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Fatal Alcohol Poisonings and Traffic Accidents in Russia

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Abstract – Russia has one of the world's highest road traffic fatality rates. There is common believe that high level of alcohol consumption in conjunction with binge drinking pattern is a major determinant of high traffic accidents mortality rates in this country. Objective: The aim of the present study was to estimate the aggregate level effect of binge drinking on the traffic accidents mortality rates in Russia. Method: Age-standardized sex-specific male and female fatal alcohol poisonings (as a proxy for binge drinking) and traffic accidents mortality data for the period 1970-2013 were analyzed by means time series analysis. The results of the analysis indicate the presence of a statistically significant association between the two time series for males and for females. Conclusions: The outcomes of this study provide support for the hypothesis that binge drinking is an important contributor to the traffic accidents mortality rates in Russian Federation. The findings from the present study have important implications as regards traffic accidents 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 conjunct with binge drinking pattern.

Key words: fatal alcohol poisonings, traffic accidents, time series analysis, Russia, 1970-2013.

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Introduction

Road traffic injuries are the eight leading cause of death globally, and the leading cause of death for children and young adults [1,2]. According to prognosis, the worldwide road traffic injuries rank among the causes of death will climb to the fifth place by 2030, resulting in an estimated 2.4 million fatalities each year [2]. It is estimated that in the European Union 1.3 million road traffic accidents occur each year, resulting in 1.7 million injuries and over 40 000 deaths annually [3]. The direct and indirect costs of these accidents sums up to 160 billion euro, equal to 2% of the gross national product of the EU [2].

Alcohol has been identified as one of the most significant risk factors for road traffic crashes in many developed and developing countries of the world [4]. At the individual level, there is dose-response relationship between alcohol consumption and fatal road traffic accidents, with risk of death increas-

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ing non-linearly with increasing alcohol consumption [3]. Zador estimated that each 0.02 increase in a driver's BAC nearly doubled the risk of fatal crash [5]. It has been also estimated that the likelihood of being a fatally injured driver was at least 9 times greater at BACs of 0.05 to 0.09% than at zero BAC [4].

Several studies report the positive association between alcohol consumption and traffic fatalities at the aggregate level. Skog evaluated the effects of changes in aggregate alcohol consumption on fatal motor vehicle traffic accidents in 14 western European countries after 1950 [6]. For male traffic accidents, significant relationships were uncovered in central and southern Europe, but not in northern Europe. Among females the effect was significant only in central Europe [6]. A more recent time series analysis based on Belarusian data for the period from 1970 to 1999 reported a close link between vodka sales per capita and road traffic fatality rates [7].

Russia has one of the world's highest road traffic fatality rates due to drunk driving, poor road conditions, an outdated vehicle fleet [8,9]. Each year, approximately 30 000 Russians die in road accidents – about the same as in the European Union [2]. Road safety has attracted attention at the top levels of Russian politics, receiving mention in Putin's 2006 Annual Address to the Federal Assembly and serves as the centerpiece of a national speech by Medvedev in August 2009 [9].

There is common believe that high level of alcohol consumption in conjunction with binge drinking pattern is a major determinant of high violent mortality rates in Russia [7,10-12]. Over the past 10 years, almost 40 000 Russians have died in road accidents caused by drunk drivers [9]. A large retrospective case-control study in three Russian industrial cities found dose-response association between alcohol consumption and mortality from road accidents: drinking of three or more bottles of vodka per week was strongly associated with deaths from road accidents both among men (RR= 4.20; CI: 3.31-5.34) and women (RR= 4.48; CI: 3.38-5.96) [13]. Although drunk driving officially accounts for 7,2% of all road traffic crashes at the national level, its proportion increases to one-fifth in some federal regions [9]. Furthermore, the most recent individual-level estimates suggest that 46.1% of all deaths from road accidents (47.7% and 41.0% of deaths among men and women respectively) were attributable to alcohol consumption [14].

In line with this evidence we assume that a combination of higher level of alcohol consumption per capita and binge drinking of vodka results in a close association between alcohol and mortality from road accidents in Russia. To test this hypothesis trends in mortality from road accidents and fatal alcohol poisoning rates from 1970 to 2013 in Russia were analyzed employing time-series analysis.

Material and methods

Data

The data on sex-specific road traffic fatality and fatal alcohol poisoning rates per 1 000 000 of the population were taken from the Russian vital statistics registration system. It should be noted that the fatal alcohol poisoning rate in Russia is likely to be a good measure of heavy episodic drinking [12]. Therefore, a common approach is to use the fatal alcohol poisoning rate as an indicator of binge drinking in this country.

Statistical analysis

The statistical analysis was performed using the package "Statistica". It is generally

agreed that bivariate correlations between the two raw time-series are spurious due to common sources of trends and autocorrelation [15]. 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: xt = xt – xt–1. This means analyzing annual changes rather than raw data. The process of removing systematic variation within the 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. The next step entails the inspection of the cross-correlation function in order to estimate the association between the two rewhitened time series [16]. We used this model to estimate the relationship between the time series fatal alcohol poisoning (as a proxy for binge drinking) and road traffic fatality rates in this paper.

Results

Across the whole period the male traffic accidents mortality rates was 3.8 times higher than the female rates (442.3 vs. 115.2 per 1 000 000) with a rates ratio of 5.0 in 1970 decreasing to 3.4 by the 2013. The trends in the sex-specific traffic accidents mortality rates are displayed in Figures 1-2. As can be seen,

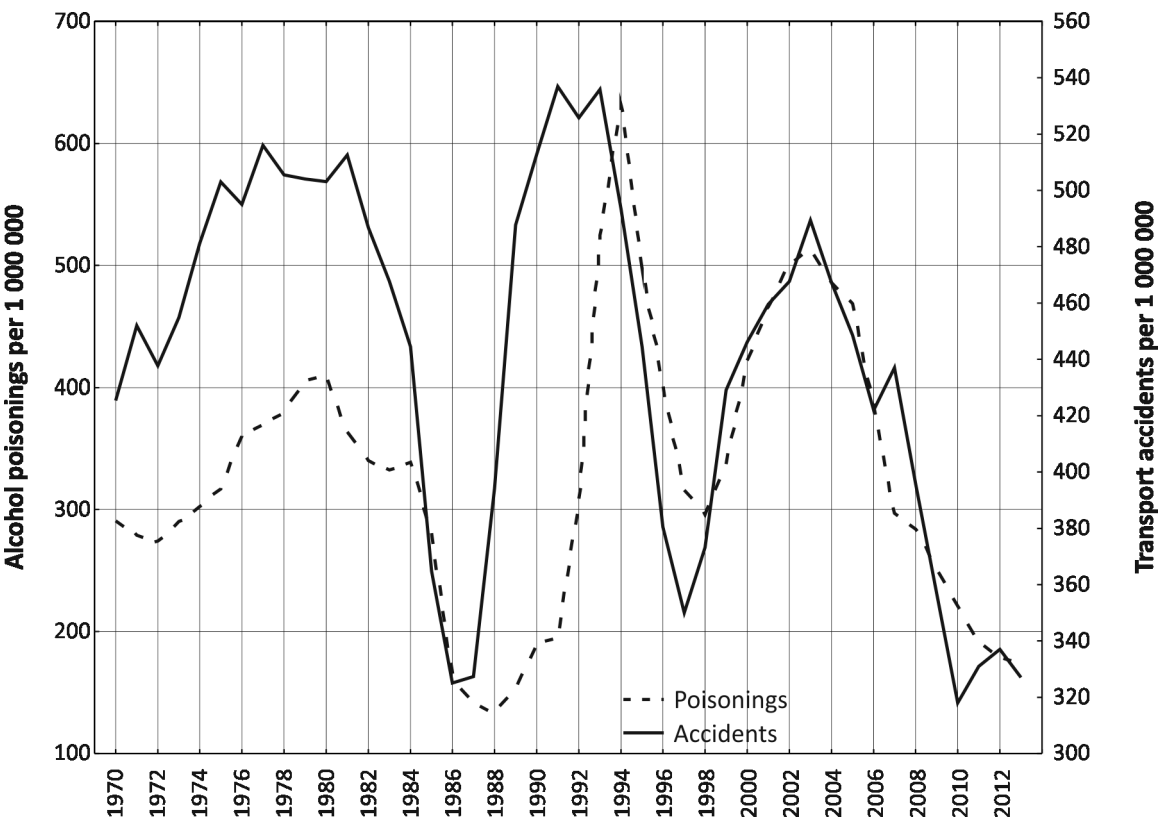

Figure 1. Trends in male fatal alcohol poisonings and road traffic fatality raters in Russia between 1970 and 2013.

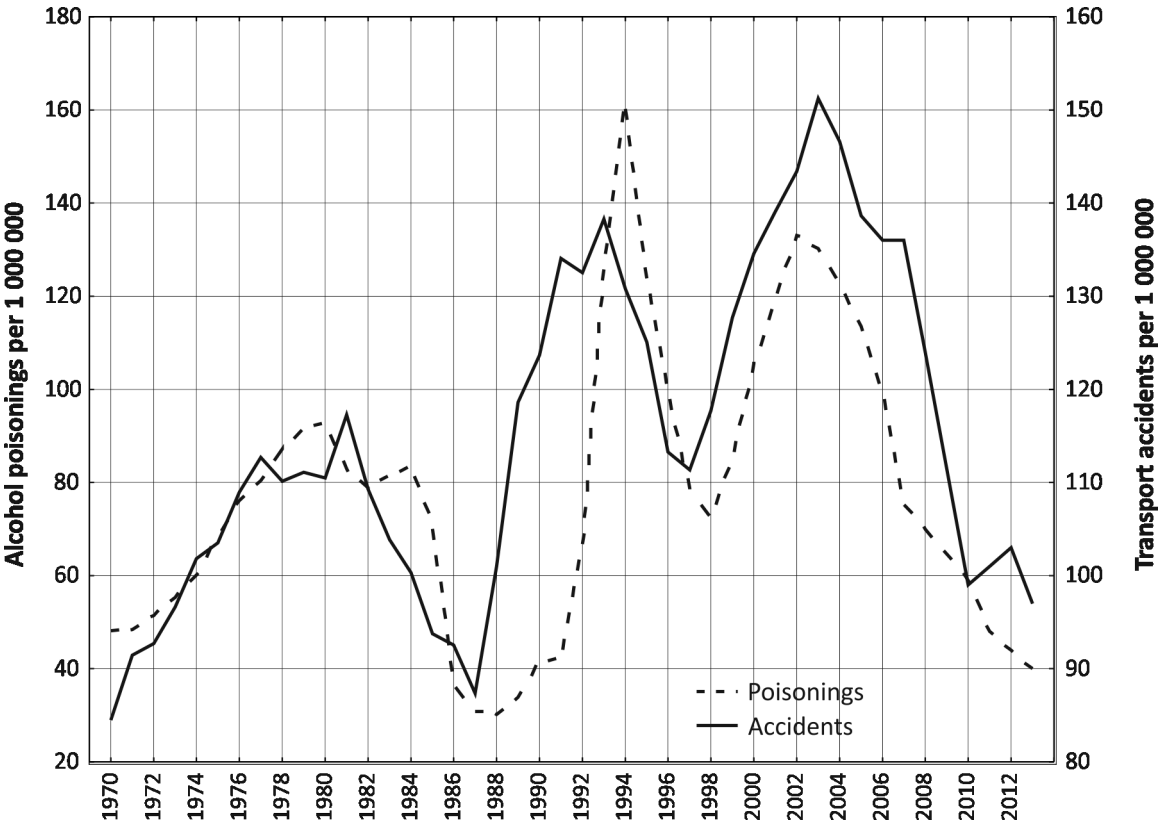

Figure 2. Trends in female fatal alcohol poisonings and road traffic fatality raters in Russia between 1970 and 2013.

the pattern of traffic accidents mortality for men and women was uniform. For both sexes the time series fluctuated greatly over the period: increased from 1970 to 1977, decreased markedly between 1981-1984 (by 13.1% for men and 14,5% for women), dropped sharply between 1984-1986 (by 27.0% for men and 7.8% for women), than jumped dramatically between 1987 and 1991 (by 64.2% for men and 53.4% for women). From 1993-1997 there was a fall in the rates before they again rising between 1997 and 2003, and than started to decrease. There was also a spike in mortality in 2012.

The graphical evidence suggests that the trends in both fatal alcohol poisonings and traffic accidents mortality for males and females seem to follow each other across the time-series (Figures 1-2). There were sharp trends in the time series data across the study period. These systematic variation was well accounted for by the application of first-order differencing. All of the final univariate models meet the diagnostic criterion (i.e., none of the autocorrelation functions are significant at the 0.05 level). After prewhitening the cross-correlations between fatal alcohol poisonings and traffic accidents mortality time series were inspected. The outcome of

Table 1. Effects of binge drinking on road traffic fatality rates. The results of cross-correlation analysis between prewhitened time series.

	males		females	
Lag	r	SE	r	SE
-3	-0.450	0.158	0.321	0.158
-2	0.287	0.156	0.158	0.156
-1	0.160	0.155	0.204	0.155
0	0.370	0.153	0.309	0.153
1	0.556	0.154	0.484	0.154
2	0.402	0.156	0.408	0.156
3	0.337	0.158	0.369	0.158

the analyses is presented in Table 1. According to the results, there was a statistically significant cross-correlation between fatal alcohol poisonings and traffic accidents mortality for males and females at lags 0,1,2,3.

Discussion

The outcome of the time-series analysis suggests a positive and statistically significant relationship between fatal alcohol poisonings (as a proxy for binge drinking) and traffic accidents mortality rates. In agreement with previous studies, we have found the gender differences in the association between alcohol and traffic accidents mortality rates, which mean that the impact of binge drinking appear to be larger on male mortality [6]. The harmful drinking might be responsible for these gender differences. The population surveys from Russia show consistently higher rates of binge drinking among men than women [17,18].

Elucidating the phenomenon of high traffic accidents mortality rates in Russia, however, does little to understand the reasons for it dramatic fluctuations across time. In relation to this, it should be emphasized, that the fatal alcohol poisonings and traffic accidents mortality trends have been more or less correlated with the great societal transformation [19]. One of the most intriguing phenomenon in this context is the substantial decline in alcohol consumption and traffic mortality rates that occurred between 1980 and 1984, which might be attributed to the increase in the price of vodka in 1981 [7]. Furthermore, the new Soviet leader Andropov, who came to power in 1982, realized that mass drunkenness was a major threat to the Soviet system and saw a great opportunity to increase labor productivity by sobering up the nation. He took a number of steps in this direction using police methods to strengthen labor discipline and to fight against drunkenness in the workplace [19]. It might be the case that this policy resulted in a decline in both per capita alcohol consumption and the traffic accidents mortality rates.

Similarly, the sharp decline in the traffic accidents mortality rates in the mid-1980s corresponds with the Gorbachev's anti-alcohol campaigns, which significantly reduced vodka consumption by limiting its availability. In particular, in August 1985 the price of vodka raised by 25%, while in August 1986, there was a further increase in the price of vodka [19,20]. It should be emphasized that

declines in traffic deaths between 1980 and 1984 not varied much by gender. However, there has been greater proportional declining in the numbers of male deaths in fatal traffic accidents during anti-alcohol campaigns: between 1984 and 1986 the number of male deaths declined by 27.0%, whereas the number of female deaths only declined by 7.8%. This fact suggests that males are more likely than females to be involved in alcohol-related fatal crashes.

The dramatic increase in the traffic accidents mortality rates in the early 1990s corresponds to the dissolution of the Soviet Union and the profound socioeconomic changes occurring during the transitional period to post-communism [20]. Treisman argue that the increase in heavy drinking of vodka in the early 1990s, which explains much of the rise in mortality, resulted largely from an increase in the affordability of vodka [21].

In Russia, traffic accidents mortality rates has declined dramatically since 2003, with the highest rates of decline in 2007 and 2010, which might be attributed to the implementation of the alcohol policy reforms, which increased government control over the alcohol market [22-24]. Anti-alcohol activity in this country began with the adoption of two laws in 2005. The first one (102-FL), among other issues, introduced new excise stamps from January 1st 2006. The second law (209-FL) significantly increased nominal capital of alcohol market players since July 1, 2006, so that the market became free from small and average players in favor of large producers. Moreover, the law 209-introduced new and more toxic denaturant additives for household alcohol-containing liquids after July 1, 2006 [19].

In his recent study Pridemore and coauthors [25] concluded that the implementation of alcohol policies was responsible for an 11% reduction in male deaths due to transport accidents or saving more than 2400 males lives annually. However, the implementation of the suite of 2006 alcohol control policies had no impact on female deaths due to transport accidents. This empirical evidence suggests that recent Russian government's attempt to curb the high alcohol-related mortality have been at least partially successful. There is, however, some doubts that recent decline in traffic fatalities in Russia is fully attributable to the alcohol control measures because alcohol policy reforms have overlapped with a significant effort to reduce road traffic fatalities. On August 2004, the State Duma of Russia adopted amendments to the Administrative Offences Code (No. 122-FZ) that prescribe heavier punishments for drunk driving. In 2005, Russia approved a Federal Targeted Program for Ensuring Road Traffic Safety, which proposed the goal of reducing road fatalities by 33% by 2012.

On July 2007, the State Duma of Russia adopted amendments to the Administrative Offences Code (No. 210-FZ) that prescribe heavier punishments for drunk driving and introduce lower maximum breath and blood alcohol content levels (0.3 promile). The penalty for drunk driving rose to 5000 rubles, and a one-and-a-half to two-year license suspension was introduced. Following the penalty increases in 2007, the number of traffic accidents fell by 11% and the number of accidents involving a drunk driver fell by 20% during the first three months of 2008 relative to the first quarter of the preceding year.

On November 2008, the State Duma of Russia adopted amendments to Criminal Code that prescribe heavier punishment for drunk driving. Article 264 sets forth penalties for violations of the Rules on Road Traffic

and Operation of Means of Transport that harm the health or cause the death of a person. The newly adopted amendments introduces the obligatory sanction for this crime as imprisonment for up to three years and a prohibition against driving for another three years if it was committed by a person under the influence of alcohol. In 2010, President Medvedev signed a low (No. 169-FZ) enforcing a zero alcohol limit for drivers.

On September 2013, Federal Law No. 196-FZ came into effect. The law introduces amendments to the Administrative Offences Code and also to Article 28 of the Federal Law on Road Traffic Safety. The new law increases the minimum fine for road traffic offences to 500 rubles (about 15 US dollars). It also introduces tougher penalties for repeated violation of certain traffic regulations. For drink driving court can impose a fine of 30.000 rubles (about 900 US dollars) and suspend a driver's license for a period of eighteen months to two years. It seems likely that stricter punishments for drunk driving played a role in the decrease in traffic fatalities during the last decade.

It might be, however, the case that both reduced alcohol consumption and road traffic fatality decline resulted from a variety of other factors, including rising incomes, falling unemployment. In a sub-national analysis, He et al. found that the rates of road traffic fatalities decreased linearly with the economic growth [26]. They showed that there was a 0.69-point reduction in the number of fatalities per unit increase in gross regional product across 67 federal regions during 2004-2011. It is worth mentioning that number of physicians partially explained the association between economic development and mortality due to traffic accidents [26].

The findings in this analysis are subject to several limitations as a number of factors may have affected the results. This principally applies to the quality of the data used. An earlier study of violent mortality data from the Soviet period concluded that they were not deliberately falsified [27]. Nevertheless, a rising rate of "injury death of undetermined intent" in the post-Soviet period may indicate declining quality in accident mortality statistics [28]. There is also concern about the completeness of Russian data on traffic crashes and fatalities [29,30].

In conclusion, this is the first time-series analysis of fatal alcohol poisonings and traffic accidents mortality rates in Russia, which has shown that binge drinking, is the strong predictor of traffic accidents mortality rates at the aggregate level. The outcomes of this study provide indirect support for the hypothesis that unfavorable mixture of higher overall level of alcohol consumption and binge drinking pattern is a major risk factor for traffic accidents mortality in Russia. The findings from the present study have important implications as regards traffic accidents mortality prevention indicating that a restrictive alcohol policy can be considered as an effective measure of prevention in countries where higher rates of alcohol consumption per capita conjunct with binge drinking pattern.

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None

Conflict of interest

None to declare

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Fatalna otrovanja alkoholom i prometne nesreće u Rusiji

Sažetak – Rusija ima jednu od najviših stopa smrtnosti u prometnim nesrećama. Uvriježeno je mišljenje da visoka stopa konzumacije alkohola u korelaciji sa binge drinking modelom pijenja važan faktor koji značajno pridonosi visokoj stopi smrtnosti u prometu. Teza: Cilj ove studije je procjena sveukupnog utjecaja ekscesivnog pijenja na navedenu visoku stopu smrtnosti u prometu u Rusiji. Metode: Podaci iz perioda od 1970. do 2013. godine o dobno-standardiziranim i spolno-specifičnim fatalnim otrovanjima alkoholom (kao faktor ekscesivnog pijenja) i stopi smrtnost u prometnim nesrećama su analizirani pomoću time series analyisis metode. Rezultati analize ukazuju na postojanje statistički značajne povezanosti između dva sistematizirana uzorka za muškarce i žene. Rezultati ove studije podupiru hipotezu da ekscesivno pijenje značajno pridonosi stopi smrtnosti u prometu u Ruskoj Federaciji. Zaključci ove studije imaju značajne implikacije u sferu prevencije s obzirom da se restriktivna politika pijenja alkohola može smatrati kao učnikovita metoda prevencije nesreća u zemljama gdje je visoka stopa smrtnosti u prometu povezana sa modelom ekscesivnog pijenja alkohola.

Ključne riječi: fatalno otrovanje alkoholo, prometne nesreće, time series analiza, Rusija, 1970.-2013.