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Russian mortality beyond vital statistics. Effects of social status and behaviours on deaths from circulatory disease and external causes - a case-control study of men aged 20-55 years in Urdmurtia, 1998-99

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Abstract

Analyses of routine data have established that extreme mortality fluctuations among young and middle-aged men is the most important single component of temporal changes and the gender gap in the Russian life expectancy at birth. It is also responsible for the largest part of the life expectancy gap between Russia and other industrialised countries. A case-control approach has been used to identify factors associated with mortality among men aged 20 to 55 in the five major cities of the Udmurt Republic in 1998-99. Men dying from external causes and circulatory disease are taken as cases. Matched controls were selected from men of the same age living in the same neighbourhood of residence. Information on the explanatory characteristics of cases and controls was obtained by interviewing proxy respondents (family members or friends). After exclusion of those deaths for which proxy informant could not be identified, a total of 205 deaths from circulatory disease, 333 deaths from external causes and equivalent numbers of controls were included. Educational level was significantly associated with mortality from circulatory diseases and external causes in a crude analysis. However, on adjustment for employment and marital status plus smoking and alcohol consumption these effects were largely eliminated. Smoking was associated with mortality from circulatory disease (crude OR=2.44, 95% CI 1.36-4.36), this effect being slightly attenuated after adjustment for socio-economic factors and alcohol consumption. Unemployment was associated with a large increased risk of death from external causes (crude OR=3.63, 95% CI 2.17-6.08), an effect that was still substantial after adjustment for other variables (adjusted OR=2.52, 95% CI 1.43-4.43). A reported history of periods of heavy drinking was linked to both deaths from circulatory disease (crude OR=4.21, 95% CI 2.35-7.55) and external cause mortality (crude OR=2.65, 95% CI 1.69-4.17). Adjustment for other variables reduced the size of these odds ratios, but they remained strikingly large for circulatory disease (adjusted OR=3.54, 95% CI 1.76-7.13) and notable for external causes (adjusted OR 1.75, 95% CI 1.02-3.00). These results suggest that unemployment is a strong risk factor for deaths from external causes, an effect not entirely explained by alcohol consumption. However a history of heavy drinking in the past few years is strongly associated with risk of death from circulatory disease. This provides the first individual-level evidence in support of the hypothesis that binge drinking is key to explaining the heavy burden of circulatory disease mortality among Russian men today.

Keywords

mortality; alcohol; smoking; case-control; socio-economic factors; Russia

Introduction

Mortality rates in Russia today are very high in comparison with those in other industrialised countries (Shkolnikov, McKee and Leon, 2001, Shkolnikov, Meslé and Leon, 2001). In 1999 life-expectancy at birth among men was 60 years and among women was 72 years. The very low level of the average length of life, enormous mortality gap between sexes and unfavorable temporal changes are mainly due to excess male mortality at working ages from external causes of death (injuries, violence and poisonings) and circulatory disease. For men the probability of death between ages 20 and 60 is about 45% in Russia compared to approximately 10% in a western country such as the UK.

Detailed analyses of national and regional routine mortality data have established that these high mortality rates, and their dramatic fluctuations that have occurred since the mid-1980s, when the alcohol consuption suddennly fell because of the the compulsory anti-alcoholic restrictions of 1985, are real and not due to artefact (Leon et al., 1997). Despite understandable scepticism (Bobak and Marmot, 1999), there is a good case (McKee, Shkolnikov and Leon, 2001) to implicate high levels of alcohol consumption, particularly binge drinking as an important proximate risk factor driving these mortality fluctuations. However, data on alcohol consumption patterns in Russia are fragmentary or indirect (Nemtsov, 2000) and suffer from all the usual concerns about reporting bias. Nevertheless, these data suggest that mortality variation over time parallels variations in alcohol consumption (Zohoori et al., 1998, Russian Longitudinal Monitoring Survey, 2001) and what evidence exists on the prevalence of binge drinking suggests that it is common (Bobak et al., 1999).

The fluctuations in life-expectancy over the past 15 years have been particularly pronounced among people of working age but have not affected all parts of Russia equally. Mortality crisis of the mid-1990s may have been most intense in the large metropolitan centres, such as Moscow and St Petersburg, possibly due to the greater pace of economic and social change and disruption that occurred in these settings (Walberg et al., 1998). There is also good evidence, parallel to that seen in other countries, that socio-economic position (particularly as measured by educational level) is related to mortality rates and that the mortality increase of the early 1990s was concentrated among the least educated (Shkolnikov et al., 1994). Particularly strong educational gradients are observed for alcohol related deaths including acute alcohol poisoning and in external causes of death (Chenet et al., 1998).

One of the most striking features of the mortality fluctuations has been the way in which some causes of death have been more affected than others. For example, deaths from external and alcohol-related causes have shown particularly marked variation. Circulatory disease has shown a parallel pattern, although the amplitude of the effect has not been as marked in proportional terms. In contrast mortality from cancer has shown relatively stable trends that have not been perturbed by the events of the 1990s. The fluctuations in circulatory disease mortality have provided a particular challenge to conventional epidemiological assumptions about the aetiology of this group of conditions, in particular the well-recognised cardio-protective nature of alcohol consumption, possibly mediated by an "improved" lipid profile. We have previously argued that this apparent contradiction may be explained by the heterogeneity of conditions encompassed by the term "coronary heart disease" and their associated risk factors (McKee, Shkolnikov and Leon, 2001). One of these conditions is sudden cardiac death, which is a much more frequent manifestation of "coronary heart disease" in Russia than in the west. Binge drinking gives rise to a distinctive set of physiological responses (high LDL and low HDL cholesterol, clotting, arrhythmias, and hypertension) that increase the risk of sudden cardiac death (McKee and Britton, 1998) and is associated specifically with sudden death in epidemiological studies (Britton and McKee, 2000).

The hypothesis that binge drinking may lead to an increased risk of sudden death is biologically plausible and is supported by individual-level data from other countries such as Finland (Kauhanen et al., 1997). However, there is no direct individual-level evidence for this relationship in Russia. Further analyses of the Russian vital statistics are unlikely to be able to look at this issue in more depth. To go further requires individual-level data on mortality in relation to the drinking habits of working-age Russian men. This is necessary in order to test the hypothesis that alcohol consumption has a central role in explaining the mortality patterns of Russian men.

At a more general level, irrespective of the role of alcohol, it is also important to explore the social pathology of mortality among Russian men of working age. While there can be not doubt that, at the level of the Russian population, the massive social, economic and political disruptions of the past 15 years have influenced mortality rates, how these manifest themselves at the individual level has not been adequately investigated.

Despite the seriousness of the mortality situation in Russia there have been very few individual-level investigations of mortality in Russia published in the past decade. This paucity of studies reflects the difficulties of undertaking research in a context where resources and infrastructure are limited and research funds are not readily available. The Lipid Research Clinics studies comparing cardiovascular disease in the USSR/Russia with the United States of America are an exception (Davis et al., 1994, Dennis et al., 1993). These analyses, however, are based on the mortality follow-up of subjects screened in the 1970s, and thus can throw little light on the impact of conditions in the 1990s on mortality. In addition, the youngest individuals in the LRC cohort have already reached age 60 by the beginning of the 1990s and, therefore, their mortality was not increased much. Importantly, the LRC analyses showed that sudden cardiac death are responsible for a big part of the educaional gap in male mortality from cardiovascular disease and that these deaths are relatively independent from the level of total and LDL cholesterol (Shestov et al., 1993).

There are conceptual difficulties in the choice of the optimal approach to studying the acute phenomena that are implied by the very rapid changes in mortality rates in Russia during the 1990s. Indeed, all population-level studies on mortality in Russia, mentioned above, clearly show that abrupt changes in social conditions (such as the anti-alcohol campaign of the mid-1980s or unexpected and radical socio-economic transformations of the early 1990s) have been always resulting in *immediate and very strong* responses in mortality. This means, that a valid study of this phenomenon should be able to capture these unusually short "exposure-response" intervals. The classic cohort study, in which disease endpoints are related to baseline exposures measured years, and sometimes decades, earlier is not going to capture these acute exposures or any changes in their frequency in the intervening period. What is necessary is a design where the effects of circumstances and exposures on mortality in the days and months immediately preceding death can be investigated. A case-control study in which information about recent exposures is obtained from relatives and friends of the study subjects overcomes this problem.

In this paper we report the findings of such a case-control study in Udmurt Republic, Russia. The aims of the study were to move beyond the limitations of routine data to investigate the association of individual-level socio-economic and behavioural characteristics on mortality from circulatory disease and injuries, poisonings and violence among working age men in

Russia. This paper extends our preliminary reports on the study that were restricted to deaths from all causes combined (Shkolnikov and Chervyakov, 2001) and to deaths from circulatory disease (Shkolnikov, Meslé and Leon, 2002).

Design and methods

The study was set up to investigate the risk of death from specific causes (circulatory disease and external causes) in Russian men of working age (20-55 years) in relation to their current socio-economic circumstances, personal characteristics and behaviours.

Study setting

The study was conducted in the Udmurt Republic (population 1.6 million). This is a part of the Russian Federation with 70% of the 1998 population living in cities. Its capital city, Izhevsk (population 650 thousand), is located 1300 km south east of Moscow in the middle Urals. The target population for the study were those living in the republic's 5 major cities : Izhevsk, Votkinsk, Sarapul, Glazov, and Kambarka. The mortality profile of the Udmurt Republic (henceforth referred to as Udmurtia) is similar in most respects to that of Russia as a whole. In 1998-99 life expectancy at birth in this region was slightly higher (by 0.3 years) than the national average (Figure 1), with similar patterns of mortality by cause of death (Table 1), with the exception of suicide, which in Udmurtia is much higher than the Russian average.

Case-control design

We used a case-control design to investigate how circumstances in the previous 1-2 years influence the risk of death. Information about the circumstances and characteristics of the cases and controls was obtained by questionnaire interviews with either family members, friends or neighbours.

Case definition and selection

Cases were selected from among the 1336 deaths of men aged 20-55 years occurring in the period August 1998 to March 1999 in the 5 major cities of Udmurtia defined above. Information about these deaths, including cause of death and last address, was obtained from the medical death certificates. In order to obtain information about the socio-economic circumstances of the deceased these medical death certificates were matched with the corresponding civil death records, which contained information such as education and marital

status. This matching procedure was successful for 1023 deaths, 768 of which were from either circulatory disease or external causes as defined in Table 2. For 538 (70%) a suitable informant, as defined below, was found and was successfully interviewed. These comprised 205 deaths from circulatory disease and 333 from external causes.

The characteristics of the 538 valid interviewed cases of circulatory or external-cause death are shown in Table 3 compared with those of the 230 deaths from these causes who were excluded for one of the reasons described above. The included deaths were slightly older than those excluded. With respect to cause, the deaths included were weighted towards circulatory disease compared to those deaths that were excluded. For circulatory disease the included deaths had a slightly larger proportion of deaths from ischaemic heart disease. With respect to external causes, deaths from homicides and other violent causes (excluding suicide) were relatively under-represented in comparison to accidents among those included.

Information on marital status and educational level of the deceased was not recorded on the civil death certificate from 1999 onwards. For the 495 deaths from circulatory disease and external causes that occurred in 1998 the distribution of included and excluded deaths by marital status and education is shown in table 4. As might be expected those included were more likely to be currently married than those excluded. This must reflect in part the fact that currently married men were most likely to have fixed addresses and would have family informants living at their last address. The distribution of those included compared to those excluded was also shifted towards those with higher levels of education.

Control definition and selection

Each case was individually matched to a control (N=538) on the basis of age (+/- 1 year) and place of residence (same or neighbouring block of houses or flats) based on information from electoral lists of 1997. Usually, there was little or no choice because only one or two men met the matching criteria. The characteristics of the matched controls were obtained by interviews with informants. Just under 90% of potential control informants who were approached agreed to be interviewed.

Questionnaire, interview and informant type

A standard interviewer-administered questionnaire was used to collect information about study subjects from informants in their own homes. Informants for cases and controls could

be either family, friends or neighbours. The questionnaire for case informants was comprised of 155 questions and that for control informants 143 questions. These questions concerned social origins and trajectory, ethnic background, character and psychological status, level of wealth and living standards, educational attainment, employment status, marital status and problems in family relations, health status and diseases/disability, health behaviours, including alcohol and tobacco consumption and history of problems with the police and the courts. Informants for the 538 cases were interviewed in the period June-August of 1999. The interviews for the 538 matched controls were conducted in the same way in the period August-October of 1999. The distribution of interviews by informant type for cases and controls is shown in Table 5. Not surprisingly there was a marked difference between cases and controls. Compared to controls, cases of death from external causes were much less likely to have wives as informants (37% *vs.* 51%). For the cases of death from circulatory disease this difference was much less pronounced (51% *vs.* 56%). This is despite the fact that the included case deaths were far more likely to be married than those excluded (Table 4).

Statistical analysis

The data were analysed using the STATA statistical package (StatCorp, 1999). The estimates of the strength of association between the variables of interest and mortality were expressed as odds ratios with 95% confidence intervals derived from fitting models using conditional logistic regression in which account was taken of the one to one matching of cases with controls.

Results

Exposure distribution by case-control status

The frequency distribution of cases and their matched controls by key variables of interest is shown in Table 6 by cause of death of the cases. The age distributions of cases and controls are the same because of close matching on age. The distribution of deaths from circulatory disease is considerably older than that from external causes. All of the other variables in this table are derived from the responses of informants at interview, and thus reflect their knowledge of and personal views about the subjects.

The case deaths from circulatory diseases were reported to have been less likely that their matched controls to be in full time employment, married and have university-level education and far more likely to be disability pensioners. They were also were more likely than controls to have smoked in the past year[1], have drunk alcohol frequently, have had periods of heavy drinking and to have increased their alcohol consumption in the past year relative to pervious years. Turning to health problems, circulatory disease cases were more likely than controls to have been perceived as having their normal activities (including their capacity to climb stairs) affected by poor health. Informants also rated circulatory disease cases to be more likely than controls to be in "bad" or "very bad" health. This could mean that a men dying from cardiovascular causes were more likely to have a prior history of poor health. However it this difference could also be due to response bias – with the health of the cases being perceived as being worse than the currently alive controls precisely because they were now dead. For this reason we have excluded these health status variables from further analysis.

The external cause deaths were also less likely than their controls to be in employment and married and have university-level education. They were also more likely to smoke, drink frequently and have periods of heavy drinking. It is striking, however, that the health status (as reported by informants) of external cause deaths was not really different to that of their matched controls, in contrast to the differences seen for circulatory disease cases and their controls with respect to health status.

[1] In accordance with other studies, a very high prevalence of smoking was detected among the Udmurt men aged 20 to 55. About 80% of cases and 70% of controls were smoking. It suggests that the importance of smoking for the whole population would be very high. Our prior analyses showed that in terms of population attributable risk smoking is the most important single factor of the cardiovascular mortality among men (Shkolnikov, Meslé and Leon, 2002).

Mortality odds ratios

Odds ratios of death by social status and behavioural factors were estimated from conditional logistic regression for circulatory disease and external causes separately and are presented in tables 7, 8 and 9. Because of matching by age, these estimates are not confounded by age. Each table is based on the sub-set of case-control pairs where there is no missing (not reported) information for any of the variables in the table. For each cause the parameters estimated from two models are presented. Model 1 estimates are crude (unadjusted for other variables). Model 2 estimates are adjusted for all other variables in the table.

Social status. Table 7 shows mortality odds ratios from circulatory disease and external causes to be related to employment status, with the lowest risk being associated with the baseline category of being in employment or a student. Marked elevations of risk are associated with being unemployed, an affect that remains after adjustment for marital status and educational level. However, it is notable that for circulatory disease the highest odds ratios are for men who were not working because they were on a disability pension. Adjustment for other social status variables in the table reduced this four-fold excess by a small amount. In contrast, these men did not appear to have any substantial increased risk of death from external causes. This is consistent with a disability pension being a marker for pre-existing circulatory disease.

With respect to marital status, not being married was associated with an increased risk mortality from external causes only. This was particularly so for divorced or widowed men. Educational level showed the predictable inverse association, with odds ratios going up as level of education declined for both circulatory disease and external causes going up as level of education declined.

Behavioural factors. The mortality odds ratios in Table 8 are based on a smaller set of case-control pairs than Table 7 as those in which informants failed to provide an answer to questions about drinking habits or behavioural factors in Table 8 were excluded. Smoking was associated with an increased risk of circulatory disease that remained pronounced on adjustment for other variables in the table. As might be expected, smoking was less strongly associated with an increased risk of death from external causes, and this ceased to be statistically significant after adjustment for the other variables in the table.

There are two alcohol variables in Table 8. What is striking is that for circulatory disease the mortality odds ratios are substantially larger for periods of heavy drinking compared to being a regular consumer of alcohol. The strength of association with periods of heavy drinking was only slightly diminished on adjustment for the other variables in the table, while the adjusted odds ratio for frequent drinking (2-3 times per week or more) showed weak evidence of a protective effect. In contrast both regular and heavy drinking were associated with an increased risk of death from external causes. Finally, with respect to Table 8, although a relatively uncommon characteristic, being reported to have been under arrest for three days or more was associated with elevated risks of mortality from circulatory disease and to a lesser degree with mortality from external causes.

Fully adjusted model

Table 9 shows the estimated crude and fully-adjusted odds ratios for the sub-set of case-control pairs where there was no missing information for any of the social status and behavioural questions that were examined separately in the two previous tables. The pattern of associations seen for the unadjusted estimates (Model 1) in the table are very similar to those observed in Tables 7 and 8, giving assurance that cases-control pairs used in Table 9 are not a biased sub-set.

Adjustment for all social status and behavioural variables had little impact on the increased risk of death from circulatory disease associated with being a disability pensioner. The inverse association of circulatory disease with education was attenuated on full adjustment to a greater degree than seen when adjusted for employment and marital status only (Table7). The effect of smoking on circulatory disease mortality was reduced on full adjustment although it remained substantial. Regular drinking (2-3 times per week) showed no association with mortality from cardiovascular disease. In contrast, there remained a very substantial elevated risk associated with a reported history of periods of heavy drinking.

The increased risk of mortality from external causes associated with unemployment was reduced on full adjustment but remained substantial. There was no association in the unadjusted or adjusted model with having a disability pension. The odds ratios of external causes associated with being single, widowed or divorced were larger than for circulatory disease, but full adjustment resulted in them becoming no longer statistically significant. Full-adjustment for social status and behavioural variables eliminated any effect of education on

external cause mortality. Both regular drinking and periods of heavy drinking were associated with elevated odds ratios for external causes. However, full-adjustment reduced these effects substantially, with only periods of heavy drinking having 95% confidence intervals that excluded unity.

Sensitivity analyses

A series of analyses were conducted to see to what extent estimates were sensitive to the types of informant. The number of case-control pairs where the informant type was the same for case and control was 91 for circulatory disease and 121 for external causes. When analyses (not shown here) were restricted to this subset the results were substantively the same and very close in terms of mortality odds ratios as seen in the full analyses (see Shkolnikov, Meslé and Leon, 2002 for more details)[2]. The results were also similar (not shown) when analyses were restricted to the 161 case-control pairs of circulatory disease deaths and 240 case-control pairs of external cause deaths where informants were restricted to first degree relatives only.

Discussion

The results of this study provide the best insights available so far into the associations between socio-economic circumstances, smoking and different patterns of alcohol consumption and the short-term (<1 year) risk of death from circulatory disease and external causes among working-age men in Russia today. Before considering the detailed findings of the study its evident weaknesses need to be discussed.

Generalisability

The majority of deaths among men aged 20-55 years in Udmurtia in the study period were from either circulatory disease (mainly ischaemic heart disease) or external causes. Of the 768 deaths from one or other of these causes we were only able to include 538 in the analyses. Those excluded differed somewhat from the ones included in terms of specific causes of death. For example, deaths from suicide, homicide and some other causes (such as drownings) were excluded disproportionately. Ideally, this would be dealt with by conducting

[2] Some of more subjective variables, which have been important at initial stages of analysis had to be finally excluded due to the informant type bias. Typically these were variables of more subjective character like bad relations with wife or reported periods of depression. Even for these variables the direction of mortality odds rations was the same with and without a control for the type of informant, but there was a substantial difference in the values of the odds ratios.

separate analyses for each sub-component of circulatory and external cause deaths. However, this study is too small for this approach, lacking the statistical power to provide precise estimates of effect at this level of disaggregation by cause.

A related issue concerns the identification of suitable case informants to the study. As is evident from Table 4, the deaths that were excluded were disproportionately weighted towards the unmarried – particularly the divorced. Cases who were either single or divorced were particularly difficult to find informants for. They either lived alone, or potential informants were unwilling to be interviewed, or they were most likely of all groups to have no private place of permanent residence. Thus our study will have differentially excluded deaths among men who were the most isolated, vulnerable and deprived. It should be noted, however, that such individuals are generally underrepresented in most epidemiological studies in which personal contact is involved regardless of design.

Having established that the cause and social composition of the deaths from circulatory disease and external causes included in the study is unlikely to be fully representative of all deaths from these causes among working age men in Udmurtia in the late 1990s, what are the implications for the validity of our results ? It is clear that the results cannot be fully generalised to all deaths from the causes of interest in Udmurtia. In other words the study does not have full external validity. However, the question of whether, given the subset of deaths we have included, our results are a valid measure of the association of mortality with socio-economic and behavioural factors is a matter of internal validity. For a case-control study this is in part about whether there is likely to have been selection bias in the recruitment of appropriate controls.

Selection bias

In principle, to avoid selection bias, one needs to recruit controls who are representative of the population from which the cases are drawn. In this study for each case a matched control was drawn from an electoral list to be of the same age to have a residential address in the same housing block as stated on the death certificate of their matched case. A weakness of the protocol, however, is that no check was made to see that the cases also appeared on the electoral list.

Implicitly, many of the factors which meant that an informant could not be found for a case would also operate for controls. For example, the extent that being single or divorced meant that an informant was less likely to be found would apply regardless of case-control status. One exception would be if the death of the case precipitated the move of family or friends from the place of residence of the case at the time of their death, although it is not easy to anticipate how this might bias the estimates of effect made in this study. In general, however, it seems that the selective recruitment of case informants which has given rise to problems with external validity, may operate in a similar way to controls, hence avoiding selection bias from this source.

Proxy informants and information bias

There is a literature on the validity of exposure information from proxy informants in epidemiological, usually case-control, studies (Walker, Velema and Robins, 1988, Nelson et al., 1990). These have found that for a range of exposures, including smoking (Nelson et al., 1990, Nelson et al., 1994) and frequency of alcohol consumption (Nelson et al., 1994, Graham and Jackson, 1993), there is good agreement between proxy and index subjects. This is particularly so for binary exposures, such as those analysed in this study. Few studies have attempted to evaluate the quality of proxy data on heavy or binge drinking, although one study[22] found that proxy-index agreement on this was lower than for frequency of alcohol consumption. Demographic information (such as education) is also reported reliably by proxies.

The use of proxies can introduce both random (non-differential) and systematic (differential) misclassification (Nelson et al., 1990). If the misclassification of exposure is non-differential this will reduce the effective sample size and thus reduce precision. There are several ways in which the mode of information collection differed between cases and controls that could introduce systematic effects. Firstly, the case informants were interviewed between 3 and 12 months after the death of the case. Informants were thus being asked to recall circumstances some months in the past, while control informants were essentially describing the circumstances and behaviours of the controls at that moment in time. This may have introduced greater misclassification of cases compared to controls simply due to the passage of time.

Secondly, certain issues arise because a wide mixture of informants was used. As documented in the literature,[22] the relationship of the informant to the subject does have an effect on the completeness and validity of the information obtained. The distribution by informant-type varies between cases and controls (Table 5), particularly for external causes as factors that are causally implicated (such as marital status and household composition) will influence availability of informants. However, the similar results obtained in the sensitivity analyses based on sub-sets of the data where either both members of a case-control pair had the same informant-type or informants were restricted to first degree relatives, suggests that any bias due to informant type is minor.

Finally, it is an inevitable feature of this case-control design that the information collected from case informants will be affected in a different way to that collected from control informants as the fact of death itself will have influenced the perceptions of family, friends and neighbours about the deceased. Interpretation of results thus must consider the extent to which such recall bias may potentially explain the findings. This however, is a general problem that all case-control studies have to contend with irrespective of whether proxy informants are used or not.

Circulatory disease mortality

The majority of circulatory disease deaths in the study are from ischaemic heart disease. Smoking is an important risk factor for this condition (Doll et al., 1994) and thus it is reassuring that it is associated with an increased risk of circulatory mortality in this study. The data also make sense in that being a disability pensioner is associated with a substantially elevated odds ratio for circulatory disease as morbidity associated with heart disease is likely to lead to giving up work and going onto a disability pension. The absence of a parallel effect for external cause deaths is what would be expected.

What is most striking are the contrasting effects of regular and heavy drinking on the risk of death from circulatory disease. Regular drinking (2-3 times per week or more) is associated with an increased risk in the crude analyses. However, when adjusted for all other risk factors it shows no effect at all. A reported history of heavy drinking is associated with a very substantial increased risk of death from circulatory disease that is only a little attenuated on adjustment for all other risk factors analysed. In terms of proportions, 46% of deaths from circulatory disease were reported to have a history of heavy drinking compared to 20% of

matched controls. This is consistent with the hypothesised role of binge drinking in causing high mortality from circulatory disease in Russia (McKee, Shkolnikov and Leon, 2001). While the question itself does not precisely specify "binge" drinking (i.e. a large amount of alcohol in one drinking session), having experienced "periods of heavy drinking" is likely to be a good proxy measure. These results, however, do not provide unambiguous proof of the role of binge drinking in cardiovascular mortality in Russia. They do, nevertheless, provide the best individual-level evidence to date in support of this hypothesis.

Educational level has been found to be related to mortality from a range of causes in Russia (Shkolnikov et al., 1998) including circulatory disease. In this study there is a clear inverse gradient apparent in the unadjusted data. However, on adjustment for behavioural factors (drinking and smoking) the association with educational level becomes considerably attenuated. This suggests that these factors are important contributors to the educational gradient observed in other studies.

External cause mortality

Being unemployed is the factor most strongly associated with mortality from external causes in this study. Some of this effect is accounted for by the other variables in the analysis, most importantly, the behavioural ones (drinking and smoking). However, even after adjustment those who were unemployed were over two and half times more likely to die from external causes as those in employment. These results are consistent with the broader literature (Wright and Kariya, 1997). The frequency of suicide is especially high in Udmurtia and deaths from suicide comprise a third of all external cause deaths in the study. Unemployment has been found to be associated with suicide in a range of studies in other countries (Moser et al., 1986, Johansson ad Sundquist, 1997). It is also implicated in intentional violence (Kyriacou et al., 1999, Poole et al., 1997), which contributes to the overall category of external causes.

Periods of heavy drinking and being reported to have drunk regularly are also associated with an increased risk of death from external causes, although after adjustment for other variables these effects are reduced and are only statistically significant for heavy drinking. It is notable, however, that the effect of heavy drinking was far less pronounced for external causes, where the mechanisms are self evident, than for circulatory disease deaths, where the association is more controversial.

Finally, external causes are known to show an inverse socio-economic gradient in Russia (Chenet et al., 1998) and elsewhere (Drever and Whitehead, 1997). We also observe an inverse gradient in this study, although it is not as strong as reported in other studies of Russian mortality (Shkolnikov et al., 1998, Chenet et al., 1998). This may in part reflect the matching by neighbourhood that is used in our design, where some of the effects of educational level on mortality from external causes may be due to area rather than individual-level effects. On adjustment for the other variables in the analysis, and in particular the behavioural ones, the educational gradient is effectively eliminated. Alcohol in particular is likely to play an important role mediating the link between educational level and external cause mortality.

Not being married is associated with significantly elevated risk of death from external causes, which becomes statistically insignificant after adjustment for behavioral variables.

In summary, this study is the first one to investigate the social and behavioural factors implicated in mortality from circulatory disease and external cause mortality in men of working age in Russia after the collapse of communism. Despite a number of methodological short comings, the associations seen between mortality from these two causes and known risk factors are consistent with what would be expected from the literature. The single most novel finding is that a history of heavy drinking is strongly associated with risk of death from circulatory disease. This further emphasises the importance of measuring not only total amount of alcohol consumed but also the pattern of consumption in epidemiological studies.

Although far from definitive, this provides the first individual-level evidence in support of the hypothesis that binge drinking plays an important role in explaining the heavy burden of circulatory disease mortality among Russian men today. The role of alcohol as an important mediator of the link between adverse socio-economic circumstances is also apparent, although it does not explain all of the association between unemployment and mortality from external causes. Further studies of this sort, avoiding the shortcomings identified in this paper, are a priority in order to further dissect the social pathology of mortality in Russia today and its proximal mediators.

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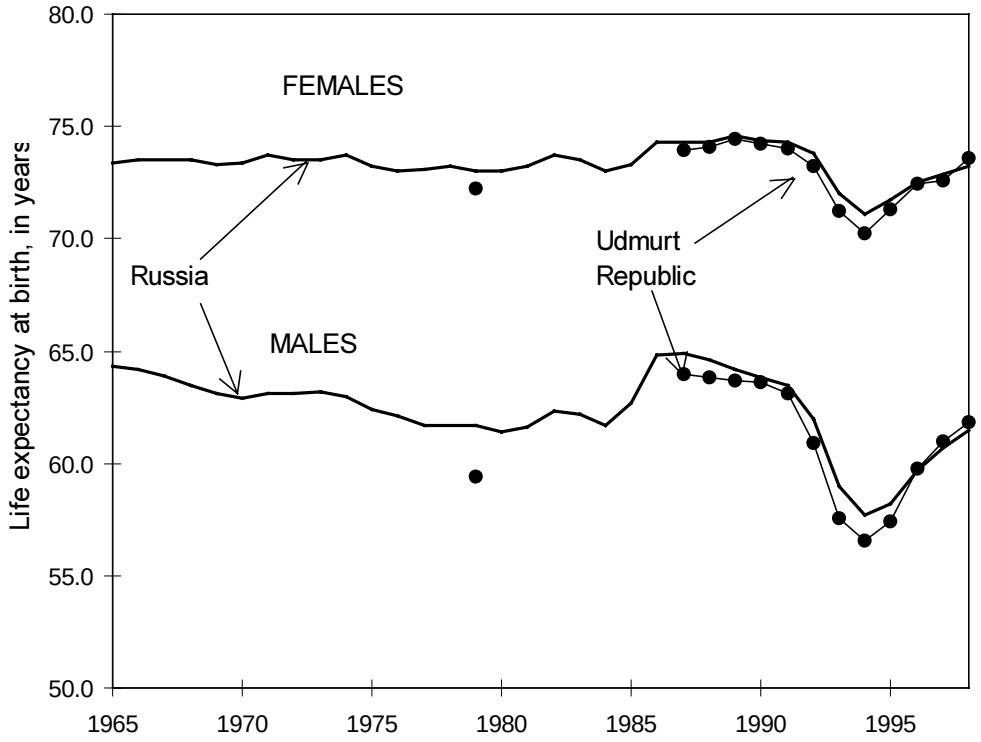
Figure 1 – Trends in life expectancy at birth: Udmurt Republic and Russia as a whole.



Source: Shkolnikov and Chervyakov, 2001.

Table – 1. Male age standardized* rates of death from principal classes of causes of death in the Udmurt Republic and Russia in 1998 and in an average western population in 1992-1994, per 100 000**

Cause of death	Udmurtia	Russia	"West"	Udmurtia / Russia	Moscow / Russia	Udmurtia / "West"	Moscow / "West"
Infectious diseases	29.53	34.49	16.24	0.86	0.59	1.82	1.26
Neoplasms	255.78	291.17	313.13	0.88	1.02	0.82	0.95
Circulatory diseases	844.00	924.66	439.47	0.91	0.94	1.92	1.98
Respiratory diseases	168.60	105.78	124.60	1.59	0.49	1.35	0.42
Digestive diseases	55.93	54.53	44.55	1.03	1.08	1.26	1.32
Other diseases	83.62	66.34	96.90	1.26	1.23	0.86	0.84
Injuries, poisonings and violence	326.83	305.12	80.49	1.07	0.89	4.06	3.38
All causes combined	**1856.16**	**1847.02**	**1115.37**	**1.00**	**0.90**	**1.66**	**1.49**

* The WHO European standard of the population age structure is used

** The notation "West" corresponds to average mortality rates for the France, Germany, Japan, the USA, and the UK.

Source: Shkolnikov and Chervyakov, 2001.

Table 2 – Underlying cause codes for circulatory disease and external causes

Class of causes of death	1998		1999	
	Brief classification of the Goskomstat* of 1988	ICD-9	Brief classification of the Goskomstat of 1999	ICD-10
Circulatory diseases	84-102	390-459	115-147	I00-I99
External causes of death (accidents and violence)	160-175	E800-E999	239-254	V01-V89

* State Statistical Committee of the Russian Federation

Table 3 - Percentage distribution of case deaths due to external causes and circulatory diseases by age, causes and ethnic background according to inclusion status. Men aged 20 to 55 Udmurt Republic 1998-99.

Characteristics	% distribution of eligible deaths included N=538	% distribution of eligible deaths excluded N=230
Age in years		
20-39	38	44
40-55	62	56
Causes of death		
Diseases of the circulatory system	38	30
Including:		
- IHD*	*24*	*18*
- Other heart diseases**	*7*	*6*
- Other circulatory diseases	*7*	*6*
External causes of death	62	70
Including:		
- Transport accidents	*7*	*6*
- Poisonings by alcohol	*10*	*11*
- Suicide	*22*	*18*
- Homicide	*10*	*15*
- Other accidents and violence	*13*	*20*
Ethnic background		
- Slavic***	72	67
- Udmurts	17	20
- Tartars	8	9
- Other	3	4
Total	100	100

* Deaths due to atherosclerosis, acute forms of the ischeamic heart disease other than myocardial infarction including stenocardia, and ill-defined acute IHD were prevalent among IHD deaths.

** Other heart diseases include cardiomyopathies, cardiac arrhithmias, myocarditis, pericarditis, conduction disorders, and heart failure. In 1998 this group of causes corresponded to items 96 and 97 in the old Russian classification of causes of death and to codes 415-429 in ICD-9. In 1999 this group of causes corresponded to items 131, 132 in the new Russian classification of causes of death and to codes 126-128, 130-151 in ICD-10.

*** Russians, Ukrainians, and Belorussians. 97% of this group are Russians.

Table 4 - Percentage distribution of case deaths due to external causes and circulatory diseases by ethnic background and education according to inclusion status. Men aged 20 to 55 Udmurt Republic 1998*

Characteristics	% distribution of eligible deaths included N=350	% distribution of eligible deaths excluded N=165
Marital status		
- Married	68	49
- Never married	19	25
- Widowed	1	2
- Divorced	12	24
Education		
- University and incomplete university**	11	7
- Specialised secondary	22	17
- Secondary	52	59
- Lower level	15	17
Total	100	100

* In 1999 the State Statistical Committee (Goskomstat) ceased to register educational level and marital status of the deceased in death records. Hence this table is based on deaths occuring in 1998 only.

** Incomplete university education comprises 7% of this group.

Table 5 – Percentage distribution of informant type by case-control status

Informant	Circulatory disease		External causes	
	Cases	Controls	Cases	Controls
	N=205	N=205	N=333	N=333
Wife	50.5	56.0	37.0	51.3
Mother	11.4	11.4	25.6	21.1
Father	1.6	1.1	4.9	1.3
Sister	2.2	1.6	5.5	3.2
Brother	4.3	1.6	2.9	1.9
Daughter	10.3	10.9	7.8	5.8
Son	6.0	6.0	2.3	3.2
Mother/father in-law	1.2	2.2	0.0	0.3
Other *	12.5	9.2	14.0	11.7
Total	100	100	100	100

* Other relatives, friends or neighbours

Table 6 – Percentage distribution of cases and controls by cause and selected variables*

	Circulatory disease				External causes			
	Cases (N=205)		Controls (N=205)		Cases (N=333)		Controls (N=333)	
Age (years) **								
20-29	4.3	*9*			23.2	*77*		
30-39	12.5	*26*			29.7	*99*		
40-49	48.6	*99*			36.5	*122*		
50-55	34.6	*71*			10.6	*35*		
Social status								
Employment status								
- Full time employed or student	49.5	*102*	73.1	*150*	59.7	*122*	80.7	*165*
- Unemployed/no regular employment	26.0	*53*	15.9	*33*	35.8	*73*	15.2	*31*
- Disability pensioners	24.0	*49*	11.0	*23*	4.5	*9*	3.6	*7*
- Not reported	0.5	*1*	0.0	*0*	0.0	*0*	0.5	*1*
Marital status								
- Married (or living as married)	78.8	*162*	82.2	*169*	67.1	*138*	80.6	*165*
- Divorced and widowed***	13.0	*27*	9.6	*20*	14.2	*29*	5.5	*11*
- Never married	8.2	*17*	8.2	*17*	18.7	*38*	13.9	*28*
- Not reported	0.0	*0*	0.0	*0*	0.0	*0*	0.0	*0*
Education								
- University and incomplete university	15.4	*32*	23.6	*48*	11.6	*24*	17.7	*36*
- Secondary specialised	17.8	*36*	18.8	*39*	15.8	*32*	15.8	*32*
- Secondary and lower	65.4	*134*	57.1	*117*	71.3	*146*	66.5	*136*
- Not reported	1.4	*3*	0.5	*1*	1.3	*3*	0.0	*0*
Behaviours								
Smoking in last year								
- No	18.3	*38*	33.2	*68*	19.7	*40*	27.4	*56*
- Yes	81.2	*166*	66.8	*137*	80.3	*165*	72.3	*148*
- Unknown	0.5	*1*	0.0	*0*	0.0	*0*	0.3	*1*
Frequency of alcohol intake in last year								
- Less than 2-3 times/week	60.1	*123*	76.4	*157*	57.7	*118*	77.1	*158*
- 2-3 times/weeks or more	33.2	*68*	20.2	*41*	38.7	*79*	19.0	*39*
- Not reported	6.7	*14*	3.4	*7*	3.6	*7*	3.9	*8*
Had periods of heavy drinking								
- No	41.3	*85*	74.0	*152*	54.5	*112*	72.9	*149*
- Yes	45.8	*94*	19.7	*40*	38.4	*79*	23.9	*49*
- Not reported	12.9	*26*	6.3	*13*	7.1	*15*	3.2	*7*
More alcohol in last year than previous year								
- No	47.5	*97*	62.5	*128*	40.0	*82*	58.4	*120*
- Yes	41.4	*85*	30.3	*62*	50.0	*103*	35.2	*72*
- Not reported	11.1	*23*	7.2	*15*	10.0	*21*	6.4	*13*
Been under arrest for more than 3 days****								
- No	68.3	*140*	91.9	*188*	75.4	*155*	87.4	*179*
- Yes	21.6	*44*	6.7	*14*	21.0	*43*	9.0	*18*
- Not reported	10.1	*21*	1.4	*3*	3.6	*7*	3.6	*7*

* Frequencies given in italics

** Age distribution of cases and controls are the same because of matching

*** Widowed men compose only 11% of this group

**** In Russia the police are not allowed to hold anyone under arrest for more than three days without opening a criminal case.

Table 6 (continued) – Frequency distribution (%) of cases and controls by cause and selected variables

	Circulatory disease				External causes			
	Cases (N=205)		Controls (N=205)		Cases (N=333)		Controls (N=333)	
Health status								
Health seriously affects normal activities								
- No	54.8	*112*	69.7	*143*	71	*146*	73.8	*151*
- Yes	44.2	*91*	29.8	*61*	25.1	*51*	25.5	*52*
- Not reported	1	*2*	0.5	*1*	3.9	*8*	0.7	*1*
Difficulty in climbing stairs to the 5th floor								
- No	69.2	*142*	93.3	*191*	92.9	*190*	92.3	*189*
- Yes	17.3	*35*	4.3	*9*	3.2	*7*	1.9	*4*
Not reported	13.5	*28*	2.4	*5*	3.9	*8*	5.8	*12*
Evaluated health: bad or very bad								
- No	75.5	*155*	89.4	*183*	88.8	*182*	92.9	*190*
- Yes	23.1	*47*	10.6	*22*	9.3	*19*	6.8	*14*
- Not reported	1.4	*3*	0	*0*	1.9	*4*	0.3	*1*

Table 7 – Mortality odds ratios (95% confidence interval) by cause in men aged 20-55 by social status variables

Social status variables	Circulatory diseases, 201 pairs		External causes, 328 pairs	
	Model 1: No adjustment	Model 2: Adjustment for other variables	Model 1: No adjustment	Model 2: Adjustment for other variables
Employed or student	1.00	1.00	1.00	1.00
Unemployed	2.45 (1.36-4.43)	2.63 (1.46-4.73)	3.49 (2.19-5.54)	3.01 (1.91-4.77)
Disability pensioner	4.21 (2.10-8.44)	4.14 (2.03-8.46)	1.79 (0.74-4.35)	1.56 (0.63-3.84)
Married	1.00	1.00	1.00	1.00
Divorced or widowed	1.36 (0.68-2.70)	0.90 (0.42-1.94)	3.30 (1.75-6.25)	2.53 (1.30-4.92)
Never married	1.09 (0.49-2.41)	0.74 (0.31-1.77)	2.07 (1.16-3.69)	1.68 (0.91-3.13)
University	1.00	1.00	1.00	1.00
Secondary specialised	1.39 (0.73-2.65)	1.44 (0.71-2.91)	1.57 (0.86-2.85)	1.39 (0.73-2.65)
Secondary and lower levels	1.80 (1.07-3.02)	1.59 (0.91-2.77)	1.69 (1.04-2.74)	1.41 (0.84-2.36)

Note : Model 1 is based on exactly the same set of observations as model 2. (Values of all the variables used in the right part of regression equation are non-missing).

Table 8 - Mortality odds ratios (95% confidence interval) by cause in men aged 20-55 by behavioural variables

Behavioural variables		Circulatory diseases, 140 pairs		External causes, 249 pairs	
		Model 1: No adjustment	Model 2: Adjustment for other variables	Model 1: No adjustment	Model 2: Adjustment for other variables
Smoking	No	1.00	1.00	1.00	1.00
	Yes	2.44 (1.36-4.36)	2.03 (1.06-3.88)	1.68 (1.10-2.56)	1.27 (0.80-2.01)
Alcohol 2-3 times/week or more	No	1.00	1.00	1.00	1.00
	Yes	1.57 (0.91-2.72)	0.86 (0.43-1.71)	2.61 (1.69-4.03)	1.95 (1.23-3.11)
Periods of heavy drinking	No	1.00	1.00	1.00	1.00
	Yes	4.29 (2.40-7.67)	3.51 (1.86-6.64)	2.69 (1.72-4.22)	1.85 (1.13-3.04)
Being under arrest for 3 days or more	No	1.00	1.00	1.00	1.00
	Yes	4.67 (1.93-11.27)	2.84 (1.11-7.29)	2.58 (1.52-4.38)	1.78 (1.00-3.15)

Note : Model 1 is based on exactly the same set of observations as model 2. (Values of all the variables used in the right part of regression equation are non-missing).

Table 9 - Mortality odds ratios (95% confidence interval) by cause in men aged 20-55 for composite model including social and behavioural variables

		Circulatory diseases, 134 pairs		External causes, 247 pairs	
		Model 1: No adjustment	Model 2: Adjustment for other variables	Model 1: No adjustment	Model 2: Adjustment for other variables
Employed or student		1.00	1.00	1.00	1.00
Unemployed		1.91 (1.03-3.56)	1.58 (0.77-3.26)	3.63 (2.17-6.08)	2.52 (1.43-4.43)
Disability pensioner		3.81 (1.77-8.16)	3.59 (1.47-8.75)	1.45 (0.58-3.65)	1.13 (0.42-3.04)
Married		1.00	1.00	1.00	1.00
Divorced or widowed		1.10 (0.49-2.45)	0.97 (0.37-2.57)	3.54 (1.71-7.35)	1.93 (0.85-4.39)
Never married		1.17 (0.50-2.79)	1.56 (0.53-4.50)	2.19 (1.13-4.22)	1.99 (0.95-4.17)
University		1.00	1.00	1.00	1.00
Secondary specialised		1.89 (0.63-4.69)	1.29 (0.48-3.63)	1.46 (0.76-2.81)	1.14 (0.55-2.39)
Secondary and lower levels		2.19 (1.14-4.19)	1.21 (0.55-2.67)	1.58 (0.95-2.63)	1.10 (0.55-2.39)
Smoking	No	1.00	1.00	1.00	1.00
	Yes	2.44 (1.36-4.36)	1.99 (0.99-3.95)	1.68 (1.10-2.56)	1.24 (0.76-2.02)
Alcohol 2-3/week or more	No	1.00	1.00	1.00	1.00
	Yes	1.65 (0.95-2.88)	1.02 (0.49-2.12)	2.61 (1.69-4.03)	1.51 (0.91-2.51)
Periods of heavy drinking	No	1.00	1.00	1.00	1.00
	Yes	4.21 (2.35-7.55)	3.54 (1.76-7.13)	2.65 (1.69-4.17)	1.75 (1.02-3.00)
Being under arrest for 3 days or more	No	1.00	1.00	1.00	1.00
	Yes	4.67 (1.93-11.27)	2.20 (0.83-5.82)	2.72 (1.59-4.67)	1.52 (0.81-2.82)

Note: Model 1 is based on exactly the same set of observations as model 2. (Values of all the variables used in the right part of regression equation are non-missing).