Population Drinking and Homicide Rate in Russia

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Abstract

Background: Although high homicide rate in Russia has been discussed widely, current literature seems to lack a consistent understanding of this phenomenon. Objective: The aim of this study was to test the hypothesis of the close aggregate level link between alcohol drinking and homicide deaths in Russia.

Method: Age-standardized sex-specific male and female homicide mortality data for the period 1970 to 2013 and data on overall alcohol consumption were analyzed by means ARIMA (autoregressive integrated moving average) time series analysis. Alcohol consumption was significantly associated with both male and female homicide rate: a 1 liter increase in overall alcohol consumption would result in an 11.3% increase in the male homicide rate and in 10.7% increase in the female homicide rate. The results of the analysis suggest that 78.9% of all male homicide deaths and 77.2% female homicide deaths in Russia could be attributed to alcohol.

Conclusions: The outcomes of this study provide support for the hypothesis that alcohol is a major contributor to the homicide rate in Russian Federation. These findings have important implications as regards violent mortality prevention indicating that a restrictive alcohol policy can be considered as an effective measure of prevention in countries where higher rate of alcohol consumption and binge drinking pattern.

Keywords: Homicide; Alcohol consumption; ARIMA time series analysis; Russia, 1970 to 2013

Introduction

The Russian homicide rate is one of the highest in the world [1]. The homicide rate had varied greatly during the last decades in this country [2]. Although high homicide rate in Russia has been discussed widely, current literature seems to lack a consistent understanding of this phenomenon. Large body of research evidence suggests that there is a strong cross-sectional and temporal relationship between population drinking and homicide rate in Russia [2-5]. Several researchers argue that a binge drinking pattern is crucial in explaining the high homicide rate in Russia [6,7]. Recent research also revealed several other factors that help to explain both high homicide rate and its dramatic fluctuations in this country, including specific historic conditions and social factors [8].

This paper will further test the hypothesis of the close aggregate level link between alcohol drinking and homicide deaths in Russia using data on overall alcohol consumption and sex-specific homicide rate between 1970 and 2013.

Methods

Data

The data on age-adjusted sex-specific homicide rates per 1000.000 of the population are taken from the Russian state statistical committee (Rosstat). Estimation of alcohol consumption per capita was based on a set of indicator of alcohol-related harm which was adjusted for the effect of recorded alcohol consumption [9,10].

Statistical analysis

To examine the relation between changes in the alcohol consumption and homicide rate across the study period a time-series analysis was performed using the statistical package "Statistica". The dependent variables were the annual homicide mortality and the independent variable was aggregate overall alcohol consumption. 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 [11]. 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: Equation 1

$$X_t = x_t - x_{t-1}$$

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 'pre-whitening'. This is subsequently followed an inspection of the cross-correlation function in order to estimate the association between the two pre-whitened time series. It was Box and Jenkins [1,12] who first proposed this particular method for undertaking a time series analysis and it is commonly referred to as ARIMA (autoregressive integrated moving average) model modeling. We used this model specification to estimate the relationship between the time series homicide mortality and alcohol consumption rates in this paper. In line with previous aggregate studies [8] we estimated semi-logarithmic models with logged output. The following model was estimated: Equation 2

$$LnM_t = a + \beta A_t + N_t$$

where ∇ means that the series is differenced, M is homicide rate, an indicates the possible trend in homicide mortality due to other factors than those included in the model, A is the alcohol consumption, β is the estimated regression parameter, and N is the noise term. The percentage increase in homicide rate associated with a 1 litre increase in alcohol consumption is given by the expression: $(\exp(\beta 1)-1)*100$. 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.

In addition to the estimated effect parameter, the alcohol effect will also be expressed in terms of alcohol-attributable fraction (AAF), which can be calculated from the estimates obtained in ARIMA models according to following formula: $AAF=1-\exp(-bX)$, where X is alcohol consumption for the whole study period and b is the estimated effect parameter [13].

Results

The trends in the age-adjusted, sex-specific homicide rate are displayed in Figures 1 and 2.
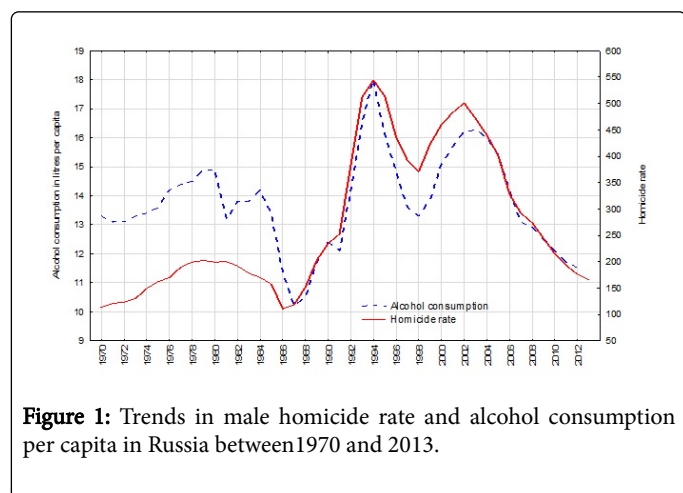
Figure 1: Trends in male homicide rate and alcohol consumption per capita in Russia between1970 and 2013.

For both sexes the time series homicide rate fluctuated greatly over the period: decreased markedly between 1984 to 1986 (by 35% and 34.9% for men and women respectively), before increasing substantially during 1992 to 1994 (by 41.8% and 46.3% for men and women respectively). From 1995 to 1998 there was a fall in the rate before they again jumping between 1998 and 2002 (by 35% and 27.1% for men and women respectively), while a dramatic decrease in the rate has been recorded in the last decade. The average per capita alcohol consumption figure was 13.8 liters with vodka being the drink overwhelmingly consumed.

The graphical evidence suggests that the trends in both alcohol consumption per capita and homicide rate for males and females seem to follow each other across the time-series (Figures 1 and 2).

As can be seen, there were sharp trends in the time series data across the study period. These trends were removed by means of a first-order differencing procedure (Figures 3 and 4).

After pre-whitening the cross-correlations between alcohol consumption and homicide mortality time series were inspected. This indicated that there was a statistically significant cross-correlation between alcohol consumption and homicide rate for males and females
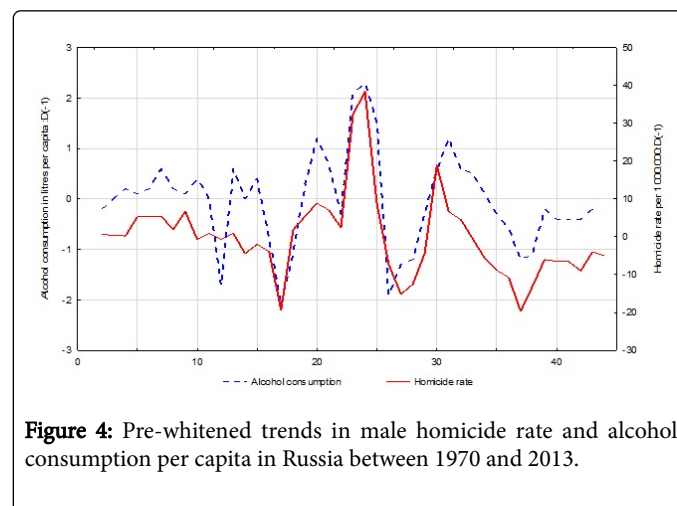
at lag zero (Table 1). The specification of the bivariate ARIMA model and outcome of the analyses are presented in Table 2.
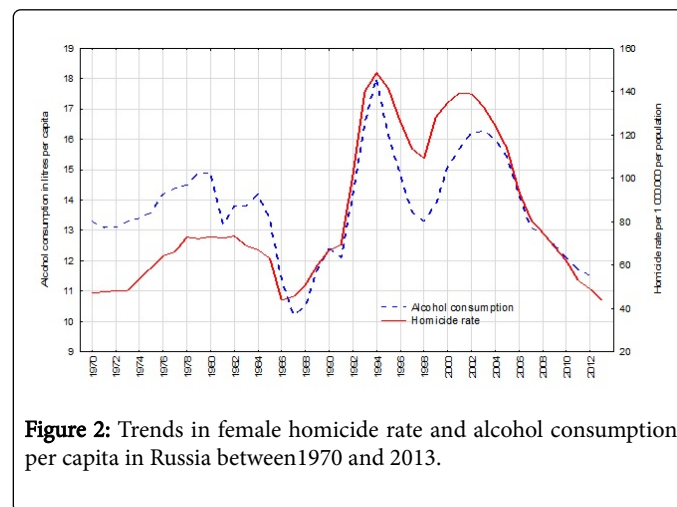
Figure 2: Trends in female homicide rate and alcohol consumption per capita in Russia between1970 and 2013.
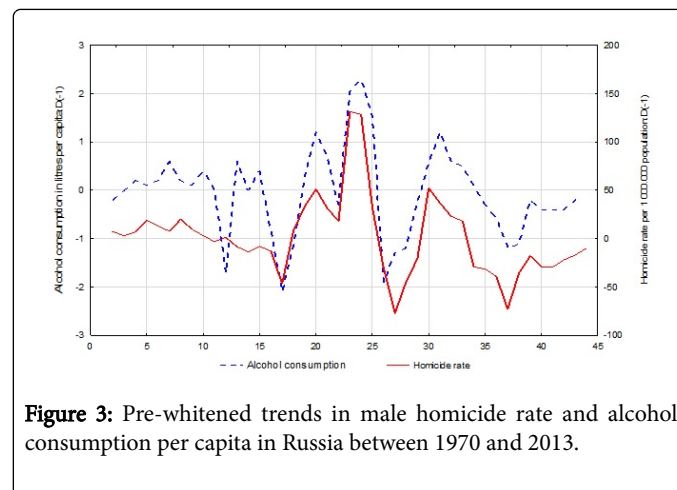
Figure 3: Pre-whitened trends in male homicide rate and alcohol consumption per capita in Russia between 1970 and 2013.

Figure 4: Pre-whitened trends in male homicide rate and alcohol consumption per capita in Russia between 1970 and 2013.

According to the results, alcohol consumption is a statistically significant associated with both male and female homicide rate, implying that a 1 litre increase in per capita consumption is associated with an increase in male mortality of 11.3% and female mortality of 10.7%. Table 2 also shows the relative proportion of alcohol-

attributable deaths to all homicide deaths by gender. The results of the analysis suggest that 78.9% of all male deaths and 77.2% female homicide deaths in Russia could be attributed to alcohol.

	Homicide males		Homicide females	
Lag	r	SE	r	SE
-3	0.17	0.160	0.12	0.160
-2	0.00	0.158	0.19	0.158
-1	0.46	0.156	0.45	0.156
0	0.83	0.154	0.83	0.154
1	0.67	0.156	0.64	0.156
2	0.18	0.158	0.14	0.158
3	0.14	0.160	0.19	0.160

Table 1: The results of cross-correlation analysis between pre-whitened time series. Effects of alcohol consumption per capita on homicide rate.

Parameter	Model	Estimation	P	AAF
Homicide males	0.1.1*	0.113	0.000	0.789
Homicide females	0.1.1	0.107	0.000	0.772

* 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 pancreatitis mortality rates.

Discussion

The positive and significant contemporaneous association between alcohol consumption and homicide rate in present analysis replicates the findings from previous time-series studies highlighted close temporal association between population drinking and homicide mortality in Russia [2,3,12,14,15]. Estimation the proportion of alcohol-attributable fraction suggests that 78.9% of male homicide deaths and 77.2% of female deaths in Russia are attributable to alcohol. This estimate accounts well with that reported in previous studies [16].

The findings from present study indicate that alcohol is a key variable in explaining the dramatic fluctuations in homicide rate in Russia during the last decades. Gorbachev's anti-alcohol campaign in the 1985-1988 is the most well-known natural experiment in the field of alcohol policy [17]. It seems obvious that sudden decline in homicide rate during this time appears to be entirely due to anti-alcohol campaign that significantly reduced alcohol consumption by limiting its manufacture and availability [16]. The collapse of the Soviet Union and the ending of the state's alcohol monopoly in January 1992 were accompanied by a sharp rise in alcohol consumption and homicide rate [6]. An alternative explanation for the increase in the homicide rate in the early 1990s relates to the socioeconomic and political transition [13]. There is strong evidence of a key role of alcohol in explaining of Russian homicide mortality crisis between 1998 and 2002, when affordability of vodka increased substantially [6].

In Russia, homicide rate has declined dramatically since 2003, which might be attributed to the implementation of the alcohol policy reforms in 2001 to 2006, which increased government control over the alcohol market [6]. The policies included strict regulations on alcohol products, which resulted in a decline in a distributors and increased consumer prices. This empirical evidence suggests that recent Russian government's attempt to curb the high alcohol-related mortality have been at least partially successful and provide additional evidence that pricing policy may be an effective strategy to reduce an alcohol-related burden.

An alternative explanation for the recent remarkable decline in homicide rate in Russia can be linked to the political and economic stability during the first decade of the 21st century. Some experts have been skeptical about the substantial decline in the homicide rate in the 2000s and considered it to be an artificial [4]. There is concern that mortality data were subjected to manipulation. In particular, during the 2000s, there was substantial increase in the number of unspecified deaths and deaths of undetermined intent, many of which are thought to be homicides [18].

In conclusion, the results of this study indicate that population drinking and homicide are positive related phenomena in Russia. Furthermore, these findings provide support for the hypothesis that alcohol is a major contributor to the homicide rate in Russian Federation. The outcomes from the present study have important implications as regards violent mortality prevention indicating that a restrictive alcohol policy can be considered as an effective measure of prevention in countries where higher rate of alcohol consumption and binge drinking pattern.

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