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Alcohol poisoning is a main determinant of recent mortality trends in Russia: evidence from a detailed analysis of mortality statistics and autopsies

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Background The changes in Russian mortality rates during the last two decades are unprecedented in a modern industrialized country. Although these fluctuations have attracted much interest, trends for major groups of causes of death have been analysed while trends in specific causes of death might shed light on the underlying determinants.

Methods We analysed trends in total and cause-specific mortality in Russia for 1991–2006. The records of 24 836 forensic autopsies carried out during the period 1990–2004 in the city of Barnaul were analysed with respect to blood alcohol level.

Results Diseases of the circulatory system (in the age group 35–69 years) and external causes (in the age group 15–34 years) were the main contributors to the fluctuations in Russian mortality rates observed in 1991–2006. The largest relative changes were for conditions directly related to alcohol intake. Among cardiovascular diseases, fluctuations were due to 'other forms' of acute and chronic ischaemia, and to atherosclerotic heart disease, while rates of myocardial infarction were low and relatively constant. In the autopsy series a very high proportion of decedents whose death was attributed to 'other' or 'not classified' cardiovascular diseases had lethal or potentially lethal concentrations of ethanol in blood.

Conclusions The increases in mortality in 1991–94 and in 1998–2003 coincided with economic and societal crisis, while decreases in 1994–98 and 2003–06 correlate with improvement in the economic situation. Excessive alcohol intake is a major cause of premature male Russian mortality, although many alcohol-related deaths are wrongly attributed to diseases of the circulatory system.

Keywords alcohol intoxication, mortality, Russia, cardiovascular diseases, epidemiology

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Introduction

Mortality rates in Russian middle-aged men were among the highest in the world in the late 1980s.[1] In addition, sharp increases in mortality rates have occurred during 1991–94,[2] which was followed by a steep decline between 1994 and 1998, with a new increase emerging between 1998 and 2001.[2,3] More recent data have not been published. It has been estimated that the increase in mortality during the period 1991–2001 has led to 2.5–3 million extra deaths in young and middle-aged Russians.[3] Evidence has accumulated that alcohol consumption is the main determinant of Russian mortality patterns.[2,4–7] Other proposed explanations include societal factors, linked to general economic and social uncertainty.[8] However, these two hypotheses are complementary, as alcohol consumption patterns, most likely, correlate with societal factors.

Although the fluctuations in Russian mortality during the last two decades have attracted much interest, only trends for major groups of causes of death have been analysed. Here we examine in detail the disease-specific rates and trends for the period 1991–2006 and, in particular for the period 1998–2006. We also analysed the cause of death and the level of ethanol in blood in 24 836 decedents who underwent forensic autopsy.

Materials and methods

The data were obtained from the State Statistics Committee and include numbers of deaths by cause, sex, 5-year age group and calendar year together with corresponding population denominators. The disease categories in classifications used in Russia before and after 1999 closely correspond to ICD-9[9] and ICD-10[10] codes and are comparable (Table A1).[3]

All death rates were standardized for age according to the World Standard population.[11] Population estimates for 1991–2001 were based on the 1989 census, while the population estimates for 2002–06 were computed on the basis of the 2002 census. In general rates based on the 2002 census are smaller than rates based on 1989 census (Table A2).

All consecutive records of 24 836 forensic autopsies carried out during 1990–2004 in Barnaul were retrieved from the local department of Forensic Medicine and data on cause of death and concentration of ethanol in blood were abstracted. Barnaul is a city with a population of about 600 000 and mortality rates and trends close to the Russian average.[3] As a rule forensic autopsy is performed when a criminal offence is suspected, or when deaths occur outside hospital and when the cause of death is unclear and cannot be determined by observation or external examination.

During 1991–2004 the autopsy rate in Barnaul was 39% for men and 24% for women. More than 80% of decedents from external causes and 36% of men and 20% of women, who died from vascular diseases underwent autopsy. The autopsy rate was high among young adults who died from vascular diseases. It was lower in middle-aged adults and low in old adults (Table A3).

Results

Out of 1 148 561 male deaths recorded in 2006 in Russia 49% (558 231) were from diseases of the circulatory system, 19% (219 216) from external causes, 13% (152 828) from cancer. Of 1 018 142 women who died in 2006 in Russia 66% (673 952) died from diseases of the circulatory system, 13% (132 305) from cancer and 6%, (63 596) from external causes.

Mortality trends in young adults (age group 15–34 years)

The overall mortality rate in young men increased between 1998 and 2000 by 22%. While a decrease was observed during the period 2000–02, the rate started to increase again in 2003–05, followed by a small decrease in 2006. Among young women, an increase in mortality from all causes was still present in 2005 and the mortality rate was higher than in 1994 (Supplementary Table 1).

Overall, mortality trends in this age group were driven by external causes. In men the sharpest increase was observed for suicides. There were also substantial increases in mortality from poisoning by alcohol, transport accidents and homicides. These increases were followed by a steep decline. The increase in the death rates from circulatory diseases was mainly due to 'other forms' of acute and chronic ischaemia, as well as of atherosclerotic heart disease, while mortality from myocardial infarction slightly declined. A marked increase in death rates has occurred for pneumonia, tuberculosis, alcoholic liver disease and cirrhosis (Supplementary Table 1).

Mortality trends in middle-aged adults (35–69 years)

The overall mortality rate increased between 1998 and 2003 by 28% and 21% in men and women, respectively. In 2003 a small downturn in rates has began to appear. The main determinants of trends were diseases of the circulatory system (Supplementary Table 1, Figure 1). The increase and subsequent decrease in mortality from circulatory diseases was predominantly due to 'other forms' of acute and chronic ischaemia, atherosclerotic heart disease and cerebrovascular disease. Death rates from myocardial infarction remained relatively constant since 1998 (Supplementary Table 1, Figure 2).

The increase in mortality from external causes, which started in 1998, continued until 2002. After 2002 a small decline was observed for both sexes. The sharpest

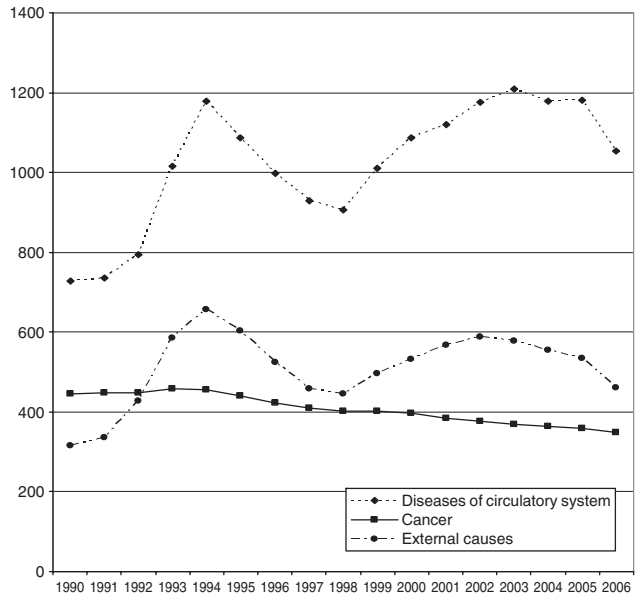

Figure 1 Age-standardized mortality rates (per 100 000) from major causes of death—Russian men aged 35–69 years, 1990–2006

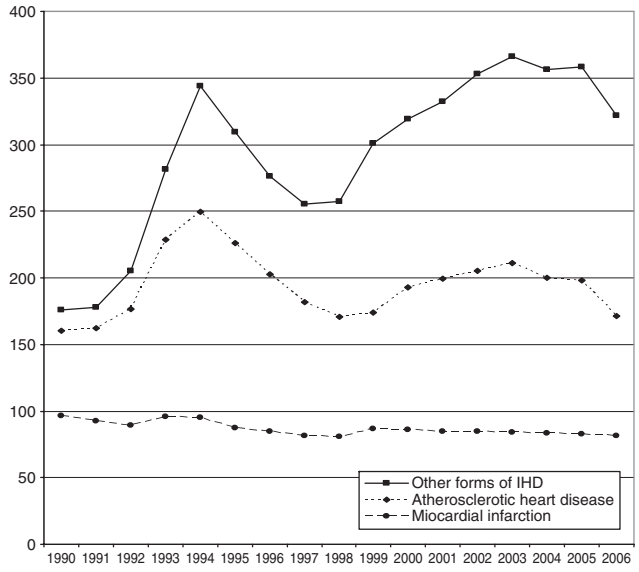

Figure 2 Age-standardized mortality rates (per 100 000) from selected cardiovascular diseases—Russian men aged 35–69 years, 1990–2006

fluctuation occurred for poisoning from alcohol suicides, pneumonia, tuberculosis, alcoholic liver disease and liver cirrhosis (Supplementary Table 1).

Since the early 1990s a downturn has been observed in the trend for cancer mortality especially for lung and stomach cancer (Supplementary Table 1).

Blood alcohol levels in forensic autopsies

We analysed records for 22 658 forensic autopsies of adults above 15 years old at death, performed in Barnaul during 1990–2004 and whose blood was tested for ethanol (Table 1). Among 5732 autopsied men in the aged 35–69 years who were reported to have died from circulatory diseases, 2781 (49%) had ethanol detected in their blood. In 14% blood concentration of ethanol was 4 g/l or more and 5 g/l or more in 7%. Among 1928 autopsied women of the same age, whose deaths were attributed to one of the circulatory diseases, 834 (43%) had ethanol detected in their blood; in 13% the concentration was 4 g/l or more and 5 g/l or more in 6%. These proportions were particularly high among those whose death was attributed to other forms of acute ischaemia, acute ischaemia, unspecified, atherosclerotic heart disease and sudden cardiac death. The proportion of autopsies with ethanol detected was low among those dying from myocardial infarction.

Of 5880 autopsied men aged 35–69 years, whose blood was tested and who were reported to have died from external causes 76% had ethanol detected in their blood. In 25% of them ethanol concentration was 4.0 g/l or more and in 13% it was 5.0 g/l or more. Among the corresponding 1804 autopsied women tested for ethanol who died from external causes 65% had ethanol detected in their blood. In 24% the concentration was 4.0 g/l or more and in 12% it was 5.0 g/l or more. Eighty-one per cent of middle-aged men and women who died from alcohol poisoning had ethanol concentration of 4 g/l or more, and about 50% had 5 g/l or more.

A similar pattern was observed among young adults and in individuals aged 70 years or more, although results were less stable because of small numbers.

Discussion

The contribution of major groups of causes of death to the increase in Russian mortality in 1998–2003 was similar to that observed in 1991–94, with diseases of the circulatory system and external causes explaining a large proportion of these trends.[2,3] The trends were similar in all administrative regions of Russia. The mortality rates and trends in Siberia, where Barnaul is situated, are very close to average Russian rates.[3] Increases in mortality rates coincided with economic crisis in Russia, while the decreases in 1994–98 and 2003–06 correlate with improvements in the economic situation.[12,13] There is strong evidence of a key role of alcohol consumption in explaining a large part of these trends. Recently, evidence has emerged that the trends may have been influenced by consumption of alcohol products not intended for consumption.[7,13]

The trends in mortality for young adults are sensitive to the population estimates used. In 2002 the rates for women based on the 2002 census are 4–5% lower than the rates based on the 1989 census (Table A2). The population estimates before the 2002 census did not included migrants, while deaths among migrants were included in mortality figures, and it was suggested

Table 1 Results of the analyses of 24 836 forensic autopsies performed in Barnaul, Russia during 1990–2004

		Men					Women				
Cause of death	**Age years**	Number of autopsies	Ethanol tested	*N* (%) with any ethanol detected	*N* (%) with ethanol 4.0+g/l	*N* (%) with ethanol 5.0+g/l	Number of autopsies	Ethanol tested	*N* (%) with any ethanol detected	*N* (%) with ethanol 4.0+g/l	*N* (%) with ethanol 5.0+g/l
I00–I99[a]	15–34	243	235	125 (53.2)	38 (16.2)	21 (8.9)	63	62	26 (41.9)	6 (9.7)	4 (6.5)
	35–69	5914	5732	2781 (48.5)	802 (14.0)	394 (6.9)	2012	1928	834 (43.3)	250 (13.0)	107 (5.5)
	70+	566	537	184 (34.3)	20 (3.7)	3 (0.6)	729	688	157 (22.8)	31 (4.5)	8 (1.2)
I24.8[b] &	15–34	180	176	95 (54.0)	31 (17.6)	17 (9.7)	43	43	20 (46.5)	6 (14.0)	4 (9.3)
124.9[c] & 125.1[d]	35–69	4462	4368	2220 (50.8)	670 (15.3)	340 (7.8)	1514	1472	652 (44.3)	213 (14.5)	93 (6.3)
	70^{+}	386	374	128 (34.2)	13 (3.5)	3 (0.8)	531	520	110 (21.2)	23 (4.4)	6 (1.2)
146.1[e]	15–34	21	20	18 (90.0)	4 (20.0)	2 (10.0)	7	7	5 (71.4)	0 (0.0)	0 (0.0)
	35–69	538	520	267 (51.3)	101 (19.4)	42 (8.1)	144	139	77 (55.4)	25 (18.0)	8 (5.8)
	70+	46	45	19 (42.2)	4 (8.9)	0 (0.0)	35	34	8 (23.5)	3 (8.8)	1 (2.9)
I21[f]&	15–34	21	19	2 (10.5)	0 (0.0)	0 (0.0)	5	5	0 (0.0)	0 (0.0)	0 (0.0)
I22[g], I25.2[h]	35–69	428	506	169 (33.4)	16 (3.2)	8 (1.6)	128	121	40 (33.1)	5 (4.1)	3 (2.5)
	70+	53	51	6 (11.8)	0 (0.0)	0 (0.0)	64	60	8 (13.3)	0 (0.0)	0 (0.0)
I60–I69[i]	15–34	14	13	8 (61.5)	1 (7.7)	0 (0.0)	2	2	0 (0.0)	0 (0.0)	0 (0.0)
	35–69	222	197	72 (36.5)	7 (3.6)	2 (1.0)	154	135	42 (31.1)	4 (3.0)	2 (1.5)
	70+	46	34	13 (38.2)	2 (5.9)	0 (0.0)	55	45	19 (42.2)	5 (11.1)	1 (2.2)
V01–Y98[j]	15–34	2336	2095	1480 (70.6)	272 (13.0)	122 (5.8)	594	519	326 (62.8)	55 (10.6)	29 (5.6)
	35–69	6357	5880	4477 (76.1)	1448 (24.6)	735 (12.5)	1983	1804	1171 (64.9)	434 (24.1)	213 (11.8)
	70+	279	259	107 (41.3)	21 (8.1)	11 (4.2)	263	240	66 (27.5)	16 (6.7)	8 (3.3)
Y20–Y34[k]	15–34	916	828	570 (68.8)	59 (7.1)	19 (2.3)	241	208	136 (65.4)	15 (7.2)	6 (2.9)
	35–69	2190	1980	1383 (69.8)	192 (9.7)	47 (2.4)	709	635	348 (54.8)	46 (7.2)	14 (2.2)
	70+	89	80	32 (40.0)	1 (1.3)	0 (0.0)	77	69	19 (27.5)	5 (7.2)	2 (2.9)
X60–X84[l]	15–34	115	95	66 (69.5)	2 (2.1)	0 (0.0)	18	16	11 (68.8)	0 (0.0)	0 (0.0)
	35–69	406	393	237 (60.3)	13 (3.3)	5 (1.3)	89	82	38 (46.3)	2 (2.4)	0 (0.0)
	70+	48	47	17 (36.2)	0 (0.0)	0 (0.0)	33	32	3 (9.4)	0 (0.0)	0 (0.0)
X40–X49[m]	15–34	395	362	203 (56.1)	28 (7.7)	15 (4.1)	136	115	61 (53.0)	4 (3.5)	2 (1.7)
Y10–Y19[n]	35–69	930	847	576 (68.0)	92 (10.9)	30 (3.5)	331	285	138 (48.4)	22 (7.7)	10 (3.5)
(excl X45 & Y15)	70+	43	38	12 (31.6)	1 (2.6)	0 (0.0)	53	45	11 (24.4)	1 (2.2)	0 (0.0)

X45, Y15	15–34	150	143	138 (96.5)	105 (73.4)	67 (46.9)	34	32	30 (93.8)	19 (59.4)	15 (46.9)
	35–69	1142	1106	1072 (96.9)	898 (81.2)	571 (51.6)	391	381	367 (96.3)	308 (80.8)	181 (47.5)
	70+	20	20	20 (100.0)	16 (80.0)	11 (55.0)	17	16	16 (100.0)	10 (62.5)	6 (37.5)
X85–Y09[p]	15–34	415	370	284 (76.8)	42 (11.4)	10 (2.7)	77	69	42 (60.9)	7 (10.1)	3 (4.3)
	35–69	675	624	485 (77.7)	97 (15.5)	22 (3.5)	191	177	112 (63.3)	25 (14.1)	2 (1.1)
	70+	22	21	7 (33.3)	1 (4.8)	0 (0.0)	21	21	7 (33.3)	0 (0.0)	0 (0.0)
X30–X39[q]	15–34	38	30	22 (73.3)	3 (10.0)	1 (3.3)	14	13	8 (61.5)	2 (15.4)	0 (0.0)
	35–69	201	177	147 (83.1)	21 (11.9)	7 (4.0)	68	58	47 (81.0)	12 (20.7)	2 (3.4)
	70+	12	10	6 (60.0)	0 (0.0)	0 (0.0)	8	8	3 (37.5)	0 (0.0)	0 (0.0)
W65–W74[r]	15–34	127	112	95 (84.8)	17 (15.2)	4 (3.6)	18	15	13 (86.7)	4 (26.7)	1 (6.7)
	35–69	204	190	176 (92.6)	35 (18.4)	9 (4.7)	28	27	21 (77.8)	5 (18.5)	1 (3.7)
	70+	2	2	1 (50.0)	0 (0.0)	0 (0.0)	1	1	1 (100.0)	0 (0.0)	0 (0.0)
C00–C97[s]	15–34	10	6	1 (16.7)	0 (0.0)	0 (0.0)	4	2	1 (50.0)	0 (0.0)	0 (0.0)
	35–69	283	238	90 (37.8)	9 (3.8)	6 (2.5)	142	116	51 (44.0)	3 (2.6)	0 (0.0)
	70+	45	32	15 (46.9)	1 (3.1)	0 (0.0)	59	47	18 (38.3)	3 (6.4)	1 (2.1)
Other causes	15–34	295	219	142 (64.8)	21 (9.6)	7 (3.2)	81	54	33 (61.1)	5 (9.3)	2 (3.7)
	35–69	1774	1374	624 (45.4)	84 (6.1)	37 (2.7)	549	409	188 (46.0)	31 (7.6)	17 (4.2)
	70+	127	84	19 (22.6)	0 (0.0)	0 (0.0)	128	98	25 (25.5)	2 (2.0)	1 (1.0)
All causes	15–34	2884	2555	1748 (68.4)	331 (13.0)	150 (5.9)	742	637	386 (60.6)	66 (10.4)	35 (5.5)
	35–69	14 328	13 224	7972 (60.3)	2343 (17.7)	1172 (8.9)	4686	4257	2244 (52.7)	718 (16.9)	337 (7.9)
	70+	1017	912	325 (35.6)	42 (4.6)	14 (1.5)	1179	1073	266 (24.8)	52 (4.8)	18 (1.7)

[a]Diseases of the circulatory system.
[b]Other forms of acute ischaemic heart disease.
[c]Acute ischaemic heart disease, unspecified.
[d]Atherosclerotic heart disease.
[e]Sudden cardiac death, so described.
[f]Acute myocardial infarction.
[g]Subsequent myocardial infarction.
[h]Old myocardial infarction.
[i]Cerebrovascular diseases.
[j]External causes.
[k]Event of undetermined intent (excl. poisonings).
[l]Intentional self-harm.
[m]Accidental poisoning by and exposure to noxious substances.
[n]Poisoning by and exposure to noxious substances, undetermined intent (exc.Y15).
[o]Poisoning by and exposure to alcohol, undetermined intent.
[p]Assault.
[q]Exposure to forces of nature.
[r]Accidental drowning and submersion.
[s]Malignant neoplasms.
Proportion (%) of deceased who had ethanol in blood.

that mortality rates in large cities, are overestimated because of the presence of migrants in the numerator but not in the denominator.[14]

The most important advantage of our mortality time-trend study is that we examined trends in specific subcategories of ischaemic heart disease, while in all previous studies only trends in aggregated ischaemic heart diseases were studied.

We have shown that fluctuations in the death rates from vascular diseases were due to changes in mortality from 'other forms' of acute and chronic ischaemia, and atherosclerotic heart disease. Death rates from myocardial infarction did not follow the fluctuations observed for total mortality. Furthermore, in Russia the proportion of deaths from myocardial infarction among all deaths from cardiovascular disease is lower than in Western countries (men: 6% vs 20–35%; women: 4% vs 15–30%),[15] while the proportion of deaths from other forms of acute or chronic ischaemia and atherosclerotic heart disease is higher. Such 'other' and 'unspecified' circulatory causes of death represent more than 50% of all deaths from circulatory diseases in Russia. These observations led us to conclude that the rates for the subcategories of ischaemic heart disease, other than myocardial infarction, are overestimated and that some of these deaths are probably caused by alcohol poisoning. This prompted our decision to carry out the autopsy study.

The results of the analysis of the forensic autopsies support the hypothesis that alcohol poisoning may play a more important role in mortality in Russia than that suggested by the analysis of death certificates. We have found lethal or potentially lethal blood concentrations of ethanol in an exceptionally high proportion of autopsies for those whose death was attributed to 'other' or 'unspecified' vascular diseases, suggesting that these deaths occurred from alcohol poisoning rather than from vascular disease.

Deaths due to the toxic effects of acute over-ingestion of alcohol usually involve blood ethanol concentrations of 0.35% and higher. However, a non-tolerant individual may die from a blood ethanol level as low as 0.20–0.30%.[16] According to Russian classification ethanol concentration in blood ranging from 3 to 5 g/l causes heavy alcohol intoxication, coma and is potentially lethal. An ethanol concentration of 5 g/l or more is absolutely lethal.[17] However it is not realistic to firmly establish a criterion for lethal concentration of ethanol in blood (and hence death definitely due to alcohol poisoning). A conservative criterion, which we propose, is 4 g/l or more, although for some people lesser concentrations would be lethal. This provides a reasonable trade-off, which will allow avoiding extreme over- and underestimation of death caused by alcohol poisoning.

The rate of forensic autopsies in Barnaul was quite high at the time of our study. Nevertheless, the results of our autopsy study, though impressive in terms of numbers, could not be extrapolated to Russia as a whole. However our observations could help in the design and interpretation of future epidemiological studies. We have pointed out, that the results of blood testing, showing potentially lethal or lethal concentrations of ethanol, do not result in a re-classification of the cause of death.

Similar results are reported in a smaller study from Kursk.[18] The results of a recent autopsy study which has shown that none of 89 deaths from cardiovascular diseases had alcohol levels above 4 g/l, may be explained by a very small sample size.[19]

It was hypothesized, that an increase in alcohol consumption in Russia caused the increase in mortality from diseases of the circulatory system.[2,4–7,19] A cohort study from Moscow which reported an increase in the risk of death from vascular diseases associated with alcohol consumption, was based on official death certificates, which we have described as potentially erroneous.[20] The author of another study from Novosibirsk analysed the association of alcohol consumption with mortality from aggregated ischaemic heart diseases, but not from subcategories of this 'broad' group of cause, such as myocardial infarction, other forms of acute and chronic ischaemia, atherosclerotic heart disease.[21]

The decline in mortality from cancer, especially from lung cancer, could also be partly explained by the under-diagnosis and under-reporting of deaths from this cause. An additional explanation of this observation in men is the gradual decline in the levels of tar in Russian cigarettes, which started in the late 1980s. It has been suggested that the decline in lung cancer followed a path determined by changes in rates of smoking in the post-war period, and is expected to begin to rise again in the first decade of the 21st century.[22] However we now see that the decrease in mortality from lung cancer has continued in 2005 and 2006.

In our autopsy series the proportion of autopsies with lethal blood concentrations of ethanol was very high among those whose deaths were attributed to an external cause. Questions arise as to the actual cause of death in theses cases. For example, where the cause was attributed to freezing, did the person die from alcohol poisoning and was subsequently found in a frozen state, or did they freeze to death in a state of heavy alcohol intoxication? Similarly, was the person killed by alcohol and subsequently found in a fire, or were they burned to death in an intoxicated state? Either way, many deaths from external causes would probably not have occurred if the persons concerned had not been drunk.

Our analysis of cause-specific patterns and trends in Russian mortality has suggested that a substantial proportion of deaths from 'vaguely' defined causes coded as diseases of the circulatory system were in fact due to poisoning by alcohol. In addition, alcohol poisoning, is most probably an actual cause of death for an appreciable proportion of deaths from external causes. Thus, alcohol plays a far more important role

in Russian mortality than can be judged from the mortality statistics alone.

Supplementary Data

Supplementary data are available at *IJE* online.

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Conflicts of interest: None declared.

KEY MESSAGES

- Diseases of circulatory system and external causes are the main contributors of the increases in mortality observed among Russian men since 1991.
- Among cardiovascular diseases, fluctuations were due to 'other forms' of acute and chronic ischaemia, and to atherosclerotic heart disease, while rates of myocardial infarction were low and relatively constant.
- In a large autopsy series a very high proportion of decedents whose death was attributed to 'other' or 'not classified' cardiovascular diseases had lethal or potentially lethal concentrations of ethanol in blood.
- Excessive alcohol intake is a major cause of male Russian mortality, although many deaths from this cause are wrongly attributed to diseases of circulatory system.

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Table A1 Correspondence between Russian and international classifications of diseases

Cause	Russian classification 1988–98	ICD-9	Russian classification 1999–2004	ICD-10
Infectious and parasitic diseases	1–44	001–139	1–19, 22–55	A00–A32, A35–A99, B00–B99
Tuberculosis	9–13	010–018	9–15	A15–A19
Cancer	45–66	140–208	56–88	C00–C97
Lip, oral cavity and pharynx	45	140–149	56	C00–C14
Oesophagus	46	150	57	C15
Stomach	47	151	58	C16
Colon	49	153	60	C18
Rectum	50	154	61	C19–C21
Larynx	52	161	65	C32
Trachea, bronchus and lung	53	162	66	C33, C34
Breast	57	174	72	C50
Cervix	58	180	73	C53
Prostate	61	185	77	C61
Urinary tract	63	188, 189.0	79–81	C64–C68
Leukaemia	65	204–208	87	C91–C95
Diseases of the blood and blood–forming organs	71, 72	280–289	90–92	D50–D89
Endocrine, nutritional and metabolic diseases	68–70	240–279	93–96	E00–E90
Diabetes mellitus	68	250	93	E10–E14
Mental and behaviour disorders	73–77	290–319	97–103	F01–F99
Due to use of alcohol	73, 75	291, 303	97, 98	F10
Diseases of the nervous system and sense organs	78–83	320–389	104–111	G00–G98
Diseases of the circulatory system	84–102	390–459	115–147	I00–I99
Rheumatic heart disease	84, 85	390–398	115, 116	I00–I02, I05–I09
Hypertensive disease	86– 89	40–405	117–120	I10–I13, I15
Miocardial infarction	90, 91	410	121, 123	I21–I23
Atherosclerotic heart disease	92, 93	414.0	125	125.0–125.1
Other forms of acute and chronic ischaemia	94, 95	411–413, 414.1, 414.8, 414.9	127, 129	I20, I24, I25.2–125.9
Ischaemic heart disease	90–95	410–414	121–129	I20–I25
Cerebrovascular disease	98, 99	430–438	133–141	I60–I69

(continued)

Table A1 Continued

Cause	Russian classification 1988–98	ICD-9	Russian classification 1999–2004	ICD-10
Diseases of the respiratory system	20, 103–114	034, 460–519	148–164	J00–J99
Acute respiratory infections	103	460–466	148, 155	J00–J01, J02.8–9, J20–J22
Pneumonia	105–107	480–483, 485,486	151–153, 154	J12–J16, J18
Chronic lower respiratory diseases	108–110	490–496	156–160	J40–J47
Lung diseases due to external agents	111	500–508	161	J60–J70
Suppurative and necrotic conditions of lower respiratory tract	112	510, 513	163	J85, J86
Diseases of the digestive system	115–127	520–579	165–179	K00–K93
Alcohol liver diseases	122	571.0–571.3	173	K70
Non-alcoholic fibrosis and cirrhosis of liver	123	571.5–571.6	174	K74
Gastric and duodenal ulcer	115, 116	531–533	165–167	K25–K27
Gastritis and duodenitis	117	535	168	K29
Deseases of appendix	118	540–543	169	K35–K38
Hernia	119	550–553	170	K40–K46
Non-infective enteritis and colitis	120	555–558	171	K50–K52
Intestinal obstruction	121	560	172	K56
Cholelithiasis and cholecystisis	124	574, 575.0	176, 177	K80, K81
Diseases of pancreas	126	577	178	K85, K86
Diseases of the urinary system	128–132	580–599	185–191	N00–N39
Urolithiasis	131	592, 594	190	N20–N23
Pregnancy, childbirth and the puerperium	135–141	630–676	21, 194–205	A34, O00–O99
Perinatal conditions	151–157	764–779	206–216	P05–P96
Congenital anomalies	145–150	740–759	217–225	Q00–Q99
Symptom, senility, ill–defined and unknown cause	158, 159	780–799	226–228	R00–R99
All external causes	160–175	E800–E999	239–255	V01–Y89
Transport accidents	160, 161, 162	E800–E807, E810–E848	239, 240, 241	V01–V99
Accidental poisoning by alcohol	163	E860	247	X45
Other accidental poisoning	164	E850–E858, E861–E869	248	X40–X44, X46–X49
Accidental falls	166	E880–E888	242	W00–W19
Accidents caused by fire	167	E890–E899	246	X00–X09
Accidental drowing	168	E910	243	W65–W74
Suicides	173	E950–E959	249	X60–X84
Homicides	174	E960–E969	250	X85–V09
Injury of undetermined intent	175	E980–E989	251	Y10–Y34

Table A2 Mortality rates in Russia in 2002 computed using two different population estimates based on the censuses carried out in 1989 and 2002

	Census 1989	Census 2002	Difference %[a]	Census 1989	Census 2002	Difference %
	Men 15–34 years			Women 15–34 years		
All causes	442	434	1.84	125	120	4.17
Infectious and parasitic diseases	20.5	20.3	0.99	5.88	5.67	3.70
Tuberculosis	17.5	17.3	1.16	4.40	4.24	3.77
Cancer	11.7	11.5	1.74	11.5	11.0	4.55
Diseases of the circulatory system	37.1	36.8	0.82	11.7	11.2	4.46
Myocardial infarction	1.38	1.37	0.73	0.22	0.21	4.76
Atherosclerotic heart disease	1.47	1.47	0.00	0.39	0.37	5.41
Other forms of acute and chronic ischaemia	9.25	9.18	0.76	2.06	1.98	4.04
Cerebrovascular diseases	5.04	4.98	1.20	2.39	2.30	3.91
Diseases of the respiratory system	11.5	11.3	1.77	4.39	4.23	3.78
Pneumonia	9.18	9.08	1.10	3.35	3.23	3.72
Chronic lower respiratory diseases	0.87	0.86	1.16	0.38	0.37	2.70
Diseases of the digestive system	13.2	13.0	1.54	5.09	4.89	4.09
Alcohol liver disease	2.26	2.24	0.89	1.02	0.98	4.08
Non-alcoholic fibrosis and cirrhosis of liver	3.89	3.86	0.78	1.74	1.67	4.19
External causes	309	303	1.98	68.5	66.0	3.79
Transport accidents	55.3	54.0	2.41	16.2	15.6	3.85
Accidental poisoning by alcohol	18.2	18.1	0.55	4.01	3.86	3.89
Other accidental poisoning	19.5	19.1	2.09	5.07	4.88	3.89
Suicides	70.0	68.5	2.19	10.0	9.67	3.41
Homicides	48.3	47.4	1.90	13.4	12.9	3.88
	Men 35–69 years			Women 35–69 years		
All causes	2673	2663	0.38	905	896	1.00
Infectious and parasitic diseases	78.4	78.5	−0.13	12.1	12.0	0.83
Tuberculosis	72.9	73.1	−0.27	8.97	8.92	0.56
Cancer	378	375	0.80	184	183	0.55
Stomach cancer	55.6	55.2	0.72	20.8	20.6	0.97
Colorectal cancer	31.6	31.4	0.64	22.6	22.4	0.89
Lung cancer	121	120	0.83	10.9	10.8	0.93
Breast cancer	–	–	–	40.0	39.6	1.01
Cervical cancer	–	–	–	10.7	10.6	0.94
Prostate cancer	12.0	11.9	0.84	–	–	–
Diseases of the circulatory system	1183	1176	0.60	434	429	1.17
Myocardial infarction	85.0	84.4	0.71	23.8	23.5	1.28
Atherosclerotic heart disease	207	205	0.98	70.4	69.6	1.15
Other forms of acute and chronic ischaemia	355	353	0.57	92.0	91.0	1.10
Cerebrovascular diseases	308	305	0.98	158	156	1.28
Diseases of the respiratory system	164	164	0	29.9	29.6	1.01
Pneumonia	87.9	87.7	0.23	16.7	16.5	1.21
Chronic lower respiratory diseases	62.1	61.6	0.81	10.5	10.4	0.96
Diseases of the digestive system	117	117	0.00	52.6	52.1	0.96
Alcohol liver disease	17.5	17.5	0.00	8.18	8.09	1.11
Non-alcoholic fibrosis and cirrhosis of liver	44.0	43.8	0.46	24.4	24.1	1.24
External causes	588	589	−0.17	127	126	0.79
Transport accidents	52.5	52.6	−0.19	14.5	14.5	0.00
Accidental poisoning by alcohol	97.3	97.4	−0.10	26.9	26.6	1.13
Other accidental poisoning	32.2	32.3	−0.31	6.83	6.77	0.89
Suicides	91.7	91.9	−0.22	13.1	13.1	0.00
Homicides	69.7	70.0	−0.43	17.8	17.6	1.14

[a]100% (rate by census 1989 − rate by census 2002)/rate by census 2002.

Table A3 Forensic autopsy rate among deceased from vascular diseases by age in Barnaul in 1990–2004, men and women (15+ years)

	15–34			**35–69**			**70+**			**Total**		
	No. of deaths	No. of autopsies	Percentage of autopsies	No. of deaths	No. of autopsies	Percentage of autopsies	No. of deaths	No. of autopsies	Percentage of autopsies	No. of deaths	No. of autopsies	Percentage of autopsies
Men												
1990	9	4	44.4	638	204	32.0	121	5	4.1	768	213	27.7
1991	16	8	50.0	695	228	32.8	129	11	8.5	840	247	29.4
1992	14	7	50.0	743	220	29.6	124	8	6.5	881	235	26.7
1993	20	17	85.0	953	392	41.1	172	14	8.1	1145	423	36.9
1994	32	26	81.3	1151	493	42.8	176	17	9.7	1359	536	39.4
1995	43	35	81.4	1031	453	43.9	206	18	8.7	1280	506	39.5
1996	33	27	81.8	995	379	38.1	242	26	10.7	1270	432	34.0
1997	33	26	78.8	868	368	42.4	248	26	10.5	1149	420	36.6
1998	17	15	88.2	731	275	37.6	250	29	11.6	998	319	32.0
1999	24	18	75.0	802	374	46.6	282	43	15.2	1108	435	39.3
2000	34	12	35.3	1058	371	35.1	355	37	10.4	1447	420	29.0
2001	36	17	47.2	1148	383	33.4	387	53	13.7	1571	453	28.8
2002	29	8	27.6	1264	584	46.2	390	53	13.6	1683	645	38.3
2003	26	11	42.3	1300	684	52.6	297	60	20.2	1623	755	46.5
2004	21	12	57.1	945	506	53.5	238	51	21.4	1204	569	47.3
Total	387	243	62.8	14 322	5914	41.3	3617	451	12.5	18 326	6608	36.1
Women												
1990	3	2	66.7	405	64	15.8	235	15	6.4	643	81	12.6
1991	8	3	37.5	413	65	15.7	196	8	4.1	617	76	12.3
1992	6	2	33.3	446	65	14.6	221	7	3.2	673	74	11.0
1993	12	10	83.3	569	142	25.0	257	11	4.3	838	163	19.5
1994	5	2	40.0	691	180	26.0	294	24	8.2	990	206	20.8
1995	7	4	57.1	642	165	25.7	311	30	9.6	960	199	20.7
1996	10	7	70.0	615	171	27.8	340	36	10.6	965	214	22.2
1997	16	8	50.0	493	116	23.5	353	40	11.3	862	164	19.0
1998	6	5	83.3	431	108	25.1	368	38	10.3	805	151	18.8
1999	7	6	85.7	413	103	24.9	344	36	10.5	764	145	19.0
2000	4	1	25.0	526	117	22.2	414	29	7.0	944	147	15.6
2001	9	5	55.6	535	117	21.9	454	33	7.3	998	155	15.5
2002	12	4	33.3	592	202	34.1	406	50	12.3	1010	256	25.3
2003	3	0	0.0	575	221	38.4	376	57	15.2	954	278	29.1
2004	6	3	50.0	429	176	41.0	251	31	12.4	686	210	30.6
Total	114	62	54.4	7775	2012	25.9	4820	445	9.2	12 709	2519	19.8