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Alcohol mortality in Russia: assessment with representative survey data

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Abstract

According to vast empirical evidence, excessive alcohol consumption is an important factor of premature mortality in Russia. At the same time, quantifying alcohol-related deaths is not so easy, as generally the discussion of alcohol mortality only concerns the causes of death attributed solely to alcohol, which significantly narrows the range of possible negative consequences. Including data on losses from myocardial infarction, coronary heart disease and other common cardiovascular and other diseases in alcohol mortality estimates is enabled by an approach using data on the relative risks of death from various causes depending on the type of alcohol consumption. Within this study, alcohol consumption, depending on sex and age, was assessed on data from a representative national survey, taking into account information on the volume of recorded sales of alcoholic beverages.

According to the obtained results, in 2018 the death rate from alcohol-related causes in Russia amounted to 196,000 people, 146,000 men and 50,000 women among them. The peak of alcohol mortality is observed among people aged over 50. The structure of alcohol mortality is dominated by diseases of the cardiovascular system and external causes, and for men the contribution of external causes is significantly higher. Excessive alcohol consumption reduces life expectancy by 5.9 and 4.7 years for men and women, and healthy life expectancy by 4.2 and 2.6 years for men and women.

Keywords

Introduction

Excessive alcohol consumption is an important factor of mortality both in Russia (Denisova 2010; Zaridze 2009; Shield and Rehm 2015) and worldwide (WHO 2019). Despite the obvious and undisputed significance of the topic, it is not so easy to quantify the contribution

of alcohol to mortality. Often, analysis of alcohol-related deaths is limited to either causes of death 100% due to alcohol, or total deaths from all alcohol-related causes. Both ways significantly distort the real values of alcohol mortality, in the first case underestimating it, and in the second — noticeably overestimating it.

In international research literature on hazardous consumption in general, smoking or alcohol abuse have been widely assessed as factors of mortality and morbidity in general population, as well as in different sex and age groups, through relative mortality risks (Rehm 2011).

Within our study, international methods for assessing the contribution of alcohol-related diseases to mortality have been adapted to Russian data. The assessment took into account the prevalence of alcohol consumption and deaths by cause in different age groups, as well as the relative risks of death from alcohol-related diseases, which were borrowed from a study based on Russian data (Zaridze et al. 2009). An important peculiarity of the obtained estimates is the use of population survey data on the prevalence of excessive alcohol consumption in calculations. The data on alcohol consumption coming from population surveys are rightly considered to be underestimated (see on this, for example, in (Parish et al. 2017; Nemtsov 2003)); nevertheless, it is a source of valuable information on the nature and dynamics of consumption of certain types of alcoholic beverages by various socio-economic groups.

Within this study, in addition to absolute count of alcohol mortality, the author gives estimates of mortality rates by sex and age for different types of alcohol consumption, which enabled constructing mortality tables for persons with a unsafe and safe type of alcohol consumption. Total life expectancy at birth (TLE) and healthy life expectancy at birth (HLE) depending on the type of alcohol consumption were then assessed using mortality tables and data on population health. In conclusion, the author briefly comments on the main findings of the study and provides recommendations for the state alcohol policy.

Overview of domestic and foreign studies assessing the contribution of alcohol consumption to population mortality

Vast empirical evidence proves alcohol to be a direct cause of over 200 types of death from various diseases and injuries, defined by triple-digit codes in the 10th revision of the International Statistical Classification of Diseases and Related Health Problems (ICD-10) (Rehm 2011; Rehm and Shield 2014). According to a WHO global study, the total number of alcohol-related deaths worldwide exceeded 3 million cases in 2016, accounting for 5.3% of all adult deaths (WHO 2019). Alcohol's effect on mortality exceeded the negative effects of tuberculosis (2.3%), HIV (1.8%), diabetes (2.8%), transport incidents (2.5%) and violence (0.8%).

For the European region, the effects of excessive alcohol consumption are even more pronounced. The gender and age standardised mortality rate for the world as a whole was 38.8 per 100,000 people, and for the WHO European region it was 62.8. At younger ages, alcohol's contribution to mortality is higher than the adult average (Guérin et al. 2013).

There are also significant gender differences in the structure of alcohol mortality, namely, for women, alcohol abuse mainly leads to death from cardiovascular disease (41.6% of alcohol-related deaths), while for men the main contribution to alcohol-related mortality is

made by unintentional injuries (22.5%), digestive diseases (21.1%) and infectious diseases (14.6%) (WHO 2019).

Some of the causes of alcohol mortality are attributed solely due to excessive alcohol consumption. In Russian statistics, these data are collected separately, and there are over 15 different causes of death in this domain, including alcoholic cardiomyopathy, accidental alcohol poisoning, etc. In 2018, the total number of alcohol-related deaths in Russia mounted up to 48.8 thousand, and the alcohol-related death rate for men and women was 54 and 16 cases per 100,000 respectively (Demographic Yearbook 2019).

The assessment of alcohol mortality is further hampered by difficulties in diagnosing the causes of death. In their study, D. Zaridze and co-authors (Zaridze et al. 2009b) analysed over 20,000 deaths among population aged over 15 in Barnaul between 1990 and 2004. A large proportion of those who died due to *other diseases* or *unclassified cardiovascular diseases* had lethal or potentially lethal concentrations of ethanol in their blood. The authors conclude that excessive alcohol consumption is the leading cause of premature male deaths in Russia, with many alcohol-related deaths being wrongly attributed to diseases of the circulatory system.

For a long time in Russia there has been observed a significant inverse relationship between deaths from alcohol poisonings and TLE, particularly noticeable in the 1990s; however, in recent times the situation has changed. Comparison of the dynamics of these indicators over three time periods, since 1965, carried out in a study by I. Danilova and co-authors (Danilova et al. 2020) showed that since 2003 the steady positive dynamics in life expectancy has been statistically independent of alcohol poisonings — in this period, the driving force for the increase in life expectancy was the decline in non-alcohol-related mortality in older ages (65 years and older).

Despite the importance of purely alcohol-related causes of death, the majority of alcohol-related deaths are diseases that are not solely caused by alcohol. A study by J. Rehm and co-authors (Rehm et al. 2017) provides an overview of over 250 papers examining the strength of the relationship between alcohol consumption and different types of diseases and external causes of death. The negative effects depend heavily on the type of excessive alcohol consumption. For the regular excess of the daily norm of ethanol consumption, the most frequent negative consequence is increased risk of death from malformations and alcohol disorders. In cases when alcohol abuse is mainly reflected in the periodic recurrent episodes of excessive consumption, it has the greatest impact on mortality from coronary heart disease and other cardiovascular diseases, as well as injuries and infectious diseases.

External causes of death constitute a significant part of alcohol mortality. The risk level of both intentional and unmeasured trauma and injury is clearly linked to alcohol levels in the blood (Taylor and Rehm 2012) and average alcohol consumption (Corrao et al. 2004).

It is not easy to extract all alcohol-related deaths from mortality statistics by cause, so researchers often either consider deaths due solely to alcohol-related causes, or all deaths due to all causes that might be partly induced by alcohol consumption. However, both of these methods lead to significant distortions of alcohol-induced mortality estimates, the first towards significant underestimation, and the second — to notable overestimation.

To better estimate alcohol mortality, we need data on the relative risks of death from various causes for people with a excessive type of alcohol consumption compared to non-drinkers. The necessary information is gathered through prospective and retrospective mortality surveys.

A global study by J. Rehm and K. D. Shield (Rehm and Shield 2014) provides estimates of deaths from alcohol-related diseases in 1990 and 2010 in the United States of America. The calculations take into account data on (1) the amount of alcohol consumed and the nature of its consumption, (2) the risks of death from various alcohol-related causes, and (3) the mortality from these causes. Within this study, individual types of cancer caused by excessive alcohol consumption, cirrhosis of the liver, and external causes were considered as the leading causes of alcohol-related death. Taking into account the positive effect of moderate alcohol consumption on the incidence of cardiovascular disease and diabetes, the authors claim that these three types of deaths stand for 89% of all alcohol-related deaths between the ages of 15 and 64, and without regard to the positive effect — for 79% of alcohol-related deaths.

The paper (Wood et al. 2018) analyzed the results of 83 prospective studies in 19 high-income countries. According to the study, the threshold for safe alcohol consumption was about 100g per week. Excessive alcohol consumption results in a decrease in life expectancy: compared to those whose weekly consumption was 0-100g per week, for those consuming 100-200g, 200-350g and over 350g per week, life expectancy at the age of 40 was lower by about 6 months, 1-2 years or 4-5 years respectively. Research on the effects of alcohol on mortality continues, and some of the emerging estimates claim that there is no safe alcohol consumption in terms of the effect on mortality. Specifically, the global study (Griswold et al. 2018) notes that the level of alcohol consumption that would minimize harm across all health indicators is zero.

Studies on the relationship between mortality and alcohol consumption carried out on the basis of Russian data are of particular interest for the author. The effect of trends developed in alcohol consumption back in the Soviet period on mortality is estimated in the work of S.L. Plavinsky and S.I. Plavinskaya (Plavinsky and Plavinskaya 2009). The empirical basis of this study is a prospective study of the mortality of 3,907 men born in 1916-1935 and residing in St. Petersburg in 1974. Along with other things, the authors revealed a *U*- shaped dependence between mortality from cardiovascular diseases and alcohol consumption, as the lowest mortality rate was observed among the moderate consumption group, not among individuals who had never consumed alcohol.

In the work of M. Bobak and co-authors (Bobak et al. 1999), the nature of alcohol consumption in Russia is studied on the basis of sociological (not epidemiological) database. The collected data included information on smoking, self-assessment of health, and socio-economic characteristics of individuals and households in which they live. The authors revealed the following factors contributing to higher alcohol consumption among men: smoking, absence of a marital partner, unemployment and low health self-assessment. The authors also note the low overall level of alcohol consumption reported by survey participants, and they suggest underreporting as a possible explanation. At the same time, episodes of one-time high consumption were quite numerous, and the authors based their estimations of the excessive alcohol consumption prevalence mainly on this parameter.

The study of M. Neufeld and J. Rehm (Neufeld and Rehm 2013) assesses possible impact of the state anti-alcohol policy on alcohol consumption and resulting mortality in Russia in 2000-2010 against the background of adoption of the public policy measures aimed at reducing the negative effects of alcohol consumption in 2006. The calculations are based on the WHO alcohol consumption data supplemented by estimates of illegal consumption provided by A. Nemtsov. According to the results of this study, there was a significant variation in both overall mortality in working age and alcohol-related mortality over the observation period. The decrease in consumption and mortality was recorded at the end of 2005, when measures regulating the production and retail of alcoholic beverages were passed at the legislative level.

There was also a change in consumption patterns. In particular, the overall decline in legal and illegal alcohol consumption was only partially offset by increases in beer and wine consumption. The authors conclude that anti-alcohol regulation, which came into force in 2006, has had a positive effect both on the nature of alcohol consumption by the population and on the scale of its negative consequences. At the same time, the authors note that the strengthening of the national anti-alcohol policy in Russia still remains highly relevant.

D. Zaridze and co-authors (Zaridze et al. 2009) estimated the relative mortality risks for individuals aged 15 to 74 demonstrating unsafe alcohol consumption patterns. These individuals were divided into three groups, namely: less than one bottle, one to three bottles, three or more bottles of vodka weekly or during the day episodically. The authors analyzed data coming from a retrospective survey of over 48,000 deaths that occurred in 1990-2001 in Russian cities with typical mortality patterns observed back in the 1990s (Tomsk, Biysk and Barnaul). The survey sample consisted of 50,066 questionnaires filled by relatives of those who died between the ages of 15 and 74 in 2001-2005.

Using an adjusted logistic regression model, the authors estimated relative mortality risks for the aforementioned three types of alcohol consumption. Consumption was considered safe if both of the following conditions were met: (1) alcohol consumption is less than 0.5 bottles of vodka (or equivalent amount of alcohol) per week, and (2) maximum daily consumption of vodka is less than 0.5 bottles. For men, three leading alcohol-related causes of death were identified as accidents and violence (relative risk $RR = 5.94$ for the category with highest alcohol consumption), alcohol poisonings ($RR = 21.68$) and acute coronary disease with the exception of myocardial infarction ($RR = 3.04$). According to the results of the study, in some years of the observation period, the contribution of alcohol-related mortality to the overall mortality of men aged 15 to 54 exceeded 50 per cent.

K. D. Shield and J. Rehm (Shield and Rehm 2015) compare relative risks of mortality estimated by D. Zaridze and co-authors (Zaridze et al. 2009) with similar results for other countries. The comparison has revealed that the alcohol-related burden of transport injuries is slightly higher when estimated using non-Russian data on relative risks, while the risk of dying from a heart attack, by contrast, is noticeably underestimated. Also using Russian estimates of relative risk increased contribution of deaths from acute and chronic pancreatitis, unintentional injuries (excluding transport), self-inflicted injuries and violence, while mortality from hemorrhagic and other non-cerebral infarctions and liver cirrhosis appeared to be lower. Alternative relative risk assessments can be used in performing robustness tests for the achieved results.

A large prospective study by D. Zaridze and co-authors (Zaridze et al. 2014), initiated as part of an earlier retrospective study, elaborates the analysis of the relationship between mortality and alcohol consumption (cf. Zaridze et al. 2009). This study bases on the observations conducted in 1999-2008, with 200,000 people in the original sample. A peculiarity of the male subsample in this survey is that almost all alcohol abusers turned out to be smokers. Here, alcohol consumption, as well as in the earlier study, was measured in vodka equivalent. The authors defined tree types of consumption, namely: low consumption (non-drinkers, former drinkers who did not quit smoking due to illness, men drinking less than 1 bottle per week, or women drinking less than 0.25 bottles per week), average consumption (men drinking 1 to 3 bottles per week, or women drinking 0.25 to 1 bottle per week), and high consumption (men drinking more than 3 bottles per week, or women drinking more than 1 bottle per week). The results of this study show that for smoking men without prior disease, the estimated 20-year risk of death at the age of 35—54 was 16% within the low alcohol consumption group, 20% within the average consumption group and 35%

within the high consumption group. Corresponding estimates for the men aged 55—74 were 50, 54 and 64% respectively. In both age categories, most of the excess mortality among high consumption respondents was due to external causes or groups of diseases directly related to alcohol. Additionally, the authors of the study note significant changes in the self-assessment of alcohol consumption by respondents during the second round of the survey, which led to a significant decrease in the assessment of the risks of alcohol consumption.

Research data and methods

Quantitative assessment of alcohol-related deaths

In order to quantify alcohol-related mortality, it is necessary to calculate the proportion of the population affected by excessive alcohol consumption — *AAF* (*alcohol attributable fraction*). In order to take into account the effect of alcohol consumption on mortality from all causes, not just the causes directly related to alcohol, the author of this study uses the methodology presented in the paper by J. Rehm and co-authors (Rehm et al. 2010). Based on estimates of relative mortality risks from a number of alcohol-related diseases (Table 1), mortality data by cause and data on prevalence of excessive alcohol consumption, one can distinguish a component, which is due specifically to alcohol consumption, in total mortality.

Alcohol consumption corresponding to the equivalent of half a bottle of vodka per week

(or $0,5 \times 500 \text{ ml} \times 0,789 \dfrac{\text{g}}{\text{ml}} \times 40\% \div 7 \approx 11,3 \text{ g of ethanol per day}$) is considered excessive

in this paper. The author defines three types of excessive alcohol consumption: (1) corresponding to the equivalent of 0.5-1 bottles of vodka (or 11-23 g of ethanol per day); (2) corresponding to the equivalent of 1-3 bottles of vodka (or 23-67 g ethanol per day) and (3) corresponding to the equivalent of 3 or more bottles of vodka (or no less than 67 g of ethanol per day). Relative risks of death from a number of causes from the paper (Zaridze et al. 2009) have been applied for these three types of consumption.

To assess mortality from diseases caused by excessive alcohol consumption the author calculated additional risk factor, *PAF (population attributable fraction)*, for various causes of death and sex and age groups:

$$PAF_{ij} = \frac{\left(p_j^{(0)} + p_j^{(1)} \times RR_{ij}^{(1)} + p_j^{(2)} \times RR_{ij}^{(2)} + p_j^{(3)} \times RR_{ij}^{(3)} \right) - 1}{p_j^{(0)} + p_j^{(1)} \times RR_{ij}^{(1)} + p_j^{(2)} \times RR_{ij}^{(2)} + p_j^{(3)} \times RR_{ij}^{(3)}}$$

where $p_j^{(1)}, p_j^{(2)}, p_j^{(3)}$ is the proportion of persons with average alcohol consumption equivalent to 0.5-1 bottles of vodka, 1-3 bottles of vodka and 3 or more bottles of vodka per week respectively, and $p_j^{(0)}$ ($p_j^{(0)} = 1 - p_j^{(1)} - p_j^{(2)} - p_j^{(3)}$) is the percentage of the rest of the population in sex and age group j_0; $RR_{ij}^{(1)}, RR_{ij}^{(2)}, RR_{ij}^{(3)}$ are relative risks of death from disease i in sex and age group j compared to the rest of the adult population, depending on the type of alcohol consumption.

The number of excess deaths caused by alcohol (added mortality, AM) for the given cause of death and the given sex and age group is calculated as $AM = OM \times PAF$, where OM (overall mortality) is the total number of deaths from the given cause of death, taken from official mortality estimates.

Table 1. Relative risks of death for men aged 15 to 74 from various causes depending on the type of alcohol consumption (measured as pure alcohol equivalent per week)

Cause of death (ICD-10)	Men			Women		
	0,5-1	1–3	≥ 3	0,5-1	1–3	≥ 3
Upper respiratory tract malignant neoplasm (C00–15, C32)	1.57	2.32	3.48	1.27	0.99	2.21
Malignant neoplasm of liver and intrahepatic bile ducts	1.01	1.28	2.11	1.52	1.17	1.57
Breast cancer (C50)				0.99	0.54	0.26
Tuberculosis (A15–19, B90)	1.01	1.97	4.14	0.93	4.06	5.32
Bronchitis, emphysema and other chronic obstructive pulmonary diseases (J40–44)	1.22	1.40	1.79	0.96	1.45	1.60
Other respiratory diseases (acute from J00–98)	0.95	1.92	3.29	2.10	3.21	3.42
Liver disease (K70–77)	0.92	1.77	6.21	2.50	7.07	12.08
Pancreatitis and other pancreatic diseases (K85–86)	1.43	2.07	6.69	1.09	5.01	19.26
Acute myocardial infarction (I20–23)	1.23	1.18	1.20	1.27	1.12	2.04
Acute ASHD without myocardial infarction (I24)	1.06	1.79	3.04	1.79	4.61	9.25
Chronic ASHD (I25)	1.05	1.20	1.49	1.39	1.42	2.58
Cerebrovascular disease (I60–69)	1.06	1.14	1.28	1.38	1.36	1.62
Other cardiovascular diseases (acute from I00–99)	1.02	1.14	1.57	1.23	1.45	2.39
Inconclusive causes of death (R00–99)	1.29	2.84	7.74	2.11	7.16	14.89
Alcohol-related causes of death	1.11	1.91	3.77	1.81	4.52	8.17
Alcohol poisonings (X45, Y15, F10)	1.94	4.06	21.68	3.11	18.04	75.23
Other external causes of death (acute from V00–Y99)	1.44	2.53	5.94	1.90	5.59	9.26
Transport accidents (V00–99)	1.52	2.68	4.20	1.98	4.48	3.17
Other accidents (W00–X44, X46–59, Y37–99)	1.58	2.48	6.07	2.08	5.24	8.56
Suicides (X60–84)	1.21	3.47	8.62	2.82	8.22	14.75
Attacks (X85–Y09)	1.75	3.67	9.47	3.55	10.23	19.11
Damage with uncertain intentions (acute)	1.49	2.36	4.40	1.43	4.54	7.93

Note: Reference category — persons with an average alcohol consumption per week of no higher than 0.5 bottles of vodka and with a maximum daily intake of not more than 0.5 bottles of vodka. *Source: (Zaridze et al. 2009).*

Prevalence of excessive alcohol consumption according to the national representative panel survey

Data on the prevalence of excessive alcohol consumption in various sex and age groups is needed to assess deaths from all causes related to alcohol. This study uses data from the Russian Longitudinal Monitoring Survey — HSE (RLMS). The Russian Longitudinal Monitoring Survey is conducted by the National Research University Higher School of Economics and LLC Demoscope with the participation of the Population Centre of the University of North Carolina at Chapel Hill and the Institute of Sociology of the Federal Research Socio-

logy Centre of the Russian Academy of Sciences (RLMS HSE survey websites: http://www.cpc.unc.edu/projects/rlms and http://www.hse.ru/rlms). Some information on alcohol consumption in the RLMS has been present since 1994, but the full amount of data needed to calculate the average total consumption of pure alcohol has been collected only since 2006.

The survey regularly gathers detailed information on the population's consumption of various alcoholic beverages of both industrial and domestic production. The questionnaire includes questions for the following beverages: industrial beer; domestic beer; brew (*braga*); dry wine or champagne of industrial production; home-made wine; fortified wine (including separately fortified home-made wine); hooch; vodka; other strong drinks (whisky, cognac, liquors); alcoholic cocktails; other alcoholic beverages. For each type of drink, the same series of questions is asked: 1) "Have you been drinking this drink in the last 30 days?"; 2) "How many grams of this drink did you usually drink a day?"; 3) "How many days a month did you drink this drink?".

Estimates of overall alcohol consumption on the basis of population survey data are significantly underestimated due to, at least, two circumstances. First, respondents tend to underestimate alcohol consumption both by the average amount of alcohol consumed per day and the number of days of alcohol consumption per month. Excessive alcohol consumption and alcoholism, as one of its effects, are generally disapproved of in society. Second, respondents, who often have to answer the interviewer's questions in the presence of their relatives, may conceal information on their actual consumption. One of the reasons to do so is that alcohol consumption often affects both the financial situation of the household and the relationship within the family (see also in the papers by Guérin et al. 2013; Bobak et al. 1999).
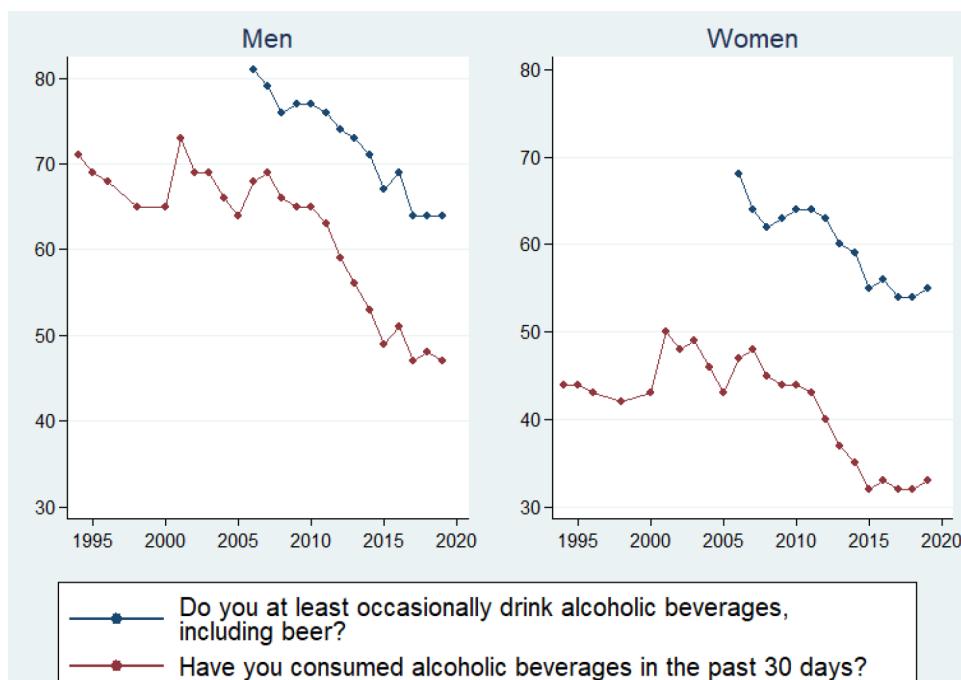

Figure 1. Prevalence of alcohol consumption according to RLMS, men and women, 1994-2018, %. *Source*: author's calculations based on the RLMS data.

Figure 1 summarizes the RLMS information on the dynamics of the proportion of alcohol consumers in the Russian adult population. In 2010-2015, the share of alcohol consumers decreased, then it stabilized, making 64% for men and 54% for women in 2018. Detailed information on the volume of consumption is gathered only for respondents who had consumed alcoholic beverages during the 30 days before survey, and in 2018 the proportion of those was 48 and 32% for men and women respectively.

Figure 2 presents differences in average annual per capita alcohol consumption estimates according to WHO statistics on recorded (accounted) and total (including unaccounted) consumption and according to the author's calculations on the RLMS data. Additionally, the author estimated this indicator using the methodology presented in the early study on the RLMS data (Zohoori et al. 1998). Evidently, the survey data significantly underestimate the recorded and especially total alcohol consumption. Thus, in 2018, consumption according to RLMS amounted to only 36% of registered sales and 24% of the estimate of total alcohol consumption in Russia according to WHO. At the same time, the survey data provide detailed information on the sex and age pattern of alcohol consumption and are therefore actively used to assess alcohol mortality in international scientific practice.
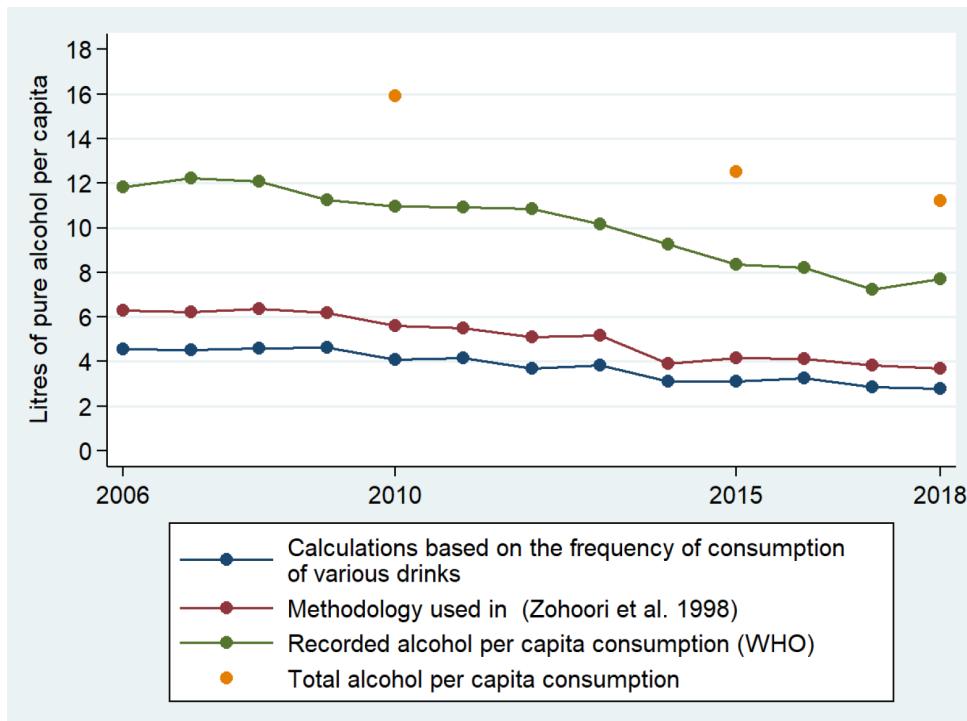

Figure 2. Estimates of alcohol consumption in Russia, liters of ethanol per capita, 2006-2018. *Source*: author's calculations based on the WHO data (see http://apps.who.int/gho/data/node.main. A1022?lang=en; date of reference 27.09.2020).

Thus, the data on alcohol consumption obtained from the population survey need further assessment. Based on the assumption of correctness of the information obtained on alcohol consumption patterns, estimates can be calibrated according to the data based on retail

statistics. For this purpose, the author uses WHO data on per capita consumption of pure alcohol estimated for population aged 15 years and over (Table 2). Other approaches to calibrating alcohol consumption statistics might be found in the literature (Rehm et al. 2010b; Rey et al. 2010; Parish et al. 2017).

Table 2. Per capita alcohol consumption estimated for population aged 15 and over, liters of pure alcohol

Year	Alcohol total (taking into account illegal consumption)	Registered alcohol total	Including strong spirits (recorded consumption)
2000	15.7	10.2	7.3
2001		10.5	7.1
2002		10.9	7.2
2003		11.3	7.3
2004		11.5	7.1
2005	17.4	11.6	6.9
2006		11.8	6.7
2007		12.2	6.3
2008		12.1	6.2
2009		11.3	5.8
2010	15.9	11.0	5.6
2011		10.9	5.5
2012		10.9	5.5
2013		10.2	4.8
2014		9.3	4.1
2015	12.5	8.4	3.6
2016		8.2	3.6
2017		7.2	3.1
2018	11.2	7.7	3.2

Source: WHO data (see http://apps.who.int/gho/data/node.main.A1022?lang=en; date of reference 27.09.2020).

Experts have repeatedly claimed that people with very high alcohol consumption are significantly underrepresented in the RLMS sample (Nemtsov 2003; Andriyenko and Nemtsov 2006). Taking this into account and considering the fact that this study provides a conservative (low) estimate of alcohol mortality, the author decided to make a further reassessment and to harmonize the survey estimates with the level of recorded consumption, that is, recorded sales of alcohol (retail statistics).

At the first step of the assessment, data on the consumption of various alcoholic beverages were aggregated and translated into the amount of pure alcohol consumed per day. The following translation scale was used for this purpose:

- beer and brew (braga), including industrial beer and domestic beer, — 5% alcohol on average;
- dry wine, champagne, house wine — 12% alcohol on average;

- fortified wine, including industrial production (martini, vermouth) — 18% alcohol on average;
- alcoholic cocktails — 7% alcohol on average;
- strong alcoholic beverages including vodka, whisky, cognac, hooch — 40% alcohol on average;
- other alcoholic beverages — 25% alcohol on average.

In 2018, the consumption of alcohol by the population aged 15 years and over, estimated on RLMS data, accounted for 36% of recorded alcohol consumption by WHO estimates and 25% of total alcohol consumption (including illegal consumption) as assessed by WHO.

According to estimates on RLMS data, the prevalence of excessive alcohol consumption for adults was 27% in 2018. Among men, excessive consumption was noticeably more common (36% of the adult population) than among women (20% of the adult population). The relatively high values of the indicator for women are partly due to lower threshold meanings.

Figure 1 shows gender and age differences in the prevalence of excessive alcohol consumption. Between the ages of 20 and 24, alcohol consumption begins to rise rapidly, reaching peak values of about 45% among men and 25 to 30% among women by the age of 30 to 39. Then for 15 years alcohol abuse remains high, although slightly decreasing, and only begins to significantly fall after the age of 65.
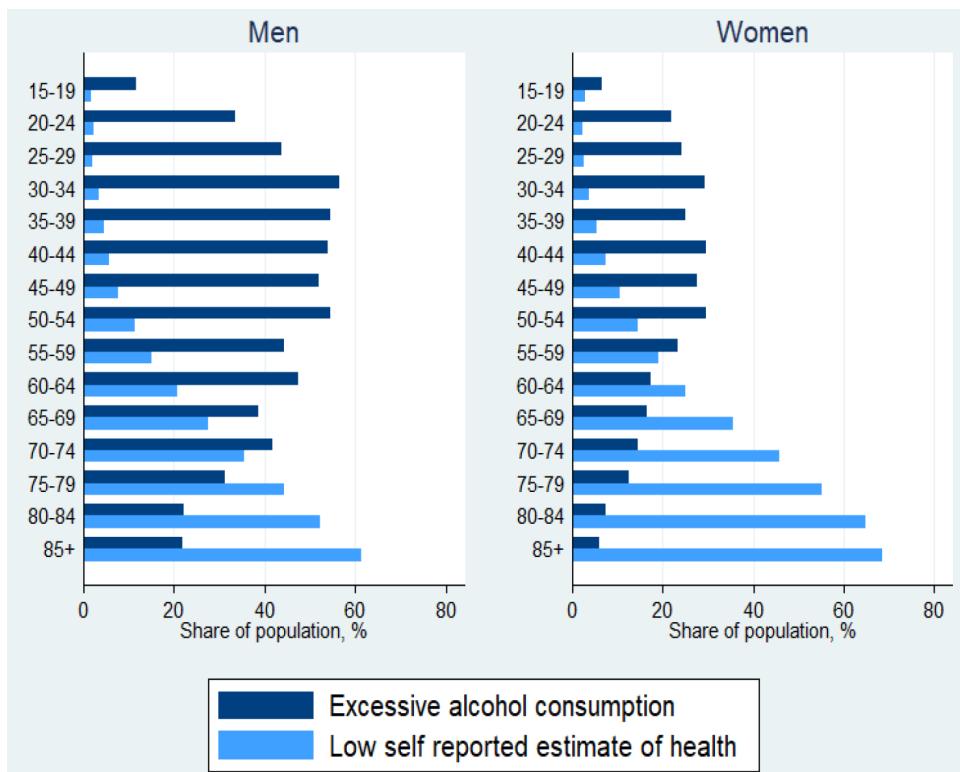

Figure 3. Prevalence of excessive alcohol consumption and low health estimates depending on age, males and females, 2018. *Source:* author's calculations based on the RLMS and Russian Fertility and Mortality Database data.

Figure 1 also shows the prevalence of low health estimates among different sex and age groups. Information about the state of health was further used to calculate the HLE. The proportion of people assessing their health as poor or very poor markedly increases with age, amounting to about 1-2% of the group aged 25-29, 8-10% of those aged 50-54, and over 37-45% of those aged over 75 years. It is particularly noteworthy that in older ages, women tend to be more pessimistic when assessing their health. This feature will significantly change the gender ratios in evaluations with the transition from TLE to HLE.

Results of the study

Applying relative risk assessments from D. Zaridze and co-authors' paper (Zaridze et al. 2009) to national data on mortality by causes and prevalence of excessive alcohol consumption, the author obtained the following estimates for number of alcohol-related deaths in 2018: 195.5 thousand people overall, including 145.7 thousand men and 49.7 thousand women. These data substantially exceeds the numbers on mortality from diseases caused solely by alcohol, which is most commonly used in the discussion of the effect of alcohol on mortality. In 2018, according to Rosstat data, 48,8 thousand people died from these causes (Demographic Yearbook 2019). Thus, employing the information on the relative risks of mortality enables to refine the data on alcohol mortality in Russia significantly.
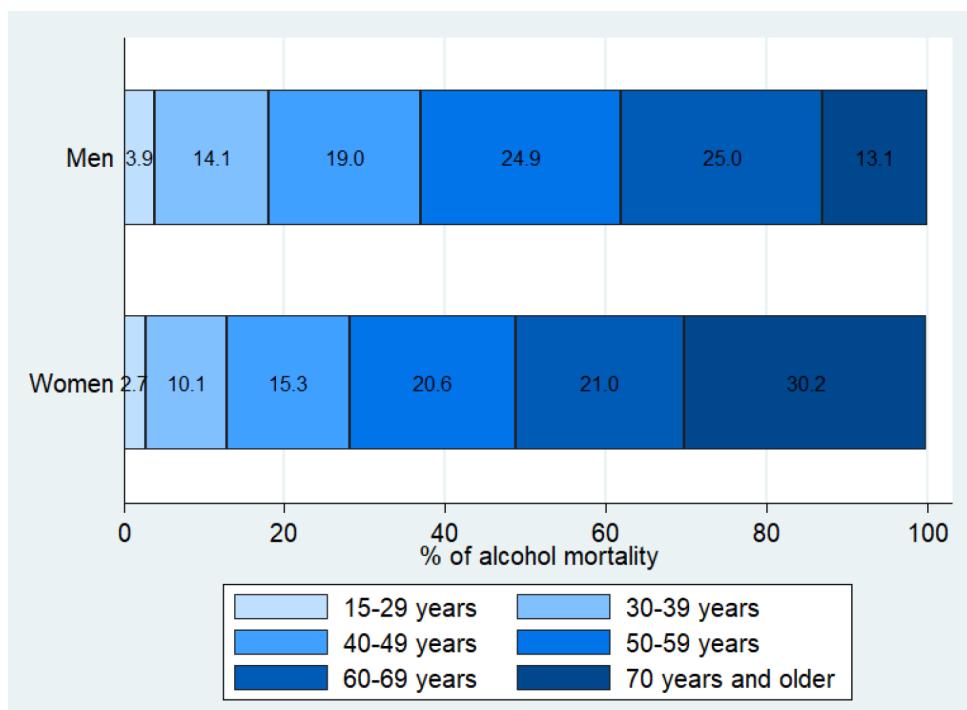

Figure 4. Number of deaths due to excessive alcohol consumption, depending on sex and age, proportion in alcohol mortality (%), men and women, 2018. *Source*: author's calculations based on the RLMS and Russian Fertility and Mortality Database data.

Information on the age structure of alcohol mortality is presented in Figure 4. The peak of alcohol mortality is observed at the age of 50 and over — 63% of all alcohol deaths among men and 72% among women are located in this group. A drastic decline in alcohol mortality is observed after the age of 80 among men and after the age of 85 years among women. It's likely that this is an age to which people who have abused alcohol over a lifetime simply don't live to. Another explanation is that, due to the deterioration of health, alcohol consumers reduce consumption while ageing or abandon alcohol completely.

Information on the structure of alcohol mortality by cause of death is presented in Figure 5. In Figure 5a the causes of death occurred solely due to alcohol are placed in a separate group, and therefore are not taken into account with related diseases. In Figure 5b, most of the causes related to alcohol abuse were attributed to the relevant disease groups, while the *other cause 100% due to alcohol* category included mostly alcohol-induced mental and behavioural disorders.

Causes related solely to alcohol account for 25% of alcohol mortality among men and women. Most often, deaths due to excessive alcohol consumption occur because of diseases of the cardiovascular system and external causes. For men, external causes are the first to contribute to alcohol mortality, accounting for 40% of all alcohol-related deaths. The next important group of causes is cardiovascular disease (31%). The pattern of alcohol mortality among women is slightly different: cardiovascular diseases are the main cause (47%), followed by external causes (23%). Liver and pancreatic diseases account for 13% of alcohol deaths among men and for 20% among women. Neoplasms in the structure of female alcohol mortality almost do not occur (0.1%), while for males their proportion is about 5%, among them, along with others, are malignant neoplasms of the lips, mouth and pharyngeal cavity (2.0%), esophagus (1.3%), larynx (0.9%) and liver (0.5%).

These estimates are broadly consistent with the findings of the WHO Global Study (WHO 2018), according to which globally the leading cause of alcohol death for women
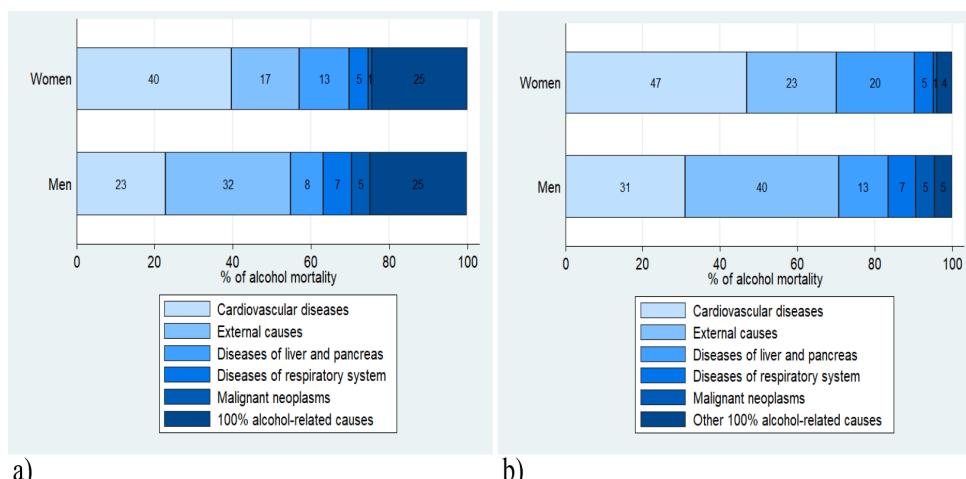

Figure 5. Number of deaths due to excessive alcohol consumption, depending on causes of death, proportion in alcohol mortality (%), men and women, 2018. (a) all causes 100% caused by alcohol are allocated to a separate group; (b) causes 100% caused by alcohol are distributed by the main groups of causes. *Source*: author's calculations based on the RLMS and Russian Fertility and Mortality Database data.

is cardiovascular diseases (41.6% of alcohol-related deaths) and for men — external causes (31.4%). It should be noted that in Russia the contribution of cardiovascular diseases and external causes to male alcohol mortality is significantly higher than in the world as a whole (in comparison: the share of cardiovascular diseases in Russia is 31%, while in the world it is estimated at 13%: the share of external causes of death in Russia mounts up to 40% and to 31.4% in the world).

The first 12 causes of death from ICD-10 in terms of their contribution to alcohol mortality are given in Table 3. According these data, only one-tenth of the contribution to alcohol mortality among women is external (accidental alcohol poisoning, 3.1%). For women, the individual causes of death with the largest contribution to alcohol mortality are cirrhosis, fibrosis and hepatitis of the liver, both non-alcoholic (7.1%) and alcoholic (4.8%); diseases of the cardiovascular system — atherosclerotic heart disease (12.2%), acute myocardial infarction (7.9%), other forms of chronic coronary heart disease (6.5%), brain infarction (5.1%) and alcoholic cardiomyopathy (4.9%). Suicide and homicide accounted for 2.4 and 2.1% of all alcohol deaths among women respectively.

For men, the situation with the contribution of certain causes to alcohol mortality is slightly different. This result is entirely predictable: as it was previously shown in the analysis of the structure of male mortality due to excessive alcohol consumption, external reasons prevail in all large demographic groups. Among the three leading causes of alcohol mortality, two are external causes: suicide (5.6%) and accidental alcohol poisoning (6.0%). Other key causes of male alcohol mortality are diseases of the cardiovascular system, including alcohol cardiomyopathy (8.0%), atherosclerotic disease (4.8%), other forms of acute coronary heart disease (3.9%), acute myocardial infarction (3.8%), and liver disease of non-alcoholic (4.6%) and alcoholic origin (4.2%).

Information on the differences in TLE between people with excessive alcohol consumption compared to the rest of the population is given in Table 4. Excessive alcohol consumption significantly — by 5.9 years for men and 4.7 years for women — reduces life expectancy; it goes from 70.7 years for safe alcohol consumption down to 64.8 years in the case of alcohol abuse for men and from 78.9 years down to 74.2 years for women.

With age, differences in TLE depending on the type of alcohol consumption are decreasing. Among men, this decrease is faster than among women: if at birth the differences in TLE depending on the type of alcohol consumption among men are markedly higher than among women (5.9 and 4.7 years respectively), by the age of 70 they go down to 2.3 and 2.4 years. This is most likely due to the impact of other factors on male mortality, including smoking and insufficient access to high-quality health care.

Another important result of the study is the assessment of the excessive alcohol consumption contribution to the population's HLE. Comparative information on the HLE of men and women, depending on the status of alcohol consumption, is also presented in table 4. HLE in the case of excessive alcohol consumption is reduced by 4.2 years for men, from 63.2 to 59.0 years, and by 2.6 years for women, from 66.1 to 63.5 years.

It should be noted that gender disparities are noticeably reduced in the transition to HLE indicators. Thus, if the difference between men and women with excessive alcohol consumption in 2018 was more than 9 years (64.8 and 74.2 years respectively), for HLE it was only 4.5 years (59.0 and 63.5 years). Gender differences for a population with a safe type of alcohol consumption behave similarly, decreasing markedly with the transition to an assessment of healthy life expectancy. A clear explanation for this behaviour of life expectancy indicators is the lower assessment of women's own health, especially in older ages (see Figure 1). Thus,

Table 3. Number of deaths due to excessive alcohol consumption, depending on cause of death (ICD-10 classification), alcohol mortality rate (%), men and women, 2018

Men		Women	
causes of death	proportion of deaths due to alcohol-related causes	causes of death	proportion of deaths due to alcohol-related causes
Alcoholic cardiomyopathy	8	Atherosclerotic heart disease	12.2
Accidental poisoning (exposure) by alcohol	6	Acute myocardial infarction	7.9
Other intentional self-harm (including suicide)	5.6	Fibrosis and cirrhosis of the liver (excl. alcohol)	7.1
Atherosclerotic heart disease	4.8	Other forms of chronic coronary heart disease	6.5
Fibrosis and cirrhosis of the liver (excl. alcohol)	4.6	Brain infarction	5.1
Alcoholic liver disease (alcoholic: cirrhosis, hepatitis, fibrosis)	4.2	Alcoholic cardiomyopathy	4.9
Other forms of acute coronary heart disease	3.9	Alcoholic liver disease	4.8
Acute myocardial infarction	3.8	Other forms of acute coronary heart disease	4.7
Other forms of chronic coronary heart disease	3.4	Other refined lesions of the brain vessels	3.7
Contact with sharp and blunt object with uncertain intentions	3.1	Accidental poisoning (exposure) by alcohol	3.1
Pneumonia without clarification of the pathogen	2.4	Cerebral atherosclerosis	2.5
Murder	2.4	Pneumonia without clarification of the pathogen)	2.2

Source: author's calculations based on the RLMS and Russian Fertility and Mortality Database data.

a higher proportion of the population with poor health among those living up to older ages contributes to a decrease in women's longevity advantage.

Concluding the presentation of the results of the study, let's note the main limitations of the obtained estimates. The analysis of deaths from alcohol-related causes has a number of limitations related to the objective complexity of the object under review, i.e. alcohol consumption and its effects. Let's try listing at least some of them. Alcohol is a legal commodity, but at the same time, there is also illegal consumption, the volume of which is difficult to estimate. Moderate alcohol consumption is not dangerous, and epidemiological studies indicate that for a number of diseases the mortality risks among moderate alcohol consumers

Table 4. HLE at various ages depending on alcohol consumption type, 2018

	Men				Women			
	TLE, years		HLE, years		TLE, years		HLE, years	
Age	abuse alcohol	do not abuse alcohol	abuse alcohol	do not abuse alcohol	abuse alcohol	do not abuse alcohol	abuse alcohol	do not abuse alcohol
0 (at birth)	64.8	70.7	59	63.2	74.2	78.9	63.5	66.1
15	50.4	56.4	44.8	49.1	59.8	64.5	49.2	51.8
30	36.7	42.2	31.3	35.1	45.4	49.9	35.1	37.5
45	25.1	29.2	19.7	22.4	32.3	35.8	22.3	24
60	15.3	17.6	10.2	11.5	20.1	22.5	11.3	12.3
75	8.3	9.5	4.1	4.6	9.6	11.2	3.7	4.3

Source: author's calculations based on the RLMS and Russian Fertility and Mortality Database data.

are lower than among those who have never consumed it. Alcohol itself comes in diverse forms and might be consumed both in strong and low degree form, and correct assessment of its total consumption is not an easy task.

Calculations of alcohol mortality require knowledge of the prevalence of excessive alcohol consumption in different sex and age groups. Aggregated retail statistics don't give that much detail. The necessary data can be obtained from representative population surveys, however, survey-based estimates are generally significantly lower when compared to sales of alcoholic beverages, which raises the question of adequate calibration of the survey data. This paper presents an attempt of such a calibration. In the future, more complex mathematical and statistical methods can be applied to the assessment of alcohol consumption, enabling finding a better approximation of real consumption volume.

Recommendations for improving Russia's policy on mortality reduction

Recommendation 1. Existing statistics on alcohol consumption and alcohol mortality require expansion and detailization; the indicators that are currently being collected do not provide an objective illustration of what is happening.

Excessive alcohol consumption is a significant factor in premature mortality in Russia. Alcohol mortality is a complex phenomenon, it cannot be characterized in simple ways. According to the estimates obtained within this study, alcohol was the direct cause of about 160,000 deaths in 2018. Of these, only about 50 thousand were related solely to alcohol mortality (including alcoholic cirrhosis of the liver, alcoholic cardiomyopathy, alcoholic poisonings, etc.). This indicator, widely used in Russian research and administrative practice for the analysis of alcohol mortality, characterizes the problem only superficially. For a thorough analysis, it is necessary to assess the contribution of alcohol to mortality from the most common causes of death, such as coronary heart disease, atherosclerosis, liver disease of non-alcoholic origin, as well as external cause of death.

Gathering complete data on alcohol consumption is possible within population surveys. Questions about alcohol consumption are asked in many of them, including RMLS — HSE, Rosstat Comprehensive Survey of Living Conditions (CSLC) and the Population Dietary Structure Sample Survey. However, a formal question about the consumption of any type of alcoholic beverages in the last 30 days is not sufficient to calculate estimates of the prevalence of a dangerous type of alcohol consumption. Alcohol is a complex commodity the consumption of which is not always dangerous, therefore fundamentally different, for example, from tobacco. Only the RLMS survey provides information sufficient to estimate the amount of alcohol consumed per month and the amount of alcohol consumed on separate days (required to identify episodes of consumption of significant amounts of ethanol).

To collect complete information about alcohol consumption the author proposes to add questions about consumption of the following alcoholic beverages to Rosstat surveys (the list is compiled on the basis of the RLMS questionnaire):

- beer and brew (braga), including industrial beer and domestic beer;
- dry wine, champagne, homemade wine;
- fortified wine, including industrial production (martini, vermouth);
- alcoholic cocktails;
- strong alcoholic beverages including vodka, whisky, cognac, hooch;
- other alcoholic beverages.

Recommendation 2. An important direction to improve the situation is to reduce the proportion of strong beverages in the structure of alcohol consumption both by competent excise policy and by means of limiting physical availability of alcohol.

Modern studies suggest various ways to define excessive alcohol consumption, but most experts support the view that alcohol abusers include: (1) individuals consuming on average high volumes of alcoholic beverages for a certain time period (e.g. within the last 30 days); and (2) individuals who occasionally consume large volumes of alcohol. Both types of alcohol abuse are more common among consumers of strong alcoholic beverages; in Russia, it is usually vodka.

Shifting alcohol consumption patterns towards less strong beverages (in particular, dry wine and beer) can reduce the prevalence of excessive alcohol consumption, which, in turn, will lead to a reduction in alcohol mortality and an increase in TLE. The main instrument of government influence on alcohol consumption patterns is the ratio of excise taxes on different types of beverages and their binding to the quantitative content of ethanol.

Currently, the excise policy in the sphere of alcohol taxation in Russia is contradictory. The rule of accounting for the strength of alcoholic beverages in the tax burden of is not universal: excise taxes on strong beverages in ethanol equivalent are higher only for excise taxes on wine, but not on beer. In addition, excise duty on vodka and other strong beverages remains low in comparison with developed countries, where it significantly impacts consumption and forces the mass consumer to switch to drinks with less alcohol content.

For example, in 2019 excise tax on alcoholic products with a volume share of ethyl alcohol over 9%, excluding beer, wines, etc. (i.e. the category of vodka and other strong drinks) was 523 rubles per 1 litre of anhydrous ethyl alcohol. For wine the excise was in the range of 5–18 rubles per 1 litre of drink, corresponding to 42–150 rubles in ethyl equivalent, for sparkling wines — 14–36 rubles per 1 litre of drink or 117–300 rubles in ethyl equivalent. For beer of a strength from 0.5 to 8.6% the excise duty was 21 rubles per litre of drink, i.e. for beer of a strength of 4% the value of the excise in ethyl equivalent was 525 rubles. Thus, the excise

duty on vodka is 1.5 to 3.5 times higher than on wine, and no different from the excise on beer of medium strength.

In this regard, it is possible to recommend gradual indexation of excise taxes on strong alcoholic beverages, with the rate outpacing the inflation rate, as well as indexation of excise taxes on other (less strong) types of beverages.

Recommendation 3. Effective law enforcement practices, including illegal alcohol trafficking and sustaining existing age restrictions, might reinforce the success of the state policy to limit alcohol consumption.

Currently in Russia there are many restrictions on consumption of alcoholic beverages, and in such a situation the issue of effective enforcement becomes the priority. There are a number of different areas of alcohol policy, of which illegal consumption as well as obeying existing age restrictions are the most relevant for the results of this study. However, it is hardly possible to call Russian policy to reduce alcohol consumption effective (see this in Grigoriev and Andreev 2015).

According to WHO estimates, Russia is the third country in Europe in terms of consumption of illegal alcohol, which in 2016 amounted to 3.6 litres of ethanol per capita per year. According to the state national project *Demography*, legal retail sales in 2016 amounted to 6.6 litres of ethanol per capita, and the proportion of illegal consumption is equal to about 30%, i.e. absolute illegal consumption is slightly lower than WHO estimates. In any case, these are significant volumes that are most likely to be located in regions where the population is poorer and less likely to shop at large retail chains where the likelihood of encountering illegal alcohol is lower.

The modern structure of illegal consumption is dominated by products manufactured at legal enterprises bypassing existing tax rules. The aim of the relevant departments and law enforcement agencies is to effectively monitor the situation and to identify existing offences in the retail of alcohol products.

Another task is the consistent enforcement of age restrictions in the alcohol sales. An important trend in recent years has been the decline in alcohol consumption among younger age cohorts. One contributing factor was the change in the retail structure of alcoholic beverages towards the growth of the share of large retail chains where it is more difficult for minors to buy alcohol than in small outlets. Obeying the existing age limits will contribute to increasing the age of drinking and will enable avoiding many of the dangers arising in situations when children and adolescents prematurely gain access to alcohol.

Conclusion

Alcohol is an important factor in premature mortality in Russia, but it is not easy to estimate the demographic losses occurring due to its consumption. The main reasons of this difficulty occur to the facts, that moderate alcohol consumption does not necessary have negative effects on health, and among the causes of alcohol mortality there are those related solely to alcohol consumption and those only partially related to it. This study presents an attempt to estimate alcohol-related mortality in its entirety.

According to the obtained estimates, in 2018 the number of alcohol-related deaths in Russia amounted to 195.5 thousand people, including 145.7 thousand men and 49.7 thousand women. The peak of alcohol mortality is observed among individuals aged 50 and older (63% of all alcohol deaths among men and 72% among women).

The official statistics in Russia estimates the negative impact of alcohol basing on the number of deaths related solely to alcohol, which leads to a significant underestimation of real demographic losses. According to the results of this study, the contribution of these causes to the overall alcohol-related mortality is only 25% for both sexes.

The structure of alcohol mortality is dominated by diseases of the cardiovascular system and external causes. There is a certain gender specificity: for men, external causes dominate the structure of alcohol mortality (40%), and cardiovascular diseases account for 31% of all alcohol-related deaths, while for women cardiovascular diseases stand as a main cause (47%), which is followed by external causes (23%). Liver and pancreatic diseases also contribute significantly to deaths caused by alcohol abuse — they account for 13 and 20% of deaths among men and women, respectively. A more detailed study of the structure of alcohol mortality enables highlighting the following individual causes with the largest contribution: alcoholic cardiomyopathy, accidental alcohol poisoning and suicides for men, and atherosclerotic heart disease, acute myocardial infarction and non-alcoholic liver diseases for women.

Excessive alcohol consumption has been shown to reduce life expectancy by 5.9 years for men and by 4.7 years for women. Corresponding losses in healthy life expectancy are 4.2 and 2.6 years for men and women, respectively.

It should be noted that gender disparities reduce noticeably with the transition to HLE indicators. The difference in TLE between men and women with excessive alcohol consumption in 2018 was over 9 years, while the difference in HLE was only 4.5 years. Gender differences for a population with a safe type of alcohol consumption behave similarly. The author tends to explain these discrepancies by the gender differences in the health self-assessment: women tend to state lower estimatesof their own health, which is particularly visible at older ages.

The mortality tables calculated by the author for persons with excessive alcohol consumption and the rest of the population can be used in insurance and actuarial calculations. generally, the study has shown that a decrease in the prevalence of alcohol abuse can lead to a significant decrease in premature mortality and an increase in TLE and HLE.

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