

## ALCOHOL AND SUICIDE IN BELARUS

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### SUMMARY

**Background:** It is well recognized that both acute and chronic alcohol use are among the major behaviorally modifiable factors that are associated with suicidal behavior. There is suggestive evidence that binge drinking pattern, i.e. excessive consumption of strong spirits results in quicker and deeper level of intoxication, increasing the propensity for alcohol-related suicide. Although alcohol seems to be an important contributor to the burden of violent mortality in Belarus, little systematic research has been undertaken on its impact on suicide mortality in this country. The aim of the present study was to address this particular deficit by using aggregate-level data on the suicide and alcohol poisoning rates from 1979 to 2007.

**Subjects and methods:** Trends in suicides and alcohol poisoning mortality rate (as a proxy for binge drinking) from 1979 to 2007 were analyzed employing an ARIMA analysis in order to assess bivariate relationship between the two time series.

**Results:** According to Bureau of Forensic Medicine autopsy reports the suicide rate increased by 41.2%, and fatal alcohol poisoning rate increased 2.1 times in Belarus. Alcohol in blood was found in 62% suicide victims for the whole period, with the minimum figure 49.3% in 1988 and maximum 68.5% in 1981. Alcohol-related suicides were more affected by the restriction of alcohol availability during the anti-alcohol campaign: between 1984 and 1986 the number of BAC-positive suicide cases drop by 54.2%, while number of BAC-negative suicides decreased by 7.1%. The results of time-series analysis indicated a statistically significant relationship between fatal alcohol poisoning rate and total suicides number, as well as number of BAC-positive suicides.

**Conclusion:** The results of the present study, as well as findings from other settings indicate that a restrictive alcohol policy can be considered as an effective measure of suicide prevention in countries where rates of both alcohol consumption and suicide are high.

**Key words:** suicide - fatal alcohol poisoning - ARIMA time series analysis - Belarus, 1979-2007

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### INTRODUCTION

Suicide is one of the leading external causes of death worldwide (LaVecchia et al. 1994, Lester 1994, Voracek et al. 2003). It is well recognized that both acute and chronic alcohol use are among the major behaviorally modifiable factors that are associated with suicidal behavior (Norstrom 1995, Lester 1995, Ramstedt 2001, Bilban & Skibin 2005). Acute alcohol intoxication may trigger self-destructive behavior by provoking depressive thoughts, decreasing self-control, and constricting cognition which impairs the generation of effective coping strategy to avoid psychological distress (Skog et al. 1993, Rossov 1993, Hufford 2001). In

his rigorous review of studies of acute alcohol use and suicidal behavior published over a 10 year period (1991-2001) Cherpitel et al. (2004) has found a wide range of alcohol-positive cases for both completed suicide (10-69%) and suicide attempts (10-73%). Several case-control studies at the individual level have shown a high prevalence of alcohol abuse and dependence among suicide victims (Pircola 2000, Kolves et al. 2006). Recent retrospective psychological autopsy study has reported that 68% of male and 29% of female who committed suicide met criteria for alcohol abuse or dependence (Kolves et al. 2006). The strong support for a direct link between alcohol and suicide comes from aggregate-level data. Both

longitudinal and cross-sectional aggregate-level studies usually report a significant and positive association between alcohol consumption and suicide (Cases & Harford 1998, Marusic 1999, Razvodovsky 2001, Pridemore & Chamlin 2006).

High suicide rate in the former Soviet Republics and its profound fluctuation over the past decades have attracted considerable interest (Wasserman et al. 1994, Lester 1998, Makinen 2000, 2006). Most authors agree that the role of alcohol is crucial in understanding this phenomenon (Razvodovsky 2001, 2003, Nemtsov 2003, Pridemore 2006). This hypothesis is based on the positive association between trends of alcohol consumption per capita and suicide rate (Wasserman et al. 1994, Nemtsov 2003, Pridemore 2006). Several researchers have focused on the role of drinking culture as a possible explanation of the extremely high suicide rate in the former Soviet Slavic republics (Razvodovsky 2001, 2003, Pridemore 2006). There is suggestive evidence that binge drinking pattern, i.e. excessive consumption of strong spirits results in quicker and deeper levels of intoxication, increasing the propensity for alcohol-related suicide. It was shown, for example, that both suicide and alcohol poisoning mortality are higher on weekends (Razvodovsky 2006a).

The level of alcohol consumption and the suicide rate in the former Soviet Slavic republic Belarus are both among the highest in the world (Kondrichin & Lester 1998, Razvodovsky 2002). Although alcohol seems to be an important contributor to the burden of violent mortality in Belarus, little systematic research has been undertaken on its impact on suicide mortality in this country (Razvodovsky 2001, 2007). The aim of the present study was to address this particular deficit by using Bureau of Forensic Medicine autopsy data on the suicide and alcohol poisoning deaths from 1979 to 2007.

## SUBJECTS AND METHODS

The data on suicide and fatal alcohol poisoning used in the article were based on autopsy reports from the Bureau of Forensic Medicine. Most researchers admit that vital statistics in the former USSR republics are reliable enough (Wasserman & Varnik 1998). All violent deaths are subjected to forensic autopsies, which include blood alcohol concentration (BAC) inspection and histological examination of organs. The cause-of-

death classification has been subjected to several changes over the last decades. In 1989-2001 the Ministry of Statistics used a coding scheme based on ICD-9. In 2002 a new coding system based on ICD-10 has been introduced. The Belarusian coding system is claimed to be compatible with ICD-9 and ICD-10. For example code 173 (1989-2001) "suicide and self-inflicted injury" corresponds with ICD-9 code E 950.0-E 959.9 and code 249 (since 2002) corresponds with ICD-10 code X 60.0-X 84.9. Code 165 (until 1988) and 163 (1989-1998) "Accident poisoning by alcohol" corresponds with ICD-9 code E 860.0-E 860.9, and code 249 (since 2002) corresponds with ICD-10 code X 45.0-45.9.

It should be noted that the alcohol poisoning rate as an indicator of binge drinking may better capture the magnitude of an intoxication-oriented drinking pattern than official sales statistics and an expert estimation of the total level of alcohol consumption (Stickley et al. 2007). This is especially true if we keep in mind that the reliable estimation of total alcohol consumption at the population level in the former Soviet republics is a tremendously difficult task. Thus, a common approach is to use the fatal alcohol poisoning rate as an indicator of binge drinking in these countries (Pridemore 2006).

The statistical analysis was performed using the package "Statistica 7". It is generally agreed that bivariate correlations between two raw time-series are spurious due to common sources of trends and autocorrelation (Norstrom & Skog 2001). Therefore in order to reduce the risk of obtaining a spurious relation between two variables that have common trends, the trends should be removed by means of a differencing procedure:  $\nabla x_t = x_t - x_{t-1}$ . This means analyzing annual changes rather than raw data. This technique for time series analysis has been suggested by Box and Jenkins and often referred to as ARIMA (autoregressive integrated moving average) model (Box & Jenkins 1976). The process of removing systematic variation within time series prior to the examination of potential causal relationships is referred to as "prewhitening". The residuals of a statistically adequate time series are distributed as a white noise process. A further step entails the inspection of the cross-correlation function in order to estimate the association between the two prewhitened time series. The final step involves a number of diagnostic checks (calculating a Box-

Jenkins test statistic for the null hypothesis in order to show that the model residuals are distributed as white noise, and a Box-Ljung Q-test statistic for the null hypothesis to demonstrate that the set of values for the cross correlations is jointly independent). We used the ARIMA model to estimate the relationship between the time series suicide and alcohol poisoning mortality rates (as a proxy for binge drinking) in this paper.

## RESULTS

In all 64162 suicide and 59489 fatal alcohol poisoning cases were examined with respect to the autopsy reports between 1979 and 2007. According to Bureau of Forensic Medicine autopsy reports the suicide rate increased by 41.2% (from 17.7 to 25 per 100.000 of residents), and fatal alcohol poisoning rate increased 2.1 times (from 12.8 to 26.7 per 100.000 of residents) in Belarus between 1979 and 2007 (Figure 1). The number of BAC-positive suicide cases increased by 47.7% (from 10.7 to 15.8 per 100.000 of residents) and number of BAC-negative suicides increased by 31.4% (from 7 to 9.2 per 100.000 of residents) (Figure 2). Alcohol in blood was found in 62% suicide victims for the whole period, with the minimum figure 49.3% in 1988 and maximum 68.5% in 1981. The trends in suicide and alcohol poisoning mortality rates are displayed in Figure 1. As can be seen, the two time series seems to follow

each other between 1979 and 2007. The two time trends fluctuated over the period: increased steadily from 1979 to 1984, then dropped sharply in 1984-1986 (suicide and alcohol poisoning rates decreased by 39.7 and 48.7% respectively), began to increase in 1988, dramatically jumped from 1991 to 1998. In 1999 there was a slight decrease in the rates and from 2000 it again began to rise until 2004, than started to decrease in the last years. The graphical evidence (Figure 3) also suggests quite a strong association between BAC-positive suicides and alcohol poisoning mortality trends. A comparative analysis show that trend in BAC-positive suicides tends to fluctuate across time series to a much greater extent that the BAC-negative suicides (Figure 2). Alcohol-related suicides were more affected by the restriction of alcohol availability during the anti-alcohol campaign: between 1984 and 1986 the number of BAC-positive suicide cases drop by 54.2% (from 15.4 to 7.0 per 100.000 of residents), while number of BAC-negative suicides decreased by 7.1% (from 7 to 6.5 per 100.000 of residents). Further, the upward trend in BAC-positive suicides in 1990s was greater than the trend in BAC-negative suicides: from 1989 to 1998 the number of BAC-positive suicides increased by 96.7% (from 9.1 to 17.9 per 100.000 of residents), while the number of BAC-negative suicides increased by 36.6% (from 7.1 to 9.7 per 100.000 of residents).

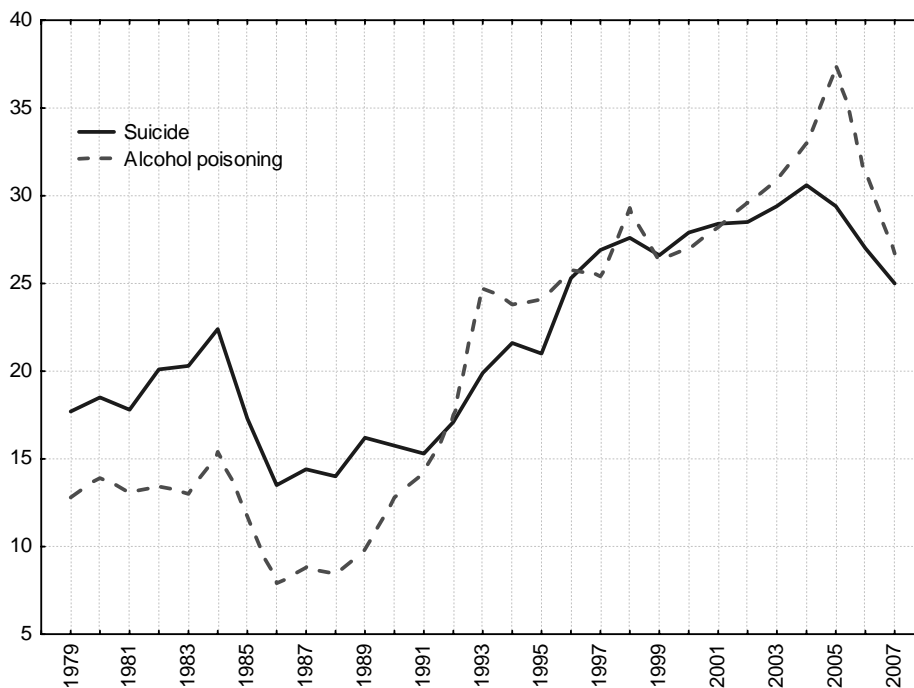
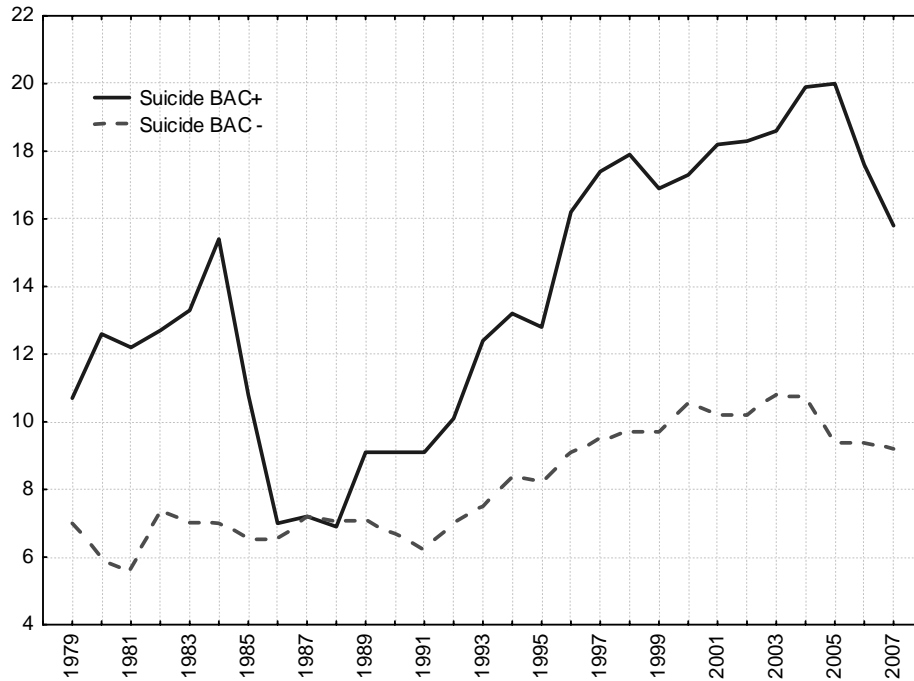
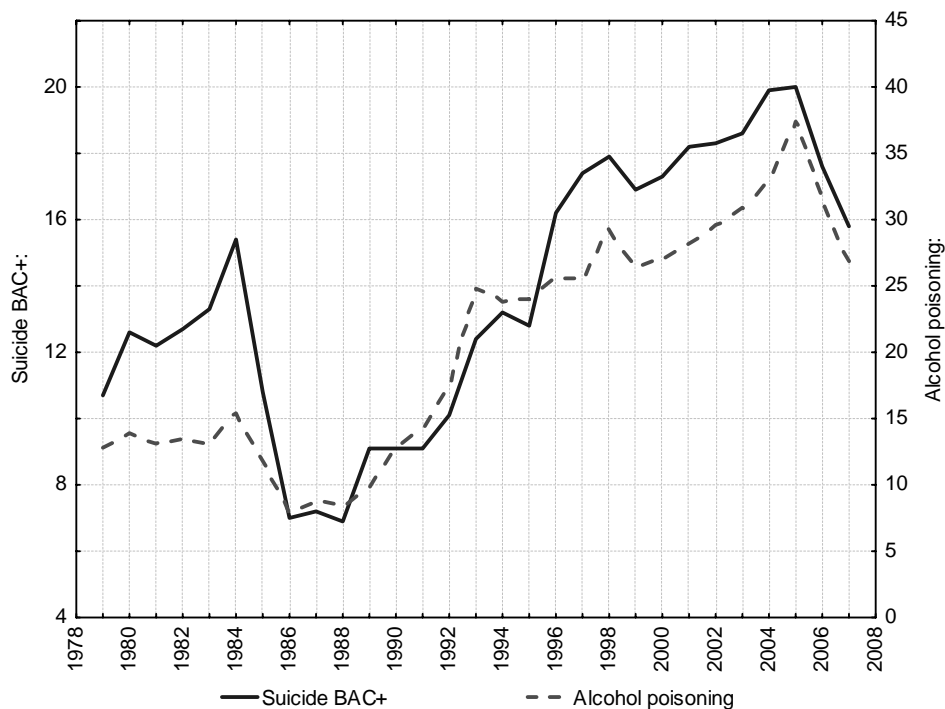


Figure 1. Trends in suicide and fatal alcohol poisoning mortality rates in Belarus from 1979 to 2007



**Figure 2.** Trends in BAC-positive and BAC-negative suicides in Belarus from 1979 to 2007



**Figure 3.** Trends in BAC-positive suicides and fatal alcohol poisoning mortality rates in Belarus from 1979 to 2007

The Spearman's correlation analysis suggests the strong positive relation between fatal alcohol poisoning rate and total suicides number ( $r=0.93$ ;  $p=0.000$ ), as well as numbers of BAC-positive ( $r=0.94$ ;  $p=0.000$ ), and BAC-negative suicides ( $r=0.79$ ;  $p=0.000$ ). As can be seen from Figures 1 there is linear trend in the time series. This trend

was removed by means of first-order differencing procedure. After pre-whitening the cross-correlations between alcohol poisoning and suicide mortality time series were inspected. The outcome indicated a statistically significant cross-correlation between fatal alcohol poisoning rate and total suicides number ( $r=0.63$   $SE=0,20$ ), as well as

number of BAC-positive suicides ( $r=0.70$ ;  $SE=0.20$ ) at zero lag. At the same time, there is no relation between the fatal alcohol poisoning and BAC-negative suicide rates ( $r=0.16$ ;  $SE=0.20$ ). So, positive correlation between these variables was spurious. The specification of the bivariate ARIMA model and outcome of the analysis are presented in the table 1. It can be seen, that the estimated effects of fatal alcohol poisoning rate (as a proxy for binge drinking) on total suicides number and number of BAC-positive suicides are clearly statistically significant.

**Table 1.** Estimated effects (bivariate ARIMA model) of alcohol on suicide rate

	Model	Estimates	p
Suicide total	0,1,1*	0.088	0.000
Suicide BAC+	0,1,1	0.111	0.000

\* The general form of ARIMA model is (p,d,q), where p – the order of the autoregressive parameter, d – the order of differencing, and q – the order of the moving average parameter.

## DISCUSSION

The large-scale socioeconomic and political changes experienced by former Soviet republics during the last decades present a unique opportunity to examine alcohol-suicide association. As can be seen suicide and alcohol poisoning trends have been more or less correlated with the great social transformation. The sharp decrease in the two time series in the mid-1980s correspond with the major anti-alcohol campaign of 1985-1988, which significantly reduced alcohol consumption by limiting its availability, and the dramatic increase in the early 1990s corresponds with the profound socioeconomic and political changes occurring during the transitional period.

As has been already highlighted, alcohol consumption is an important determinant of suicide rate at the aggregate level. It seems that Belarus is not an exception in this respect. Indeed, more than 60% of suicide victims were BAC-positive at time of death. To our knowledge, only two studies have addressed BAC in suicide cases during the last decades in the former Soviet republics. Nemtsov has highlighted that in Russia the number of BAC-positive suicides shrank by 55%, while the number of BAC-negative suicides did not change substantially during Gorbachev perestroika (Nemtsov 2003). Similarly, in Estonia during the anti-alcohol campaign BAC-positive suicides

decreased by 39.4%, while BAC-negative suicides increased by 3% (Varnik et al. 2006). It should be noted, that the proportion of BAC-positive suicides in Belarus in the early 1980s (65.8%) is higher than in Russia (60.2%) and in Estonia (47.9%).

The results from the time series analysis suggest a positive relationship between fatal alcohol poisoning (as a proxy for alcohol consumption) and suicide at zero lag. In this case the independent variable is directly influencing the dependent variable and there is no evidence of a lagged relationship between the two time series. This may support the point that binge drinking, which results in a quicker and deeper intoxication is a risk factor for auto aggressive behaviour, especially in people predisposed to suicide. This research evidence is consistent with the findings from previous studies highlighting that the relationship between alcohol and suicide was stronger for consumption of distilled spirits (vodka) relative to total level of alcohol consumption. It was shown that a 1% increase in vodka consumption per capita would result in a 0.57% increase in suicide rate among males and 0.24% increase in suicide rate among females (Razvodovsky 2006b).

There is a suggestion that the decrease in suicide rate in the former Soviet republics in the mid-1980s could have been related to the political and social liberalization during the period known as "perestroika", which gave rise to social optimism and new hope (Varnic et al. 1998). However, the results of the present study suggest that the number of BAC-positive suicides shrank by 54.2%, while the number of BAC-negative suicides did not change substantially during Gorbachev's perestroika.

Several scholars have argued that psychosocial distress resulting from the "shock therapy" economic reform and sudden collapse of the Soviet paternalist system was the main determinant of the suicide mortality crisis in the former Soviet republics in the 1990s (Leon & Shkolnikov 1998, Stone 2000). Similarly, Lester (1998) suggested that the increase in suicide rate in this period may be a result of the disappointment over the changes in the standard of living after the initial hope that social conditions would improve rapidly. To address these points it is necessary to focus on the social and economic changes that have occurred in Belarus in the 1990s. The collapse of communism and the initial moves to establish a market

economy resulted in the newly independent country experiencing a severe economic and social crisis. Between 1991 and 1995 real gross product fell by over 30%, inflation had reached more than 2300%, and unemployment rose substantially (World Bank). Against this background, the level of poverty rose sharply while increasing social dislocation was manifested in falling birth and marriage rates and growing number of divorces (Ministry of Statistics 2005). So, psychosocial distress may be an important underlying factor in the suicide mortality crisis the 1990s. However, the fact that the number of BAC-suicides dramatically jumped in the 1990s strongly supports an alcohol related hypothesis and suggests that rather than playing a major causal role, psychosocial distress may represent a confounding factor. It seems plausible that the psychosocial distress resulting from the reforms were the main causes of increased demand for alcohol at this time. This demand was met by factors that increased supply. Following the repeal of the state alcohol monopoly in 1992, Belarusian's alcohol market became fragmented, including many private producers and importers operating without a license or registration. The country was practically flooded by a wave of homemade, counterfeit, and imported alcohol of low quality. In the second half of the 1990s, the overall level of alcohol consumption grew to 14-14.5 litres per capita, the highest rate in the countries history (Razvodovsky 2008). The negative outcomes of increase of alcohol consumption during this period included a sharp rise in alcohol-related mortality. After an introduction of measures against illegal alcohol production, import, and sale in 1998, the overall level of alcohol consumption began to diminish (Razvodovsky 2008).

## CONCLUSION

This study replicates previous findings that suggested a close link between alcohol and suicide at the aggregate level. The outcome of this study also supports the hypothesis that suicide and alcohol are closely connected in culture with prevailing intoxication-oriented drinking pattern and adds to growing body of evidence that a substantial proportion of suicides in Belarus are due to the acute effect of binge drinking. The results of the present study, as well as the findings from other settings indicate that a restrictive

alcohol policy can be considered as an effective measure of suicide prevention in countries where rates of both alcohol consumption and suicide are high.

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