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ESTIMATION OF THE VOLUME OF CONSUMPTION OF UNREGISTRTED ALCOHOL IN THE REPUBLIC OF BELARUS

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Abstract

An objective and scientifically substantiated assessment of the volume of alcohol consumption (including unregistered alcohol) is necessary to determine the damage from alcohol consumption, as well as for presenting the real alcohol situation in countries.

Based on this, the purpose of this study was to assess the volume of consumption of unregistered alcohol, taking into account international approaches and the national characteristics of the Republic of Belarus.

The results of the study allowed us to propose the following algorithm for calculating unregistered alcohol, which can be used for monitoring the alcohol situation:

1. The calculation of the volume of consumption of unregistered alcohol according to a sociological survey.
2. The calculation of the volume of consumption of absolute alcohol per capita by people 15 years old and older, which is in illegal circulation, based on expert estimates.
3. Modelling the volume of unregistered alcohol consumption using regression models;
4. The final calculation of the volume of consumption of unregistered alcohol in the Republic of Belarus.

In addition, two groups of regression models have been developed to estimate the volume of unregistered alcohol consumption:

- based on a time series of indicators of socio-economic development,
- based on mortality rates from alcohol-related diseases.

The proposed model for calculating unregistered alcohol makes it possible to completely objectify the picture of the overall level of alcohol consumption and use the obtained indicators for the purposes of optimal planning of anti-alcohol policy.

Key words: alcohol consumption, anti-alcohol policy, unregistered alcohol, estimate the volume of unregistered alcohol consumption, system analysis, conceptual analysis, statistical analysis, econometric modelling

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Introduction

Alcohol consumption in the European Region continues to be one of the highest in the world. However, it should be understood that the per capita consumption figures hide the existing significant variation in individual levels and patterns of alcohol consumption.

The problem of obtaining reliable information on the volume of alcohol consumption is relevant for any country due to the significant impact of alcohol on the health of the population. According to the WHO, of all deaths in the world associated with alcohol consumption, 41.6% are accounted for by injuries and poisoning, 21.6% are malignant neoplasms, 16.6% are liver cirrhosis, 14% are diseases of the circulatory system and diabetes, and 6 % - neurological and mental disorders [1].

An objective and scientifically substantiated assessment of the volume of alcohol consumption (including unregistered alcohol) in Belarus is necessary, first of all, to determine the damage from alcohol consumption, as well as to present the real alcohol situation in the republic, including at the international level.

Based on this, the purpose of this study was to assess the volume of consumption of unregistered alcohol, taking into account international approaches and the national characteristics of the Republic of Belarus.

Research objectives:

1) Calculate the volume of consumption of unregistered alcohol according to a sociological survey.
2) Calculate the volume of consumption of absolute alcohol per capita aged 15 and older, which is in illegal circulation, based on expert estimates.
3) Model the consumption of unregistered alcohol using regression models.
4) Perform a final calculation of the volume of unregistered alcohol consumption in the Republic of Belarus.

Materials and methods

Research methods - questioning, system analysis, conceptual analysis, statistical analysis, and econometric modelling. For the purposes of the study, a special questionnaire was developed, and a questionnaire was conducted among the focus group of alcohol abusers. The material for the study was derived from a database compiled on the basis of the answers of 771 respondents who are under dispensary supervision in regional drug treatment organizations, the results of the STEPS study for 2016 and the results of sociological studies among the adult population and among young people for 2013. Data processing was carried out on personal computers using the Microsoft Office and SPSS ˙Statistics application packages.

Main part

Unregistered alcohol includes alcoholic beverages that are not produced or sold by officially licensed establishments and therefore are not reflected in official sales statistics. Since the production and distribution of such alcohol is not controlled by the state, then, firstly, it is not taxed (therefore much cheaper), and, secondly, it is not subject to quality control (therefore, as a rule, it contains harmful impurities that are dangerous to the health of consumers).
The main sources of unregistered alcohol are:

1) legally or illegally produced alcohol at home (moonshine, home brew, wine, beer);
2) imported alcohol, including legally imported alcohol for personal use, as well as contraband alcohol;
3) various alcohol-containing liquids, medicines (tinctures of motherwort, hawthorn, etc.), as well as liquids not intended for ingestion (for example, denatured alcohol, glass cleaners, shaving products, etc.).

Methods for assessing the volume of consumption of unregistered alcohol are divided into direct, indirect and expert estimates.

Direct methods include conducting national sociological research [2, 3, 4, 5]. There are many different versions of questionnaires and sociological research techniques, which makes it much more difficult to compare data obtained in different years and in different countries. The disadvantage of sociological research is that respondents tend to underestimate the amount of alcohol they consume.

The development of indirect methods involves estimating total alcohol consumption based on indicators of the level of alcohol-related problems, such as the rate of alcohol-related mortality. Several such methods have been proposed in recent years.

In addition to direct and indirect methods for assessing the volume of unregistered alcohol consumption, expert estimates there is and isare an often used the method of expert estimates. Experts can be specialists from various institutions whose professional responsibilities include studying the problems associated with the production, storage, sale and consumption of unregistered alcohol [7].

Results and discussion

4.1. The calculation of the volume of consumption of unregistered alcohol according to a sociological survey

According to the results of the STEPS study, the volume of unregistered alcohol consumption by persons aged 18 - 69 was 0.085 litres. [6]. Due to the lack of accurate data on the volume of alcohol consumption by persons aged 15-17 years, as well as persons over 69 years old, we assume for the purposes of this work the volume of unregistered alcohol consumption by persons aged 15 and older is equal to 0.085 litres.

To correct the subjectivity of self-assessment of their own volume of alcohol consumption, the respondents should take into account the coefficient of subjectivity (Ksub = 8.80).

To account for the volume of alcohol consumption by people who drink excessively, it is necessary to apply an appropriate coefficient (Kchrezm = 1.71).

To account for the number of illegal temporary labour migrants, it is also necessary to apply the corresponding coefficient (Kmigr = 1.014).

Thus, to calculate the volume of consumption of unregistered alcohol in the Republic of Belarus by persons aged 15 and older, we use correction factors reflecting the level of subjectivity of self-assessment, the volume of consumption of unregistered alcohol by the excessively drinking contingent of the population and the influence of illegal labour migrants on the volume of consumption, to the volume of consumption of unregistered alcohol obtained in a sociological study:
Ktotal = (Ksub * Kchrezm * Kmigr) = 8.80 * 1.71 * 1.014 ≈ 15.26.

The volume of consumption of unregistered alcohol by the population of the Republic of Belarus, taking into account the correction factors - Ysoc - is the product of the volume of consumption of unregistered alcohol according to the sociological research data by the general correction factor -
Ysoc = Y * K total., Where
Y is the volume of consumption of unregistered alcohol obtained according to the results of sociological surveys.
Ysoc = Y * Ktotal = 0.085 * 15.26 ≈ 1.30.
Ysoc = 1.30 l.

Thus, the estimated volume of consumption of unregistered alcohol according to the sociological survey of 2016 (STEPS) and taking into account the correction factors is equal to 1.30 litres of absolute alcohol per year per capita aged 15 and older.

4.2. The volume of consumption of absolute alcohol per capita of the population aged 15 and over, which is in illegal circulation, based on expert estimates

In view of the fact that the respondents who take part in sociological surveys, including specially interviewed persons who drink excessively, answer the questions posed on a voluntary basis, it is highly likely that they will keep silent about the volumes of illegal alcohol consumption, production and sale,

which is prosecuted by the laws of the Republic of Belarus. Therefore, it is advisable to refer to the data of the Ministry of Internal Affairs of the Republic of Belarus on the volumes of arrested and seized alcoholic and other alcohol-containing products and beer, in order to take into account the information received when assessing the volume of consumption of unregistered alcohol in the Republic of Belarus.

The calculation of the volume of consumption of absolute alcohol per capita aged 15 and older, which is in illegal circulation, was made on the basis of expert estimates.

The Ministry of Internal Affairs provided information on the volume of arrested and seized alcoholic and other alcohol-containing products and beer, the number of persons held accountable for the illegal circulation of these types of goods. Some of the information provided formed the basis of the following table:

Tab. 4.2.1: The volume of withdrawals removal from illegal circulation of alcoholic beverages

1	**Years**	**Withdrawn from the illegal circulation of alcoholic beverages, l**				**Moonshine and home brew withdrawn, l**	**Total withdrawn from the illegal turnover of alcoholic beverages, l**
2		**Alcoholic beverages**	**Wine**	**Ethyl alcohol and alcohol-containing products**	**Beer**		
3	2013	45,338	317,327	101,066	77,429	815,577	1,356,737
4	2014	202,688	219,404	260,166	46,235	791,793	1,520,286
5	2015	459,156	49,902	205,576	50,793	691,651	1,457,078
6	2016	95,215	7,521	94,681	34,062	512,482	743,961
7	2017	49,299	380,527	318,999	8,940	553,905	1,311,670
8	total for five years	851,696	974,681	980,488	217,459	3,365,408	6,389,732
9	five-year average	170339.2	194936.2	196097.6	43491.8	673081.6	1,277,946
10	conversion factor to absolute alcohol	0.35 ((0.4+0.3)/2)	0.14	0.68	0.04	0.4	0.3844 (average absolute alcohol content)
11	average absolute alcohol over five years, litres	59,618.72	27,291.1	((0.4+0.96)/2)	1739.7	269,232.64	
12	total	491,228.468		total absolute alcohol withdrawn on average over five years, litres			
13		7,804,642.8		5-year average population aged 15 and over			
14		0.0629405		seized per capita aged 15 and over			

From the data received from the Ministry of Internal Affairs, it is possible to calculate the average annual amount of seized absolute alcohol over a five-year period (line 12 of Table 4.2.1) per capita aged 15 and older (line 13 of Table 4.2.1 shows the average over five years of the population aged 15 and older), which is equal to 0.06 litres (line 14 of table 4.2.1) (491,228.468 litres divided by 7,804,642.8 people).

However, it is not possible to accurately estimate the volume of alcoholic beverages remaining in the illegal turnover, therefore, it is advisable to consult the opinion of experts dealing with the problem of the shadow market of alcoholic beverages at a professional level:

According to experts of the Ministry of Internal Affairs, the shadow market of alcoholic beverages is estimated at up to 2.8 million decaliters per year (2015).

The data presented in table. 1, allow us to calculate the average content of absolute alcohol in seized alcoholic beverages 38.44% (line 10 of Table 3.2.1) and calculate the estimated volume of the shadow market in absolute alcohol 0.3844 * 28 million litres ≈ 10,763,200 litres (assuming that the structure of seized alcoholic beverages corresponds to the structure of the entire shadow market (by types and their ratio).

In per capita terms, aged 15 and over, we get 1.38 literslitres (10,763,200 literslitres divided by 7,804,642.8 people in 2015).

According to open information sources, "in 2017, 319 thousand literslitres of alcohol and alcohol-containing products, more than 49 thousand literslitres of alcoholic beverages were seized. There is no formula for assessing what part of all illegal alcohol is seized. According to expert estimates, the detained illegal alcohol accounts for about 2% of all counterfeit alcohol. "

Based on the published data, the following calculations can be made: seized 319,000l * 0.68 + 49,000l * 0.35 ≈ 234,070l of absolute alcohol, where

319,000 l - the volume of seized alcohol and alcohol-containing products with an average absolute alcohol content of 68% (conversion factor 0.68 (see table 4.2.1, line 10)),

49,000 litres - the volume of seized alcoholic beverages with an average absolute alcohol content of 35% (conversion factor 0.35 (see table 4.2.1, line 10)).

If 234,070 litres of seized absolute alcohol is 2% of the total volume of alcoholic beverages in illegal circulation ion the territory of the Republic of Belarus, then 98% remain for consumption by the population, or 11,469,430 literslitres (based on the calculation of the proportion: if 2% is 234,070 litres, then 98% - this is 11,469,430 litres), which in terms of per capita population aged 15 and older in 2017 (7,013,663 people) is equal to 1.6 litres (11,469,430 litres divided by 7,013,663 people).

4.3. Modelling unregistered alcohol consumption using regression models

Since the consumption of unregistered alcohol is a quantity that is not amenable toattainable from direct statistical observation, several aspects should be distinguished to estimate it based on econometric modelling:

- to consider the consumption of unregistered alcohol as a result of the influence of socio-economic factors, which, first of all, include such indicators as the per capita income of the population, the level of consumer prices for alcoholic beverages, the level of education of the population (the share of those employed with higher education, with secondary specialized education, the share of families with a per capita income below the subsistence level budget, etc.);
- to consider the consumption of unregistered alcohol as a factor influencing mortality rates from diseases associated with alcohol consumption, indicators of violent deaths in the state of alcoholic intoxication;
- to simulate the value of consumption of unregistered alcohol, based on international experience and scientific developments of domestic and foreign scientists dealing with this problem.

In order to model the trends in the consumption of unregistered alcohol per capita, two groups of indicators are considered: socio-economic and mortality rates from diseases associated with alcohol consumption.

The first group of indicators is socio-economic:

- cash income per capita in US dollars (x1t);
- the level of higher education of the population (share of people with higher education) (x2t) ;,%;
- the level of secondary specialized education of the population (share of persons with secondary specialized education) (x3t) ;,%;
- the level of vocational education of the population (share of persons with vocational education) (x4t) ;,%;
- the volume of registered consumption of vodka per capita aged 15 years and older per year, literslitres (x5t);%.

For the first group of indicators, the volume of unregistered alcohol consumption acted as a dependent variable XNZ. The simulation results are presented in table 4.3.1:

Tab. 4.3.1: Estimation of consumption of unregistered alcohol using regression models based on socio-economic indicators

Regression models	Calculation for 2016, litres
X_{nz}= 2.455 – 0.0028x_{1t} t расч (15,2) (-4,9)	1,73
X_{nz}= −1,382 + 0,11174x_{2t} t расч (-0,75) (1,49)	1,48
X_{nz}= 2,232 – 0,041x_{3t} t расч (15,2) (-4,9)	1,34
X_{nz}= 0,495 + 0,0347x_{4t} t расч (0,42) (0,74)	1,39
X_{nz}= 1,700 - 0,0641x_{5t} t расч (6,12) (-1,33)	1,386
Average	1,465

The second group of indicators - mortality rates from diseases associated with alcohol use:

- the number of deaths from acute pancreatitis per 100,000 population (y1t);
- the number of deaths from alcoholic liver disease per 100,000 population (y2t);
- the number of deaths in a state of alcoholic intoxication as a result of violent deaths per 100,000 population (y3t);
- the number of deaths from accidental alcohol poisoning per 100,000 population (y4t);
- the number of deaths from alcoholic psychosis, encephalopathy, dementia per 100,000 population (y5t).

Based on the available data for the second group of variables presented in Table 4.3.2, paired linear regression models were constructed, where the volume of total alcohol consumption (registered and unregistered) per capita (Xtotall) acts as an independent variable, and y - indicators of the second group. This choice of the factor variable is due to the fact that mortality from alcoholic diseases occurs as a result of the consumption of both registered and unregistered alcohol.

Tab. 4.3.2: Estimation of consumption of unregistered alcohol using regression models based on socio-economic indicators

Years (t)	y1t	y2t	y3t	y4t	y5t
2000				22.7	0,1
2001				24.4	0,2
2002	5,0	3,3		26.9	0,5
2003	4,2	4,0		27.9	0,6
2004	4,4	4,0		31.0	0,6
2005	4,7	5,4		33.8	0,9
2006	5,0	4,9		30.5	0,6
2007	5,2	5,6		25.9	0,6
2008	5,5	5,5	5,7	27.3	0,6
2009	6,3	6,1	4,7	26.2	0,6
2010	6,3	7,1	4,2	25.9	0,9
2011	6,8	9,7	3,9	25.5	1,4
2012	5,2	6,5	2,5	20.3	0,7
2013	4,9	5,7	2,7	17.6	0,6
2014	4,9	5,2	2,3	15.9	0,4
2015	4,4	3,9	1,7	14.7	0,3
2016	4,1	4,1	1,4	15.4	0,3
2017	3,9	3,9	1,2	15.8	0,3

For the second group of indicators, regression analysis gave significantly better modelling results, which were subsequently used to estimate the volume of unregistered alcohol consumption in 2016. The simulation results are presented in table 4.3.3:

Tab. 4.3.3: Estimation of consumption of unregistered alcohol using regression models based on socio-economic indicators

Regression models $\hat{Y}t = a + b * x_t$	Value Xtotall $\hat{X}_t=(y_t - a)/b$	
	Xtotall	Хнезар.l
$\hat{Y}_{1t}$ = -0,131145 + 0.46799x_{totall} t расч (-0,85) (5,335)	10,9	1.2
$\hat{Y}_{2t}$ = -4,610 + 0,77934x_{totall} t расч (-1,44) (3,35)	10.7	1,0
$\hat{Y}_{3t}$ = -4,81648 + 0,56662x_{totall} t расч (-3,11) (5,04)	10,97	1,27
$\hat{Y}_{4t}$ = -12,6415 + 2,4029x_{totall} t расч (-2,186) (5,725)	11,7	2,0
$\hat{Y}_{5t}$ = -1,29237 + 0,14217x_{totall} t расч (-1,791) (2,715)	11,2	1,5
Average		1,394

The final estimate of unreported alcohol consumption from the modelled values can be calculated as an arithmetic mean:

(1.465 + 1.394) / 2 ≈ 1.43 litres

Thus, with the emerging dynamics of the variables taken to construct the regression models, the volume of unregistered alcohol consumption per capita aged 15 and older in terms of absolute alcohol in the Republic of Belarus was estimated at 1.43 litres for 2017.

4.4. Final calculation of the volume of consumption of unregistered alcohol in the Republic of Belarus

The volume of unregistered alcohol consumption according to the STEPS study and taking into account the correction factors was 1.30 litres.

The volume of consumption of absolute alcohol in illegal circulation per capita at the age of 15 and older, according to the information on seizures and on the basis of expert estimates, is 1.77 litres.

The arithmetic mean of the volume of unregistered alcohol consumption based on regression models is 1.43 litres.

Taking into account all the approaches, we get (1.3 + 1.77 + 1.43) / 3≈1.5 - the volume of consumption of unregistered alcohol per year per capita aged of 15 and older (Table 4.4.1).

Tab. 4.4.1: Average annual consumption of unregistered alcohol per capita aged 15 and older, taking into account three approaches

Approach	Value, l
According to a sociological survey, taking into account the correction factors	1,30
According to expert estimates	1,77
Based on the results of calculations based on regression models	1,43
Average	1,50

Thus, the final formula for calculating the volume of unregistered alcohol consumption is as follows:

X = (Ysoc + Yexp + Yregr) / 3, where

Ysoc - the volume of consumption of unregistered alcohol, obtained according to the results of sociological surveys, taking into account the correction factors:

Ysoc = U * Ksub * Kchrezm * Kmigr, where

Y - the volume of consumption of unregistered alcohol, obtained according to the results of sociological surveys;

Ksub - coefficient of subjectivity;

Kchrezm is a coefficient that takes into account the consumption of alcohol by excessive drinkers;

Kmigr is a coefficient that takes into account the number of illegal temporary labour migrants - citizens of the Republic of Belarus to the Russian Federation;

Yexp - the volume of consumption of absolute alcohol per capita aged 15 years and older, which is in illegal circulation ion the territory of the Republic of Belarus, calculated on the basis of the operational information of the Ministry of Internal Affairs of the Republic of Belarus on the volumes of arrested and seized alcoholic, other alcohol-containing products and beer and on on the basis of expert assessments of the ratio of the withdrawn alcohol to the remaining one;

Yregr is the average value of the volume of unregistered alcohol consumption, obtained from the results of regression analysis.

Conclusion

The results of the study allowed us to propose the following algorithm for calculating unregistered alcohol, which can be used for monitoring the alcohol situation:

1. Calculation of the volume of consumption of unregistered alcohol according to a sociological survey.
2. Calculation of the volume of consumption of absolute alcohol per capita at the age of 15 and older, which is in illegal circulation, based on expert estimates.
3. Modelling the volume of unregistered alcohol consumption using regression models;
4. Final calculation of the volume of consumption of unregistered alcohol in the Republic of Belarus.

In addition, two groups of regression models have been developed to estimate the volume of unregistered alcohol consumption:

- based on time series of indicators of socio-economic development,
- based on mortality rates from alcohol-related diseases.

The proposed model for calculating unregistered alcohol makes it possible to completely objectify the picture of the overall level of alcohol consumption and use the obtained indicators for the purposes of optimal planning of anti-alcohol policy.

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