

The Effects of Alcohol on Suicide Rate in Russia

Razvodovsky YE*

Grodno State Medical University, Grodno, str. Gorky 80, Belarus

Abstract

High suicide rate in Russia and its profound fluctuations over the past decades have attracted considerable interest. Purpose: To estimate the aggregate level effect of alcohol on the suicide rate in Russia. Method: Trends in age-adjusted, sex-specific suicide and alcoholism mortality rate (as a proxy for alcohol consumption) from 1956 to 2005 in Russia were analyzed employing an ARIMA analysis in order to assess bivariate relationship between the two time series. Results: The results of the time series analysis indicates the presence of a statistically significant association between the two time series at zero lag for male ($r=0.61$; $SE=0.142$), and for female ($r=0.44$; $SE=0.142$). Conclusion: In conclusion, the present study replicates previous findings suggesting close aggregate level association between alcohol and suicide mortality in Russia. The outcome of this study provides indirect support for the hypothesis that alcohol played a crucial role in the fluctuation in suicide mortality rate in Russia during recent decades.

Keywords: Suicide; Alcoholism mortality; ARIMA Time series analysis; Russia 1956-2005

Introduction

Suicide is one of the main causes of premature mortality in Russia [1]. High suicide rate in this country and its profound fluctuations over the past decades have attracted considerable interest [2-6]. There is strong evidence of a crucial role of alcohol in explanation of this phenomenon [2,3,7,8]. Several studies highlighted a significant aggregate level association between alcohol and suicide in Russia. In his time series analysis data for the period 1965-99 [7] has reported that a 1-litre increase in alcohol consumption is expected to increase suicide rate by 12% for total population (13% for men and 6% for women). In another study based on the Russian time series data between 1980 and 2005, Landberg 2008 found that overall alcohol consumption is significantly associated with both male and female suicides: a 1-litre increase in alcohol consumption would result in increase in suicide rate of 7.2% (8% for male and 4.3% for female). A more recent update suggests that 1 litre increase in per capita consumption is associated with an increase in suicide rate of 7.0% for male and 3.2% for female [9]. In his time series analysis [10] found a positive association between alcohol-related mortality and suicide in Russia between 1956 and 2002. In another study Pridemore has highlighted a close cross-sectional link between alcohol and suicide in Russian regions during the mid-1990s [8].

Several researchers have focused on the role of drinking culture as a possible explanation of the extremely high suicide rates in Russia [10,11]. The distinctive traits of Russian drinking culture are the heavy episodic (binge) drinking pattern, the preference for distilled spirits, and sociocultural tolerance for heavy drinking [8]. A world wide assessment of drinking pattern showed that Russia and former Soviet republics had the most hazardous pattern of drinking [12]. The findings suggest that binge drinking and suicide mortality are positively related phenomena in Russia. The results from a study based on Russian data from 1956 to 2005 showed a positive association between fatal alcoholism mortality (as a proxy for binge drinking) and suicide rate [11]. These results are consistent with the findings that relationship between alcohol and suicide was stronger for consumption of distilled spirits relative to total level of alcohol consumption [9]. In a more recent time series analysis Stickley and coauthors concluded that binge drinking had a significant association with the occurrence of suicide in Russia and the magnitude

of the relation is the same across the course of the later-tsarist, Soviet, and post-Soviet periods [13,14]. Collectively this evidence provides additional support for the hypothesis that unfavorable mixture of higher overall level of alcohol consumption and binge drinking pattern is a major risk factor for suicide mortality in Russia.

In present study we will further test the hypothesis of the close aggregate level link between alcohol and suicide in Russia using data on sex-specific suicide rate and alcoholism mortality rate as a proxy for alcohol consumption. The alcoholism mortality rate was used as a proxy for alcohol consumption because this indicator depends almost entirely on alcohol consumption [3].

Methods

Data

The data on age-adjusted sex-specific suicide and alcoholism mortality rate per 1000,000 of the population are taken from the Russian vital statistics registration system. The Goscomstat's cause of death classification has undergone several changes in recent decades. Until 1988 the cause of death classification was based upon the Soviet nomenclature which had a limited number of causes of death in comparison with the International Classification of Diseases (ICD) system. From 1989-1998 Rosstat used a coding scheme that was based on ICD-9. From 1999 a new coding system based on ICD-10 was introduced. Rosstat issued a table of correspondence between its classification system and ICD-9 and ICD-10 and it has been claimed that the Russian system of coding was and is compatible with the ICD. For example Goscomstat's code 173 (1989-1998) "suicide and self-inflicted injury) corresponds with ICD-9 code E 950.0-E 959.9 and code 249 (since 1999) corresponds with ICD-10 code X 60.0-X 84.9.

*Corresponding author: Razvodovsky YE, Grodno State Medical University, Grodno, str. Gorky 80, Belarus 230009, E-mail: razvodovsky@tut.by

Received October 07, 2014; Accepted October 27, 2014; Published November 15, 2014

Citation: Razvodovsky YE (2014) The Effects of Alcohol on Suicide Rate in Russia. J Socialomics 3: 112. doi:10.4172/2167-0358.1000112

Copyright: © 2014 Razvodovsky YE. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Statistical analysis

To examine the relation between changes in alcoholism and suicide mortality rates across the study period a time-series analysis was performed using the statistical package “Statistica”. Bivariate correlations between the raw data from two time-series can often be spurious due to common sources in the trends and due to autocorrelation [14]. One way to reduce the risk of obtaining a spurious relation between two variables that have common trends is to remove these trends by means of a ‘differencing’ procedure, as expressed in formula:

$$\nabla x_t = x_t - x_{t-1}$$

This means that the annual changes ‘ ∇ ’ in variable ‘X’ are analyzed rather than raw data. The process whereby systematic variation within a time series is eliminated before the examination of potential causal relationships is referred to as ‘prewhitening’. This is subsequently followed an inspection of the cross-correlation function in order to estimate the association between the two prewhitened time series. It was Box and Jenkins [15] who first proposed this particular method for undertaking a time series analysis and it is commonly referred to as ARIMA (autoregressive integrated moving average) modeling. We used this model specification to estimate the relationship between the time series alcoholism and suicide mortality rates in this paper. In line with previous aggregate [16,17] we estimated semi-logarithmic models with logged output. The following model was estimated:

$$\nabla \ln M_t = a + \beta \nabla A_t + \nabla N_t$$

where ∇ means that the series is differenced, M is suicide mortality rate, *a* indicates the possible trend in suicide mortality due to other factors than those included in the model, *A* is the alcoholism mortality rate, β is the estimated regression parameter, and *N* is the noise term. A semi-logarithmic model is based on the assumption that the risk of suicide increases more than proportionally for a given increase in alcohol consumption because alcohol may trigger the impact of other suicidogenic factors [16]. The temporal structure of the error term was estimated by using autoregressive (AR) or moving average (MA) parameters in the model. A diagnostic test for residual correlation is given by the Box-Ljung Q-test, which indicates whether the model has been adequately fitted.

Results

According to official statistics, the male suicide rate increased 2.0 times (from 296.3 to 598.8 per 1000.000 of population) and female suicide rate increased by 29.2% (from 72.3 to 93.7 per 1.000.000 of population) in Russia from 1956 to 2005. The alcoholism mortality rate for male increased 3.1 times (from 23.1 to 72.3 per 1000.000 of population), and for female increased 1.7 times (from 10.4 to 17.3 per 1000.000 of population). It can be seen that the male suicide rate was significantly higher than the female rate with a rate ratio of 3.9 in 1956 increasing to 6.4 by the 2005. In contrast, the upward trend in fatal alcoholism mortality rate across the time series has been greater for women than for men. The trends in age-adjusted, sex-specific suicide and alcoholism mortality rates are displayed in Figures 1-3. As can be seen, the trends in suicide mortality for male and female seem to follow each other across the 1956-2005 time series. The two time series fluctuated over the period for both sexes: increased steadily from 1956 to 1984, then dropped sharply in 1984-1986, began to increase in 1987-1988, dramatically jumped from 1991 to 1994. From 1995 there was a fall in the rates until 1998 when it again began to rise and then started to decrease in the last years. It is important to point out that there is a substantial difference between sex-specific suicide trends. For example, across the period from 1956 to 1984 the upward trend in suicide rate has been greater for men than for women (the male rate increased 2.4 times, while the female rate increased 1.9 times). Further, suicide mortality dropped more sharply for males than for females during the anti-alcohol campaign: between 1984 and 1986 the male rate drop of 40.5 per cent, while the female rate decreased by 23.5 per cent. Similarly, rate of suicide increased dramatically for both males and females during the transition, but it appear that males were more adversely affected during this period. From 1991 to 1994 the male suicide rate increased by 62.2 per cent, while the female rate increased by 24.5 per cent. Thus, the male suicide rate tends to fluctuated across time series to a much greater extent than the female rate. Although the trends for suicide and alcoholism mortality rates are rather similar over time series for both sexes, there are differences. For example, there is marked discrepancy between the two time series for men in the early 1980s: an upward trend in the suicide rate and a downward trend in the alcoholism mortality rate. There is also divergence between the two time series for women between 1956 and 1990: a downward trend in the alcoholism rate and an upward trend in the suicide rate.

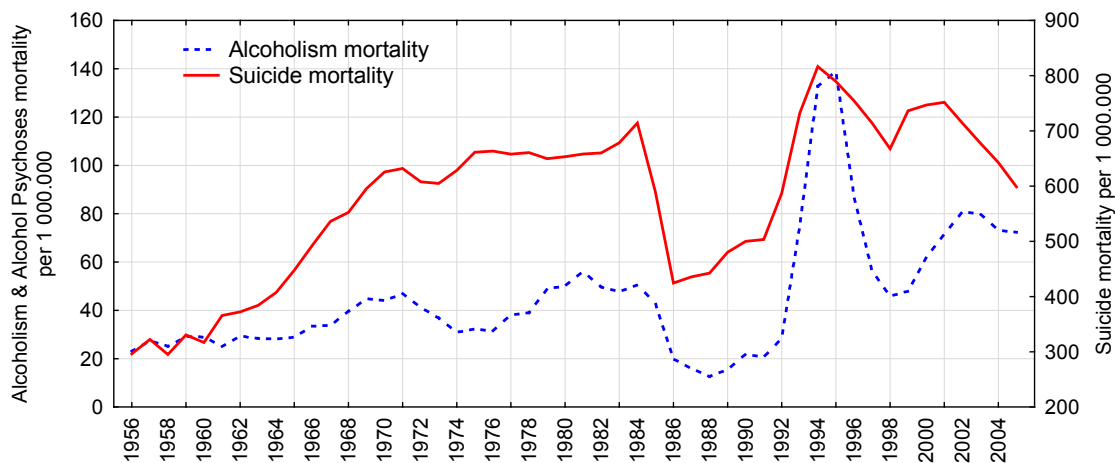


Figure 1: Trends in male alcoholism and suicide mortality rates in Russia between 1965 and 2005.

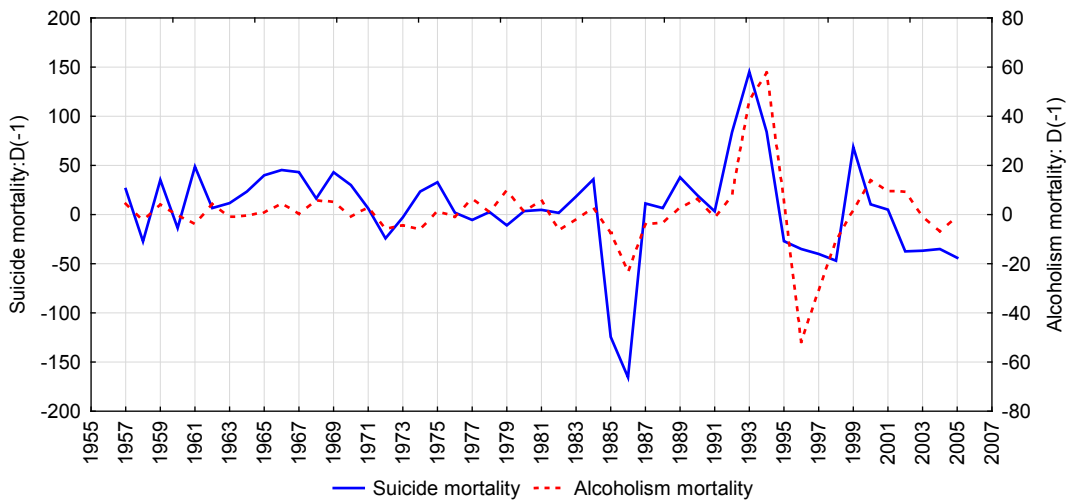


Figure 2: Prewhitened trends in male alcoholism and suicide mortality rates in Russia between 1965 and 2005.

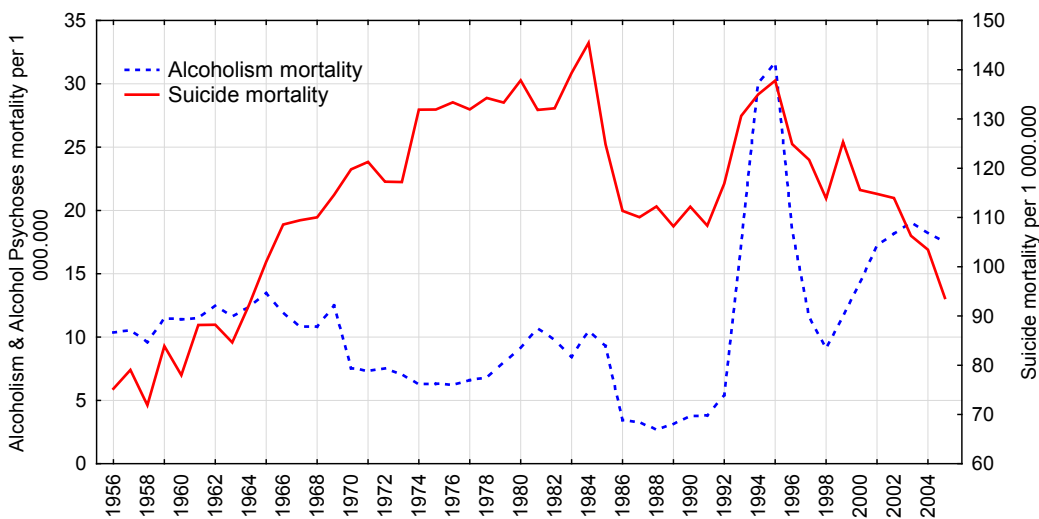


Figure 3: Trends in female alcoholism and suicide mortality rates in Russia between 1965 and 2005.

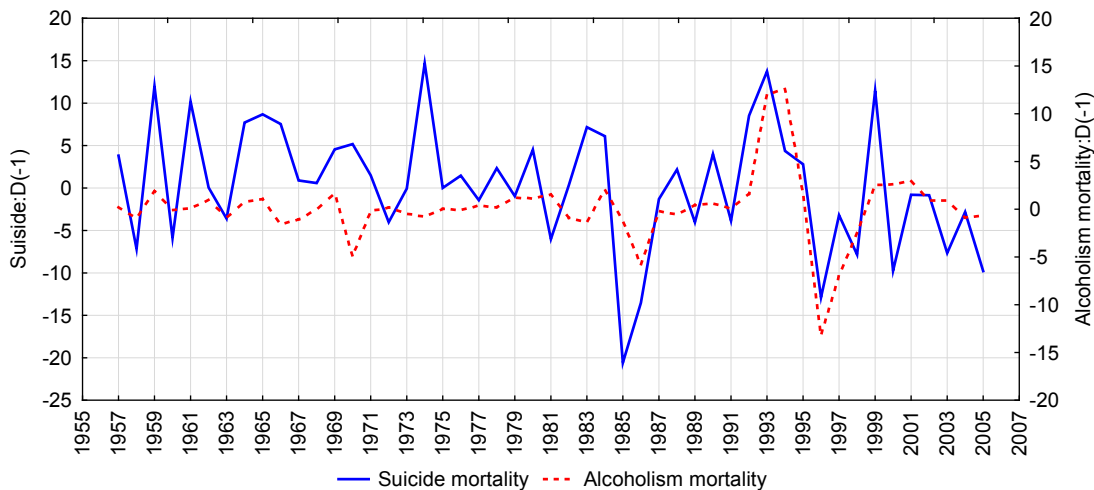


Figure 4: Prewhitened trends in female alcoholism and suicide mortality rates in Russia between 1965 and 2005.

A Spearman correlation analysis suggests a strong association between the two variables for male ($r=0.72$; $p<0,000$). The correlation between the two variables for female was also positive, but statistically not significant ($r=0.35$; $p<0.808$). As can be seen from Figures 1-3 there are linear and S-shape trends in the time series. These trends were removed by means of first-order differencing procedure (Figures 2-4). After pre-whitening the cross-correlations between alcoholism and suicide mortality time series were inspected. The outcome indicated statistically significant cross-correlation between the two variables for male ($r=0.61$; $SE=0.142$) and female ($r=0.44$; $SE=0.142$) at zero lag (Table 1). Further, a non-seasonal ARIMA model was used to convert each series to a white noise process. The specification of the bivariate ARIMA model and outcome of the analyses are presented in Table 2. It can be seen, that the estimated alcohol effect on suicide mortality are clearly statistically significant both for male and female. The results of distributed lags analysis also suggest that it is only contemporaneous correlation (lag 0) statistically significant both for male and female (Tables 3-4).

Discussion

Natural experiments, such as sudden and large changes in alcohol consumption level, provide an opportunity to test the efficacy of policy attempts to reduce the rate of alcohol-related problems in the population. This type of experiments is being used in the social epidemiology and allows to rigorously evaluate the efficacy of public health interventions. Russia, due to its high overall level of consumption, hazardous drinking pattern and its high suicide rate, provides an important contextual setting for this type of analysis. During the last decades, Soviet and later Russian governments adopted a series of restrictive measures in an attempt to curb the alcohol-related burden. In 1958 a Central Committee and Council of Ministers resolution had called for a struggle against alcoholism. The main emphasis was placed upon education and propaganda, although restrictions upon the sale of alcohol were also introduced. In 1966 the Presidium of the Supreme Soviet adopted a decree on hooliganism, introducing a system of fines for public drunkenness. In 1972 a resolution by the CPSU Central Committee "About the Measures Restricting Alcohol Consumption" was passed. According to the document, the production of vodka and the number of shops selling it were to be cut. There was evidence that anti-alcohol measures did lead to a slight decrease in alcohol-related

Lag	Suicide males		Suicide females	
	r	SE	r	SE
-3	-0.246	0.146	-0.208	0.146
-2	0.120	0.145	0.060	0.145
-1	0.165	0.144	0.051	0.144
0	0.606	0.142	0.442	0.142
1	0.599	0.144	0.326	0.144
2	0.099	0.145	0.014	0.145
3	-0.246	0.147	0.232	0.147

Table 1: Effects of alcohol on suicide mortality rates. The results of cross-correlation analysis between prewhitened time series.

Parameter	Model	Estim.	SE	p
Suicide males	0.1.1*	0.007	0.001	0.000
Suicide females	0.1.1	0.003	0.001	0.002

*The general form of non-seasonal 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. Q test for residuals are satisfactory in all models

Table 2: Estimated effects (bivariate ARIMA model) of overall alcohol consumption on suicide mortality rates.

Lag	Regres Coeff	SE	t	p
0	2.58	0.54	4.78	0.000
1	-1.18	0.69	-1.72	0.092
2	0.81	0.69	1.18	0.246
3	-0.26	0.54	-0.48	0.634

Table 3: Effects of alcohol on suicide mortality rates. The results of distributed lags analysis for male.

Lag	Regres Coeff	Standard Error	t	p
0	1.08	0.33	3.25	0.002
1	-0.65	0.38	-1.68	0.099
2	0.52	0.38	1.36	0.181
3	-0.30	0.33	0.71	0.366

Table 4: Effects of alcohol on suicide mortality rates. The results of distributed lags analysis for female.

mortality rate. In 1973 a network of "commissions for the struggle against alcoholism" was established and from 1976 a narcological service began to operate. The beginning of the 1980s was marked by a new attempt to fight alcohol-related problems. The new Soviet leaders, Andropov first and then Chernenko, took a number of measures aimed at alcohol availability restriction. It was done within a campaign to strengthen public order and discipline in the workplace. There was evidence that official politics taken resulted in a decline of both alcohol consumption per capita and alcohol-related mortality level.

Gorbachev's anti-alcohol campaign in the 1985-1988 is the most well-known natural experiment in the field of alcohol policy. The campaign restricted hours of alcohol sales, increased the price of alcohol, implemented purchase quotas, imposed tougher legal sanctions on home production and destroyed most of the vineyards across a number of Soviet republics. However, despite these efforts anti-alcohol campaign failed dramatically because the severe restrictions brought to the fore rapid growth of home brewing and substantial improvement in alcohol-related phenomena following the campaign was short-lived [7,18].

Major social, political and economic changes throughout the 1990s caused dramatic grows in alcohol consumption. Increasing alcohol consumption was one of the outcomes of collapse following "shock therapy" economic reforms that left a majority of the population below poverty level. In January 1992 the state alcohol monopoly was abolished as part of the economic liberalization that lead to the fragmentation of the alcohol industry. Import began to reach the Russian market in significant quantities: by early 1994 as much as 60 per cent of all vodka sold in Russia was imported. Apart from increase supply of legally produced and imported beverages alcohol was produced illegally on a massive scale, while the quality of beverages diminished substantially [7,18]. It was estimated that by 1994 half of the alcohol sold was illicit. This associated with rapid increase in alcohol consumption, the peak of which was reached in 1994-1996, and dramatic growth in alcohol-related mortality [19]. Thus, alcohol was one of the factors, the contribution of which to Russian mortality crisis has already been discussed many times and recognized as a significant [7,13]. In 1997 a State Dumas Comities reported concern about mass drunkenness and proclaimed the parliament to start drafting a federal law "On the principles of alcohol policy in the Russian federation". In 1998 the state alcohol monopoly in Russia was reestablished. In July 2005 President Putin has signed a law on regulation of the production and turnover of alcohol. The main concern of this document is the control of the volume and quality of alcohol production and sale. Brief historical retrospective witnesses that attempts to control alcohol market in Russia have failed,

primarily because of absence comprehensive alcohol control policy and weak public support.

It is well recognized, that cultural and social structure characteristics are implicated in the fluctuation in suicide mortality rate [3,8]. The experiences of Russia during the last decades present a remarkable opportunity to examine the relationship between culture, social forces and suicide mortality. As we can see, the suicide and alcoholism mortality trends have been more or less correlated with the great societal transformation. The sharp decline in the time series in the mid-1980s corresponds with the anti-alcohol campaigns by Gorbachev, which significantly reduced alcohol consumption by limiting its manufacture and availability. The dramatic increases in the two time trends in the early 1990s corresponds to dissolution of the Soviet Union and the profound socio-economic and political changes occurring during the transitional period to the post communism. It also seems plausible, that suicide and alcoholism mortality rates increase observed in the yearly 1990s resulted from the socio-economic crisis and anomic conditions was reinforced by the abolishing the state alcohol monopoly in 1992. Moreover, there is indirect evidence that mortality fluctuations during the 1990s may be related to changes in alcohol availability. When price of alcohol fell relative to basic foods stuffs and alcohol supply increased, the mortality rose substantially. Alternatively, the improvement in mortality in late 1995 coincided with a reduction in alcohol sales outlets.

The shock in the early 1990s was followed by a period of relative improvement and stability in the middle years of the decade. The subsequent rise in the suicide and alcoholism mortality rates from 1998 may be associated with the financial crisis and a worsening economic situation. It should be noted that the apparent turnabout in the male suicide and alcoholism mortality trends in the early 1980s highlights an intermediate role for the social factors in the alcohol-suicide association. Although the exact nature of this phenomenon remains uncertain, one potential explanation may be particularly relevant in this context. At the beginning of 1980s the newly coming Soviet state leader Andropov took a number of measures aimed at alcohol availability restriction. It was done in the framework of the labor discipline strengthening campaign and resulted in a steady decrease in the alcohol consumption per capita and alcoholism mortality rates, but it appear that suicide rate was adversely affected during this period.

The time series analysis suggests a positive relationship between alcoholism and suicide mortality rates at lag zero. We argue that in this case independent variable is directly influencing the dependent variable and that there is no evidence of a lagged relationship between the two time series. However, it might be the case that alcoholism and suicide mortality rates are being influenced by a confounding variable i.e. that the correlation is spurious. It is possible that there may have been other factors underlying the suicide mortality crisis in the early 1990s. Several scholars have argued that the dramatic increase in suicide rates may reflects the rise in stress experienced by Russians during the transition period [20]. So, psychosocial distress may be an important underlying factor of suicide mortality crisis. In this respect it should be noted that the dynamics of suicide in the 1990-s fits a typical stress-related pattern: dramatic growth in the early 1990-s (the acute stage) and stabilization in the late 1990-s (the stage of adaptation). It is important to point out that the size of the bivariate association between alcoholism mortality and suicide for men is substantially greater than for women. This mean that alcohol-suicide association is stronger for male than for female, as it was shown in the previous studies [7]. It seems plausible that the sudden decline in the suicide and alcoholism mortality rates in the mid-1980s appeared to be entirely due to anti-

alcohol campaign of 1985-1988, which significantly reduced alcohol consumption. Therefore, the coincident trends between the two time series in this period strongly support an alcohol-related hypothesis. Nevertheless, several researchers believed that this phenomenon at list partially 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 [3,4]. In contrast, Nemtsov has highlighted that in Russia the number of BAC-positive suicides shrank by 55 per cent, while the number of BAC-negative suicides did not change substantially during Gorbachev's perestroika [7]. Moreover, it has been shown that the oldest age groups of both men and women did not experience a reduction in their suicide rates during the anti-alcohol campaign, while working-age males faced the greater decreases in suicide mortality in the mid-1980s and the subsequent increases in the late 1980s and yearly 1990s [1].

There may also have been potential problems with the mortality data we used. However, earlier study has confirmed the reliability of the statistics on violent death for the Soviet period [21]. In the post-Soviet period virtually all deaths from external causes are subjected to forensic autopsies, which include BAC inspection and histological examination of organs [13]. At the same time, analysis by subcategory of deaths from external causes in Russia showed that there was a massive increase in the rates of injury death of undetermined intent, almost to a level on a pair with suicide rate in recent years [22]. In this context, some researchers argue that a rising rate of injury death of undetermined intent indicates declining quality of mortality statistics in Russia [23].

In conclusion, the present study replicates previous findings suggesting close aggregate level association between alcohol and suicide mortality in Russia. The outcome of this study provides indirect support for the hypothesis that alcohol played a crucial role in the fluctuation in suicide mortality rate in Russia during recent decades. The finding from this study indicates that a restrictive alcohol policy can be considered as an effective intervention for suicide prevention in countries where rates of both alcohol and suicide are high.

References

1. Pridemore WA, Spivak AL (2003) Pattern of suicide mortality in Russia. *Suicide and Life-Threatening Behavior*. 33; 132-150.
2. Wasserman D, Varnik A, Eklund G (1994) Male suicides and alcohol consumption in the former USSR. *Acta Psychiatr Scand* 89; 306-313.
3. Lester D (1998) Suicide and homicide after the fall of communist regimes. *Eur Psychiatry*, 13; 98-100.
4. Varnik A, Wasserman D, Dankowicz M, Eklund G (1998) Age-specific suicide rates in the Slavic and Baltic regions of the former USSR during perestroika, in comparison with 22 European countries. *Acta Psychiatr Scand*, 20-25.
5. Makinen IH (2006) Suicide mortality of Eastern European regions before and after the communist period *Social Science & Medicine*, 63; 307-319.
6. Makinen IH. (2000) Eastern European transition and suicide mortality *Social Science & Medicine*. 51; 1405-1420..
7. Nemtsov AV (2003) Suicide and alcohol consumption in Russia, 1965-1999. *Drug and Alcohol Dependence* 1; 161-168.
8. Pridemore WA (2006) Heavy drinking and suicide in Russia. *Social Forces* 85; 413-430.
9. Razvodovsky YE (2009b) Beverage-specific alcohol sale and suicide in Russia. *Crisis* 30: 186-191
10. Pridemore WA, Chamlin MB (2006) A time-series analysis of the impact of heavy drinking on homicide and suicide mortality in Russia, 1956-2002. *Addiction* 101: 1719-1729.
11. Razvodovsky YE (2009a) Suicide and fatal alcohol poisoning in Russia, 1956-2005. *Drugs: Education, Prevention and Policy* 16: 127-139.

12. Rehm J, Taylor B, Patra J (2006) Volume of alcohol consumption, pattern of drinking and burden of disease in the European region. *Addiction* 101: 1086–95.
13. Stickley A, Leinsalu M, Andreev E, Razvodovsky Y, Vagero D, et al. (2007) Alcohol poisoning in Russia and the countries in the European part of the former Soviet Union, 1970-2002. *Euro J Pub Health* 17; 444-449.
14. Norstrom T, Skog OJ (2001) Alcohol and mortality: methodological and analytical issue in aggregate analysis, *Addiction* 96: 5-17.
15. Box GEP, Jenkins GM (1976) *Time Series Analysis: forecasting and control*. Holden-Day Inc. London.
16. Norstrom T, Rossov I (1999) Beverage specific effects on suicide. *Nord Stud Alcohol Drugs* 16: 109-118.
17. Ramstedt M (2001) Alcohol and suicide in 14 European countries. *Addiction* 96: 59-75.
18. Bobak M, McKee M, Rose R, Marmot M. (1999) Alcohol consumption in a sample of the Russian population. *Addiction* 94: 857-866.
19. Leon DA, Shkolnikov VM (1998) Social stress and the Russian mortality crisis. *JAMA* 79: 790-791.
20. Gavrilova NS, Semyonova VG, Evdokushkina GN, Gavrilov LA (2000) The response of violent mortality to economic crisis in Russia. *Population Research and Policy Review* 19: 397-419.
21. Wasserman D, Varnik A (1998) Reliability of statistics on violent death and suicide in the former USSR, 1970-1990. *Acta Psychiatrica Scandinavica* 394: 34-41.
22. Varnik P, Sisask M, Varnik A, Yuryev A, Kolves K, et al. (2010) Massive increase in injury deaths of undermined intent in ex-USSR Baltic and Slavic countries: hidden suicides? *Scandinavian J Pub Health* 38: 395-403.
23. Gavrilova NS (2008) Russian mortality crisis and the quality of vital statistics. *Population Research and Policy Review* 27: 551-574.