. died	466	466	466	466	466	466	466
N	24077	23827	23827	23827	23827	23681	23827
Pseudo R^2	.121	.150	.151	.153	.154	.154	.154

Coefficients are reported as odds ratios. Z-statistics in parentheses. Standard errors are calculated using the Huber/White method and are corrected for individual clustering. All regressions include controls for marital status, education level, year of the survey, and large region (North, Central, Volga, North Caucuses, Urals, West Siberia, East Siberia, Moscow/St. Petersburg).

*** Statistically significant at the 1 percent level or less.
** Statistically significant at the 5percent level or less.
* Statistically significant at the 10 percent level or less.

Table 7b. Logistic Regressions for Women Age 18 - 75 Dying in the Russian Longitudinal Monitoring Survey, 1994-2004

[dependent variable: dummy variable for whether the person died]

Independent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Age	1.10*** (11.1)	1.09*** (8.61)	1.08*** (8.58)	1.08*** (8.14)	1.09*** (8.74)	1.09*** (8.72)	1.09*** (8.75)
Log(real income per capita)	-.770*** (3.35)	-.824** (2.28)	-.824** (2.28)	-.843** (1.97)	-.834** (2.11)	-.836** (2.06)	-.826** (2.18)
Poor health (1=yes)	–	2.18*** (3.97)	2.19*** (4.00)	2.16*** (3.94)	2.19*** (4.01)	2.19*** (4.01)	2.20*** (4.01)
BMI	–	-.954** (2.36)	-.954** (2.36)	-.954** (2.38)	-.955** (2.33)	-.955** (2.33)	-.955** (2.33)
BMI squared	–	1.000** (1.92)	1.000** (1.92)	1.000** (1.95)	1.000* (1.88)	1.000* (1.89)	1.000* (1.89)
Ever had a heart attack	–	1.18 (0.46)	1.18 (0.46)	1.19 (0.48)	1.17 (0.45)	1.17 (0.45)	1.16 (0.42)
Diabetic	–	1.56* (1.87)	1.56* (1.88)	1.58* (1.92)	1.55* (1.84)	1.55* (1.84)	1.53* (1.79)
Ever had a stroke	–	2.09** (2.07)	2.10** (2.10)	2.08** (2.05)	2.11** (2.09)	2.11** (2.09)	2.08** (2.05)
Smoker	3.00*** (3.96)	2.47*** (3.00)	2.42*** (2.91)	2.55*** (3.12)	2.23*** (2.59)	2.24*** (2.60)	2.22*** (2.57)
Alcohol consumption	–	–	1.002** (2.24)	–	1.002** (1.93)	1.002** (1.93)	1.002** (1.92)
Vodka consumption	–	–	–	-.997 (0.40)	–	–	–
Samogon consumption	–	–	–	1.008** (2.20)	–	–	–
Beer consumption	–	–	–	-.959 (0.41)	–	–	–
Wine consumption	–	–	–	-.462** (1.92)	–	–	–
Fortified wine consumption	–	–	–	1.025 (0.50)	–	–	–
Other alcohol consumption	–	–	–	-.994 (0.19)	–	–	–

Unemployed	–	–	–	–	2.08* (1.88)	2.07* (1.87)	2.07* (1.87)
Regional inflation rate	–	–	–	–	–	-.999 (0.11)	–
Min. wage as % of average wage	–	–	–	–	–	–	-.967 (0.87)
No. died	187	187	187	187	187	187	187
N	2883	28649	28649	28649	28649	28475	28649
Pseudo R^2	.178	.190	.190	.196	.192	.191	.192

Coefficients are reported as odds ratios. Z-statistics in parentheses. Standard errors are calculated using the Huber/White method and are corrected for individual clustering. All regressions include controls for marital status, education level, year of the survey, and large region (North, Central, Volga, North Caucuses, Urals, West Siberia, East Siberia, Moscow/St. Petersburg).

*** Statistically significant at the 1 percent level or less.
** Statistically significant at the 5percent level or less.
* Statistically significant at the 10 percent level or less.

Table 8. Logistic Regressions for Men Age 18 - 25 Dying in the Russian Longitudinal Monitoring Survey, By Cause, 2000-2004

DV:	CVD Deaths				Accidental Deaths			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Age	1.08*** (7.45)	1.08*** (7.28)	1.08*** (7.31)	1.08*** (7.28)	1.02** (1.94)	1.03*** (2.55)	1.03*** (2.61)	1.03*** (2.56)
Log(real income per capita)	-.777* (1.80)	-.780* (1.79)	-.738** (2.17)	-.771* (1.84)	-.663*** (3.48)	-.746** (2.19)	-.737** (2.24)	-.742** (2.16)
Poor health (1=yes)	1.61 (1.50)	1.61 (1.50)	1.68* (1.63)	1.61 (1.49)	-.770 (0.55)	-.810 (0.44)	-.813 (0.43)	-.824 (0.41)
BMI	-.913 (1.45)	-.913 (1.45)	-.913 (1.47)	-.915 (1.41)	–	–	–	–
BMI squared	1.002** (2.34)	1.002** (2.34)	1.002** (2.33)	1.002** (2.31)	–	–	–	–
Ever had a heart attack	2.27*** (2.58)	2.27*** (2.58)	2.22*** (2.52)	2.26*** (2.57)	–	–	–	–
Diabetic	2.80** (2.28)	2.80*** (2.28)	2.69** (2.18)	2.79** (2.26)	–	–	–	–
Ever had a stroke	3.02*** (2.67)	3.03*** (2.67)	2.95*** (2.62)	2.96*** (2.62)	–	–	–	–
Smoker	1.80** (2.12)	1.80** (2.12)	1.80** (2.10)	1.82** (2.14)	1.49 (1.21)	1.37 (0.95)	1.36 (0.91)	1.36 (0.92)
Alcohol consumption	-.998 (0.99)	-.998 (1.00)	-.998 (1.03)	-.998 (1.03)	1.003*** (4.29)	1.003*** (4.12)	1.003*** (4.08)	1.003*** (4.09)
Unemployed	–	1.09 (0.15)	1.09 (0.16)	1.09 (0.15)	–	3.67*** (3.91)	3.75*** (3.96)	3.73*** (3.98)
Minimum wage/avg. wage	–	–	-.0001** (2.39)	–	–	–	-.0001 (1.06)	–
Regional inflation rate	–	–	–	1.07 (1.45)	–	–	–	1.08 (1.60)
No. died	80	80	80	80	49	49	49	49
N	13551	13551	13551	13551	13668	13668	13668	13668
Pseudo R^2	.182	.182	.188	.184	.068	.087	.088	.091

Coefficients are reported as odds ratios. Z-statistics in parentheses. Standard errors are calculated using the Huber/White method and are corrected for individual clustering. All regressions include controls for marital status, education level, year of the survey, and large region (North, Central, Volga, North Caucuses, Urals, West Siberia, East Siberia, Moscow/St. Petersburg).

*** Statistically significant at the 1 percent level or less.

** Statistically significant at the 5percent level or less.

* Statistically significant at the 10 percent level or less

Appendix Table 1. Life expectancy at birth across Russia's regions

	Men			% change	Women			% change
	1989	1994	1999	1989-94	1989	1994	1999	1989-94
Russian Federation	64.2	57.6	59.9	-10.3	74.5	71.2	72.4	-4.4
Northern region								
Karelia rep.	64.2	55.0	57.6	-14.4	74.4	69.0	70.9	-7.3
Komi rep.	63.6	55.2	60.6	-13.1	73.5	68.4	71.8	-6.9
Arkhangelskaya obl.	64.1	55.9	58.0	-12.7	74.9	70.0	71.1	-6.6
Vologodskaya obl.	64.5	57.2	59.3	-11.4	75.2	71.6	72.2	-4.8
Murmanskaya obl.	65.2	57.0	62.5	-12.6	74.5	69.7	72.8	-6.5
Northwestern region								
St. Petersburg	65.6	58.1	61.6	-11.4	74.3	71.2	73.1	-4.2
Leningradskaya obl.	63.3	54.7	57.6	-13.6	74.4	69.2	71.0	-6.9
Novgorodskaya obl.	61.9	55.0	57.0	-11.1	74.1	69.3	71.5	-6.5
Pskovskaya obl.	63.2	54.4	56.3	-13.9	74.5	68.4	69.2	-8.2
Central region								
Bryanskaya obl.	64.9	58.7	58.6	-9.6	75.9	72.6	73.0	-4.4
Vladimirskaya obl.	64.1	57.9	57.9	-9.7	75.2	72.1	72.1	-4.1
Ivanovskaya obl.	63.7	57.1	56.7	-10.4	74.6	71.4	71.1	-4.3
Kaluzhskaya obl.	63.8	57.8	58.7	-9.4	74.8	71.3	72.0	-4.6
Kostromskaya obl.	64.1	57.7	58.8	-9.9	74.3	71.2	71.5	-4.2
City of Moscow	65.2	57.4	62.2	-12.0	74.3	71.5	73.7	-3.7
Moskovskaya obl.	64.4	56.4	59.2	-12.4	74.7	71.0	72.4	-4.9
Orlovskaya obl.	64.5	58.5	60.7	-9.3	75.1	73.1	73.0	-2.7
Ryazanskaya obl.	63.6	57.3	58.8	-9.9	75.5	72.4	73.0	-4.1
Smolenskaya obl.	63.9	57.7	57.6	-9.7	75.1	71.6	71.0	-4.6
Tverskaya obl.	62.8	55.2	57.0	-12.1	74.7	70.1	70.9	-6.1
Tulskaya obl.	63.5	56.1	57.6	-11.7	74.5	70.9	71.7	-4.8
Yaroslavskaya obl.	64.1	56.8	58.7	-11.4	75.2	71.6	72.2	-4.9
Volga-Vyatsky region								
Marii el rep.	63.7	58.4	59.3	-8.4	74.5	70.9	72.0	-4.8
Rep. of Mordovia	65.4	60.4	61.3	-7.6	76.0	73.3	73.7	-3.5
Chuvashskaya rep.	65.4	60.5	61.1	-7.4	75.2	72.4	73.1	-3.7
Kirovskaya obl.	64.4	58.7	60.9	-8.8	74.6	72.2	72.9	-3.2
Nizhegorodskaya obl.	64.1	57.8	59.8	-9.9	75.3	72.3	73.0	-4.1
Central Chernozem								
Belgorodskaya obl.	65.3	61.1	62.2	-6.4	76.2	74.0	74.5	-2.9
Voronezhskaya obl.	65.3	60.2	60.8	-7.8	75.9	73.8	73.5	-2.7
Kurskaya obl.	63.7	58.8	59.6	-7.7	75.1	72.5	72.6	-3.4
Lipetskaya obl.	64.4	59.2	61.1	-8.1	75.5	73.0	73.7	-3.4
Povolzhsky region								
Tambovskaya obl.	62.9	58.2	59.5	-7.4	75.0	73.1	72.6	-2.5
Rep. of Kalmykiya	61.8	60.7	60.2	-1.8	72.6	72.3	72.4	-0.4
Rep. of Tatarstan	65.6	60.3	62.2	-8.1	76.0	73.8	74.7	-2.9
Astrakhanskaya obl.	64.1	59.2	59.8	-7.7	74.7	71.9	73.4	-3.8
Volgogradskaya obl.	65.4	58.9	60.2	-9.9	75.3	72.6	72.5	-3.6
Penzenskaya obl.	65.0	59.8	60.3	-8.0	76.0	73.4	73.6	-3.4
Samarskaya obl.	64.8	58.9	59.5	-9.2	75.0	72.2	73.0	-3.7
Saratovskaya obl.	64.7	58.5	59.9	-9.5	75.1	71.9	72.9	-4.2
Ulyanovskaya obl.	64.9	60.1	61.0	-7.5	75.2	72.6	73.2	-3.4

North Caucuses								
Rep. of Adygeya	na	61.0	63.4	na	na	73.0	74.4	na
Rep. of Dagestan	67.6	65.5	65.2	-3.0	77.0	75.5	75.0	-2.0
Kabardino-Balk. rep.	65.8	62.6	62.4	-4.9	76.1	74.8	74.1	-1.7
Karachaevo-Cherk. rep.	na	63.3	63.0	na	na	75.2	74.3	na
North Ossetia	66.1	61.2	61.6	-7.5	76.4	73.7	74.5	-3.6
Krasnodarskii krai	64.2	58.8	61.8	-8.4	74.7	72.2	73.5	-3.4
Stavropolskii krai	65.3	60.8	62.5	-6.8	75.1	73.3	73.5	-2.4
Rostovskaya obl.	64.8	59.2	61.4	-8.6	74.7	72.3	72.3	-3.2
Urals region								
Rep. of Bashkortostan	64.9	59.1	61.0	-9.0	75.2	72.5	73.4	-3.6
Udmurtskaya rep.	63.7	56.7	60.4	-11.0	74.5	70.3	73.2	-5.7
Kurganskaya obl.	63.9	58.1	59.8	-9.1	74.8	71.9	72.5	-3.9
Orenburgskaya obl.	65.3	58.7	59.7	-10.2	75.4	72.0	72.3	-4.5
Permskaya obl.	63.9	56.0	58.9	-12.3	73.6	69.0	71.1	-6.2
Sverdlovskaya obl.	64.1	57.1	58.8	-11.0	74.2	70.3	71.8	-5.3
Chelyabinskaya obl.	64.8	58.5	60.0	-9.8	74.8	72.1	72.4	-3.6
Western Siberia								
Altai rep.	na	53.5	57.4	na	na	67.2	69.7	na
Altaiskii krai	63.2	58.2	61.0	-8.0	74.0	71.0	72.8	-4.0
Kemerovskaya obl.	63.1	55.0	57.2	-12.9	73.4	68.4	69.9	-6.8
Novosibirskaya obl.	64.0	56.9	61.2	-11.1	74.4	70.2	72.7	-5.7
Omskaya obl.	64.5	59.7	60.8	-7.5	74.2	72.1	73.0	-2.9
Tomskaya obl.	63.5	58.7	60.3	-7.6	73.1	71.4	71.7	-2.3
Tyumenskaya obl.	64.6	57.4	62.2	-11.2	75.0	71.3	73.8	-4.9
Eastern Siberia								
Rep. of Buryatia	63.2	55.5	57.3	-12.1	72.9	68.8	69.8	-5.6
Tuva rep.	56.6	49.0	50.7	-13.4	67.0	63.2	62.1	-5.7
Rep. of Khakasiya	na	54.2	57.8	na	na	67.5	69.9	na
Krasnoyaskii krai	63.0	55.1	57.4	-12.6	73.4	69.1	70.3	-5.8
Irkutskaya obl.	62.4	54.1	56.0	-13.4	73.0	68.5	69.7	-6.2
Chitinskaya obl.	63.4	54.3	56.4	-14.4	73.0	67.8	69.3	-7.2
Far East								
Sakha rep.	63.5	56.5	58.5	-11.0	71.5	69.1	70.6	-3.4
Evreiskaya a.o.	na	54.9	56.5	na	na	68.0	70.0	na
Chukotskii a.o.	na	57.5	62.4	na	na	69.2	72.7	na
Primorskii krai	63.0	56.8	59.6	-9.8	73.1	69.4	71.0	-5.0
Khabarovskii krai	62.4	56.6	58.2	-9.4	72.9	69.5	70.6	-4.7
Amurskaya obl.	63.8	57.2	58.5	-10.4	73.5	69.4	70.4	-5.6
Kamchatskaya obl.	60.2	55.7	59.7	-7.5	71.2	67.3	69.8	-5.5
Magadanskaya obl.	62.8	54.6	60.7	-13.1	71.5	67.4	70.9	-5.7
Sakhalinskaya obl.	62.6	54.6	58.9	-12.8	72.8	68.1	70.2	-6.4
Kaliningradskaya obl.	64.3	57.1	59.3	-11.3	73.9	69.8	71.2	-5.5
Minimum	56.6	49.0	50.7	-14.4	67.0	63.2	62.1	-8.2
Maximum	67.6	65.5	65.2	-1.8	77.0	75.5	75.0	-0.4