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Cross-sectional study on the characteristics of unrecorded alcohol consumption in nine newly independent states between 2013 and 2017

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ABSTRACT

Objectives As unrecorded alcohol use contributes to a substantial burden of disease, this study characterises this phenomenon in newly independent states (NIS) of the former Soviet Union with regard to the sources of unrecorded alcohol, and the proportion of unrecorded of total alcohol consumption. We also investigate associated sociodemographic characteristics and drinking patterns.

Design Cross-sectional data on overall and unrecorded alcohol use in the past 7 days from WHO STEPwise Approach to NCD Risk Factor Surveillance (STEPS) surveys. Descriptive statistics were calculated at the country level, hierarchical logistic and linear regression models were used to investigate sociodemographic characteristics and drinking patterns associated with using unrecorded alcohol.

Setting Nine NIS (Armenia, Azerbaijan, Belarus, Georgia, Kyrgyzstan, Republic of Moldova, Tajikistan, Turkmenistan and Uzbekistan) in the years 2013–2017.

Participants Nationally representative samples including a total of 36 259 participants.

Results A total of 6251 participants (19.7%; 95% CI 7.9% to 31.5%) reported alcohol consumption in the past 7 days, 2185 of which (35.1%; 95% CI 8.2% to 62.0%) reported unrecorded alcohol consumption with pronounced differences between countries. The population-weighted average proportion of unrecorded consumption in nine NIS was 8.7% (95% CI 5.9% to 12.4%). The most common type of unrecorded alcohol was home-made spirits, followed by home-made beer and wine. Older (45–69 vs 25–44 years) and unemployed (vs employed) participants had higher odds of using unrecorded alcohol. More nuanced sociodemographic differences were observed for specific types of unrecorded alcohol.

Conclusions This contribution is the first to highlight both, prevalence and composition of unrecorded alcohol consumption in nine NIS. The observed proportions and sources of unrecorded alcohol are discussed in light of local challenges in policy implementation, especially in

Strengths and limitations of this study

► Population surveys are likely to underestimate the amount of unrecorded alcohol actually consumed, especially in countries with strong social norms and religious rules opposing alcohol consumption.

► Considering that the STEPS is a household survey, it does not include institutionalised individuals who are more often heavy alcohol users and it also does not capture a large share of impoverished surrogate consumers, who are homeless or are living in other conditions than a household.

► This is the first and most comprehensive study currently available that provides a quantitative assessment of the prevalence of unrecorded alcohol consumption in newly independent states of the former Soviet Union.

► All country-level estimates are based on empirical data generated with the same survey methodology.

regard to the newly formed Eurasian Economic Union (EAEU), as some but not all NIS are in the EAEU.

INTRODUCTION

It is currently estimated that about 20% of the total alcohol consumed in the WHO European Region is unrecorded.[1 2] Accordingly, unrecorded alcohol makes an important contribution to the burden of disease attributable to alcohol consumption.[3] This study examined unrecorded alcohol in nine newly independent states (NIS). The term NIS denotes countries of the former Soviet Union, comprising Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Republic of Moldova, Russia, Tajikistan, Turkmenistan, Ukraine and Uzbekistan.[4] In the

current study, all NIS but Kazakhstan, Russia and Ukraine were included. Studying unrecorded alcohol in NIS is interesting as these countries are diverse in potential influencing factors of unrecorded consumption, such as wealth[5 6] and varying proportions of Muslim population.[6 7]

Unrecorded alcohol is an umbrella term for all alcohol that is not captured by routine statistics (eg, through domestic taxation),[2 8] comprising several heterogeneous sources whose importance differs by country.[9] These sources of unrecorded alcohol include home-made alcohol (eg, fermented and/or distilled home-made beverages)[10–12]; surrogate alcohol (ie, alcohol intended for industrial or medical uses such as antifreeze, mouthwash, or rubbing alcohol)[13–15]; counterfeit (ie, alcohol that is sold in replica bottles suggesting a certain brand)[16] and other illegally produced alcohol (eg, alcohol that is produced in factories without declaring the production to the authorities), and alcohol that is brought across the border (eg, through duty free shopping or smuggling).[17]

By definition unrecorded alcohol is outside of government control of the country, where it is used, and not subject to quality checks. Accordingly, it may contain additional toxic compounds, such as methanol or heavy metals.[9] Due to lack of price control, unrecorded alcohol is often the cheapest form of alcohol available,[9 14 18] and as a consequence, its consumption has been linked to more risky drinking patterns and health consequences, such as alcohol poisoning.[19–21]

Effective alcohol policies to reduce unrecorded alcohol consumption require country-specific knowledge about the sources of unrecorded alcohol.[22] Furthermore, the sociodemographic characteristics of consumers of unrecorded alcohol need to be known for targeted interventions. There is evidence that some sources of unrecorded alcohol such as home-made or surrogate alcohol are more likely to be used by people with lower socioeconomic status.[23] However, the evidence on the sociodemographic characteristics related to unrecorded alcohol use is scarce and divided.[24]

There are little to no systematic efforts to empirically monitor the consumption of unrecorded alcohol on national or supranational levels.[25–27] The few examples of supranational efforts, to assess unrecorded alcohol are the Joint Action on Reducing Alcohol-Related Harm-Standardised European Alcohol Survey including seven European countries[24 28]; the European Comparative Alcohol Study including six European countries[29]; and a global expert assessment including 41 countries.[1] Furthermore, single countries such as Sweden perform regular assessments of unrecorded alcohol consumption and its sources.[30–32] Lastly, assessment of unrecorded alcohol consumption is being included in the STEPwise approach to surveillance surveys (STEPS surveys) since 2013,[33] but data regarding the sources of unrecorded alcohol have not been published to date.

The objectives of this study were (1) to characterise unrecorded consumption in nine NIS with regard to prevalence and average quantity of consumption, proportion of unrecorded alcohol of the total alcohol consumption and major sources of unrecorded alcohol; (2) to investigate sociodemographic characteristics of drinkers that report using unrecorded alcohol and (3) to investigate differences in drinking patterns of drinkers that report unrecorded consumption compared with those who do not.

METHODS
Data
Cross-sectional data came from STEPS surveys performed in nine NIS between 2013 and 2017,[33] including a total of 36 259 participants with complete data (less than 1% of observations with missing information on relevant variables). STEPS surveys are designed to be nationally representative of the adult population, aged 18–69 years (further details on the methodology are reported elsewhere).[33] An overview of all data sets included and core country characteristics[2 34 35] is shown in table 1.

Sociodemographic characteristics including age, sex, level of education and employment status were assessed for all participants. Education was categorised into low (primary school or less), medium (secondary school/ high school completed) and high education (college degree or higher). Employment status was categorised into employed, unemployed and other (homemaker, student, retired). Age was categorised into young adults (18–24), middle-aged adults (25–44) and older adults (45–69).

The quantity of total and unrecorded alcohol consumed was assessed for the past 7 days. The total alcohol consumption (irrespective of unrecorded alcohol) was assessed as the number of standard drinks consumed on each of the past 7 days. Unrecorded alcohol consumption was assessed for five sources of unrecorded alcohol ('On average, how many standard drinks of the following did you consume during the past 7 days'): (1) Homebrewed spirits, eg, moonshine; (2) Homebrewed beer or wine, eg, beer, palm or fruit wine; (3) Alcohol brought over the border/from another country; (4) Alcohol not intended for drinking, eg, alcohol-based medicines, perfumes, aftershaves; (5) Other untaxed alcohol in the country (not further specified). Showcards were used in all assessments to provide country-specific examples for standard drinks and beverages. A standard drink in STEPS is defined as 10 g. However, in order to counteract the vast under-reporting,[36] a standard drink was assumed to contain 12 g of pure alcohol in all countries in order to calculate average grams of pure alcohol per day (GPD).

The frequency of alcohol use was assessed for the past 12 months and dichotomised to high (5 or more drinking days per week) and low/medium frequency (less than 5 days per week). Heavy episodic drinking (yes/no), defined as having used six or more standard drinks on a single occasion in the past 30 days.

Table 1 Overview of surveys included in this study: the country where the survey was conducted including the region, the World Bank income level,[34] the proportion of Muslims in the general population,[35] WHO estimates on litres of recorded alcohol per capita,[2] recorded grams per day (GPD) among drinkers;[2] the year of the survey, response rate, total sample (N), number of current drinkers (N (CD); past 7 days) as well as the number of current drinkers reporting use of unrecorded alcohol (N (unrec); past 7 days)

Country	Region	Income level*	Muslim religion*	Recorded APC*	Recorded GPD among drinkers†	Survey year	Response rate	N	N (CD)	N (unrec)
Armenia	Transcaucasia	UMIC	0.5%	3.8	13.9	2016	42%	2349	373	106
Azerbaijan	Transcaucasia	UMIC	97.2%	0.4	2.8	2017‡	97%	5602	478	42
Belarus	Eastern Europe	UMIC	0.5%	10.1	30.1	2016/2017‡	87%	5010	1348	157
Georgia	Transcaucasia	LMIC	11.2%	7.4	26.6	2016	76%	4204	801	488
Kyrgyzstan	Central Asia	LMIC	88.4%	5.7	61.7	2013	100%	2623	473	56
Republic of Moldova	Eastern Europe	LMIC	0.5%	9.6	27.3	2013	84%	4807	2020	1308
Tajikistan	Central Asia	LMIC	96.5%	0.9	14.6	2016	99%	2717	98	2
Turkmenistan	Central Asia	UMIC	93.0%	3.9	33.8	2013	89%	5113	311	21
Uzbekistan	Central Asia	LMIC	96.9%	1.5	22.1	2014	89%	3834	349	19

*Referring to the year of the survey
†Expressed as average consumption of pure alcohol in grams per day.
‡Referring to 2016.
APC, alcohol per capita; LMIC, lower-middle-income country; UMIC, upper-middle-income country.

Statistical analyses

First, descriptive statistics on the prevalence of total and unrecorded alcohol use and average quantity (GPD) among current drinkers were calculated. The sources of unrecorded alcohol were calculated as the proportion of all unrecorded alcohol. Averages across all nine NIS were population weighted.

Second, sociodemographic characteristics (sex, age, level of education, and employment status; independent variables) associated with (1) consumption of any unrecorded alcohol and (2) consumption of unrecorded alcohol from specific sources (dependent variables) were analysed using hierarchical logistic regression models. We investigated bivariate associations between independent and dependent variables in crude models before entering all independent variables simultaneously into a multivariate, fully adjusted model.

Third, the association between unrecorded alcohol consumption (independent variable) and three drinking patterns (dependent variables) was investigated among current drinkers, adjusting for age and sex. Hierarchical logistic regression models were used for (1) drinking at *high* vs low/medium frequency and (2) heavy episodic drinking. A hierarchical linear regression model was used for (3) GPD (average quantity), after log-transforming GPD.

All hierarchical models used random intercepts for each country. Appropriate survey weights were applied in all analyses to account for complex design and non-response rate in each survey, thus making the results representative at country level.

RESULTS
Consumption and sources of unrecorded alcohol

In the total sample, 6251 participants reported using alcohol in the past 7 days, 2185 of which used unrecorded alcohol. The population weighted average prevalence of current drinking was 19.7% (95% CI 7.9% to 31.5%) with an average of 35.1% (95% CI 8.2% to 62.0%) of the current drinkers using unrecorded alcohol. The prevalence of any and unrecorded alcohol use in the past 7 days was highest in the Republic of Moldova with 46.7% (95% CI 44.3% to 49.1%) and 29.5% (95% CI 26.8% to 32.2%), respectively. The lowest prevalence for any (3.2%; 95% CI 2.1% to 4.2%), and unrecorded alcohol use (0.02%; 95% CI 0.0% to 0.1%), was reported in Tajikistan (figure 1).

The proportion of drinkers consuming unrecorded alcohol was highest in the Republic of Moldova (61.8%; 95% CI 57.3% to 66.3%) and Georgia (58.7%; 95% CI 53.6% to 63.8%) and lowest in Tajikistan (0.7%; 95% CI 0.0% to 1.9%), Turkmenistan (3.7%; 95% CI 0.6% to 6.8%) and Uzbekistan (3.0%; 95% CI 0.8% to 5.1%). As only two participants reported using unrecorded alcohol in Tajikistan, the survey was excluded from descriptive analyses on sources of unrecorded alcohol on the country level.
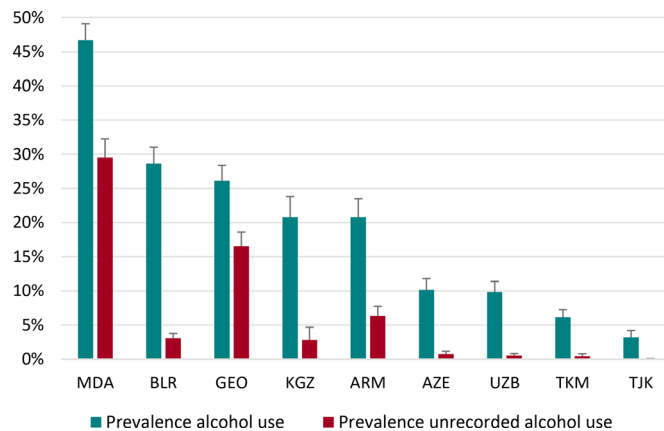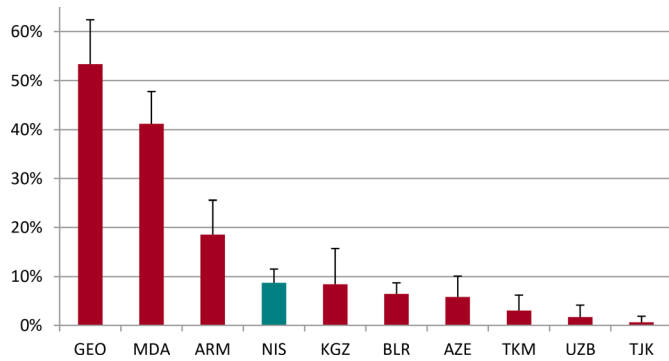

Figure 1 Prevalence of current alcohol use (past 7 days) and current use of unrecorded alcohol (past 7 days) in Armenia (ARM), Azerbaijan (AZE), Belarus (BLR), Georgia (GEO), Kyrgyzstan (KGZ), Republic of Moldova (MDA), Tajikistan (TJK), Turkmenistan (TKM) and Uzbekistan (UZB).

The average quantity of total alcohol consumed among current drinkers was lowest in Armenia (9.4 GPD; 95% CI 8.0 to 10.8) and Azerbaijan (8.1 GPD; 95% CI 6.4 to 9.9) and highest in Tajikistan (15.3 GPD; 95% CI 9.6 to 20.9) and Georgia (13.6 GPD; 95% CI 12.2 to 15.0). The highest average quantity of unrecorded alcohol consumed among current drinkers was observed in Georgia (7.3 GPD; 95% CI 6.3 to 8.2) and the Republic of Moldova (5.0 GPD; 95% CI 4.3 to 5.7). In the seven remaining countries, drinkers consumed one GPD or less, with the exception of Armenia (1.8 GPD; 95% CI 1.1 to 2.4).

The proportion of unrecorded alcohol of total alcohol is shown in figure 2. The proportion was highest in Georgia with 53.4% (95% CI 44.3% to 62.5%), closely followed by the Republic of Moldova (41.2%, 95% CI 34.5% to 47.8%). The lowest proportions of unrecorded alcohol consumption were observed in Turkmenistan and Uzbekistan (less than 5%). Across all nine NIS, the population-weighted proportion of unrecorded consumption was 8.7% (95% CI 5.9% to 12.4%).

The sources of unrecorded alcohol by country are shown in figure 3. In all countries, more than half of the unrecorded alcohol came from home-made alcohol. In Azerbaijan, Armenia and Turkmenistan the largest share of unrecorded alcohol (>60%) came from home-made spirits, whereas in Georgia, Republic of Moldova and Kyrgyzstan home-made beer/wine made up the largest proportion (>60%). In Belarus, approximately equal shares of unrecorded alcohol were reported to be home-made spirits (29%), home-made beer/wine (27%) and alcohol brought across the border (33%). The only other country where cross-border alcohol made up more than 10% of the unrecorded consumption was Kyrgyzstan (19%). The latter was also the only country with a considerable share of surrogate alcohol (18%).
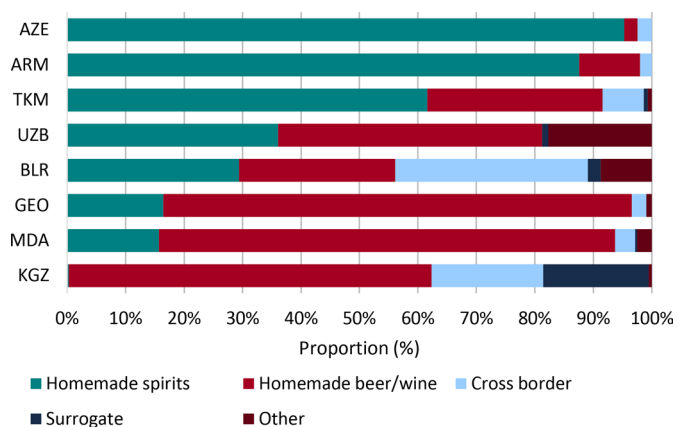
Figure 2 Proportion of unrecorded alcohol of the total alcohol consumed (past 7 days) in Armenia (ARM), Azerbaijan (AZE), Belarus (BLR), Georgia (GEO), Kyrgyzstan (KGZ), Republic of Moldova (MDA), Turkmenistan (TKM), Uzbekistan (UZB) and all nine newly independent states included in this analysis.

Sociodemographic characteristics associated with unrecorded alcohol use

Among drinkers, older adults and participants without employment (unemployed or other) had elevated odds of reporting unrecorded alcohol use compared with middle-aged and employed participants, respectively (table 2). Younger adults were less likely to report unrecorded consumption compared with middle-aged adults. No association with unrecorded alcohol use was found for sex and education.

Looking at the odds of consuming unrecorded alcohol from specific sources revealed a more nuanced picture. Systematic differences by sex were observed for consuming home-made spirits with higher odds for males compared with females. Regarding age, the same age pattern as for any unrecorded alcohol was observed for home-made spirits and home-made beer/wine. Employment status was relevant for the consumption of home-made beer/wine with elevated odds among participants without employment (unemployed and other). For alcohol brought across the border, the highest odds were

Figure 3 Sources of unrecorded alcohol (% of total unrecorded) in Armenia (ARM), Azerbaijan (AZE), Belarus (BLR), Georgia (GEO), Kyrgyzstan (KGZ), Republic of Moldova (MDA), and Uzbekistan (UZB). Note: results for Tajikistan were omitted due to low sample size (n=2).

observed among unemployed respondents, while other employment status was associated with the lowest odds. Further, low education (compared with high education) was associated with increased odds of home-made spirits consumption and decreased odds of cross border alcohol consumption.

Drinking patterns associated with unrecorded alcohol use

Compared with current drinkers who did not report unrecorded alcohol use, drinkers that used unrecorded alcohol had higher odds of drinking alcohol in a high frequency (OR=1.61; 95% CI 1.24 to 2.08; p=0.003) and of engaging in heavy episodic drinking (OR=1.38; 95% CI 1.05 to 1.82; p=0.027). Finally, unrecorded alcohol use was associated with a more than two grams higher average quantity of total alcohol consumed GPD (2.36; 95% CI 0.54 to 4.17; p=0.017).

DISCUSSION

In nine NIS, more than one-third of current drinkers used unrecorded alcohol in the past 7 days and overall, about 10% of the total alcohol consumed was unrecorded. However, there was great variation between the countries. In Georgia and Republic of Moldova consumption of unrecorded alcohol was highest, making up more than 40% of the total consumption. When comparing the results for the proportion of unrecorded alcohol to estimates published in the most recent Global Status Report on Alcohol and Health (GSRAH), some high discrepancies are evident,[2] specifically in Turkmenistan (this study: 3.1%, GSRAH: 46.3%), Uzbekistan (this study: 1.7%, GSRAH: 40.7%) and Tajikistan (this study: 0.6%, GSRAH: 69.7%). One reason for the observed discrepancies may be selective refusal of survey participation or underreporting of any alcohol use and unrecorded alcohol in particular due to stigma, social desirability related to norms and religious rules and fear of (legal) repercussions. Five out of nine countries included in this study (including those with the highest discrepancy to GSRAH estimates) are Muslim majority countries.[35] Hence, the disclosure of alcohol use is against religious and cultural norms that are embedded in social practices and alcohol policies.[37 38]

Another more technical reason for the discrepancy in the estimates is that in countries with low alcohol consumption the proportion of unrecorded alcohol is sensitive to small changes in the quantity of either recorded or unrecorded consumption and measurement error.

Overall, the discrepancies underline the current considerable uncertainty of unrecorded alcohol estimates. To improve the estimates, high-quality sources of unrecorded alcohol data are needed. Triangulation of multiple sources of information, including survey data as well as expert judgements, and state-of-the-art methods are key for reliable estimates.[1]

While findings regarding drinking patterns and user characteristics were in general in line with previous

Table 2 Hierarchical logistic regression analyses on using unrecorded alcohol in the past 7 days among people who used any alcohol in the past 7 days (N=6339)

Type of unrecorded (N)	Category (reference)		Crude model*			Full model		
			OR	P value	95% CI	OR	P value	95% CI
All unrecorded (2199)								
	Sex (female)	Male	1.10	0.527	0.78 to 1.56	1.11	0.568	0.74 to 1.66
	Age (25–44)	18–24	0.49	<0.001	0.42 to 0.58	0.45	<0.001	0.38 to 0.54
		45–69	1.48	0.028	1.06 to 2.07	1.47	0.026	1.06 to 2.05
	Employment (employed)	Unemployed	1.50	<0.001	1.28 to 1.75	1.64	0.001	1.32 to 2.04
		Other	1.20	0.010	1.06 to 1.36	1.35	0.029	1.04 to 1.76
	Education (high)	Low	1.03	0.862	0.74 to 1.43	0.98	0.920	0.65 to 1.48
		Medium	1.04	0.812	0.70 to 1.55	1.00	0.996	0.63 to 1.57
Home-made spirits (586)								
	Sex (female)	Male	1.88	0.005	1.29 to 2.73	1.79	0.005	1.26 to 2.55
	Age (25–44)	18–24	0.50	0.007	0.32 to 0.78	0.54	0.004	0.38 to 0.76
		45–69	1.58	0.021	1.09 to 2.27	1.68	0.008	1.19 to 2.36
	Employment (employed)	Unemployed	1.08	0.545	0.82 to 1.42	1.08	0.530	0.82 to 1.43
		Other	0.81	0.432	0.46 to 2.04	0.92	0.707	0.55 to 1.53
	Education (high)	Low	1.41	0.061	0.98 to 2.04	1.49	0.008	1.14 to 1.93
		Medium	1.22	0.199	0.88 to 1.69	1.25	0.220	0.85 to 1.85
Home-made beer/wine (1636)								
	Sex (female)	Male	1.24	0.221	0.85 to 1.80	1.28	0.189	0.86 to 1.92
	Age (25–44)	18–24	0.59	<0.001	0.50 to 0.70	0.52	<0.001	0.41 to 0.67
		45–69	1.47	0.014	1.11 to 1.94	1.45	0.018	1.09 to 1.94
	Employment (employed)	Unemployed	1.44	0.009	1.13 to 1.84	1.51	0.015	1.11 to 2.06
		Other	1.25	0.095	0.95 to 1.64	1.43	0.004	1.17 to 1.76
	Education (high)	Low	1.21	0.218	0.87 to 1.69	1.18	0.367	0.79 to 1.74
		Medium	1.20	0.316	0.81 to1.79	1.17	0.465	0.73 to 1.86
Cross-border (148)								
	Sex (female)	Male	0.68	0.456	0.22 to 2.10	0.59	0.289	0.20 to 1.72
	Age (25–44)	18–24	0.66	0.285	0.28 to 1.53	0.78	0.539	0.32 to 1.92
		45–69	0.66	0.054	0.43 to 1.01	0.73	0.054	0.53 to 1.01
	Employment (employed)	Unemployed	1.28	0.125	0.92 to 1.78	1.46	0.034	1.04 to 2.06
		Other	0.44	0.009	0.25 to 0.76	0.45	0.008	0.27 to 0.76
	Education (high)	Low	0.41	0.045	0.17 to 0.97	0.43	0.022	0.21 to 0.85
		Medium	0.77	0.423	0.38 to 1.56	0.81	0.493	0.41 to 1.59
Surrogate alcohol (19)								
	Sex (female)	Male	1.09	0.849	0.42 to 2.83	1.19	0.730	0.39 to 3.61
	Age (25–44)	18–24	n/a			n/a		
		45–69	1.45	0.239	0.74 to 2.85	1.25	0.448	0.66 to 2.39
	Employment (employed)	Unemployed	1.76	0.130	0.81 to 3.81	2.07	0.145	0.73 to 5.87
		Other	1.93	0.243	0.58 to 6.44	2.03	0.090	0.87 to 4.75
	Education (high)	Low	0.59	0.529	0.09 to 3.78	0.55	0.492	0.08 to 3.70
		Medium	1.68	0.665	0.12 to 24.37	1.52	0.712	0.12 to 18.94

*Crude model on the bivariate association between dependent variable and one covariate.
†Multivariate model adjusting for all covariates simultaneously.
n/a, not available.

studies,[20 24 39] the current study allowed for a more nuanced analysis of drinkers' characteristics by the source of unrecorded alcohol. Specifically, the study showed that some sources of unrecorded alcohol (eg, cross-border alcohol) were less likely to be consumed by people with

lower education, whereas the opposite was true for home-made spirits.

Across the NIS, the majority of unrecorded alcohol was consumed as home-made alcohol with differences between countries with regard to the beverage type (spirits vs beer/wine). The current legislative landscape regarding home-made alcohol is very diverse across NIS. For example, in Belarus, it is legal to produce up to five litres of spirits per person for own consumption with sales being prohibited but enforcement is poor. In other countries, such as Georgia, there is no legislation in place regarding the production of home-made or informally produced beverages.[2] Next to cultural aspects, price and affordability of recorded alcohol may influence differences in the amount and type of unrecorded alcohol consumed in each of the countries. There are considerable differences between the countries included in this study with alcohol prices in Tajikistan being overall at the lower and Georgia being at the upper end of the price spectrum,[40] warranting additional research into the role of different pricing and taxation policies for the consumption of unrecorded alcohol.

Findings from the current study indicate that countries such as Georgia and Armenia could attempt to decrease their alcohol consumption considerably by regulating the production of home-made spirits. While ethanol is responsible for a large part of the risks related to unrecorded alcohol consumption, additional health risks may arise from toxic compounds in home-made spirits.[41–43] Another approach to potentially reduce the harms related to home-made alcohol is to incentivise the registration of home-made alcohol.[44–46]

Countries such as Belarus and Kyrgyzstan, where more than 15% of the unrecorded alcohol come across the border, could consider stricter custom duty regulations and border controls.[44 47] In 2013, the Eurasian Customs Union (Belarus, Kazakhstan and the Russian Federation) has adopted an agreement on the activities of the alcohol industry that gives clear guidance on import and duty payments and also take into account national alcohol regulations, for instance the sales ban on home-made alcohol in Russia or the minimum legal drinking age of 21 in Kazakhstan.[48 49] In 2014, the Eurasian Customs Union was incorporated in the Eurasian Economic Union's (EAEU) legal framework with Armenia and Kyrgyzstan joining. However, the existing discrepancies in national alcohol taxes and, subsequently, alcohol prices create a situation where cross-border imports between certain countries are economically attractive. For instance, alcohol excise taxes in Kazakhstan are two to three times lower than in Russia. The harmonisation of alcohol regulations across all five member states is not yet completed and many of the current discussions are concerned with questions of alcohol pricing and prevention of tax evasion within the newly formed union. Although joint excise tax rates were agreed for 2024 with the provision of reviewing and adapting the rates every 5 years, it remains to be seen how this will affect the issue of unrecorded alcohol in the region.[50]

It is also worth noting that the outlined provisions regulate import and sales of alcoholic beverages by legal entities only and that no such regulations could be identified for private individuals. For instance, according to the customs regulations, up to 3 L of alcoholic beverages (irrespective of alcohol content) can be imported freely per person into the EAEU,[51 52] but no such regulations for imports within the countries of the union seem to exist. Although there were attempts at the national level to introduce such restrictions, they were not supported by national governments. This highlights the need for international agreements and coordination of pricing measures to prevent the illegal sale of cheap alcoholic products across borders within and outside of the EAEU, also in light of the fact that not all NIS are members of the EAEU. As various NIS have been raising alcohols excise taxes in the past and also introduced minimum price regulations, the issue of cross-border sales needs to be monitored closely to not undermine these efforts.[53 54]

For surrogate alcohol, which was mainly reported in Kyrgyzstan, several policy options to reduce its consumption and related health risks should be considered, namely (1) to increase taxes on alcoholic products that can be misused as surrogate alcohol; (2) to reduce container sizes of these products; (3) to prohibit toxic compounds used to denature alcohol (such as methanol) and (4) to use denaturing compounds which prohibit misuse, such as bittering agents.[8 14 15 44]

Strengths and limitations

A general limitation of survey data is that only a relatively small proportion of the alcohol actually consumed is assessed.[55–57] The low coverage of alcohol assessment in surveys may be exacerbated for unrecorded alcohol and in countries with strong social norms and religious rules opposing alcohol consumption. The cell count for any and unrecorded alcohol use was low in the five Muslim majority countries of the sample, introducing higher uncertainty in the analyses.

Moreover, similar research on unrecorded consumption in NIS suggests that consumption of surrogate alcohol is common among individuals with alcohol dependence from lower socio-economic strata at the end of their drinking trajectory, who can no longer afford any other type of alcohol.[13 20 58] Consumption of surrogates is more stigmatised and less likely to be disclosed in a survey. Unfortunately, information on income was not available in the data to further explore the association between income and unrecorded alcohol use. Furthermore, relevant groups of the population may be excluded from the household-based sampling or opt out of participating in the survey. Considering that the STEPS is a household survey, it does not include institutionalised individuals who are more often heavy alcohol users and it also does not capture a large share of impoverished surrogate consumers, who are homeless or are living in other conditions than a household (eg, hostels, shelters and other types of collective housing). Heavy alcohol users,

as well as very wealthy individuals, are less likely to give consent for participation in the survey, introducing self-selection bias that may skew the estimates of unrecorded alcohol. Overall, this suggests that surrogate alcohol use in particular may be underestimated based on the surveys included in this study. This also means that the degree to which unrecorded alcohol use was under-reported in each country may depend on the country-specific structure of the unrecorded alcohol consumption concerning the different sources of unrecorded alcohol.

Nevertheless, this is the most comprehensive study currently available on unrecorded alcohol consumption in NIS and the first study that provides a quantitative assessment of the prevalence of unrecorded alcohol consumption as based on empirical data generated with the same survey methodology.

CONCLUSIONS

The discrepancies between findings of this study and GSRAH estimates indicate that monitoring of unrecorded alcohol needs to be strengthened to produce consistent estimates over time. As outlined in the example of the EAEU, unrecorded alcohol can undermine countries' efforts to tax and control legal alcohol production. Furthermore, some of the most effective alcohol policies such as taxation and availability restrictions[59] are less effective if a high proportion of alcohol used is unrecorded. To adequately plan alcohol control measures, not only the total quantity of unrecorded alcohol consumed needs to be known, but also the composition of its sources and patterns of unrecorded alcohol consumption across different socioeconomic groups.[22 60 61] Therefore, a comprehensive system for monitoring, auditing and enforcement of tax collection purposes, including recent technologies in the production of tax stamps and the use of so-called 'Quick Response' codes in point-of-sale receipts (as introduced in Russia), are urgently needed and recommended.

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REFERENCES

1 Probst C, Fleischmann A, Gmel G, et al. The global proportion and volume of unrecorded alcohol in 2015. *J Glob Health* 2019;9:010421.

2 World Health Organization. *Global status report on alcohol and health*. Geneva, Switzerland: World Health Organization, 2018.

3 Afshin A, Gakidou E, GBD 2017 Risk Factor Collaborators. Global, regional, and national comparative risk assessment of 84 behavioural, environmental and occupational, and metabolic risks or clusters of risks for 195 countries and territories, 1990-2017: a systematic analysis for the global burden of disease study 2017. *Lancet* 2018;392:1923–94.

4 World Health Organization Regional Office for Europe. Programme support Handbook. country groupings, 2021. Available: http://apps. euro.who.int/handbook/ [Accessed 23 Mar 2021].

5 Rehm J, Larsen E, Lewis-Laietmark C, et al. Estimation of unrecorded alcohol consumption in low-, middle-, and high-income economies for 2010. *Alcohol Clin Exp Res* 2016;40:1283–9.

6 Probst C, Manthey J, Merey A, et al. Unrecorded alcohol use: a global modelling study based on nominal group assessments and survey data. *Addiction* 2018;113:1231–41.

7 Treml VG. *Rutgers center of alcohol S. alcohol in the USSR: a statistical study*. Durham, N.C.: Duke University Press, 1982.

8 Lachenmeier DW, Neufeld M, Rehm J. The impact of unrecorded alcohol use on health: what do we know in 2020? *J Stud Alcohol Drugs* 2021;82:28–41.

9 Rehm J, Kailasapillai S, Larsen E, et al. A systematic review of the epidemiology of unrecorded alcohol consumption and the chemical composition of unrecorded alcohol. *Addiction* 2014;109:880–93.

10 Chakrabarti A, Rai TK, Sharma B. Culturally prevalent unrecorded alcohol consumption in Sikkim, North East India: cross-sectional situation assessment. *Journal of Substance Use* 2015;20:162–7.

11 Makhubele JC. Concoction of harmful substances in homemade alcoholic beverages in rural areas of Mopani district in Limpopo province-RSA: implications for social work practice. *J Evid Based Soc Work* 2013;10:435–46.

12 McCoy SI, Ralph LJ, Wilson W, et al. Alcohol production as an adaptive livelihood strategy for women farmers in Tanzania and its potential for unintended consequences on women's reproductive health. *PLoS One* 2013;8:e59343.

13 Razvodovsky YE. Consumption of alcohol surrogates among alcohol-dependent women. *Subst Use Misuse* 2015;50:1453–8.

14 Lachenmeier DW, Rehm J, Gmel G. Surrogate alcohol: what do we know and where do we go? *Alcohol Clin Exp Res* 2007;31:1613–24.

15 Neufeld M, Lachenmeier D, Hausler T, et al. Surrogate alcohol containing methanol, social deprivation and public health in Novosibirsk, Russia. *Int J Drug Policy* 2016;37:107–10.

16 Neufeld M, Lachenmeier DW, Walch SG, et al. The internet trade of counterfeit spirits in Russia - an emerging problem undermining alcohol, public health and youth protection policies? *F1000Res* 2017;6:520.

17 Grittner U, Bloomfield K. Changes in private alcohol importation after alcohol tax reductions and import allowance increases in Denmark. *Nordisk Alkohol Nark* 2009;26:177–91.

18 Gil A, Polikina O, Koroleva N, et al. Availability and characteristics of nonbeverage alcohols sold in 17 Russian cities in 2007. *Alcohol Clin Exp Res* 2009;33:79–85.

19 Cuong PV, Casswell S, Parker K. Cross-country comparison of proportion of alcohol consumed in harmful drinking occasions using the International alcohol control study. *Drug Alcohol Rev* 2018.

20 Neufeld M, Wittchen H-U, Rehm J. Drinking patterns and harm of unrecorded alcohol in Russia: a qualitative interview study. *Addict Res Theory* 2017:1–11.

21 Leon DA, Saburova L, Tomkins S, et al. Hazardous alcohol drinking and premature mortality in Russia: a population based case-control study. *Lancet* 2007;369:2001–9.

22 Neufeld M, Rehm J. Effectiveness of policy changes to reduce harm from unrecorded alcohol in Russia between 2005 and now. *Int J Drug Policy* 2018;51:1–9.

23 Lachenmeier DW, Gmel G, Rehm J. Unrecorded alcohol consumption. In: Boyle P, Boffetta P, Lowenfels AB, et al, eds. *Alcohol: science, policy, and public health*. Oxford, U.K: Oxford University Press, 2013: 132–42.

24 Manthey J, Probst C, Kilian C, et al. Unrecorded alcohol consumption in seven European Union countries. *Eur Addict Res* 2020;26:316–25.

25 Rehm J, Poznyak V. On monitoring unrecorded alcohol consumption. *Alcoholism and Drug Addiction* 2015;28:79–89.

26 Ministry of Health of the Russian Federation. Prikaz № 575 "Ob utverzhdenii metodiki otsenki srednedushevogo potrebleniya alkogolya v Rossiiskoi Federatsii" [Order № 575 "On adoption of the methodology for assessing per capita alcohol consumption in Russian Federation"], 2019. Available: http://docs.cntd.ru/document/ 560925948 [Accessed 25 Dec 2019].

27 et alOsipchik SI, Kral'ko AA, Korotkevich TV. Ocenka urovnja potreblenija nezaregistrirovannogo alkogolja. [Assessment of the level of consumption of unregistered alcohol]. Republican Scientific and Practical Center for Mental Health.], 2018. Available: http:// mentalhealth.by/media/doc/ocenka-urovnja-nezaregistrirovannogo-alkogolja.pdf [Accessed 12/20/2019].

28 Moskalewicz J, Room R, Thom B. *Comparative monitoring of alcohol epidemiology across the EU - Baseline assessment and suggestions for future action. Synthesis report*. Warsaw: Joint Action on Reducing Alcohol Related Harm (RARHA), 2016.

29 Leifman H. The Six-Country survey of the European comparative alcohol study: comparing patterns and assessing validity. *Contemporary Drug Problems* 2002;29:477–500.

30 Norström T, Ramstedt M. Unregistered alcohol consumption and alcohol-related harm in Sweden, 2001–2005. *Nordic studies on alcohol and drugs* 2008;25:101–13.

31 Norström T, Raninen J. Is there a link between per capita alcohol consumption and youth drinking? A time-series analysis for Sweden in 1972-2012. *Addiction* 2015;110:967–74.

32 Nordlund S, Osterberg E. Unrecorded alcohol consumption: its economics and its effects on alcohol control in the Nordic countries. *Addiction* 2000;95 Suppl 4:S551–64.

33 World Health Organization. Data from: stepwise approach to surveillance (steps). Available: http://www.who.int/chp/steps/en/

34 World Bank Development Research Group. Data from: world development indicators. world bank. Available: http://databank. worldbank.org/data/reports.aspx?source=world-development-indicators

35 Pew Research Center. Data from: the future of World Religions: population growth projections, 2010-2050. Available: https:// www.pewforum.org/2015/04/02/religious-projections-2010-2050/ [Accessed 12 Jun 2015].

36 Kilian C, Manthey J, Probst C, et al. Why is per capita consumption underestimated in alcohol surveys? results from 39 surveys in 23 European countries. *Alcohol Alcohol* 2020;55:554–63.

37 Kalema D, Vanderplasschen W, Vindevogel S, et al. The role of religion in alcohol consumption and demand reduction in Muslim majority countries (MMC). *Addiction* 2016;111:1716–8.

38 Al-Ansari B, Thow A-M, Day CA, et al. Extent of alcohol prohibition in civil policy in Muslim majority countries: the impact of globalization. *Addiction* 2016;111:1703–13.

39 Mkuu RS, Barry AE, Montiel Ishino FA, et al. Examining characteristics of recorded and unrecorded alcohol consumers in Kenya. *BMC Public Health* 2018;18:1058–58.

40 Kilian C, Rovira P, Neufeld M, et al. Modelling the impact of increased alcohol taxation on alcohol-attributable cancers in the who European region. *The Lancet Regional Health - Europe* 2021;27:100225.

41 Lachenmeier DW, Samokhvalov AV, Leitz J, et al. The composition of unrecorded alcohol from eastern Ukraine: is there a toxicological concern beyond ethanol alone? *Food Chem Toxicol* 2010;48:2842–7.

42 Szucs S, Sárváry A, McKee M, et al. Could the high level of cirrhosis in central and eastern Europe be due partly to the quality of alcohol consumed? an exploratory investigation. *Addiction* 2005;100:536–42.

43 Arslan MM, Zeren C, Aydin Z, et al. Analysis of methanol and its derivatives in illegally produced alcoholic beverages. *J Forensic Leg Med* 2015;33:56–60.

44 Lachenmeier DW, Taylor BJ, Rehm J. Alcohol under the radar: do we have policy options regarding unrecorded alcohol? *Int J Drug Policy* 2011;22:153–60.

45 Lachenmeier DW, Rehm J, Vieldrinkern VSund. Die Auswirkungen des deutschen Branntweinmonopols auf den gesundheitlichen Verbraucherschutz. [Bootleggers and heavy drinkers The impact of the German alcohol monopoly on public health and consumer safety]. *Sucht* 2010;56:91–3.

46 Lachenmeier DW, Schoeberl K, Kanteres F, et al. Is contaminated unrecorded alcohol a health problem in the European Union? A review of existing and methodological outline for future studies. *Addiction* 2011;106 Suppl 1:20–30.

47 Karlsson T, Österberg E. The Nordic borders are not alike. *Nordic Studies on Alcohol and Drugs* 2009;26:117–39.

48 Eurasian Economic Commission. *Soglashenie o regulirovanii dejatel'nosti uchastnikov alkogol'nogo rynka na territorijah gosudarstv – chlenov Tamozhennogo sojuza i Edinogo ekonomicheskogo prostranstva [Agreement on the regulation of the activities of alcohol market participants in the territories of the Member States of the Customs Union and the Common Economic Space]*, 2020.

49 Commission EE. *Reshenie o proekte Soglashenija o regulirovanii dejatel'nosti uchastnikov alkogol'nogo rynka na territorii gosudarstv - chlenov Tamozhennogo sojuza i Edinogo jekonomicheskogo*

prostranstva. [Decision on the draft Agreement on the regulation of the activities of alcohol market participants in the territory of the Member States of the Customs Union and the Common Economic Space], 2013.

50 Eaeunion.org. *Rasporjazhenie KollegiiEvrazijskoj jekonomicheskoj komissii ot 28 nojabrja 2018 g. N 184 "Oproektah soglashenij o principah vedenija nalogovoj politiki v oblasti akcizovna alkogol'nuju i tabachnuju produkciju gosudarstv – chlenov Evrazijskogojekonomicheskogo sojuza" [Order of the Board of the Eurasian Economic Commission of November 28, 2018 N 184 "On draft agreements on the principles of tax policy in the field of excise taxes on alcohol and tobacco products of the Member States of the Eurasian Economic Union"]*, 2018.

51 Tamozhennyye pravila [Customs Regulations]. BELARUS.BY, 2019. Available: https://www.belarus.by/ru/travel/customs-regulations

52 Kyrgyzstan Customs. Currency & Airport Tax regulations details: International Air Transport Association, 2019. Available: https://www.iatatravelcentre.com/KG-Kyrgyzstan-customs-currency-airport-tax-regulations-details.htm

53 Neufeld M, Bobrova A, Davletov K, *et al*. Alcohol control policies in former Soviet Union countries: a narrative review of three decades of policy changes and their apparent effects. *Drug Alcohol Rev* 2021;40:350–67.

54 World Health Organization,. *Regional Office for Europe. Implementing alcohol policies in the Commonwealth of Independent States: a workshop of "First Mover" countries*. Copenhagen: World Health Organization. Regional Office for Europe, 2020.

55 Mäkelä P, Huhtanen P. The effect of survey sampling frame on coverage: the level of and changes in alcohol-related mortality in Finland as a test case. *Addiction* 2010;105:1935–41.

56 Probst C, Shuper PA, Rehm J. Coverage of alcohol consumption by national surveys in South Africa. *Addiction* 2017;112:705–10.

57 Shield KD, Rehm J. Difficulties with telephone-based surveys on alcohol consumption in high-income countries: the Canadian example. *Int J Methods Psychiatr Res* 2012;21:17–28.

58 Bobrova N, West R, Malutina D, *et al*. Drinking alcohol surrogates among clients of an alcohol-misuser treatment clinic in Novosibirsk, Russia. *Subst Use Misuse* 2009;44:1821–32.

59 Chisholm D, Moro D, Bertram M, *et al*. Are the "Best Buys" for alcohol control still valid? An update on the comparative cost-effectiveness of alcohol control strategies at the global level. *J Stud Alcohol Drugs* 2018;79:514–22.

60 World Health Organization. *Global strategy to reduce the harmful use of alcohol*. Geneva, Switzerland: World Health Organization, 2010.

61 Anderson P, Braddick F, Conrod P. *The new governance of addictive substances and behaviours*. Oxford, U.K.: Oxford University Press, 2017.