

Alcohol, pattern of drinking and all-cause mortality in Russia, Belarus and Hungary: a retrospective indirect cohort study based on mortality of relatives

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Abstract

Aims. To assess the relationship between alcohol intake frequency and mortality among males and females in three Eastern European populations, and to estimate the additional mortality risk posed by a combination of frequent drinking, binge drinking and other hazardous drinking habits.

Design. Retrospective cohort study; the cohort consisted of close relatives of survey participants.

Setting. Middle-sized settlements in Russia, Belarus and Hungary.

Participants. 124,150 subjects aged 35-69 years in 1998 and followed-up until 2013.

Measurements. Survey respondents provided information on their mothers, fathers, siblings and partners of female respondents. This information, including current vital status and dates of birth and death, was used to construct the cohort of relatives. Alcohol consumption indices, reported by survey participants, included drinking frequency, binge drinking and hazardous drinking (consuming non-beverage and/or illicitly-produced alcohol and/or heavy drinking over several days [*zanoi* in Russian]).

Findings. Drinking frequency was positively associated with mortality in all three countries and both genders. At each drinking frequency level, mortality risk increased among those who also engaged in binge and/or hazardous drinking. Regular male drinkers who were also binge drinkers and hazardous drinkers had the highest risk of death; their hazard ratios (HR), compared with non-binge-non-hazardous occasional drinkers, were 2.56 [95% CI 2.27-2.88], 2.14 [1.84-2.48] and 2.11 [1.90-2.35] in Russia, Belarus and Hungary, respectively. In women, the corresponding HRs (using a lower frequency cut-off) were 2.86 [1.99-4.12] in Russia, 3.44 [2.17-5.44] in Belarus and 3.01 [2.26-4.01] in Hungary.

Conclusions. Drinking frequency is positively associated with mortality among men and women in Russia, Belarus and Hungary. The mortality risk is higher among frequent drinkers who exhibit binge and hazardous drinking patterns.

INTRODUCTION

Two decades of mortality research in Eastern Europe following the collapse of communism precipitated a major reassessment of the contribution of alcohol to population health. While the role of alcohol in liver cirrhosis, injuries and violence has long been recognised, less was known about its association with other diseases. For example, the first Global Burden of disease study stated that “alcohol is cardioprotective at all levels of consumption”(1). Using aggregate data, early studies investigating both the high overall mortality and its large fluctuations in the former Soviet Union countries in the 1990s revealed close temporal (2) and, later, geographical (3) associations with deaths from a range of conditions. Subsequent studies, using a range of methods, identified mechanisms by which hazardous drinking might affect these other causes of death (4-6).

A series of individual-level studies in Russia followed, including case-control (7-9) and cohort studies, (10, 11) with one of the former (7) using validated methods collecting data from proxy informants (close relatives) to overcome the challenges of obtaining information about sudden deaths (12). These studies identified three types of hazardous drinking. The first is binge drinking, or episodic consumption of large volumes on a single occasion. The second is drinking alcohol products not intended for consumption, ranging from technical alcohols, such as cleaning fluids, to medicinal tinctures and aftershaves (*odekolon* in Russian). These low-cost alcohols were widely available in the 1990s and early 2000s in many post-Soviet countries (13, 14), and contain between 70% and 95% ethanol (15, 16). A study in the Russian city Izhevsk found that one in twelve working-age men consumed surrogate alcohols (17). The third relates to drinking to intoxication for several days, preventing the individual involved from

functioning normally (*zapoï* in Russian). In the Izhevsk study one in ten working-age men had experienced *zapoï* in the previous year (17).

Although hazardous drinking is common in many former communist countries, including the Soviet Union and former Soviet satellites in Central Eastern Europe, mortality trends have varied in the past three decades. This partly reflects differences in the underlying political changes, (18) and may partly reflect socioeconomic differences between populations, which are important determinants of hazardous drinking (17). However, there are national differences in predominant patterns of drinking (19, 20). In contrast to Russia, research in Central European countries focused on the overall volume of alcohol drunk and the consumption of homemade alcohols containing long-chain alcohols (21) linked to cirrhosis and inflammatory responses, (22, 23) rather than episodic heavy consumption.

This raises the question of the extent to which the research on hazardous drinking from Russia is applicable to other countries. In this paper, we explored whether those forms of hazardous drinking that have been implicated in mortality among Russian men are also associated with mortality in other countries and in women. Specifically, we investigated the relationship between alcohol intake frequency and mortality three Eastern European populations (Hungary in Central Europe and Russia and Belarus in the former Soviet Union), estimated the additional mortality risk posed by combination of frequent drinking, binge drinking and other hazardous drinking habits, and whether the observed associations are consistent between men and women and across populations.

METHODS

We used data from the PrivMort retrospective convenience cohort study (24). As the primary aim of this study was to test the hypothesis that rapid privatisation in the 1990s was associated with increased mortality, it was undertaken in a sample of settlements (towns and cities) selected based on whether the local economy was dominated by a single enterprise or multiple enterprises and whether post-communist privatisation was slow or fast. Although we refer to countries, the samples were not designed to be nationally representative.

Study design

We used a modified demographic method developed for estimating mortality in settings where conventional data are not available. In this method, information collected from informants in sample surveys about the survival status of relatives is used to assess mortality risk of these relatives.

Participants

Population sample surveys were conducted in 30 middle-sized settlements in Russia, 20 settlements in Belarus and 52 settlements in Hungary. Randomly chosen respondents born before or in 1972 were asked about vital status and other characteristics of their close relatives during the period of post-communist transition, thus providing information on mortality across a range of age- and space-specific cohorts. Face-to-face interviews with respondents were conducted by trained interviewers in 2014 and 2015. In Russia, Belarus and Hungary, 22,997, 16,000 and 24,076 respondents provided information on 71,009, 55,976 and 78,622 relatives, respectively. The corresponding response rates were 48%, 39% and 85% of those invited to participate. The study was approved by the University of Cambridge Ethics Committee.

Measurements

The respondents answered questions about themselves and about the current vital status, alcohol consumption and other characteristics of their close relatives (e.g. demographic characteristics, residential and employment histories, education, and smoking). Information was collected on up to five relatives: mother, father, maximum two siblings, and, if female respondent, first long-term partner/spouse. The first partner was chosen to avoid differential exclusion of men who died prematurely. Previous research suggested women recalled life events more accurately than men, therefore only female respondents were asked about their partners (25). Detailed information was collected on up to two surviving siblings; few respondents had more than two eligible siblings.

The survey asked about each relative's usual alcohol consumption, without specifying time period. The question on the frequency of drinking any alcohol was asked about all relatives. Five categories were used in Hungary. Excluding relatives who never drank alcohol (abstainers), information was also collected on the pattern of drinking: 1) frequency of drinking about 0.5 litre (half bottle) of vodka (*pálinka* in Hungary) (approx. 160 g of ethanol) or 2 bottles of wine (approx. 140 g of ethanol) or 5 half-litre bottles of beer (approx. 100 g of ethanol) in one evening (binge drinking); 2) frequency of drinking illicitly-produced alcohol; 3) frequency of drinking surrogate alcohols; and 4) frequency of drinking all day, for five or more days (*zapoï* in Russia and Belarus). Responses to these questions were dichotomised (yes versus no). These three variables were used to construct a category labelled "risky drinking" (illicit alcohol and/or surrogates and/or *zapoï*). Risky drinking was considered missing for those relatives who had no observations on all variables used to construct the measure. The Cronbach Alpha coefficient of the three items used to create the "risky

drinking” indicator was 0.63, and the correlations between the three item and the indicator ranged from 0.41 and 0.52, suggesting acceptable internal consistency of the indicator.

To identify persons with the potentially most harmful drinking habits, the relatives were classified into those who engaged in 1) binge drinking alone, 2) risky drinking alone, 3) both binge and risky drinking, or 4) neither binge nor risky drinking. To investigate the role of drinking pattern in the association between alcohol and mortality we compared the effect of drinking frequency on mortality in these different types of drinkers. Because of small numbers of regular and risky drinkers in women, we combined the two highest categories for the analysis of drinking frequency into a single category (“several times a week or more”) and dichotomised drinking frequency (into “up to once a month” versus “once a month or more”) for the analysis of risky drinking pattern. While we could not formally validate the measures, all alcohol consumption indices were associated with known predictors (such as age, education, marital status and smoking) in the expected direction, with associations being strongest for the combined outcome (Supplementary Table 1), providing indirect support for their validity.

Covariates used in the analysis were selected based on pre-existing evidence of their associations with alcohol consumption and mortality. They include smoking (never smoked, former or regular smoker), educational attainment (no education, elementary, academic secondary, vocational secondary, vocational higher, or academic higher), marital status (single, married/co-habiting, divorced/separated, or widowed), demographic measures (birth year and country of residence), and basic characteristics about the respondent (relation to relative, birth year and sex). Relatives with missing observations on mortality, drinking frequency or covariates were excluded from subsequent analyses.

Statistical analysis

The analytic sample included deaths occurring between 1998 and 2013 in adults aged between 35 to 69 years at the start of follow-up period to avoid retrospective reporting over a very long period. Follow-up time was defined as the time in years from 1998, or the year the relative first became at risk if later than 1998, to the year of death or 2013 for surviving relatives. A total of 76,883 male and 52,967 female relatives met the inclusion criteria.

We used Cox proportional hazards regression to estimate the effects of alcohol on all-cause mortality. We report hazard ratios (HRs) with 95% confidence intervals (95% CIs). We conducted country-specific (to assess consistency between populations) and gender-specific analyses (because of large gender differences in drinking patterns). As the largest mortality increases during the post-communist transition were observed in working-age persons, we also stratified the analysis by baseline age (<55 years and 55+ years). HRs were first adjusted for the relatives' year of birth and country of residence, and characteristics of the respondent, and then additionally adjusted for smoking, education and marital status. The proportionality assumption was examined using log-negative-log plots and weighted testing of Schoenfeld residuals, neither of which suggested important violations of the proportional hazards. The drinking frequency of "up to once a month (on special occasions)" was used as the reference category. Analyses of risky drinking pattern were restricted to drinkers (excluding abstainers and those who quit drinking). Finally, we conducted additional analyses for the effect of binge drinking and risky drinking on total mortality, adjusting for drinking frequency (Supplementary material, Tables S1-S2). We formally tested for heterogeneity between countries by including interaction terms for alcohol measures and country to the regression models. All analyses were conducted in Stata SE, version 14 (26).

RESULTS

After excluding missing observations, 124,150 (41% female) relatives were included in the mortality analysis. A total of 24,066 male and 11,258 female deaths from all-causes were reported during 959,645 and 709,324 person-years of follow up, respectively. Significant interactions suggested there was heterogeneity between countries, especially in men ($p < 0.001$).

Table 1 shows descriptive characteristics of the relatives of respondents by country and gender.

There were some notable differences in alcohol consumption between countries. In men, regular drinking (almost every day) was more common in Hungary than in Russia and Belarus but the reverse was true for binge drinking (almost 30% in Russia and Belarus versus 19% in Hungary). The prevalence of *zapoï* was as high in Hungarian as in Russian men (8%) and slightly lower in Belarus. The proportions consuming informally-produced and surrogate alcohols were higher in Russia than in the other countries but, overall, were not high. In men, the prevalence of risky drinking was similar in Russia and Hungary (12% versus 11%) and slightly lower in Belarus (8%). Risky and binge drinking was rare in women in all countries.

Table 2 shows results for drinking frequency and all-cause mortality. In fully-adjusted models, mortality risks were highest among men drinking almost every day (HRs were 1.98 in Russia, 1.85 in Belarus and 1.65 in Hungary). A similar pattern but with higher hazard ratios was observed in women (2.70 in Russia, 4.02 in Belarus and 2.10 in Hungary). In Russia, abstainers had a lower mortality risk than occasional drinkers (in the other countries, results fell just short of statistical significance). In both genders, those who quit drinking had significantly lower HRs for mortality but the results are difficult to interpret because it is not clear when and why the behaviour change occurred.

Table 3 shows the hazard ratios of mortality by drinking pattern in male drinkers, relative to those who were non-binge drinkers, non-risky drinkers and were drinking up to once a month. In all countries, the strongest association of mortality with drinking frequency was seen in men engaged in both binge and risky drinking; in each country, drinking almost daily combined with both risky and binge drinking was associated with more than two-fold increased mortality, compared with occasional non-binge/non-risky drinkers. There were some differences between countries in other pattern groups. Most notably, among men who did not engage in binge or risky drinking, mortality was strongly associated with drinking frequency in Russia but less so in the other countries.

In women (table 4), the numbers of individuals and events in binge and risky drinking categories were small but, similarly to men, more frequent drinking combined with both binge and risky drinking exhibited the strongest association with mortality in all countries, with an approximately three-fold increase in mortality risk in this group. Associations with mortality in other drinking pattern groups were similar across countries.

We attempted to separate drinking pattern from drinking frequency by adjusting the association between drinking pattern and mortality for drinking frequency (Supplementary Tables S2 and S3). The results consistently showed the highest mortality risk with the combination of binge and risky drinking across countries and genders.

Alcohol-related mortality in the post-communist period was most pronounced in working-age persons, thus in Table 5 we present analyses stratified by age (<55 years and 55+ years). Consistently with the hypothesis, the HRs associated with frequent consumption in

combination with binge and risky drinking were approximately two-fold higher in younger relatives.

DISCUSSION

This large retrospective indirect cohort study in Russia, Belarus and Hungary found a strong association between drinking frequency and all-cause mortality, confirming previous mostly aggregate-level reports in the wider region (19, 20) and individual-level reports in Russia (8, 9). In all three countries and in both genders, the greatest increase in mortality risk was associated with the combination of high drinking frequency with both binge and risky drinking. The effect of drinking pattern did not appear to be driven solely by drinking frequency. Among men who did not engage in binge or risky drinking, drinking frequency was strongly associated with mortality in Russia but less strongly in the other countries. Despite the rarity of frequent and risky drinking among women, the associations of alcohol with mortality in women were as strong as in men.

Limitations and strengths

The main limitation is that alcohol consumption was reported by proxy respondents. Surveys tend to underestimate alcohol consumption and inaccurate reporting of alcohol consumption may be exacerbated by using proxy respondents. In addition, the proxy informant attribution of death of a relative to alcohol may bias his/her reporting of alcohol intake of the relative and result in biased estimates of relative risk. However, acceptable agreement was previously found between alcohol consumption reported by relatives and self-reported by index subjects, particularly for ordinal measures such as drinking frequency (27). Reliable assessment by proxy informants may be more difficult for deceased relatives, although two case-control

studies in Russia elicited reliable retrospective information on alcohol from proxy respondents (7, 8). An indirect support for the validity of alcohol measures in this study is provided by expected correlations with known predictors. To reduce biases associated with long recall periods and changing time trends, the follow up was restricted to the last 16 years. Our prevalence estimates of frequent drinking and abstention appear lower and higher than in some other studies in Eastern Europe, but estimates of binge drinking prevalence were broadly similar (28, 29). In addition, the distributions of alcohol drinking were similar across countries in our study, suggesting the method performs adequately. On balance the under-reporting and/or misclassification of alcohol consumption means that the reported hazard ratios likely underestimate the underlying mortality risk associated with long-term alcohol consumption and drinking patterns.

A related but important limitation is the lack of information on the volume of alcohol consumed. It would be difficult for the informants to know, or, if they did, to recall this type of information accurately. Consequently, we could not separate the average volume of drinking from drinking pattern, and the estimated hazard ratios for drinking pattern may partly reflect the volumes consumed.

The analysis was adjusted for major conventional confounders (sex, age, smoking, education and marital status) but no data was available on relatives' health, long-standing illnesses and other factors. Thus, residual confounding cannot be ruled out.

The relatively low response rates in Russia and Belarus affects representativeness and may introduce selection bias. Non-response is not random; it is usually associated with lower socioeconomic status, more risky behaviours and worse health status. Given that family

members are more likely to be of similar socioeconomic and health status, the sample of relatives may not fully represent the entire socioeconomic spectrum. Given the non-random nature of missingness, the overall levels of drinking in Russia and Belarus may have been underestimated, and the absolute levels of alcohol indices may not be directly comparable between countries. However, the associations of drinking with mortality should not be affected, unless non-response was associated with misreporting of both alcohol intake and mortality of relatives of survey respondents.

The major strengths of this study are the large sample size with a large number of deaths, inclusion of several questions on hazardous drinking and adoption of a uniform protocol in all countries allowing examination of consistency of results across populations with different drinking cultures.

Interpretation of the findings

The findings indicate that hazardous drinking is associated with increased mortality. This is consistent with the Izhevsk case-control (7) and prospective cohort (30) studies which found a strong effect of hazardous drinking on mortality of working-age men. Despite some differences in the distributions of drinking behaviours, we found similar associations between the risky drinking pattern and mortality in Belarus and Hungary, although the hazard ratios were somewhat weaker than in Russia. Much of the existing literature focused on men; our study suggests that the effects of risky drinking pattern are equally salient in women. A study in Arkhangelsk, Russia, also found a strong association between mortality and alcohol consumption in women (31).

Binge drinking alone was not strongly related to mortality, after accounting for risky consumption and drinking frequency. An earlier convenience cohort study of relatives in Russia reported a higher risk of mortality in male binge drinkers, even after accounting for drinking frequency (32). However, not all previous studies in Russia found a strong effect of binge drinking on mortality. In a prospective urban cohort in Russia (11) only male regular heavy drinkers had about double the risk of mortality compared to moderate drinkers. Similarly, a large prospective cohort study of Eastern European men and women (including Novosibirsk, Russia) found higher mortality risk at high average levels of alcohol intake but drinking pattern had little effect (except on alcohol-related deaths in men) (33, 34). However, these studies assessed alcohol consumption using different measures and did not examine risky drinking. Risky drinking, as defined in this study, probably reflects more extreme heavy alcohol consumption than binging, which may also explain why risky drinking without binge drinking was relatively uncommon.

In our study, mortality risk increased with increasing drinking frequency in both genders and all countries, without a protective effect on mortality at low or moderate frequency of drinking. We extend observation, consistent with a previous Russian convenience cohort study (32), to Belarus and Hungary.

There is growing evidence that heavy regular or episodic drinking increases the risk of both short-term (35) and long-term cardiovascular mortality (33, 34, 36). In a meta-analysis, moderate drinking (<60 g of ethanol per day) no longer had a cardioprotective effect when combined with at least monthly heavy drinking episodes (36). Binge drinking also increases the risk of death from injury and other external causes (37). Similar mechanisms are likely involved in risky drinking.

In Russia, hazardous drinking pattern has been implicated both in the mortality crisis of the 1990s (2, 38) and the high long-term mortality (28, 32, 39). Our findings support and extend this hypothesis, in that they suggest that drinking pattern is associated with mortality in Russia, Belarus and Hungary in both genders, and particularly when it also includes binge drinking. The relative risks were as high in women as in men, although given the low proportion of drinkers in women, the population impact of alcohol in women is likely to be smaller than in men.

We were surprised by the lower risk among former drinkers but this may be a methodological artefact. Relatives who were alive at the time of the survey were likely to be reported as “quitters” even if they had stopped drinking shortly before the interview, while those who died were likely to be remembered as “drinkers” if they were long-term drinkers, even if they had stopped drinking before death. Unfortunately, we did not have sufficient data to test this hypothesis.

CONCLUSION

This study confirms that alcohol is associated with increased adult mortality risk in Russia and other Eastern European countries, with effects in women as strong as in men. The increased mortality risk in drinkers with a hazardous pattern gives weight to the argument that the pattern of drinking, and not just average levels of alcohol consumption, is fundamental for understanding the relationship between alcohol and high mortality in Russia and other post-communist countries.

Declaration of interests

None.

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Accepted Article

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Table 1 Descriptive characteristics of the analytic sample of male and female relatives by country

	Men			Women		
	Russia	Belarus	Hungary	Russia	Belarus	Hungary
	%	%	%	%	%	%
Drinking frequency						
Almost every day	4.1	2.7	8.6			
Several times a week	9.9	7.3	11.6	1.0	0.5	1.7
About 2-4 times a month	19.8	23.6	16.7	3.5	2.5	2.9
Up to once a month	44.5	51.6	21.8	51.5	61.3	12.4
Quit drinking	11.1	5.7	6.8	2.8	1.3	1.4
Never drank	10.6	9.1	34.4	41.3	34.4	81.7
Binge drinking	28.9	29.1	18.5	3.9	4.0	2.3
Not reported	14.6	7.3	1.7	3.3	1.9	0.3
Surrogates	3.0	0.7	0.7	0.5	0.1	0.1
Not reported	18.1	8.9	3.0	3.9	2.1	0.6
Unofficially-made alcohol	6.7	3.0	5.1	0.9	0.3	0.6
Not reported	28.0	18.1	3.5	8.3	5.8	0.5
Zapoi	8.2	6.2	8.3	0.7	0.5	0.9
Not reported	11.2	4.4	1.7	2.3	1.3	0.4
Any risky drinking	11.9	8.3	10.6	1.6	0.8	1.2
Not reported	9.1	2.6	1.0	1.3	0.8	0.2
Decade of birth						
1929-1939	24.5	24.3	25.9	37.5	33.5	34.0
1940-1949	25.3	23.2	29.8	28.0	25.6	31.1
1950-1959	28.5	26.3	25.4	21.8	22.2	21.0
≥1960	21.8	26.2	18.9	12.8	18.7	13.9
Vital status						
Died	33.4	30.7	28.6	23.2	19.2	19.5
Education						
No education	5.0	11.5	4.5	9.5	18.8	10.5
Elementary	12.8	8.1	22.3	16.2	9.5	39.0
Academic secondary	19.5	15.9	5.0	18.4	13.5	7.1
Vocational secondary	22.5	19.6	57.3	15.6	11.7	34.6
Vocational higher	26.8	29.6	2.1	28.0	31.9	1.8
Academic higher	13.4	15.2	8.9	12.3	14.5	7.0
Smoking status						
Never smoked	25.3	32.3	40.5	92.4	93.9	75.1
Used to smoke but quit	18.9	15.7	22.8	3.0	2.4	9.3
Currently regular smoker	55.8	52.0	36.7	4.6	3.6	15.6
Marital status						
Single	1.4	1.8	2.9	3.0	2.3	2.1
Married/co-habiting	79.2	42.6	78.3	53.5	55.5	56.2
Divorced/separated	15.7	50.8	14.3	14.7	11.4	10.1
Widowed	3.8	4.8	4.6	28.8	30.8	31.6
Relation to informant						

Father	20.3	19.4	17.2			
Mother				49.6	41.3	39.6
Sibling	28.5	37.6	41.2	50.4	58.7	60.5
Partner	51.3	43.1	41.6			
Female informant	84.7	83.9	79.0	70.0	72.7	64.6
Median birth year of informant	1956	1958	1955	1959	1960	1956

Measures of risky alcohol consumption do not include relatives who never drank.
Total number of informants was 64,590.

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Table 2 Country-specific adjusted hazard ratios (95% CIs) for drinking frequency in relation to all-cause mortality

	Men (n=73,587)						Women (n= 50,563)					
	N	Events	Model 1		Model 2		N	Events	Model 1		Model 2	
			HR	95% CI	HR	95% CI			HR	95% CI	HR	95% CI
Russia												
Drinking frequency, (N)	25355						16388					
Never drank	2690	606	0.74	[0.68,0.81]	0.85	[0.78,0.93]	6771	1687	0.93	[0.87,1.00]	0.91	[0.85,0.98]
Quit drinking	2825	607	0.64	[0.59,0.70]	0.66	[0.61,0.72]	454	78	0.69	[0.55,0.86]	0.72	[0.57,0.90]
Up to once a month	11273	3273	1.00		1.00		8438	1834	1.00		1.00	
2-4 times a month	5019	2043	1.54	[1.46,1.63]	1.38	[1.31,1.46]	569	148	1.49	[1.26,1.77]	1.42	[1.19,1.68]
Several times a week	2513	1379	2.21	[2.07,2.35]	1.85	[1.73,1.97]	156	59	2.90	[2.23,3.76]	2.70	[2.06,3.53]
Almost every day	1035	556	2.35	[2.15,2.57]	1.98	[1.81,2.17]						
Belarus												
Drinking frequency, (N)	21257						14735					
Never drank	1924	448	0.79	[0.71,0.87]	0.92	[0.83,1.01]	5073	1134	1.02	[0.95,1.11]	1.03	[0.96,1.12]
Quit drinking	1213	251	0.56	[0.49,0.64]	0.59	[0.52,0.67]	194	30	0.68	[0.47,0.98]	0.63	[0.44,0.91]
Up to once a month	10975	3027	1.00		1.00		9034	1578	1.00		1.00	
2-4 times a month	5015	1820	1.39	[1.31,1.47]	1.20	[1.13,1.27]	362	62	1.48	[1.15,1.91]	1.28	[0.99,1.66]
Several times a week	1547	716	1.99	[1.83,2.16]	1.65	[1.52,1.80]	72	29	4.39	[3.04,6.35]	4.02	[2.77,5.84]
Almost every day	583	271	2.30	[2.03,2.60]	1.85	[1.63,2.10]						
Hungary												
Drinking frequency, (N)	26975						19440					
Never drank	9278	2083	0.84	[0.79,0.90]	0.93	[0.87,1.00]	15881	3067	0.92	[0.83,1.02]	0.96	[0.86,1.06]
Quit drinking	1828	397	0.69	[0.62,0.77]	0.66	[0.59,0.74]	265	37	0.68	[0.49,0.96]	0.66	[0.47,0.92]
Up to once a month	5888	1558	1.00		1.00		2406	406	1.00		1.00	
2-4 times a month	4512	1393	1.17	[1.08,1.25]	1.07	[0.99,1.15]	567	148	1.66	[1.37,2.00]	1.45	[1.20,1.75]
Several times a week	3140	1249	1.58	[1.46,1.70]	1.37	[1.27,1.48]	321	124	2.79	[2.29,3.42]	2.10	[1.71,2.58]
Almost every day	2329	1042	1.90	[1.76,2.06]	1.65	[1.52,1.79]						

Reference category is “up to once a month”.

Model 1 is adjusted for year of birth of relative, country, relation to informant, sex and year of birth of informant.

Model 2 is additionally adjusted for marital status, education and smoking.

Table 3 Country-specific adjusted hazard ratios (95% CIs) for risky drinking pattern in relation to all-cause mortality in men

	Neither				Binge drinking				Risky drinking				Both			
	N	Events	HR	95% CI	N	Events	HR	95% CI	N	Events	HR	95% CI	N	Events	HR	95% CI
Russia (n=17,534)																
Frequency of drinking																
Up to once a month	7446	2085	1.00		2194	675	1.06	[0.97,1.16]	195	57	1.01	[0.78,1.32]	300	97	1.06	[0.87,1.30]
2-4 times a month	2081	797	1.30	[1.20,1.41]	1585	635	1.38	[1.26,1.52]	124	47	1.23	[0.92,1.65]	531	258	1.86	[1.63,2.12]
Several times a week	485	256	1.62	[1.42,1.85]	686	359	1.60	[1.43,1.79]	88	55	2.22	[1.70,2.90]	897	503	2.21	[1.99,2.44]
Almost every day	59	39	2.28	[1.65,3.13]	231	97	1.05	[0.86,1.29]	19	10	1.74	[0.93,3.25]	613	341	2.56	[2.27,2.88]
Belarus (n=16,522)																
Frequency of drinking																
Up to once a month	7996	2165	1.00		1865	537	1.04	[0.95,1.15]	101	30	0.98	[0.69,1.41]	134	33	0.85	[0.60,1.19]
2-4 times a month	1927	703	1.15	[1.05,1.25]	2170	736	1.17	[1.07,1.28]	98	44	1.50	[1.11,2.02]	319	152	1.62	[1.37,1.91]
Several times a week	307	136	1.35	[1.14,1.61]	527	238	1.52	[1.32,1.74]	47	22	1.48	[0.97,2.25]	492	242	2.14	[1.87,2.45]
Almost every day	42	18	1.48	[0.93,2.35]	69	25	1.14	[0.77,1.69]	23	8	1.09	[0.54,2.18]	405	199	2.14	[1.84,2.48]

**Hungary
(n=15,411)**

Frequency
of drinking

Up to once a month	4723	1226	1.00		796	221	0.97	[0.84,1.11]	78	24	1.27	[0.85,1.90]	200	66	1.26	[0.98,1.61]
2-4 times a month	3130	925	1.02	[0.93,1.11]	753	251	1.21	[1.06,1.39]	222	69	1.15	[0.90,1.47]	284	113	1.47	[1.21,1.78]
Several times a week	1543	585	1.24	[1.12,1.37]	675	286	1.45	[1.27,1.65]	96	51	1.79	[1.35,2.37]	699	282	1.72	[1.51,1.97]
Almost every day	719	266	1.19	[1.04,1.36]	328	141	1.62	[1.36,1.94]	82	28	1.16	[0.80,1.69]	1083	545	2.11	[1.90,2.35]

Reference category is “up to once a month with no binge or risky consumption”.

Analysis is restricted to drinkers; never drinkers and those who quit drinking were excluded.

Analysis is adjusted for year of birth of relative, country, relation to informant, sex and year of birth of informant, marital status, education and smoking.

Table 4 Country-specific adjusted hazard ratios (95% CIs) for risky drinking pattern in relation to all-cause mortality in women

	Neither				Binge drinking				Risky drinking				Both			
	N	Events	HR	95% CI	N	Events	HR	95% CI	N	Events	HR	95% CI	N	Events	HR	95% CI
Russia (n=8,628)																
Frequency of drinking																
Up to once a month	752	1647	1.0		37	78	1.1	[0.90,1.43]	8	26	1.4	[0.95,2.08]	47	17	2.0	[1.24,3.24]
	6		0		6		3		5		1				1	
Once a month or more	392	90	1.2	[1.04,1.59]	10	30	1.3	[0.91,1.90]	1	5	1.6	[0.68,4.02]	79	32	2.8	[1.99,4.12]
			9		7		2		6		6				6	
Belarus (n=9,177)																
Frequency of drinking																
Up to once a month	832	1462	1.0		42	72	1.0	[0.80,1.29]	3	11	1.3	[0.71,2.36]	17	3	0.9	[0.29,2.81]
	7		0		1		2		8		0				0	
Once a month or more	228	32	1.0	[0.76,1.56]	96	22	1.9	[1.24,2.92]	8	1	0.5	[0.08,4.13]	42	19	3.4	[2.17,5.44]
			9				1				8				4	
Hungary (n=3,241)																

Frequency
of
drinking

Up to once a month	217 2	365 0	1.0		15 1	29 0	1.4 0	[0.95,2.05]	2 1	3 2	1.0 2	[0.32,3.17]	44	8	0.9 6	[0.47,1.93]
Once a month or more	585	153 6	1.4 6	[1.20,1.77]	10 2	29 0	1.6 0	[1.09,2.35]	3 0	12 1	2.0 1	[1.13,3.60]	13 6	67	3.0 1	[2.26,4.01]

Reference category is “up to once a month with no binge or risky consumption”.

Analysis is restricted to drinkers; never drinkers and those who quit drinking were excluded.

Analysis is adjusted for year of birth of relative, country, relation to informant, sex and year of birth of informant, marital status, education and smoking.

Table 5 Age-stratified adjusted hazard ratios (95% CIs) for alcohol consumption and all-cause mortality

	All				Binge & risky drinkers			
	N	Events	HR	95% CI	N	Events	HR	95% CI
Men								
<55 years (n=47,764)								
Frequency of drinking								
Never drank	8979	1057	0.99	[0.92,1.07]				
Quit drinking	3585	404	0.65	[0.58,0.72]				
Up to once a month	18589	2762	1.00	[1.00,1.00]	434	80	1.09	[0.87,1.37]
2-4 times a month	9390	2004	1.29	[1.22,1.37]	749	248	2.11	[1.85,2.42]
Several times a week	4546	1522	2.08	[1.95,2.22]	1497	581	2.63	[2.39,2.90]
Almost every day	2675	1034	2.57	[2.38,2.77]	1538	662	3.08	[2.80,3.39]
≥55 years (n=25,823)								
Frequency of drinking								
Never drank	4913	2080	0.92	[0.87,0.97]				
Quit drinking	2281	851	0.64	[0.60,0.69]				
Up to once a month	9547	5096	1.00	[1.00,1.00]	200	116	1.03	[0.86,1.24]
2-4 times a month	5156	3252	1.20	[1.14,1.25]	385	275	1.43	[1.26,1.61]
Several times a week	2654	1822	1.37	[1.30,1.45]	591	446	1.60	[1.45,1.77]
Almost every day	1272	835	1.33	[1.23,1.43]	563	423	1.66	[1.49,1.84]
Women								
<55 years (n=26,973)								
Frequency of drinking								
Never drank	13646	1066	1.12	[1.01,1.24]				
Quit drinking	488	36	0.90	[0.64,1.26]				
Up to once a month	11487	771	1.00	[1.00,1.00]	60	5	0.94	[0.39,2.28]
2-4 times a month	982	114	1.55	[1.27,1.90]	57	14	2.69	[1.57,4.62]
Several times a week	370	119	4.32	[3.51,5.30]	125	52	5.48	[4.02,7.47]
≥55 years								

(n=23,590)

Frequency of drinking

Never drank	14079	4822	0.92	[0.88,0.97]				
Quit drinking	425	109	0.64	[0.52,0.77]				
Up to once a month	8391	3047	1.00	[1.00,1.00]	48	23	1.54	[1.02,2.33]
2-4 times a month	516	244	1.37	[1.20,1.56]	20	12	1.89	[1.06,3.35]
Several times a week	179	93	1.61	[1.30,1.99]	55	40	2.30	[1.66,3.19]

Results stratified by baseline age; younger than 55 years vs. 55 years or older.

Adjusted for year of birth, country, relation to informant, sex and year of birth of informant, marital status, education and smoking.

Far-right column shows results for the combination of binge and risky drinking from the analysis of drinking pattern and mortality.

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