

THEORY AND METHODS

Is the link between alcohol and cardiovascular death among young Russian men attributable to misclassification of acute alcohol intoxication? Evidence from the city of Izhevsk

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Background: Research on the aetiology of sudden cardiac death among young men in Russia strongly suggests an association with binge drinking. However, the possibility remains that such deaths are misclassified as being attributable to cardiovascular disease when they are really caused by acute alcohol poisoning.

Objective: To describe postmortem levels of blood alcohol in Russian men dying from various causes and so determine whether deaths from alcohol poisoning are being misclassified as cardiovascular deaths.

Setting: Ishevsk, capital of the Udmurt Republic, situated in the Ural region of the Russian Federation.

Methods: The study was part of a larger one on adult mortality. The study sample was 309 deaths among men aged 20–55 dying between August 1998 and March 1999 from other than neoplasms, infectious diseases or unspecified causes and on whom necropsy records could be obtained. Information on cause of death was extracted from death certificates and data on postmortem blood alcohol concentration (BAC) from forensic records. Blood alcohol concentrations were adjusted where necessary to allow for delay in necropsy.

Results: Medium or greater levels of intoxication occurred in a quarter of those recorded as dying from cardiovascular disease but in over half of those dying from external causes. BAC levels consistent with at least strong intoxication were seen in 13.5% of deaths from cardiovascular disease and 27.1% from external causes. No cardiovascular deaths had BAC at levels usually thought to be fatal while this level was seen in 26% of deaths from accidental poisoning.

Conclusion: Evidence of recent consumption of alcohol is common among Russian men dying under the age of 55, with severe intoxication common where death is from external causes. However, the high death rates from cardiovascular disease in Russia cannot be explained by misclassification of deaths attributable to acute alcohol poisoning. This study thus resolves one of the outstanding controversies in the story of alcohol and cardiovascular disease in the former Soviet Union.

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A growing body of evidence links alcohol with the large fluctuations in mortality in Russia since the mid-1980s.^{1–3} A causal relation with deaths from alcohol poisoning and from violence is uncontroversial. However, in Russia there is also a close correlation between alcohol and cardiovascular deaths. During the anti-alcohol campaign of the mid-1980s the death rate from cardiovascular diseases underwent a sudden fall, with a subsequent increase in the late 1980s and early 1990s when alcohol consumption was rising.¹ The amplitude of the fluctuation reached $\pm 40\%$ of the underlying mortality rates between the ages of 30 and 55, although the changes were much smaller at older ages. This immediate response in cardiovascular mortality to a change in alcohol consumption is unexpected and especially problematic, given the well known cardioprotective effect of alcohol.⁴

Elsewhere we have argued that this phenomenon may be attributable to binge drinking, which is common in Russia. This is known to increase the risk of sudden cardiac death,⁵ a mode of cardiovascular death more frequent in this region than in the west,⁶ by means of physiological responses to alcohol that differ markedly from those seen with regular moderate consumption.⁷ This view has, however, been challenged.⁸ Many objections have been dealt with elsewhere⁹ but one remains. This is that the apparent correlation between alcohol consumption and cardiovascular mortality arises because a substantial proportion of deaths among middle aged adults

that are recorded as sudden cardiac death are actually attributable to acute alcohol related conditions such as poisoning by alcohol, perhaps to reduce the social stigma involved.

A study in 1991 in Kursk reported that many deaths attributed to "other forms of ischaemic heart disease" and "other heart diseases" had lethal or nearly lethal blood alcohol levels.¹⁰ Unfortunately, it gave few details of subjects or methods.

If the aetiology of cardiovascular disease in Russia is to be understood it is essential to study the problem of a possible overreporting of cardiovascular deaths. This requires in depth validation studies. This paper contributes to this process by reporting blood alcohol concentrations among men dying at age of 20 and 55, whose deaths were attributed to cardiovascular disease or to causes conventionally associated with alcohol consumption, especially injuries and violence.

DATA AND METHODS

The study is set in Izhevsk, capital of the Udmurt Republic, one of the leading industrial centres in the Urals, with mortality close to the Russian average.¹¹ This study was part of a larger study¹¹ that used verbal necropsy¹² to ascertain circumstances leading to death among young and middle aged men.

The larger sample from which the cases presented here were drawn was of 594 male deaths from causes other than

Table 1 Structure of the study sample by age and cause of death in relation to larger sets of male deaths: five major cities* of the Udmurt Republic, age 20–55, deaths from neoplasms, infectious diseases and ill defined causes excluded. Data shown as percentages

	All deaths in 1998 and the first 6 months of 1999 (n=2898)	All deaths in 1998 and the first 6 months of 1999 with complete necropsy results (n=2598)	Verbal necropsy study (n=594)	Study sample (n=309)
Age 20–39	42	45	38	42
Age 40–55	58	55	62	58
Cardiovascular diseases	33	30	37	29
External causes	54	66	54	64
Other causes	13	4	9	7

*Izhevsk, Votkinsk, Sarapul, Glazov, Kambarka.

neoplasms, infectious diseases, and ill defined causes, for whom it had been possible to identify key informants. It had been drawn from a complete set of all deaths from 1 August 1998 to 31 March 1999 among men aged 20 to 55 living in five major cities of the Udmurt Republic (Izhevsk, Votkinsk, Sarapul, Glazov, Kambarka). It was broadly representative of all eligible deaths in terms of age, classes of causes of death, ethnic and educational composition.^{11–13} There was some inevitable bias compared with all potentially eligible deaths because of the requirement to identify key informants. Thus there was overrepresentation of married men (70% in the sample versus 65% in all eligible deaths) and underrepresentation of divorced men (11% versus 14%, respectively). It is also probable that socially isolated men and those leading a marginal existence were underrepresented.

The sample used in this study was a subset of the 594 cases, selected by the ability to obtain to obtain complete necropsy reports from the regional forensic medicine department situated in the city of Izhevsk. It consisted of 309 cases (56% of the larger sample).

Table 1 compares the age distribution and percentages of deaths from external and cardiovascular causes in the different populations: all deaths at age 20–55 in the five cities of the Udmurt Republic from causes other than neoplasms, infectious diseases, and ill defined conditions (2898 deaths); all deaths with complete necropsy results (2598 deaths); deaths used in the verbal necropsy study (594 deaths); and those in present study (309 deaths). The final sample of deaths is similar to that of all deaths undergoing necropsy. External causes of death are, however, somewhat overrepresented among deaths undergoing necropsy, which is inevitable because it reflects the current indications for conducting necropsies.

As variation in necropsy rates could introduce bias, a brief description of current procedures is necessary. In the Soviet era all deaths under age 60 had to undergo necropsy. Thus, in the 1980s the rate of necropsy was almost 100% at working ages. New regulations set out in the Health Ministry's directive 84 of 29 April 1994 made it possible, in certain circumstances (religious beliefs, explicit will of deceased, request of relatives) not to undergo necropsy.¹⁴ However, necropsy remains obligatory in all cases where the diagnosis is not clear or violence is suspected. In fact, among all male deaths in Udmurtia at ages 20 to 55 occurring during 1998 and the first half of the 1999 (5148 deaths) the necropsy rate was still high (82%). Among deaths from causes other than neoplasms, infectious diseases, and ill defined causes occurring in the five cities (2898 deaths) it is 89%. It is especially high for deaths at young ages, reaching 95% for deaths at age 20–39, falling only to 85% at age 40–55. It was almost 100% for deaths from external causes (only four deaths without necropsy) and 81% for deaths from cardiovascular diseases.

For all male deaths in the cities studied at age 20–55, other than those from neoplasms, infectious diseases, and ill defined causes (2898 deaths), 73% of medical death certificates were issued by forensic pathologists, 14% by hospital pathologists,

and 13% by other physicians. In the study sample, in contrast, 99% of death certificates were issued by forensic experts.

Causes of death were obtained from civil death certificates, used to generate routine mortality statistics. Statisticians in the regional statistical office code principal cause of death on civil death certificates by applying the brief Russian classification of causes of death to the ICD codes and basic narrative information listing multiple causes (immediate, intermediate, underlying and complementary causes) on medical death certificates. An earlier study in which we recoded the principal cause of death on a sample of 1023 matched medical and civil death certificates relating to male deaths at age 20–55¹¹ showed very little disagreement in terms of the ICD classes of causes of death. That is to say that if a death is classified as a death from cardiovascular disease or from an external cause than it is very unlikely that such a death would be found to be in another class of causes of death.

Alcohol was measured by gas chromatography from blood taken routinely at necropsy. Necropsies are usually completed within two days after death. If not, an established formula is used to take account of tissue decay.

Norms established in the USSR in 1977, updated in Russia in 1996,¹⁵ were applied: under 30 mg/dl—no adverse health effects; 30–50 mg/dl—insignificant intoxication; 50–149 mg/dl—slight intoxication; 150–249 mg/dl—medium intoxication; 250–299 mg/dl—strong intoxication; 300–499 mg/dl—advanced and potentially lethal intoxication; and above 500 mg/dl—lethal. These are broadly comparable with views in the west.¹⁶ We took the midpoint of the potentially lethal band, 400 mg/dl, as where death was probable attributable to alcohol poisoning.

RESULTS

Some 61.8% deaths had more than none or insignificant levels of blood alcohol. Table 2 shows that 42.7% of deaths had medium intoxication or above (that is, 150 mg/dl and higher) and 22% in strong or advanced intoxication (that is, above 250 mg/dl). Thus, many Russian men who die at this age are intoxicated at the time of death. No men dying from cardiovascular disease had blood alcohol concentrations in excess of 400 mg/dl although 5.6% had concentrations above 300 mg/dl while corresponding figures for external causes were 5% and 16% respectively. Fourteen per cent of deaths from cardiovascular causes had levels consistent with strong intoxication, although a quarter had levels consistent with moderate intoxication.

Nearly all cardiovascular deaths with significant quantities of alcohol detected were ascribed to "Other forms of ischaemic heart disease without hypertensive disease" or "Other heart diseases" (using the Russian classification of causes of death). The first group includes deaths attributable to atherosclerosis, acute forms of ischaemic heart disease other than myocardial infarction including ill defined acute ischaemic heart disease; the second group includes cardiomyopathies, cardiac arrhythmias, myocarditis, pericarditis, conduction disorders and heart failure.

Table 2 Distribution of the deceased by blood alcohol concentration (BAC) and by cause of death, for 309 male deaths at ages 20–55 in the city of Izhevsk, 1998–1999

Cause of death	Number of deaths (% of row total)			
	Total	Of which BAC >150 mg/dl	Of which BAC >250 mg/dl	Of which BAC >400 mg/dl
Cardiovascular diseases	89	22 (24.7)	12 (13.5)	0
<i>Of which:</i>				
Other forms of ischaemic heart disease*	40	13 (32.5)	7 (17.5)	0
Other heart diseases†	22	8 (36.4)	5 (22.7)	0
External causes of death	199	104 (52.3)	54 (27.1)	10 (5.0)
<i>Of which:</i>				
Road vehicle accident	22	8 (36.4)	2 (9.1)	1 (4.5)
Accidental poisonings	27	20 (74.1)	18 (66.7)	7 (25.9)
Fire related accident	6	4 (66.7)	1 (16.7)	0
Accidental drowning	6	3 (50)	2 (33.3)	0
Suicide	69	30 (43.5)	10 (14.5)	2 (2.9)
Homicide	31	17 (54.8)	4 (12.9)	0
Ill defined violent cause	5	2 (40)	2 (40)	0
Other diseases	21	6 (28.6)	3 (14.3)	0
<i>Of which:</i>				
Chronic alcoholism	6	4 (66.7)	2 (33.3)	0
All causes combined	309	132 (42.7)	69 (22.3)	10 (3.2)

*In 1998: item 95 of the former Russian classification of causes of death corresponding to items 411 and 414 in ICD-9. In 1999: items 127 and 129 of the current Russian classification of causes of death corresponding to items I20, I24–I25 in ICD-10; †in 1998: items 96–97 of the former Russian classification of causes of death corresponding to items 415–429 in ICD-9. In 1999: items 131–132 of the current Russian classification of causes of death corresponding to items I26–I28, I30–I51 in ICD-10.

In contrast, advanced intoxication was more common in deaths from external causes, over half of whom had levels consistent with moderate intoxication and over a quarter with severe intoxication. Rates were especially high for accidental poisoning by alcohol, which included most cases with very high levels. The relative rarity of intoxication in deaths from motor vehicle accidents is plausibly attributable to those who had not been drinking being killed by those who had.

DISCUSSION

This study does not support the argument that most young and middle aged Russian men, whose deaths are ascribed to cardiovascular disease, are in reality killed simply by alcohol poisoning. It does confirm the high frequency of intoxication among those dying in this age group, although the immediate cause of death is commonly alcohol poisoning or injury.

The proposed role of alcohol in cardiovascular death requires a brief explanation. While we argue that binge drinking is causally associated with sudden cardiac death, the physiological pathways do not require that death will necessarily occur during a binge. The threshold for ventricular irritability is reduced after recovery from a binge¹⁷ and changes in blood coagulability are most adverse after cessation of heavy drinking.¹⁸ Thus, the findings that many of those dying have been drinking, but are not fatally intoxicated, is entirely consistent with the proposed mechanisms.

Research on this topic, and in this setting, is not easy and, inevitably, the findings are subject to many limitations. It was retrospective so blood samples were not taken under standardised conditions, although this would anyway have been difficult because of differing intervals before bodies were transmitted to pathologists. Recorded levels could plausibly overestimate values at death because of postmortem production of alcohol but this would not affect our conclusions. It is also possible that metabolism of alcohol after cessation of drinking could produce lower levels postmortem than were present at the onset of illness or injury. Superficially this seems more likely to be able to challenge our conclusion, and

Key points

- Although there is now considerable evidence to link binge drinking with the high rates of cardiovascular disease, in particular sudden cardiac death, in Russia, a counter-argument is that the apparent association may arise because of misclassification of deaths from acute alcohol poisoning.
- This study, in which postmortem blood alcohol concentrations were measured in young Russian men, shows that this is not the case, and while many of those dying from cardiovascular disease have been drinking, the levels are not sufficient to cause death from acute alcohol poisoning.

Policy implications

This study dispels one of the remaining objections to the argument that alcohol is a major factor in the high rate of cardiovascular disease in the former Soviet Union and strengthens the case for an effective policy response to this major cause of premature death.

It would certainly suggest that the true level of intoxication in those dying from injury, where survival is more probable, is higher than in our results. However, it would require that men dying from alcohol poisoning lived long enough for their blood levels to fall to those consistent with only moderate intoxication, at which stage they died. On the basis of published rates of alcohol breakdown, this is likely to take about 8–10 hours.¹⁹ While not inconceivable, it seems implausible that this would be a sufficiently common situation. It is unlikely to be sufficient to explain the very much higher Russian death rate (515 deaths/100 000 in Russia in 1996 compared with 162/100 000 in the European Union)²⁰ as being attributable, to any significant extent, to misclassification of deaths attributable to alcohol poisoning.

Obviously these findings can only be extended to other parts of Russia with caution. Izhevsk and its neighbouring Udmurt cities are typical of the urban population of Russia in terms of patterns of mortality, economic indicators, and socio-demographic composition. However, it must be accepted that medical diagnosis and practices involved in cause of death coding and necropsy may differ significantly between Russian regions.

Clearly more research is required to understand why premature cardiovascular death is so common among Russians. However, in the light of the present results the high cardiovascular death rate among young and middle aged men in Russia cannot simply be dismissed as coding artefact.

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