The Effect of Beverage Type on Alcoholic Psychoses Rate in Russia

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Abstract — Aims: To test the hypothesis of beverage-specific effect in Russia on the incidence rate of alcoholic psychoses (a known indicator of a population’s alcohol-related problems). Methods: Time series analytical modeling techniques (ARIMA) were used to examine the relation between the sales of different alcoholic beverages (vodka, wine, beer) and alcoholic psychoses incidence rate between 1970 and 2013. Results: The analysis suggests that of the three beverages vodka alone was associated with alcoholic psychoses incidence rate. The estimated effect of vodka sales on the alcohol psychoses rate is statistically significant: a 1 l per person per year increase in vodka sales would result in a 23.4% increase in the alcoholic psychoses incidence rate. Conclusion: The incidence of alcoholic psychoses is more responsive to changes in vodka sales per capita than wine or beer sales.

INTRODUCTION

Alcoholic psychoses are associated with alcohol-induced brain damage and include delirium tremens, alcoholic hallucinosis, alcoholic paranoia and Korsakoffs psychosis (Jordaan and Emsley, 2014). Alcoholic psychoses are characterized by an acute onset of hallucinations that occur during or after a period of heavy alcohol consumption (Schuckit et al., 1995). The patients with alcoholic psychoses have more severe dependence, earlier onset age of alcohol problems, higher consumption of alcohol per occasion, and a greater number of alcohol-related medical and social problems (Achté et al., 1969). A recent study indicates that mortality among those who have suffered alcohol-induced psychotic disorder is 20 times that of others in the same age group (Perälä et al., 2010).

The alcoholic psychoses incidence rate is a reliable indicator of alcohol-related problems at the population level since there is a strong relationship between alcoholic psychoses incidence rate and alcohol consumption per capita (Nemtsov et al., 1989). There is also evidence that beverage preference may have modifying influence on alcoholic psychoses risk independently of the amount of alcohol consumed. In pioneering work Wald and Jaroszewski (1983), using Polish data, reported a close association between the incidence of alcoholic psychoses with consumption of distilled spirits but not with consumption of wine or beer. More recently, Razvodovsky (2002) replicates this finding in his time series analysis based on Belarusian data.

Russia ranks among the world’s heaviest drinking countries with an annual official consumption rate ~101 l of pure alcohol per capita, while independent estimates show a figure as high as 17 l (Razvodovsky, 2013a). The increase in the death rate in Russia during 1990s was associated with a rapid growth in sales of strong spirits (vodka); and the epidemic heavy or binge drinking pattern of consuming strong spirits that is commonplace has also been linked to an increased level of alcohol-related morbidity and mortality (Stickley et al., 2007; Nemtsov, 2011). Russia has the highest incidence of alcoholic psychoses in Europe (Anderson and Baumberg, 2006), which may be explained by high overall population drinking and prevalence of irregular heavy drinking of vodka (Pridemore, 2006; Stickley et al., 2007; Nemtsov and Razvodovsky, 2008).

The follow-up study of alcoholic psychoses in male patients admitted to a clinical department of a psychiatric hospital indicated that patients with alcoholic psychoses made up from 15 to 30% of all patients (Aleksin and Egorov, 2011). Alcoholic delirium morbidity made up from 69 to 82% of the total number of alcoholic psychoses; alcoholic hallucinosis varied from 14 to 27%. In Russia, like in other countries, alcoholic psychosis is mainly a male phenomenon with a male to female ratio of 5:1 (Iliuk et al., 2011). Beverage preference and harmful drinking pattern might be responsible for the gender difference in alcoholic psychoses rate as vodka continues to be the drinking of choice for the majority of men in Russia, while women not only drink less often than men, but those who do drink, consume vodka less frequently than men (Pomerleau et al., 2008).

In line with these pieces of evidence, we assume that occasional heavy drinking of vodka in Russia should result in a positive association between vodka consumption and the alcoholic psychoses incidence rate at the aggregate level. In this study we will test the hypothesis of beverage-specific effect on alcoholic psychoses incidence rate by analyzing Russian’s time series data between 1970 and 2013.

METHODS

Data
We specified the incidence of alcoholic psychosis as the number of persons who were admitted to hospital for the first time with alcoholic psychoses: (ICD-10: F 10). Since alcoholic psychosis is a disease in which patients are usually admitted to hospital, first admission figures are good proxy of the real incidence. The data on alcohol psychoses incidence rate (per 100,000 of the population) and data on per capita beverage-specific alcohol sales (vodka, wine, beer in liters of pure alcohol) are taken from the Russian State Statistical Committee (Rosstat) reports (www.gks.ru).

Statistical analysis
To examine the relation between changes in the consumption of different types of alcoholic beverage and alcohol psychoses incidence rate across the study period a time series analysis was performed using the statistical package ‘Statistica’. The
dependent variable was the alcohol psychoses incidence rate and the independent variables were aggregate beverage-specific alcohol sales. 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 (Norström and Skog, 2001). 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:

$$\tilde{N}_t = x_t - x_{t-1}$$

This means that the annual changes ‘\(\nabla\)’ 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 by an inspection of the cross-correlation function in order to estimate the association between the two prewhitened time series. It was Box and Jenkins (1976) who first proposed this particular method for undertaking a time series analysis and it is commonly referred to as ARIMA modeling. We used this model specification to estimate the relationship between the time series alcohol psychoses incidence and sales of different types of alcoholic beverage in this paper. In line with previous aggregate studies (Norström and Skog, 2001; Razvodovsky, 2010) we estimated semi-logarithmic models with logged output. A semi-logarithmic model is based on the assumption that the risk of alcohol-related problems increases more than proportionally for a given increase in alcohol consumption (Norström and Skog, 2001). The following model was estimated:

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

where \(\nabla\) means that the series is differenced, \(M\) is alcoholic psychoses incidence rate, \(a\) indicates the possible trend in alcoholic psychoses incidence rate due to other factors than those included in the model, \(A\) is the beverage-specific alcohol sales, \(\beta\) is the estimated regression parameter, and \(N\) is the noise term. The percentage increase in alcoholic psychoses incidence rate associated with a 1-l increase in alcohol consumption is given by the expression: \((\exp(\beta_1) - 1)\times 100\). 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.

RESULTS

The average per capita alcohol sales figure was 8.7 l with vodka being the drink overwhelmingly consumed. The temporal pattern of alcohol sales per capita in Russia is shown in Fig. 1. As can be seen, the alcohol sales have experienced sharp fluctuations across the period. Thus, a brief Andropov’s anti-alcohol campaign in the early 1980s resulted in a decline in alcohol sales. An especially sharp fall was recorded in alcohol sales in 1985–1987 that coincided with Mikhail Gorbachev’s anti-alcohol campaign. Similarly, the collapse of the Soviet Union and the ending of the state’s alcohol monopoly in the early 1990s were accompanied by a sharp rise in alcohol sales. However, total alcohol sales figures mask differing trends among the beverages across the period (Fig. 1).

While there has been a substantial drop in vodka sales from 4.8 to 3.7 l and wine sales from 2.2 to 1.1 l between 1970 and 2013, there has been a sharp growth in beer sales—especially in recent years. Between 1998 and 2007 the per capita figure for beer rose three times (from 1.6 to 4.8 l). Since 2007, beer sales started to decrease. There was also a change in the share of beverage sales with vodka sales falling from 81.1% in 1994 to 42.8% in 2013.

The trend in the alcoholic psychoses incidence rate is displayed in Fig. 2. As can be seen, the alcoholic psychoses incidence rate fluctuated greatly over the period: decreased markedly from 1980 to 1984, dropped sharply between 1984 and 1988 (4 times; from 20.5 to 5.1 per 100,000 of population), then started on an upward trend from 1988 to 1992, before jumping dramatically during 1992 to 1995 (3.7 times; from 13.3 to 49.0 per 100,000 of population). From 1995 to 1999 there was a fall in the rates before they again jumped between 1999 and 2003, and then started to decrease in the most recent years.

The graphical evidence suggests that the temporal pattern of alcoholic psychoses incidence rate fits closely with changes in total alcohol sales and vodka sales per capita (Fig. 2). 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. The specification of the bivariate ARIMA model and outcome of the analyses are presented in Table 1. According to the results, total alcohol sales is a statistically significant associated with alcoholic psychoses incidence rate, implying that a 1-l increase in per capita alcohol sales is associated with an increase in the alcoholic psychoses incidence rate of 15.5%. The analysis also suggests that the three beverages vodka alone was associated with alcoholic psychoses incidence rate in Russia. The estimated effects of vodka sales on the alcoholic psychoses incidence rate are clearly statistically significant: a 1-l increase in vodka sales would result in a 23.4% increase in the alcoholic psychoses incidence rate. The association between wine or beer sales per capita and alcoholic psychoses incidence rate was also positive, but statistically not significant.

DISCUSSION

The results of present study are important because despite the growing literature on alcohol and alcohol-related morbidity and mortality in Russia there has been no prior time series analysis of beverage-specific effect of alcohol sales on the alcoholic psychoses incidence rate. According to the results of present analysis there was a positive and statistically significant effect of per capita alcohol sales on alcoholic psychoses incidence rate in Russia. Furthermore, the results of beverage-specific modeling indicated that vodka was the key beverage driving the association between per capita alcohol consumption and alcoholic psychoses incidence rate. These results are consistent with the previous findings from other settings that spirits is the most significant beverage-specific predictor of alcoholic psychoses incidence (Wald and Jaroszewski, 1983; Razvodovsky, 2002).

The stronger association between the alcoholic psychoses incidence rate and vodka sales may be attributable to biological and sociobehavioral mechanisms. A more likely explanation for this finding is that the heavy drinkers tend to prefer spirits
as the least expensive form of alcohol (Razvodovsky, 2013b). A second possible explanation for these findings is that drinking pattern of spirits users was substantially different from wine or beer users. There is suggestive evidence that consumption of spirits is more closely associated with larger quantities of alcohol consumed per occasion (Brandish and Sheron, 2010). The role of binge drinking of vodka in modifying the effect of alcohol on the risk of alcoholic psychoses in Russia has been emphasized in clinical studies. In his study of case histories of alcohol dependent men, Iliuk et al. (2011) demonstrated a strong association between the risk of alcoholic psychoses and vodka consumptions. Vodka preference was associated with the consumption of bigger doses of pure ethanol, more severe withdrawal syndrome, more frequent complications, such as the convulsive syndrome and alcoholic psychoses, compared with the beer preference. Another study of outpatients with alcohol dependence revealed that patients who preferred hard liquor during the last month consumed more alcohol in terms of pure ethanol (Aleksin and Egorov, 2011). Also, the period of hard drinking was longer and
patients had more social, legal, and psychological problems as well as somatic and psychopathological disorders. Emerging evidence also indicate that binge drinking has profound effects on neurobiological processes in the brain and amplifies the risk of brain damage (McQueeny et al., 2009; Welcome et al., 2014).

Studies from many countries have shown that availability/affordability of alcohol is one of the most important predictors of alcohol-related outcomes (Wagenaar et al., 2010; Razvodovsky, 2013c). This is particularly true in relation to Russia where Gorbachev’s anti-alcohol campaign was associated with a rapid reduction in the alcoholic psychoses incidence rate. Similarly, the increase in heavy drinking in Russia during transition, which triggered the dramatic rise in alcoholic psychoses incidence rate, resulted from an increase in the affordability of vodka. With price liberalization in 1992, vodka became much more affordable because of a sharp drop in the price of vodka relative to those of other goods and alcoholic beverages including beer (Nemtsov, 2011). The relative fall in price for vodka explains an apparent paradox—an increase in alcohol consumption against a background of economic crisis.

There are several potential factors behind the decrease in vodka consumption and alcoholic psychoses incidence rate between 1995 and 1998. They include better regulation of the alcohol market that may have resulted in a relative increase in prices for vodka compared with those for food products (Tretiak, 2010; Nemtsov, 2011). By 1995, the real price of vodka fell to its lowest point, after which point the real vodka price recovered until 1999, and then the affordability trend turned down again (Nemtsov and Razvodovsky, 2008). In this period the government affected the alcohol market through a struggle against production of illegal vodka. Thus, only in 1995, agencies of the Ministry of Internal Affairs closed more than 2300 underground workshops producing contrafactual vodka (Nemtsov, 2011). Another possible factor in the decrease in alcohol consumption was impoverishment and decrease in the purchasing capacity of the population due to unpaid or delayed salaries (Nemtsov and Razvodovsky, 2008). An important factor in the decrease in the alcoholic psychoses incidence rate that began in 1995 may have been the excess deaths in the cohort of alcoholics in previous years (Nemtsov, 2011).

Since 2003, Russia has experienced steep decline in the alcoholic psychoses incidence rate. There was also a parallel downward trend in the population drinking, driven mainly by a decrease in vodka consumption. Indeed, official sales statistics and data from population survey indicate that there have been favorable changes in the structure of alcohol consumption and drinking pattern (Neufeld and Rehm, 2013). It appears likely that the shift in the structure of consumption from vodka toward beer as a result of alcohol control measures have had a positive impact on bringing down the alcoholic psychoses incidence rate in Russia during recent decade. Indeed, despite of the dramatic increase in the beer consumption in the Russian Federation between 1999 and 2009, the incidence of alcoholic psychoses had decreased.

A coincidence in the alcoholic psychoses incidence and vodka sales trends allows us to hypothesize that the reduction in the alcoholic psychoses incidence rates during the last years might be attributed to the implementation of the alcohol policy reforms in 2001–2006, which increased government control over the alcohol market (Neufeld and Rehm, 2013). The policies included strict regulations on alcohol products, which resulted in a decline in a distributors and increased consumer prices. Making vodka less affordable through differential taxation was an essential element of the Russian alcohol policy (Schkolnicov et al., 2013).

Recently, Pridemore et al. (2013a,b, 2014) have reported findings that lend support to this hypothesis. Using sophisticated analytical techniques (autoregressive integrated moving average interrupted time series analysis) they concluded that the implementation of alcohol policies was responsible for a decline in deaths due to alcohol poisoning, alcoholic cardiomyopathy, alcoholic liver cirrhosis, alcohol-related mental and behavioral disorders, as well as decrease in male traffic fatalities and suicides. This empirical and research evidence suggest that recent Russian government’s attempt to curb the high alcohol-related morbidity and 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. The Russian historical perspective also provides evidence that decreasing in vodka affordability by raising taxes is an effective strategy for reducing alcohol-related harm. In particular, using historical data from tsarist Russia, Norström and Stickley (2012) reported that changes in vodka taxes were significantly associated with alcohol consumption and alcohol-related mortality.

Before concluding, we should address the potential limitations of this study. In particular, we relied on official alcohol sales data as a proxy measure for trends in alcohol consumption across the period. However, unrecorded consumption of alcohol was commonplace in Russia throughout the study period, especially in the mid-1990s, when a considerable proportion of vodka came from illicit sources (Razvodovsky, 2008; Nemtsov, 2011). The consumption of homemade spirits (samogon) and surrogates might also have a particularly negative impact on alcohol-related morbidity and morbidity (McKee et al., 2005). The findings from Izhevsk (Russia) study indicated that among working-age males who reported surrogate use, the relative risk of dying from causes directly related to problem drinking (e.g. alcoholic psychosis, alcoholic cardiomyopathy, alcoholic liver cirrhosis and acute alcohol poisoning) was 25.5 in relation to those who consumed only

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Total alcohol sale</th>
<th>Vodka sale</th>
<th>Wine sale</th>
<th>Beer sale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcoholic psychoses incidence</td>
<td>0.1.0</td>
<td>0.155*</td>
<td>0.1.0</td>
<td>0.234*</td>
</tr>
</tbody>
</table>

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. *P < 0.001.

Table 1. Estimated effects of beverage-specific alcohol sales on alcoholic psychoses incidence rate

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legal alcoholic beverages (Leon et al., 2007). It was also suggested that unrecorded alcohol may account for a significant part of the high level of alcoholic psychoses morbidity in Russia (Aleksin and Egorov, 2011).

Further, the limitations stem from effects, which might interfere with time series of alcoholic psychoses incidence data: change of classification systems and diagnostic habits, changes in health service organization (use of new forms of alcoholism treatment/rehabilitation, early intervention programs, and alternative services). It is possible that the increase in alcoholic psychoses incidence rate in Russia in the mid-1990s, at least partly, was a consequence of deterioration in the quality of health care system, following the collapse of Soviet Union in late 1991. As the command economy collapsed, the public health system faced a financial crisis. Left without proper funding, the health care system was unable to maintain the needed level of medical care (Braiered and Cutler, 2005). A process of destruction of the state-funded narcological service that began in 1989 continued in the 1990s (Nemtsov, 2011). During the 1990s, three main changes, all linked to broader post-Soviet political and economic transformations, had significant effects on the narcological service: the arrival of new forms of alcoholism treatment and rehabilitation, the commercialization of narcology and the abolishing of compulsory treatment (Raihel, 2010). However, while many aspects of alcoholism treatment in post-Soviet Russia had been radically transformed during the 1990s, the overall structure of the state-funded network had not changed significantly since the 1970s when the Soviet narcological service was established (Krasnov and Gurovich, 2012).

In conclusion, this is the first time series analysis of beverage-specific alcohol sales and alcoholic psychoses incidence rate in Russia, which has shown that the alcoholic psychoses incidence rate tend to be more responsive to changes in vodka sales per capita than to the total alcohol or wine/beer sales. The outcomes of this study provide indirect support for the hypothesis that the dramatic fluctuations in the alcoholic psychoses incidence rate in Russia during the last decades were related to the availability/affordability of vodka. These results also support the idea that heavy drinkers are sensitive to availability/affordability of alcohol. The findings from the present study have important implications as regards alcohol policy in Russia, suggesting that any attempts to reduce overall consumption should also be linked with efforts through differential taxation to shift beverage preference away from spirits.

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