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Economic Crises, Stress and Mortality in Russia

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Abstract

In 1992 and 1998 Russia experienced two economic crises that led to dramatic impoverishment of population, social anxiety, and followed by mortality surges. This study analyzes age- and sex-specific mortality from violent causes in Russia after the 1992 and 1998 economic crises, using official statistical data. Accidents, injuries and alcohol poisoning demonstrated the most rapid relative increase in mortality for both sexes during the first 1992 crisis. Suicide mortality surge was particularly high in males while homicide dynamics was relatively similar for both sexes. The response to the 1998 crisis was different: the relative rate of homicide increase was particularly high among women while suicide dynamics did not demonstrate profound sex differences. Our findings suggest that the effects of the first crisis are related to stress and self-directed violence, while the second crisis is associated with violence against other persons (especially women). Further study of homicide and suicide mortality found specific responses to crisis of different age groups in the case of suicide mortality and the leading role of alcohol consumption in homicide mortality. Analysis of gender differences in suicide and homicide mortality showed increasing disadvantage of working age males in the case of suicides and increasing disadvantage of young females in the case of homicides. Factor analysis of violent mortality revealed 3 major underlying factors explaining over 92 percent of variation in external mortality which can be related to alcohol, violence, and stress. The effect of alcohol factor on violent mortality is dominating although its role in the recent years decreased while two other factors increased after 1992. Thus, violence and stress are the issues of major concern in explaining the most recent tendencies of mortality increase from violent causes. Supported in part by the grant from the MacArthur Foundation.

Introduction

In 1992 and 1998 Russia experienced two serious economic crises accompanied with drop in personal income and rapid impoverishment. In both cases, adverse economic changes were followed by mortality increase.

From 1992 to 1994 life expectancy of Russian males dropped from 63.8 to 57.7 years. Female life expectancy dropped from 74.4 years to 71.2 years. This decrease in life expectancy coincided in time with the introduction of painful economic experiments ('reforms') in Russia, leading to a rapid decrease in real wages and pensions, nearly complete loss of personal savings, and a tremendous increase in the poverty rate. The main causes of death that contributed to this mortality decline were diseases of the circulatory system, accidents, poisoning and injuries, diseases of the respiratory system. After 1995 mortality in Russia demonstrated slow but stable decrease. However, in August 1998 Russia experienced another economic crisis (crash of the banking system) resulting in mass impoverishment. Shortly after this crisis mortality started to grow again and male life expectancy dropped from 61.0 in 1998 to 59.7 years in 1999, while female life expectancy dropped from 72.6 to 71.9 years. In both cases population at working ages appeared to be the most vulnerable age group while children and the elderly were not significantly affected (Notzon et al., 1998).

The first economic crisis in Russia (called also a "shock therapy") occurred in 1992 after political decision to accomplish a rapid transition to market economy. The first step in this direction was a complete abolition of price control by the government. As a result, consumer prices grew 3.5 times faster than wages in 1992 (1st quarter, Goskomstat, 1993) and exploded by 2500% for the entire 1992 calendar year (Klugman, Braithwaite, 1998). The gross domestic product (GDP) fell more than 40 percent during 1991-96 as a result of output collapse (EBRD, 1997; Klugman, Braithwaite, 1998). The number of poor households in Russia rose sharply after early 1993, reaching a record 35 percent of the population living below the official poverty line by the end of 1995 (Klugman, Braithwaite, 1998; Zohoori et al., 1998). The average real earnings fell by one-half in 1992 and then stabilized around this low level (Klugman, Braithwaite, 1998).

Shortly after the beginning of economic reforms, Russia experienced a significant and steep rise in total age-specific mortality that resulted in the fall of life expectancy to 57.6 years for males and to 71.2 years for females in 1994 (see Table 1). The losses in life expectancy were more than 5 years for males and 3 years for females compared to the life expectancy in pre-crisis 1991. These decreases are beyond the peacetime experience of any industrialized country. Current life expectancy in Russia is lower than in China and even less than in some countries of Africa (see Table 1). Thus, the shock effect of "shock therapy" was achieved, but no therapy was provided.

Table 1 about here

This phenomenon received significant attention in a number of papers (Ellman, 1994; Gavrilova et al., 1997; Notzon et al., 1998; Leon et al., 1997; Leon, Shkolnikov, 1998;

Shkolnikov et al., 1996a; 1996b; 1998; Tulchinsky, Varavikova, 1997; Walberg et al., 1998), which showed that diseases of the circulatory system, injuries, and diseases of the respiratory system were the major causes of death contributing to the decrease in life expectancy in Russia after 1991.

Although previous studies provided important information on the magnitude of mortality changes and on major causes of the decrease in life expectancy, these studies have not addressed changes in mortality with a more detailed cause-of-death breakdown. Also, previous research focused mainly on analyses of life expectancy or age-adjusted mortality as integral demographic indicators, while age-specific mortality trajectories were not analyzed in detail. In addition to that, mortality changes after the second 1998 economic crisis were not yet analyzed.

The purpose of this paper is to study in more detail the response of mortality from suicides and homicides to the 1992 and 1998 Russian economic crises. A special emphasis in this study is placed on the analysis of gender- and age-specific mortality trends and on the roles of alcohol and stress in mortality fluctuations.

Data and Methods

Official data on mortality provided by Russian State Statistical Committee (Goskomstat), include deaths by cause, sex, five-year age group, for each single calendar year of death, together with corresponding population denominators. Population age distributions for years 1991-98 were presented by the Goskomstat five-year age estimates adjusted for migration at the beginning of the year (Leon et al., 1997). The corresponding mid-year populations were calculated on the basis of two adjacent population age distributions.

The Goskomstat cause-of-death classification has not changed since 1988. Although the current classification is based on the 9th revision of the International Classification of Diseases (WHO, 1977-1978), there are differences between the International and Russian classifications, especially for cardiovascular diseases. In this study, we focused our attention on two violent causes of death: suicides (Russian code 173) and homicides (Russian code 174) because both causes of death played the leading role in the recent mortality surge in Russia. Data for homicide and suicide mortality were available since 1988 and data for mortality from external causes of death were available since 1981.

The age-specific mortality rates that are used in this paper are the result of our calculations, based on official statistics (numbers of deaths and corresponding population denominators). Age-standardized (age-adjusted) mortality rates were calculated using the direct method of age adjustment (Chiang, 1978). The standard population chosen was the WHO "new" European standard population (see WHO, 1992).

Data Quality

The rapid and sharp changes in mortality experienced by Russia in recent decades have generated some concerns about the quality of Russian vital statistics. Most of authors who worked with Russian mortality data admitted that recent mortality fluctuations in Russia are not artifactual and population estimates and death counts are accurate enough

to ensure correct statistical analyses (Notzon et al., 1998; Leon et al., 1997; Bennett et al., 1998; Andreev, 1999). Wasserman and Varnik (1998) conducted a study of the reliability of statistics on violent death and suicide in the republics of the former USSR. They concluded that mortality data were reliable for Russia, Ukraine, and Belarus. The completeness of death reporting in Russia is rather high except for the North Caucasus Republics and the Republic of Tuva (Andreev, 1999). Unspecified diagnoses ("senility without mention of psychosis" or "symptoms and other unspecified conditions") which often serve as a measure of quality for cause-of-death statistics, comprised only 4.4 per cent of all medical certificates in 1996 (Andreev, 1999). On the other hand, the quality of cause-of-death coding is not always high (Notzon et al., 1998; Andreev, 1999), and the last audit of the accuracy in reporting causes of death was conducted in Russia only in 1982 (see Shkolnikov et al., 1996a). The autopsies were performed on 33.2 per cent of all deaths in 1996 (Andreev, 1999).

For violent causes, the main concern is the increase in mortality from "injuries undetermined whether accidentally or purposely inflicted" (Russian code 175) or simply "undetermined injuries". This term could be used to conceal some cases of homicide and suicide in order to avoid criminal investigation (Wasserman, Varnik, 1998). Male mortality from this cause increased dramatically after the "shock therapy" in 1992 reaching its maximum in 1994. We found that in Moscow, with its relatively high proportion of unregistered migrants, homeless, and refugees, the "undetermined injuries" for males exceeded any other cause of violent mortality in 1994. Thus, while the population estimates and death counts are reasonably accurate, the quality of death coding is less satisfactory. This deficiency can bias the estimates of violent mortality and lead to mortality underestimation for some causes (especially for homicide and suicide deaths which may be assigned to "undetermined injuries"). To cope with this problem, we included in our analysis the whole class of external mortality which is less influenced by misclassification bias.

Another problem of the Russian mortality statistics is the increase in the proportion of deaths with undefined (not stated) ages during the crisis. Although the contribution of such deaths is not substantial for total mortality (0.25% in 1991 and 1.19% in 1994 for males), it is much higher for mortality from violent deaths (0.73% in 1991 and 2.59% in 1994 for males). The latter fact can affect the proper estimation of demographic indicators dependent on age distribution.

Despite the problems listed above, most researchers studying mortality in Russia admit that the quality of Russian vital statistics is good enough, with nearly 94% of all deaths being medically certified (Leon et al., 1997; Notzon et al., 1998; Wasserman, Varnik, 1998; Andreev, 1999). One of the arguments supporting the acceptable quality of Russian statistics is the temporal stability of cancer mortality in 1992-95 against the background of a dramatic increase in total mortality (Leon et al., 1997). Also, the standard rules of cause-of-death coding in Russia ensure comparability of regional cause-specific mortality statistics. The mandatory internal passport system ensures a low level of age misreporting in death certificates, although age information in census data (denominators) may be less accurate because of self-reporting bias. Nevertheless, there is every reason to believe that

the quality of Russian mortality data, although not perfect, is reasonably good for conducting demographic analyses.

Two Economic Crises and the Patterns of Mortality Increase from Violent Causes of Death

Temporary changes in life expectancy after 1991 demonstrate a three-stage pattern. In the first stage (immediately after 1992), when response to the sharp changes in life style and living standards was particularly acute, mortality rapidly increased reaching a peak in 1994. In the second stage, mortality was gradually decreasing until 1998 although it did not reach the initial pre-crisis levels. In the third stage, which is not yet finished, mortality increased again as a response to the 1998 financial crisis. Coincidence in timing for both economic crises (resulted in rapid impoverishment of population) and subsequent mortality hikes gives us a reason to suggest possible causal link between these events.

Mortality from diseases of the circulatory system and violent deaths demonstrated very strong response to economic crisis, while mortality from neoplasms did not change during this period (Leon et al., 1997; Gavrilova et al., 1997; Notzon et al., 1998; Shkolnikov et al., 1996a; 1996b; 1998). The secular stability of mortality from neoplasms could be expected from the nature of these diseases (long-term multistage process) and also indicates that the fluctuations in other causes of death are not caused by errors in population estimates (denominator problem) (Leon et al., 1997). During the first health crisis, mortality from violent deaths moved from the third to the second place for males, replacing mortality from neoplasms, while for women violent causes remained the third major cause of death. Mortality from violent causes started to increase rapidly in 1992 and reached its maximum values in 1994. The only exception was mortality from transport accidents, including traffic accidents (Russian codes 160-162, see Gavrilova et al., 2001). Cause-specific mortality changes after the second crisis (1998) were not yet well studied, so we tried to analyze these changes in more detail.

The results of our study are presented in Table 2. It shows the age-adjusted mortality rates for major causes of death and their relative increase after the crises of 1992 and 1998. It looks like the mortality increase after 1998 did not reach its maximum yet and may continue in future. After the first crisis, the causes of death demonstrated the highest rate of increase were injuries, infectious diseases, and respiratory diseases for males and injuries, infectious diseases and cardiovascular diseases for females. During the first crisis (1992-94) the violent causes of death (accidents, injuries and poisoning) had the highest rate of growth for both sexes and the role of alcohol-related mortality was especially important. Many researchers now believe that psychological stress after rapid impoverishment was the main cause of the first wave of mortality increase in 90s. Although we do not have direct evidence that psychological stress was the major cause of mortality increase in 1992-94, there are some indications that support this explanation. Population surveys demonstrated that the decrease in personal income in 1992-94 was not accompanied with malnutrition or starvation. In addition to that, age groups that are

traditionally more vulnerable to the decline in living condition - children and the elderly - did not demonstrate substantial growth of mortality. The increase in total mortality was observed mainly for the persons of working ages who experienced rapid changes in their income, social status, and occupation. We will return to the stress-related hypothesis of mortality crisis in Russia later in this paper.

Table 2 about here

When we compare the increase of mortality after the second economic crisis of 1998, the most striking difference is a rapid growth of mortality from infectious and respiratory diseases with relatively slow growth of violent deaths. This second crisis is characterized by unprecedented jump in tuberculosis mortality and substantial growth of alcohol-related mortality. A distressing feature of the recent mortality changes is the increasing mortality from some infectious diseases (e.g., tuberculosis, sexually transmitted diseases) that were previously essentially under control (Vishnevsky, 1998). More important role of infectious diseases in the recent mortality crisis does not mean that psychological stress did not contribute to the mortality increase. Increase in mortality from circulatory diseases, some behavior-related causes (suicide, homicide, accidental poisoning by alcohol), and gastric ulcer (by 7 percent for males) indicates that psychological stress may be also a contributing factor in the second mortality crisis.

Data presented in Table 2 also demonstrate that after the first crisis suicide mortality surge was particularly high in males while homicide dynamics was relatively similar for both sexes. The response to the 1998 crisis was different: the relative rate of homicide increase was particularly high among women while suicide dynamics did not demonstrate profound gender differences. Our findings indicate that the effects of the first crisis are more related to self-directed violence, while the second crisis is associated with increasing violence against other persons (especially women). The most dramatic increase in violent mortality is observed for mortality from accidental poisoning by alcohol (see Table 2). This cause of death became more common in 1994 than homicide and traffic accidents. Mortality from alcohol poisoning also shows the most rapid decrease after 1994. Mortality from homicide follows similar temporary pattern as mortality from alcohol poisoning (Gavrilova et al., 2001). This similarity implies some relation between these two causes of death. At the same time, homicide mortality demonstrates a slower decline after 1994 compared to the mortality from alcohol poisoning which suggests an additional, non-alcohol component in this type of violent death. Suicide mortality increased dramatically after 1992 and continued to be the main cause of violent death for males in Russia. After 1994, this cause of death demonstrated a slow but steady decline in mortality with another increase in 1999.

These results support the hypothesis that alcohol consumption (in addition to psychological stress) may be an important underlying factor of violent mortality. It may be argued, however, that there is no difference between these two factors since alcohol consumption is merely one of the pathways through which social stress achieves a pathophysiological manifestation. This argument may be valid for the Western societies with different pattern of alcohol drinking (McKee et al., 2001). In Russia drinking of

high amounts of alcohol (in the form of binge drinking) is a part of life style for a considerable number of males (and less educated males in particular). This drinking habit usually include gathering on weekends (Chenet et al., 1998) with a company of friends (or even strangers), so that such drinking may be considered as a specific kind of "entertainment" not necessarily related to stress. This controversy generated different views on the nature of mortality increase after 1992. Some researchers consider social stress as a major determinant of this increase (Shapiro, 1997; Shkolnikov et al., 1998b; Vlassov, 1999) while others believe that this increase in mortality was caused by simple increase of access to alcohol products (Vichnevsky, 2000).

Alcohol and Stress Related Hypotheses of the Observed Mortality Surge

Following the "shock therapy," views on the underlying causes of the mortality crisis gradually evolved. Initially, researchers proposed multiple explanations for the observed mortality increase: poor lifestyle (alcoholism, smoking), environmental catastrophe, economic impoverishment, widening social inequality, legacy of the communist system, deterioration of the health system, and malnutrition (Feshbach, 1995; Chen et al., 1996; Cockerham, 1997; Notzon et al., 1997). Although poor life style, a deteriorating of health care system, and environment are important in explaining the rather high baseline mortality observed in 1991, they could not explain the mortality hike in 1992-94.

The hypothesis that the increase in alcohol consumption is a major cause of the observed mortality upsurge in 1992-1994 has received significant attention (Ryan, 1995; Leon et al., 1997; Notzon et al., 1998; Leon, Shkolnikov, 1998; Vichnevsky, 2000). The rise in alcohol consumption undoubtedly contributed to the rapid increase in mortality from violent causes of death (Nemtzov, Shkolnikov, 1999). Some authors considered increase in the alcohol consumption after the end of anti-alcohol campaign as one of the major causes of the mortality upsurge in 1992-94 (Leon et al., 1997; Notzon et al., 1998; Leon, Shkolnikov, 1998). On one hand, these conclusions proved to be correct (see Table 2). On the other hand, the increase in mortality during 1992-94 was not a simple return to the situation that occurred before the anti-alcohol campaign. Shkolnikov et al. (1996) has demonstrated that the increase in life expectancy in 1985-88 (during anti-alcohol campaign) was achieved mostly due to a decrease in violent deaths (especially for males), while the decrease in life expectancy after 1992 included substantial cardiovascular component. Using the the latter fact, some researchers challenged the view that alcohol might be a major factor in the Russian mortality crisis of the 1990s (Bobak, Marmot, 1999). Later McKee et al. (2001) provided convincing evidence that increase in cardiovascular mortality could be related to increase in alcohol consumption which is a cause sudden cardiac death in middle-aged men.

It is interesting to compare alcohol-related mortality in Russia with data on alcohol consumption obtained from the Russian Longitudinal Monitoring Survey, RLMS (Zohoori et al., 1998; 1999). According to the survey data, the mean daily amount of alcohol consumption for adult males increased by August of 1993 with a 38% increase over the 1992 level, but did not change significantly until November 1998. For females,

the mean daily amount of alcohol consumption gradually increased reaching maximum in August 1993 with subsequent gradual decrease to the initial values by 1998. Thus, the patterns of alcohol consumption in 1992-98 obtained by the survey are not consistent with the patterns of alcohol-related mortality (rapid increase with peak in 1994 and rapid decrease afterwards). We believe that RLMS data reflect alcohol consumption among the "normal" resident population, but it is unlikely that this survey covered marginal groups of the population: homeless, institutionalized persons or heavy alcoholics who could not be interviewed in a regular way. These marginal groups may be responsible for almost 50% of total alcohol consumption (Nemtsov and Shkolnikov, 1999) and seems responsible for the majority of alcohol-related deaths. Also, the estimates of annual alcohol consumption based on RLMS data were almost three times lower than other three independent estimates based on the official statistics (Nemtsov and Shkolnikov, 1999; Nemtsov, 2000) suggesting that RLMS did not cover marginal groups of the population with heavy alcohol consumption. This may be particularly true for women who normally do not drink much (and RLMS data suggest this fact), but demonstrated the same pattern of alcohol-related mortality as men.

Recently, researchers have begun to pay more attention to the role of stress as a major cause of mortality crisis (Shapiro, 1997; Shkolnikov et al., 1998b; Vlassov, 1999). Studies of regional mortality in Russia have showed that the mortality increase after the economic crisis was related to the pace of economic changes, crime rate, and social inequality rather than the average level of personal income or sales of alcohol (Walberg et al., 1998). Another study of regional mortality has demonstrated a strong negative influence of high divorce rate on mortality from violent causes (Becker, Hemley, 1998). Kennedy et al. (1998) have studied the role of social capital in the regional differences in Russian mortality using a regression model which included a set of proxy indicators of social capital. They found strong links between age-adjusted sex-specific mortality and such proxy measures of social capital as the level of distrust in local government, disinterest in politics, crime rate, and divorce rate (Kennedy et al., 1998). These studies demonstrate that psychological stress, social disadaptation, and disintegration, and loss of social capital have played a significant role in the recent mortality increase (Shkolnikov et al., 1998; Walberg et al., 1998; Kennedy et al., 1998), while the role of such traditional economic indicators as poverty and unemployment have been far less important (Shkolnikov et al., 1998; Walberg et al., 1998; Zoohuri et al., 1998). However, the estimates of economic indicators in Russia are not particularly accurate and reliable. Also, the divorce and crime rates may be again strongly related to increased alcohol consumption.

Population surveys demonstrated that the rapid decline in living standards did not affect mortality rates directly through mass malnutrition or starvation (Shkolnikov et al., 1998; Zohoori et al., 1999). Moreover, children and the elderly who should be more vulnerable to malnutrition and often are the first victims of economic crisis in other countries (Palloni, Hill, 1997) were much less affected compared to adults. Increase in mortality predominantly among working ages provides some support to the stress-related hypothesis. According to this hypothesis, it is more likely that increase in mortality was one of the first manifestations of stress experienced by the population after rapid

impoverishment and change in living conditions in 1992 (Shapiro, 1995; Shkolnikov et al., 1998). Loss of traditional sources of income and personal savings forced the active part of the population to change their traditional life style. In many cases, these life style changes resulted in deviant behavior, including increased alcohol consumption, suicides, and homicides. The observed two-stage dynamics of mortality in 1991-98 (acute stage and recovery) fits the typical stress-related pattern (Braunstein, Toister, 1981). After the period of initial acute response to stress (1992-94), people adapted to the changing living conditions, found ways to make additional income, and mortality began to decline. At this moment, the available data do not provide a convincing support in favor of stress-related hypothesis over alcohol related one and vice versa. In addition to that, it seems that the selection processes also played some role in the initial mortality increase: the most vulnerable groups of the population (heavy alcohol drinkers in our case) show increased mortality during the crisis periods (Palloni, Hill, 1997). For example, mortality from acute poisoning by alcohol demonstrated a very rapid decrease after its initial hike that is more consistent with the selection of heavy drinkers rather than with their adaptation when a slower recovery would be expected (Nemtsov, Shkolnikov, 1999). In this study we tried to separate the role of alcohol and stress in the recent mortality crisis using data on age- and sex-specific mortality from homicide and suicide.

Age-Specific Changes in Violent Mortality after the First and the Second Economic Crisis

Analysis of age-specific mortality is important for understanding what particular age groups are the most vulnerable during the economic crisis. Our previous studies of violent mortality in Russia demonstrated that pre-retirement ages (50-59 years) appear to be the most vulnerable after 1992 and showed the most acute response in violent mortality to economic changes (Gavrilova et al., 2001). The retirement age in Russia is 60 years for men and 55 years for women. People of pre-retirement ages lost almost all their personal savings. Because of their age, they had no hope of creating new savings for impending retirement. This group of people is particularly at risk to lose their jobs and has the smallest chance of finding a new one. This group also experienced the highest loss in social ranking when the prestige of many previously respectable professions (physicians, scientists, teachers, etc.) vanished. More detailed analysis of violent causes of death demonstrated that this acute response of pre-retirement ages was mainly due to the surge of mortality from alcohol poisoning that occurred mainly at ages 45-55 years (both for males and females). Despite the common belief that the elderly is the most vulnerable part of population, there is no significant change in violent mortality for the age groups older than 70 years. The mortality dynamics at younger ages (15-25 years) raises the most concern. Mortality from violent deaths in this age group increased after 1994, but in contrast to the middle age groups, it did not decline significantly after 1994 (Gavrilova et al., 2001). Moreover, mortality of young people from suicide and homicide (females) remained virtually unchanged since 1994. Thus, in contrast to the common wisdom, teenagers and younger adults seem more sensitive to the Russian economic crisis than the elderly.

These specific patterns of mortality changes in different age groups during the period of crisis allow us to suggest that mortality changes in different age groups may be related to different underlying factors. The reason for this suggestion is the fact that young adults, middle-age adults and the elderly had very different social roles and experience during the transition period. Older people were not much involved in the economic and social changes that occurred in Russia during that time. Existence of small but guaranteed pension support could mitigate the adverse effects of transition. Retired persons also did not change their social status and occupation. This age group survived Stalin terror and World War II in the past, so they had previous experience of survival during hard times. Thus, there are all reasons to expect relatively small changes in suicide mortality among the elderly. In contrast to the older age group, the middle-aged adults (born during and after the war) never experienced serious difficulties in their lives before. By the time of economic transition they achieved relatively stable position in the social hierarchy and the loss of previous social status was especially painful for this age group. They often did not have even small support from the government and were dependent on their own activitiy in the case of long-term wage arrears. Thus we could expect the highest mortality from stress-related causes among this age group. The young adults by the time of economic transition did not have an established position in the society so they had nothing to lose. They also did not have the old stereotypes in behavior formed during the socialist period, so this age group was especially active in opening new businesses and finding new ways of income. However, in some cases these activities were related to 'black' market or criminal businesses and, therefore, were particularly hazardous.

This brief description of young, middle, and old age groups was used as a starting point in our study of stress and violence in Russia during the transition period.

Gender Differences in Violent Mortality During the Economic Crisis

Gender is another factor that may seriously influence human behavior and hence mortality from suicide and homicide. Analysis of changes in violent mortality during the crisis demonstrated gender-specific pattern for suicide mortality. Suicide was the main cause of violent mortality both for males and females before the crisis. The relative role of suicide in the first rise of violent mortality (after 1992) was higher for males compared to females. Male suicide mortality demonstrates a very rapid increase after 1992 while female mortality shows a rather small change after that time. The age-adjusted suicide mortality rate was 1.6 times higher for males and 1.2 times higher for females in 1994 compared to 1991 (see Table 2). The different dynamics of suicide mortality for males and females may be explained by taking into account a lower contribution of alcohol consumption to female suicides compared to male suicides (Wasserman et al., 1998). It was estimated that the attributable fraction of alcohol consumption for female suicides in the former USSR (27%) is approximately half that for male suicides (50%) (Wasserman et al., 1998). Since alcohol consumption is considered an important factor contributing to the mortality increase in 1990s (Leon, Shkolnikov, 1998), one would expect a larger increase in suicide mortality for males compared to females. At the same time, it seems that alcohol is not the only explanation for the increased response in suicide mortality for

males. In contrast to the mortality from alcohol poisoning, which rapidly declined after 1994, suicide mortality for males was decreasing very slowly after 1994. Additional explanation of rather weak response of female suicide to the economic crisis is care-giving function of women who often have to take care for children or old parents. These family responsibilities may protect women from committing suicide.

The age-adjusted homicide mortality rate increased two-fold by 1994 compared to 1990 for both sexes. The relative importance of homicide as a cause of violent death increased significantly for females after 1992: by 1998 homicide became as common a cause of death for females as suicide. In 1994, age-adjusted mortality from alcohol poisoning was 3.2 times higher for males and 3.8 times higher for females compared to 1990. Thus, the immediate response of mortality from alcohol poisoning to economic crisis was much the same for both sexes.

These gender-specific patterns of response to economic crisis allows us to suggest different mechanisms of mortality from suicide and homicide. To study this issue in more detail, we used an approach based on determination of sex-concordant causes of death applied earlier in the study of developed countries (Gavrilov, Gavrilova 1991). The main idea of this approach is to analyze the relationship between male and female mortality for particular cause (and age group). It has been found that causes of death differ strongly in the extent of relationship between male and female mortality rates. For some causes of death (stomach cancer, pneumonia, cirrhosis of liver) the values of male and female mortality rates are in a very strong agreement (correlation coefficient, $r > 0.85$) while for other causes of death (lung cancer, cancer of larynx) this agreement is very small ($r < 0.5$). The strong agreement in male-female mortality for gender-concordant causes of death suggests that these causes of death are related to the same (presumably environmental) underlying factors. In the case of gender-discordant causes of death, mortality is determined by gender-specific (presumably behavioral) factors. Developing this approach further, we suggest that mortality from one and the same cause of death may be determined by different factors at different ages. We check this hypothesis using data on suicide and homicide mortality in Russia.

The results of our study are presented in Table 3. These data demonstrate that age patterns of agreement between male and female mortality are completely different for suicide and homicide. In the case of suicide, younger age groups demonstrate very good agreement in male-female suicide mortality while older age groups show very poor concordance. The borderline of good and poor male-female mortality concordance for suicides falls to the retirement ages (55-60 years) suggesting different underlying factors of suicide for working and retired age groups. This result indicates that at younger ages males and females respond in a similar way to the stressful factors of social environment. At older ages men and women respond differently to the stressful conditions: older women traditionally play an important role in Russian family looking after grandchildren ('babushka' role) which may be protective against suicide.

Table 3 about here

In contrast to suicide mortality, the agreement between male and female homicide mortality is less strong for younger ages (15-24) but substantially better for the middle and old ages. Possible explanation of this phenomenon may be an existing difference in behavior of younger and older males: while older males more often become victims of a crime (and hence have similar with females likelihood to be murdered), younger males more often participate in criminal activities subjecting themselves to additional danger.

Our further analyses of gender-specific factors included comparison of temporary changes in male-female mortality ratios for suicide and homicide. These analyses would help us to indicate the major trends in gender-specific mortality. Increasing male-female mortality ratio indicates growing male disadvantage and vice versa. Figure 1 shows the temporary changes in suicide mortality demonstrating continuous increase of male disadvantage among younger males. For middle-aged and older adults this ratio initially increased after the first crisis, but then almost stabilized at the higher level. These results indicate that the adverse effects of stressful environment are increasing at younger ages and for younger males in particular. At the same time, for older adults the effect of initial shock is slowly but gradually declining. Similar analysis of homicide mortality (Figure 2) demonstrates very disturbing pattern of rapidly increasing female disadvantage after 1992. This pattern apparently indicates an unfortunate tendency of growing involvement of young females in prostitution activities (as was recently admitted by Russian health experts, see BBC Monitoring Service - United Kingdom; Mar 9, 2001). For middle-aged and old age groups the ratio remains very stable demonstrating almost equal chances to become a victim for old males and females and 3-fold greater chances to become a victim for middle-aged males compared to females of the same age.

Figure 1 about here

Figure 2 about here

Factor Analysis of Violent Mortality

Our previous analyses showed an existence of substantial age and gender-specific effects as well as their possible interactions. To collapse the observed age- and gender-specific changes in violent mortality into simpler pattern, we used the method of factor analysis that allows us to reduce the set of variables to a smaller number of factors.

In our study we used an exploratory factor analysis in order to uncover the underlying structure of a set of variables (age groups). The specific type of factor analysis we used was the principal component analysis with paramax method of rotation (FACTOR procedure in SAS statistical package). Since the set of years for which data on suicide and homicide are available is not particularly long (12 cases), we have selected only 3 the most representative age groups for the analysis: 20-24 years (young adults), 50-54 years (middle-aged, pre-retired), 75-79 years (the elderly, retired). The analyses were

conducted both separately and together for males and females. Data for the whole class of external causes of death (accidents, injuries, poisoning) are available since 1981 that allowed us to include two additional variables into analysis.

The results of factor analysis for suicide mortality are presented in Table 4. The first three principal components account for 97 percent of the variation in suicide mortality. Although the eigenvalue for the third factor is less than 1, we retained this factor since it has very strong correlation with mortality of old females. The first factor has the highest correlations with middle-age mortality and explains 54 percent of the total variation, while the second factor related to the young age, explains 31 percent of the total variation. The last factor related to the old age mortality explains only 12 percent of variation in suicide mortality. The results of factor analysis confirm our previous results obtained on the basis of male-female correlations. Mortality of males and females at young and middle ages have similar correlations with factors 1 and 2. This is especially true for young age group. At the same time, mortality of old females is determined exclusively by the third factor while mortality of old males is determined by two factors (3 and 1). We may suggest that factor 1 can be interpreted as a factor of alcohol consumption. Strong correlation of this factor with middle ages (demonstrated high proportion of alcohol-related mortality) allows us to suggest that this factor explains suicides resulted from alcohol abuse as a method to cope with stress. The second factor may be interpreted as a factor related to stress caused by involvement in new activities.
Score estimates for each factor show that the first factor reached maximum in 1994, slightly increased after 1998, but its role is less important now. More disturbing is the rapid growth of factor 2 related to the young-age suicides. Although this factor does not play the leading role in determining suicide mortality, it may become more significant in the future that would potentially result in further increase of suicide mortality. Changes of the third factor which determines the old-age mortality does not have an explicit temporary pattern.

Table 4 about here

The results of factor analysis of homicide mortality are presented in Table 5 and demonstrate relatively simple factor structure: 92 percent of variation is explained by the first factor. The first three principal components account for 98 percent of the total variation in homicide mortality. The second and the third factors account for 4 and 2 percent of variation correspondingly. Although the eigenvalues for these factors are small these factors have very strong correlations with mortality at young ages and may provide additional clue for understanding homicide mortality changes. The first factor has the highest correlations with mortality of old middle-aged adults and old males which suggests strong relation of this factor to alcohol consumption. The second factor has the highest correlation with mortality of young females and old females, so we may call this factor as a factor of violence against weak victims. The third factor has very high correlation with homicide mortality of young males, so it may be related to more aggressive behavior of this particular age group. The results of factor analysis of homicide mortality suggest our previous findings obtained using male-female mortality correlations: mortality of males and females at young age cannot be explained by the

same underlying factor. Score estimates for each factor show that the first factor reached its maximum in 1995 and increased again after 1998 suggesting that frequency of alcohol-related homicides increased again after the 1998 financial crisis. Rapid growth of the second factor ('violence') after 1992 (accelerated after 1998) demonstrates that social environment is becoming increasingly dangerous in Russia. Interpretation of temporary changes of the third factor is more difficult. One possible explanation is that criminal groups became more organized and established now in Russia that resulted in decline of criminal wars between these groups. Thus, the factor analysis of homicide mortality does not provide much optimism for the future tendencies.

Table 5 about here

Summarizing the results obtained for the factor analysis of different age groups, we would like to conclude that variation in suicide mortality for the elderly has entirely different underlying causes compared to the working age groups, while variation of homicide mortality has additional specific causes for young age ages compared to older ages.

The discussion of possible causes of these differences should include alcohol and stress as two major factors that determine mortality fluctuations after the economic crises. We already mentioned two hypotheses (stress and alcohol) on the nature of recent changes in violent mortality. The proof of each hypothesis is complicated by the lack of reliable statistics on alcohol consumption (especially before 1992) and adequate measures of social stress. For example, statistics of alcohol sales underestimates 'black' market production. The estimates of alcohol consumption obtained through the population survey (RLMS) are almost three times lower than estimates of alcohol consumption based on alcohol sales (Nemtsov, Shkolnikov, 1998), so are not particularly reliable. Measures of social stress based on the measures of social cohesion are very indirect and usually do not cover marginal social groups let alone earlier time periods (before 1992).

In this situation we tried to discriminate between alcohol- and stress-related hypotheses using available data on mortality from causes which are known to be directly related to alcohol and stress. As a proxy measure of alcohol consumption we included into analyses age-adjusted mortality from alcohol-related causes (accidental poisoning by alcohol, alcohol dependence syndrome, alcohol psychoses and alcohol-related cirrhosis of liver). As a proxy measure of stress we used age-adjusted mortality from gastric ulcer.

Factor analysis of suicide mortality with added alcohol and stress variables produced factor structure that is similar to the results presented in Table 4. Alcohol has very strong correlation (r=0.97) with the first factor (middle age group). In contrast to alcohol, stress has almost equal moderate correlations with middle-aged suicide (r=0.67) and young-age suicide (r=0.60). The role of stress in young suicide is higher (r=0.60) than the role of alcohol (r=0.33). Neither stress nor alcohol is related to suicide mortality at old ages. These results apparently demonstrate that stress is an equally important factor of suicide mortality both at young and middle ages suggesting the leading role of stress at working place (or unemployment) in suicide mortality. However, heavy drinking at middle ages

adds an additional risk of suicide to mortality in this age group. It appears that more than half alcohol-related suicides are caused by social stress (correlation of stress variable with the first, alcohol-related factor is 0.67) while the rest of suicide deaths may be related to the adverse effects of alcohol on human behavior.

Factor analysis of homicide mortality with alcohol and stress variables also produced results that are similar to the results presented in Table 5. Alcohol is strongly correlated with the first factor (0.99) which is able to explain almost all variation in homicide mortality (88%). Stress has very strong correlation (r=0.996) with the third factor which explains 5 percent of variation in homicide mortality and is related to mortality of males. The second factor (explains 6% of variation) has a strong correlation with mortality of young and old females and moderate correlation with alcohol and stress, so we can call it a factor of violence (or 'unsafety' of social environment). The analysis of temporal changes in all 3 factors for homicide mortality produces rather interesting results: (1) alcohol-related factor increased after the crisis of 1992 reaching its peak in 1994, but after 1996 the role of this factor substantially diminished; (2) unsafety of social environment (factor 2) increased after the 1992 economic crisis and especially after the 1998 crisis, so we may expect its growth in the future; (3) stress-related factor rapidly increases after each crisis (peaks in 1992-93 and 1999) but then rapidly decreases. This analysis allowed us to separete (at least partially) the role of alcohol and stress in the recent changes of violent mortality.

The analyses presented above are limited to the period of 1989 and later. Also, there are some limitations in Russian cause-of-death statistics resulting in rather high proportion of causes which fall into the category "injury undetermined whether accidentally or purposely inflicted." This category may contain considerable number of homicide and (less likely) suicide cases. The proportion of deaths assigned to this category increased after 1992, so we may suggest that substantial number of homicide deaths is undercounted. In order to cope with these limitations we conducted our analyses for the whole class of external deaths (accidents, injuries, and poisoning). In this case we could use a long time series from 1981 and not to worry about cause-of-death misclassification.

The results of factor analysis applied to the mortality from external causes of death are presented in Table 7. Three factors are able to explain 94 percent of total variation in mortality from external causes. The first factor is strongly related to alcohol and explains 78 percent of variation. The factor structure obtained for external mortality is very similar to the factor structure obtained for the homicide mortality. Again, the first factor that explains considerable part of mortality variation is related to alcohol and has high correlations with middle age groups. The second factor is related to mortality of young and old females ('violence' factor) and the third factor is related to stress and has high correlation with mortality at young ages. Longer time series allows us to estimate the dynamics of each mortality factor in history. Alcohol-related factor (factor 1) was high before the 1985 anti-alcohol campaign and reached high levels again in 1993-96. After 1996, however, its values declined. Stress-related factor (factor 3) also was relatively high before 1984 suggesting that social environment at that times was rather stressful although less stressful than after 1991. Values of this factor have a tendency to jump

after each economic crisis (in 1992 and 1999) and remain at higher levels after 1992. The factor of violence (or unsafety of social environment, factor 2) is new and has a disturbing tendency to increase in time. Thus, we may suggest that it is factor of violence (unsafety of social environment) rather than alcohol consumption that will determine variations in external mortality in the future.

Table 6 about here

The most interesting result obtained here is a separation of stress factor from the alcohol factor. Most studies of high fluctuations in Russian mortality have to mix both factors together (Makinen, 2000; Brainerd, 2001). For example, stronger relation of divorce rate and crime rate with mortality compared to alcohol consumption is often interpreted as an evidence in favor of stress-related hypothesis (Brainerd, 2001). However both high crime rate and divorce rate may be a consequence of high alcohol consumption, so it is more likely that alcohol is behind the increasing mortality, crime and divorce rates. Weaker relation of total alcohol consumption to the violent mortality compared to divorce rate and crime rate found in these studies may be a result of poor estimates of alcohol consumption. Our results show that alcohol-related mortality has substantial strong stress-related component, but stress alone does not explain all cases of violent mortality. It is interesting to note that the values of stress-related factor are minimal in 1989-90 - a period when perestroika and glasnost reached their peak and when the first free parliament elections took place (see Table 6). In later years the positive effects of perestroika were overshadowed by numerous national conflicts and growing economic problems. Even suicide mortality that is often considered as a stress-related cause of death dropped sharply after the anti-alcohol campaign, but started slow increase after 1987 (Gilinski, Roumiantseva, 1998) indicating the important role of alcohol consumption in suicide etiology in Russia. Some researchers try to explain the decrease in violent mortality after the anti-alcohol campaign (1985-87) by positive effects of perestroika (Gilinski, Roumiantseva, 1998; McKee, 2000; Brainerd, 2001). This is not the case since perestroika started after 1987, so the rapid decrease of mortality in 1985-86 occurred solely due to efficient restriction of access to alcohol. This observation is not surprising because male suicide is usually caused by family conflicts (Gilinski, Roumiantseva, 1998) that in turn may be provoked by heavy alcohol drinking of husband. It seems that comparison of mortality structure after the anti-alcohol campaign and perestroika may be an interesting new direction of research attempting to discriminate between alcohol and stress effects.

Conclusion

In this paper we tried to analyze changes in violent mortality in Russia using data on age- and gender-specific mortality from violent causes of death. Our study demonstrated that variations in both suicide and homicide mortality are strongly related to the mortality at pre-retirement ages that could be in turn related to the variations in alcohol consumption. The role of alcohol consumption is apparently more significant for homicide mortality and less significant for suicide mortality. Alcohol abuse is a traditional factor of violent

mortality in Russia, but its role as a mortality determinant is apparently decreasing now. Although stress seems to be an important factor of mortality increase after the economic crisis, only part of alcohol-related deaths may be attributed to stress. We may also suggest that each economic crisis was associated with a rapid increase in stress-related violent mortality. On the other hand, new factors (hazards) related to unsafety of social environment and young age mortality are becoming more and more significant. These new hazards include rapid increase in violence against the most helpless victims (young and old women) and stress experienced by individuals involved in new activities and may determine the future of violent mortality in Russia.

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Table 1. Life Expectancy at Birth in Russia and Other Countries

Country	Year	Life expectancy at birth	
		Males	Females
Russia	1991	63.5	74.3
	1992	62.0	73.8
	1993	58.9	71.9
	1994	**57.6**	**71.2**
	1995	58.3	71.7
	1996	59.8	72.5
	1997	60.8	72.9
India	1994-1997	62.4	63.4
China	1994-1997	69.0	73.0
Tunisia	1994-1997	69.5	73.3
United States	1997	73.6	79.4

Source: Russian official statistics (Goskomstat); World Health Organization; National Center of Health Statistics.

Table 2. Age-adjusted mortality rates (per 100,000 population) for various causes of death in pre- and post-crisis years in Russia.

Males

Cause of death	1991 (1)	1994 (2)	(2)/(1)	1998 (3)	1999 (4)	(4)/(3)
All causes	1629.8	2224.4	1.37	1787.8	1928.3	1.08
Diseases of the circulatory system	815.1	1084.7	1.33	885.8	960.6	1.08
Accidents, injuries, poison.	243.9	423.5	1.74	309.9	338.8	1.09
Diseases of the respiratory system	104.5	150.6	1.44	101.8	113.7	1.12
Infectious diseases	20.8	35.5	1.71	33.5	43.2	1.29
Suicide	47.7	76.9	1.61	62.9	69.3	1.10
Homicide	25.1	52.8	2.10	36.0	40.7	1.13
Accidental poisoning by alcohol	19.4	61.2	3.15	28.7	32.5	1.13
Tuberculosis	16.1	28.2	1.75	28.5	37.0	1.30

Females

Cause of death	1991 (1)	1994 (2)	(2)/(1)	1998 (3)	1999 (4)	(4)/(3)
All causes	1278.6	1539.9	1.20	1365.3	1433.1	1.05
Diseases of the circulatory system	861.3	1015.9	1.18	901.5	953.7	1.06
Accidents, injuries, poison.	62.5	103.3	1.65	79.5	85.3	1.07
Diseases of the respiratory system	47.5	53.3	1.12	37.7	40.9	1.08
Infectious diseases	5.5	8.1	1.47	6.9	8.1	1.17
Suicide	11.2	13.6	1.21	11.6	12.7	1.09
Homicide	6.9	14.5	2.10	10.8	12.6	1.17
Accidental poisoning by alcohol	4.2	15.8	3.76	7.1	8.4	1.18
Tuberculosis	2.1	3.1	1.48	3.6	4.2	1.16

Table 3. Correlation between male and female mortality rates in Russia.

Age group	Correlation coefficients	
	Suicide	Homicide
15-19	**0.962**	0.855
20-24	**0.957**	0.800
25-29	**0.978**	**0.951**
30-34	**0.969**	**0.977**
35-39	**0.983**	**0.989**
40-44	0.866	**0.974**
45-49	0.855	**0.995**
50-54	**0.922**	**0.980**
55-59	0.380, NS	**0.991**
60-64	0.218, NS	**0.987**
65-69	0.550, NS	**0.958**
70-74	-0.233, NS	**0.984**
75-79	0.418, NS	**0.929**

NS - non-significantly different from 0.

Table 4. Factor analysis of suicide mortality in Russia.

Eigenvalues of the Correlation Matrix: Total = 6 Average = 1

Factor	Eigenvalue	Difference	Proportion	Cumulative
1	3.220363	1.351828	0.5367	0.5367
2	1.868535	1.131858	0.3114	0.8481
3	0.736677	0.625023	0.1228	0.9709
4	0.111654	0.067904	0.0186	0.9895
5	0.04375	0.024729	0.0073	0.9968
6	0.019021		0.0032	1

Factor structure after rotation (correlations)

Variable	Factor1	Factor2	Factor3
Females, 50-54	**0.97421**	0.12367	0.28685
Males, 50-54	**0.97590**	0.40392	0.10846
Males, 20-24	0.58495	**0.90400**	-0.06844
Females, 20-24	0.59685	**0.90344**	-0.08470
Males, 75-79	0.21002	-0.86694	0.43814
Females, 75-79	0.18132	-0.27136	**0.99772**

Factor score estimates

YEAR	Factor1 (pre-retirement age)	Factor2 (young age)	Factor3 (old age)
1988	-1.25681	-1.21004	-1.56730
1989	-0.99328	-0.93475	1.79751
1990	-0.71164	-0.94334	0.66530
1991	-0.87767	-0.81227	-0.12350
1992	-0.10018	-0.32909	-0.16781
1993	1.24958	-0.69607	0.51462
1994	1.75556	-0.40924	0.06902
1995	1.26849	0.84480	0.98286
1996	0.45497	0.87079	-0.92677
1997	0.10600	0.69766	0.74834
1998	-0.81887	1.21011	-1.30222
1999	-0.07614	1.71144	-0.69005

Table 5. Factor analysis of homicide mortality in Russia.

Eigenvalues of the Correlation Matrix: Total = 6 Average = 1

Factor	Eigenvalue	Difference	Proportion	Cumulative
1	5.523912	5.294251	0.9207	0.9207
2	0.229661	0.089867	0.0383	0.9589
3	0.139794	0.085359	0.0233	0.9822
4	0.054435	0.015049	0.0091	0.9913
5	0.039386	0.026575	0.0066	0.9979
6	0.012811		0.0021	1

Factor structure after rotation (correlations)

Variable	Factor1	Factor2	Factor3
Males, 75-79	**0.97676**	0.82016	0.76634
Females, 50-54	**0.95854**	0.80609	0.85704
Males, 50-54	**0.95499**	0.85187	0.84663
Females, 20-24	0.80368	**0.98995**	0.72723
Females, 75-79	0.89549	**0.93787**	0.78531
Males, 20-24	0.80692	0.74256	**0.98915**

Factor score estimates

YEAR	Factor1 ('alcohol')	Factor2 ('violence')	Factor3 ('stress/aggressor')
1988	-0.87214	-1.80379	-2.29281
1989	-1.18070	-1.12684	-0.90531
1990	-1.30490	-0.87625	-0.48212
1991	-1.04289	-0.98111	-0.39907
1992	-0.27673	-0.48728	0.69250
1993	1.07181	0.42575	1.27837
1994	1.32468	0.68503	1.22498
1995	1.56734	0.59515	0.69408
1996	0.18490	0.55086	0.60544
1997	0.20102	0.69669	-0.06359
1998	-0.33118	1.06137	-0.21431
1999	0.65879	1.26043	-0.13815

Table 6. Factor analysis of mortality from external causes of death in Russia. Alcohol and stress-related variables were added to the analysis.

Eigenvalues of the Correlation Matrix: Total = 6 Average = 1

Factor	Eigenvalue	Difference	Proportion	Cumulative
1	4.386239	2.224143	0.5483	0.5483
2	2.162096	1.356276	0.2703	0.8185
3	0.80582	0.317646	0.1007	0.9193
4	0.488174	0.411773	0.061	0.9803
5	0.076401	0.010509	0.0096	0.9898
6	0.065893	0.055774	0.0082	0.9981
7	0.010119	0.004861	0.0013	0.9993
8	0.005258		0.0007	1

Factor structure after paramax method of rotation (correlations)

Variable	Factor1	Factor2	Factor3
Males, 75-79	**0.96193**	0.58147	0.50508
Alcohol	**0.97301**	0.68402	0.60457
Females, 50-54	**0.96819**	0.78439	0.65063
Males, 50-54	**0.95587**	0.81311	0.68682
Females, 75-79	0.69999	**0.94535**	0.38237
Females, 20-24	0.59825	**0.93680**	0.71016
Males, 20-24	0.70047	0.82883	0.71401
Stress	0.59923	0.53600	**0.97858**

Factor score estimates

Year	Factor1 'alcohol'	Factor2 'violence'	Factor3 'stress'
1982	0.20794	-0.77129	0.19996
1983	0.38224	-0.89193	0.16106
1984	0.42835	-0.80405	0.17412
1985	-0.16886	-0.74769	-0.98953
1986	-1.34071	-0.82085	-1.12900
1987	-1.42763	-0.86108	-1.15914
1988	-1.28463	-1.83402	0.32907
1989	-0.84535	-0.84098	-1.67951
1990	-0.68514	-0.13419	-1.20149
1991	-0.45566	-0.18130	-1.10222
1992	-0.09129	0.05051	1.21026
1993	1.44089	0.91940	1.17316
1994	2.21275	1.25971	0.05516
1995	1.54541	1.27962	1.25580
1996	0.49497	1.12943	0.36433
1997	-0.00692	1.06342	0.19735
1998	-0.31368	1.11037	0.42418
1999	-0.09266	1.07493	1.71642

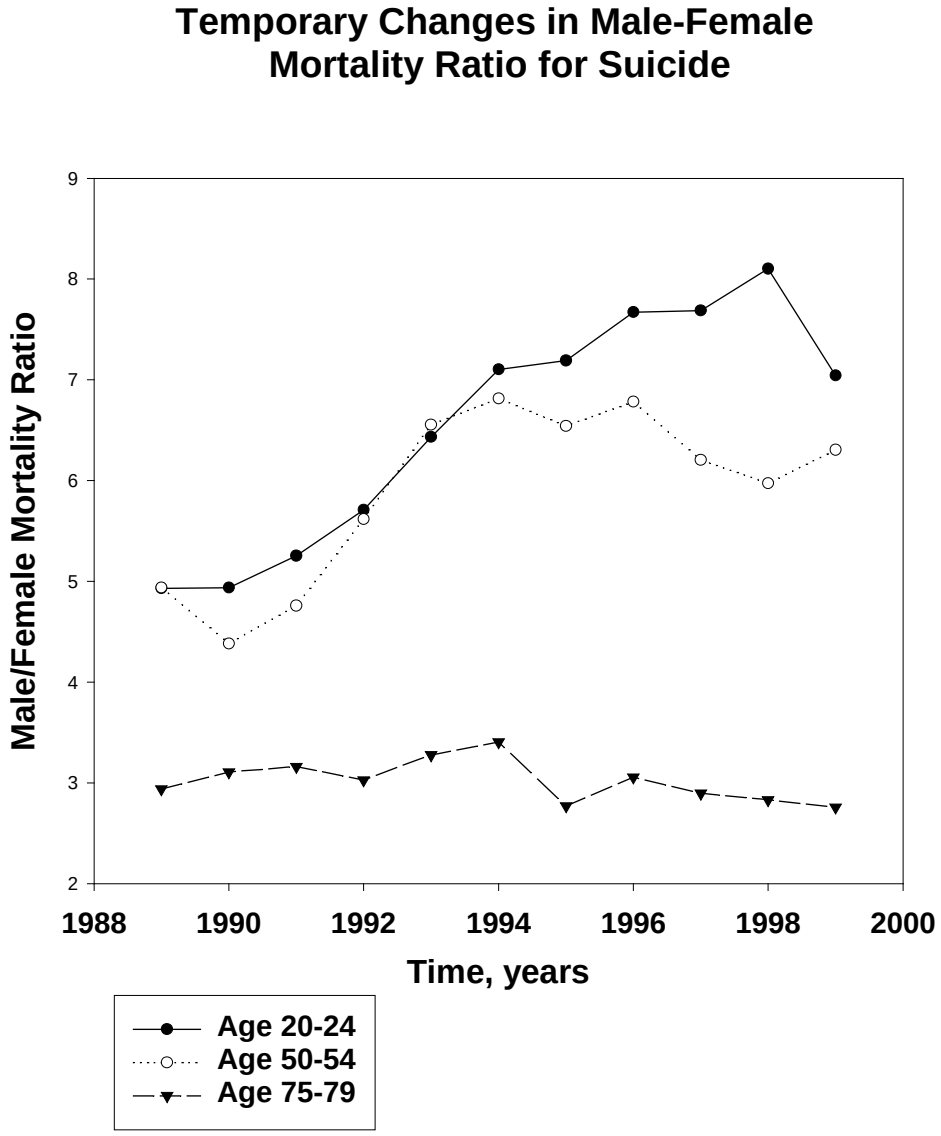
Temporary Changes in Male-Female Mortality Ratio for Suicide
Male/Female Mortality Ratio
9
8
7
6
5
4
3
2
1988
1990
1992
1994
1996
1998
2000
Time, years
Age 20-24
Age 50-54
Age 75-79

Figure 1

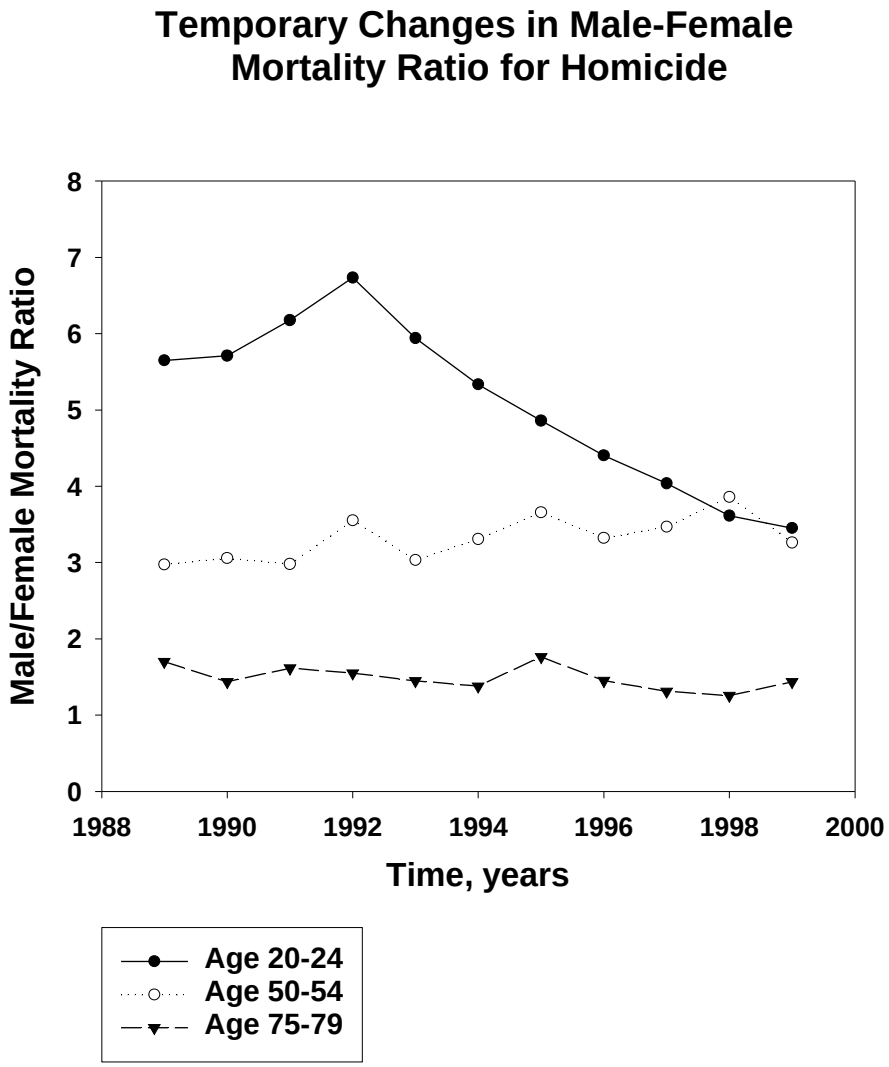
Temporary Changes in Male-Female Mortality Ratio for Homicide
Male/Female Mortality Ratio
0
1
2
3
4
5
6
7
8
1988
1990
1992
1994
1996
1998
2000
Time, years
Age 20-24
Age 50-54
Age 75-79

Figure 2