Fraction of stroke mortality attributable to alcohol consumption in Russia

Fracción de la mortalidad por accidente cerebrovascular atribuible al consumo de alcohol en Rusia

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Resumen

El accidente cerebrovascular es un problema internacional de salud asociado a altos costes humanos y económicos. La tasa de mortalidad por accidente cerebrovascular en Rusia es una de las más altas del mundo. Por lo tanto, la identificación de los factores de riesgo constituye una prioridad desde el punto de vista de la salud pública. La evidencia epidemiológica sugiere que el consumo de atracón (binge drinking) supone en Rusia un importante factor determinante de dicha alta tasa de mortalidad por accidente cerebrovascular. El objetivo del presente estudio fue estimar la mortalidad prematura por accidente cerebrovascular atribuible al consumo de alcohol sobre una base de datos agregados de mortalidad por accidente cerebrovascular y de consumo de alcohol. Datos estandarizados, por grupo de edad y sexo, de mortalidad por accidente cerebrovascular para el periodo 1980-2005 y datos del consumo total de alcohol se analizaron mediante análisis de series temporales ARIMA. Los resultados del análisis indican que el 26,8% de todas las muertes por accidente cerebrovascular, entre los varones, y el 18,4%, entre las mujeres, serian atribuibles al alcohol. La fracción atribuible al alcohol para los hombres oscila entre un 16,2% (grupo de +75 años) y un 57,5% (grupo de 30-44 años); y para las mujeres entre el 21,7% (grupo de 60-74 años) y 43,5% (grupo de 30-44 años). Los resultados de este estudio apoyan la hipótesis de que el alcohol es un importante factor que contribuye a las altas tasas de mortalidad por accidente cerebrovascular en la Federación Rusa. Por tanto, la prevención del daño atribuible al alcohol debe tener una mayor prioridad de la salud pública en Rusia. Dada la distribución de las muertes por accidente cerebrovascular relacionado con el alcohol, las intervenciones deben centrarse en los hombres y mujeres de mediana edad.

Palabras Clave: accidente cerebrovascular, mortalidad, consumo de alcohol, series de análisis temporales ARIMA, Rusia, 1980-2005.

Abstract

Stroke is an international health problem with high associated human and economic costs. The mortality rate from stroke in Russia is one of the highest in the world. Risk factors identification is therefore a high priority from the public health perspective. Epidemiological evidence suggests that binge drinking is an important determinant of high stroke mortality rate in Russia. The aim of the present study was to estimate the premature stroke mortality attributable to alcohol abuse in Russia on the basis of aggregate-level data of stroke mortality and alcohol consumption. Age-standardized sex-specific male and female stroke mortality data for the period 1980-2005 and data on overall alcohol consumption were analyzed by means ARIMA time series analysis. The results of the analysis suggest that 26.8% of all male stroke deaths and 18.4% female stroke deaths in Russia could be attributed to alcohol. The estimated alcohol-attributable fraction for men ranged from 16.2% (75+ age group) to 57,5% (30-44 age group) and for women from 21.7% (60-74 age group) and 43.5% (30-44 age group). The outcomes of this study provide support for the hypothesis that alcohol is an important contributor to the high stroke mortality rate in Russian Federation. Therefore prevention of alcohol-attributable harm should be a major public health priority in Russia. Given the distribution of alcohol-related stroke deaths, interventions should be focused on the young and middle-aged men and women.

Key Words: stroke, mortality, alcohol consumption, ARIMA time series analysis, Russia, 1980-2005.

Recibido: septiembre 2013; Aceptado: enero 2013

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Stroke is one of the major causes of death in the developed world and a top ten contributor to the global burden of disease (Donna, Fisher, Macleod, & Davis, 2007). Stroke burden is expected to be rising, especially in developing countries (Kim & Johnston, 2011). In relation to this, identification of the risk factors is a high priority front the public health perspective.

The association between alcohol consumption and stroke risk remain controversial. Alcohol has been identified as both a risk and a protective factor for stroke (Gorelic, 1987; Sacco et al., 1999). Accumulated research evidence suggests that heavy alcohol consumption increases the relative risk of stroke, while light or moderate alcohol consumption may be protective against ischemic stroke (Djousse et al., 2002; Patra et al., 2010). The meta-analysis of 35 observational studies published between 1966 and 2002 revealed that compared with abstainers, consumption of more than 60 g of alcohol per day was associated with an increased relative risk of total stroke, 1.64 (95% CI, 1.39-1.93), ischemic stroke, 1.69 (95% CI, 1.34-2.15), and hemorrhagic stroke, 2.18 (95% CI, 1.48-3.20) (Reynolds et al., 2003).

There is evidence that pattern of drinking may have modifying influence on stroke risk independently of the amount of alcohol consumed (Sundell, Salomaa, Vartiainen, Poikolainen, & Laatikainen, 2008). Previous findings indicated an acute detrimental effect of binge drinking as a trigger of stroke. For instance, a Finish case-control study reported that consumption of 151 to 300 g and > 300 g of alcohol within the week before stroke onset is associated with a significantly higher risk of stroke with adjusted OR of 3.6 (95% CI 1.7 to 7.8) and 3.7 (95% CI, 1.6 to 8.7) respectively (Hillbom, Numminen, & Juvela, 1999). A Swedish cohort study reported a higher risk of ischemic stroke among occasional heavy drinkers than among life-time abstainers (Romelsjo & Leifman, 1999). In the prospective cohort study binge drinking pattern was an independent risk factor for all strokes (Sundell et al., 2008). Comparing with non-binge drinkers, the hazard ratio for total stroke among binge drinkers was 1.85 (95% CI, 1.35 to 2.54) after adjusting for average alcohol consumption and other potential confounders. Furthermore, heavy drinking within 24 hours before the onset of stroke was found to be a risk factor for ischemic stroke due to cardiogenic embolism (Mostofsky et al., 2010).

Proposed physiological mechanisms that increased the risk of stroke include the hypertensive effect of irregular heavy drinking, the increase low density lipoproteins, the increase of platelet aggregation and decrease fibrinolitic activity (Gorelic, 1987; McKee & Britton, 1998). Other possible mechanisms include cerebral vasoconstriction and hyperhomocysteinemia (Sundell et al., 2008).

Russia has one of the world's highest stroke incidence and mortality rates (Kim et al., 2011). In contrast to Western Europe (WE), where stroke rates are falling, in Russia stroke is rising cause of disability and deaths (Kesteloot, Sans, & Kromhout, 2006; Muller-Nordhorn, Binting, Roll, & Willich, 2008). The higher rates of stroke mortality observed in Russia as compared with WE were in the young and middle-age groups. In 2002 the stroke mortality rate in Russia among men age 45-54 years was ten times higher than in France, Germany or Italy (Kim et al., 2011). It was concluded that these differences can only be partly accounted for by differences in quality of stroke care throughout Europe and might be attributed to different prevalence for risk factors (Ginter, 1995; Pajak & Kozela, 2012; Petruchin & Lunina, 2012). In a population-based case-control study hypertension, ischemic heart disease, smoking and high body mass index were major risk factors for ischemic stroke in the Russian population (Feigin, Wiebers, Nikitin, O'Fallon, & Whisnant, 1998).

Several studies have emphasized the importance of binge drinking as determinant of high stroke mortality rate in Russia. In particular, the results of a case-control study suggest that recent episodes of heavy drinking is associated with substantial increases in stroke mortality independently of long-term hazardous drinking (Shkolnikov, McKee, Chervyakov, & Kyrianov, 2002). More recent case-control study from western Siberia reported a positive association of stroke risk with amount of alcohol drunk on single occasion (Leon & Shkolnikov, 2005).

The level of alcohol consumption in Russia is among the highest in the world with an annual sales rate about 10 litres of pure alcohol per capita, while independent estimates show a figure as high as 17 litres (Nemtsov & Razvodovsky, 2008). The distinctive trait of Russian drinking culture is the preference for binge drinking of vodka, leading to an increase in deaths from alcohol poisoning and cardiovascular diseases (Nemtsov, 2002; Nemtsov et al., 2008; Stickley et al., 2007). Taken together this evidence is a good reason to expect positive association between alcohol consumption and stroke mortality at the aggregate level in Russia.

The aim of the present study was to estimate the premature stroke mortality attributable to alcohol abuse in Russia using aggregate-level data of stroke mortality and estimates of overall level of alcohol consumption from 1980 to 2005.

Methods

Data

The data on age-adjusted sex-specific stroke mortality rates per 100.000 of the population are taken from the Russian State Statistical Committee (*Rosstat*). The Rosstat'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

Tabla 1
Estimated effects (bivariate ARIMA model) of overall alcohol consumption (in litres of pure alcohol) on stroke mortality rates (per 1000,000) and estimation of alcohol-attributable fraction (AAF).

	Men				Women			
Age	Model	Estimates	p	AAF	Model	Estimates	p	AAF
15-29	0,1,1	0,026	0,001	0,297	1,1,0	0.009	0,469	-
30-44	0,1,1	0,063	0,000	0,575	1,1,0	0,042	0,000	0,435
45-59	0,1,0	0,045	0,000	0,457	1,1,0	0,037	0,000	0,395
60-74	0,1,0	0,027	0,000	0,307	1,1,0	0,018	0,006	0,217
75+	0,1,0	0,013	0,063	0,162	1,1,0	0,008	0,140	-
15-75+	1,1,0	0,023	0,063	0,268	1,1,0	0,015	0,050	0,184

*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.

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.

Realizing the difficulties associated with measuring alcohol consumption at the population level in Russia (Nemtsov, 2002), we employed an alternative measure of overall alcohol consumption relative to Nemtsov's estimates (Razvodovsky, 2010a). 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 employing ARIMA (autoregressive integrated moving average) model (Razvodovsky, 2010a). More specifically, we calculated the level of unrecorded alcohol consumption as the difference between observed changes in the harm indicator and changes that would be expected on the bases of alcohol sales. The harm indicator series used was alcohol psychoses incidence rate because this indicator depends almost entirely on alcohol consumption (Nemtsov et al., 2008). We specified the number of persons, witches were admitted for the first time for the treatment as incidence of alcohol psychoses: (ICD–10: F 10). The data on alcohol psychoses incidence rate (per 100.000 of the population) are taken from the Russian State Statistical Committee (*Rosstat*). The alcohol series used was the volume of alcohol sales in liters of pure alcohol per capita. The data on alcohol sales per capita are taken from the Russian State Statistical Committee (*Rosstat*).

Statistical analysis

To examine the relation between changes in the alcohol consumption and stroke mortality across the study period a time-series analysis was performed using the statistical package "Statistica". The dependent variables were the annual stroke 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 (Norström & 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:

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

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 (Box & Jenkins, 1976) 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 stroke mortality and alcohol consumption rates in this paper. In line with previous aggregate studies (Norström et al., 2001; Razvodovsky, 2005, 2006, 2009, 2010b), we estimated semi-logarithmic models with logged output. The following model was estimated:

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

where ∇ means that the series is differenced, M is stroke mortality rates, *a* indicates the possible trend in stroke 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 stroke mortality rate rates 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.

A change in aggregate level drinking is expected to have an immediate effect on acute forms of alcohol-related problems (such as accidents and injuries), as well as a long-term effect on chronic problems (liver cirrhosis) (Norström & Skog, 2001). As stroke attributed to the chronic rather than acute alcohol-related problems we should expect that the stroke mortality response to changes in aggregate level alcohol consumption will be distributed over several years (Norström et al., 2001). Thus, we should consider the time-lag problem. In order to deal with this problem we inspected the cross-correlations between two time series at different lags.

In addition to the estimated effect parameter, the alcohol effect will also be expressed in terms of alcohol-attributable fraction (AAF), which is interpreted as the proportion of stroke deaths that is attributable to alcohol. AAF 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 (Norström, 1989).

Results

The trends in the age-adjusted, sex-specific stroke mortality rates are displayed in Figures 1-2. For both sexes the time series stroke mortality rates fluctuated greatly over the period: decreased substantially (by 14.2% and 10.7%

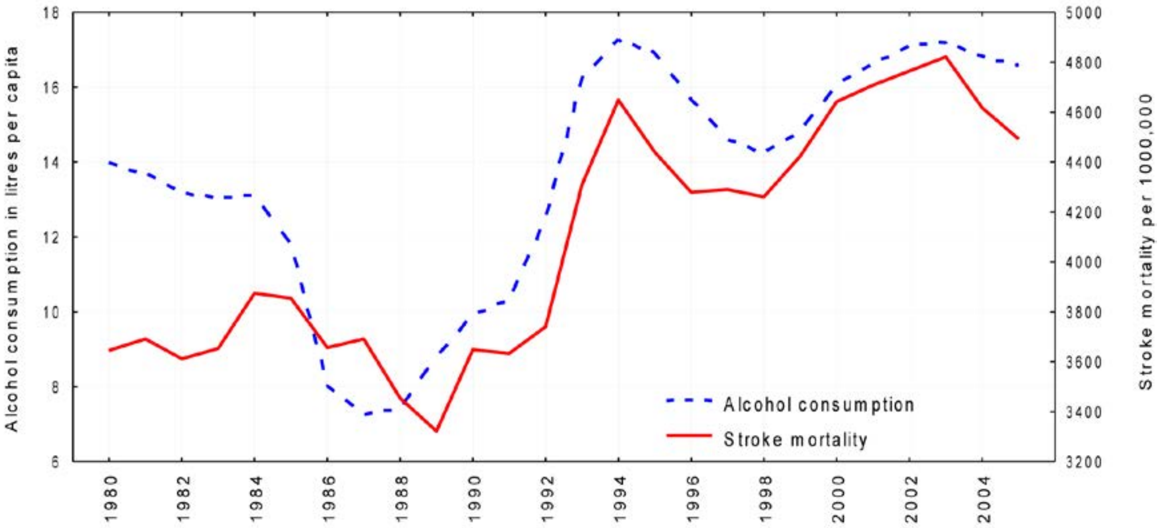

Figure 1. Trends in male stroke mortality rate and alcohol consumption per capita in Russia between 1980 and 2005.

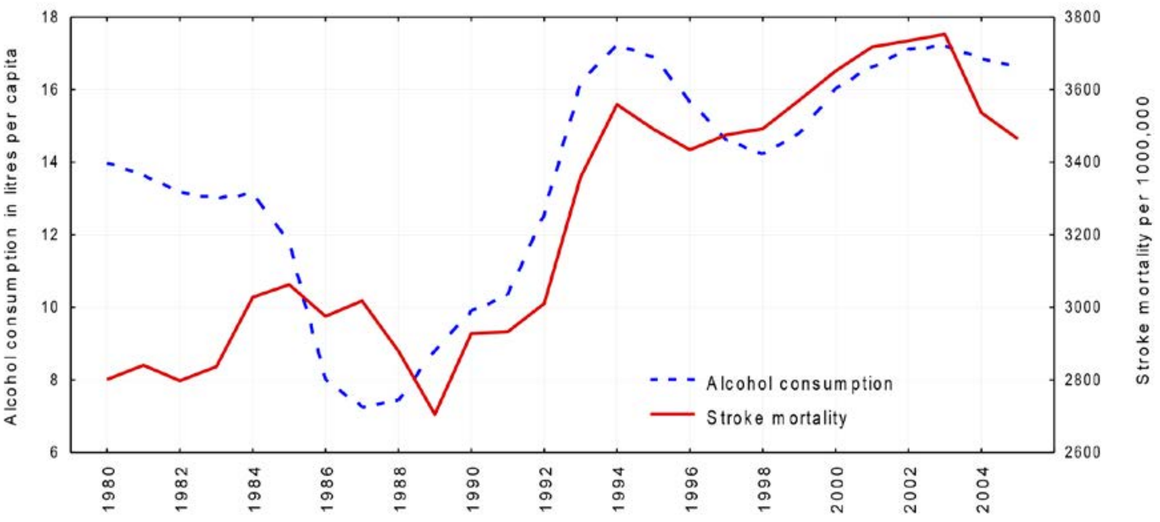

Figure 2. Trends in female stroke mortality rate and alcohol consumption per capita in Russia between 1980 and 2005.

for men and women respectively) between 1984-1989, than started on an upward trend from 1988-1989, before jumping dramatically during 1991 to 1994 (by 27.9% and 21.4% for men and women respectively). From 1995-1998 there was a fall in the rates before they again began to rise while a decrease in rates has been recorded in the most recent years.

It is important to point out, that the pattern of stroke mortality for men and women was not uniform. Stroke mortality rate dropped more sharply for males than for females during the anti-alcohol campaign. Further, the rates of stroke mortality increased for both sexes during the transition, but it appears that males were more adversely affected during this period. In general, the male stroke mortality rate tends to fluctuated across time series to a greater extent than the female rate. It should be also emphasis that working-age males and females showed greater decrease in stroke mortality in the mid-1980s, while fluctuations in stroke mortality rates for oldest age groups of both men and women were more pronounced during the 1990s.

The graphical evidence suggests that the trends in both alcohol consumption per capita and stroke mortality for males and females seem to follow each other across the time-series (Figures 1-2). 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. After prewhitening the cross-correlations between alcohol consumption and the stroke mortality time series were inspected. This indicated that there was a statistically significant cross-correlation between alcohol consumption and stroke mortality for males and females at lag 0. The specification of the bivariate ARIMA model and outcome of the analyses are presented in Table 1. According to the results, alcohol consumption is a statistically significant associated with both male and female stroke mortality rates, implying that a 1-litre increase in per capita consumption is associated with an increase in male mortality of 2.3% and female mortality of 1.5%. The estimated effect of alcohol consumption on the age-specific stroke mortality rates for men ranged from 1.3% (75+ age group) to 6.3% (30-44 age group). The estimated effect of alcohol consumption on the age-specific stroke mortality rates for women was 4.2% for 30-44 age group, 3.7% for 45-59 age group and 1.8% for 60-74 age group. The estimates for women age groups 15-29 and 75+ were also positive, but statistically not significant.

Table 1 shows the relative proportion of alcohol-attributable deaths to all deaths by gender and age. The results of the analysis suggest that 26.8 % of all male deaths and 18.4% female deaths from stroke in Russia could be attributed to alcohol. The estimated AAF for men ranged from 16.2 % (75+ age group) to 57.5 % (30-44). The estimated AAF for women was 43.5% for 30-44 age group, 39.5% for 45-59 age group and 21.7% for 60-74 age group.

Discussion

Understanding the reasons of dramatic fluctuations in stroke mortality in Russia is very important from public health perspective. To address this issue it is necessary to focus on the social and economic changes that have occurred in Russia in the last decades. There is evidence that the stroke mortality trends in Russia influenced by the three major factors: Gorbachev's anti-alcohol campaign 1985-88; severe socioeconomic crisis imposed by rapid societal transformation in the early 1990s; financial crisis and worsening economic situation in 1998. A fairly close match between trends in alcohol consumption and stroke mortality during the Gorbachev's anti-alcohol campaigns may be use as evidence for the hypothesis suggesting that alcohol is responsible for a substantial number of stroke deaths in Russia. This empirical evidence also indicates that a restrictive alcohol policy can be considered as an effective measure of stroke prevention.

It seems plausible that alcohol is a key variable in explaining of Russian stroke mortality crisis in the early-1990s. An increase of alcohol consumption in this period was to a great extent due to increase of alcohol availability following the repeal of the state alcohol monopoly in January 1992. The country was practically flooded by a wave of homemade, counterfeit, and imported alcohol, mainly spirits (Nemtsov, 2002). The negative outcomes of an increase of alcohol consumption during this period included a sharp rise in alcohol-related and cardiovascular mortality (Stickley, et al., 2007; Razvodovsky, 2012b). There are several potential factors behind the decrease in alcohol consumption and stroke mortality rate between 1994 and 1998. They include better regulation of the alcohol market that may have resulted in a relative increase in prices for vodka compared to those for food products (Nemtsov et al., 2008). 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, 2002).

According to the results of time-series analysis there was a positive and statistically significant effect of per capita alcohol consumption on stroke mortality in Russia. These findings clearly indicate that population drinking and stroke mortality are positively related phenomena in Russia. It should be emphasis that the results suggest a quick response (et lag zero) of stroke mortality rates to changes in alcohol consumption level. The instantaneous response in mortality rates from stroke seem quite surprising when considering the long latency period at the individual level. The reasonable explanation from this seeming inconsistency has been suggested by Norström et al. (2001). They argue that in a population there exists a reservoir of heavy drinkers who are near the critical threshold-value for a dying from chronic alcohol-related consequences. In case when these high risk individuals increase alcohol consumption during a given year, they will exceed the threshold value and dy from alcohol-related diseases. This is the reason why the immediate impact on chronic alcohol related mortality can be registered from marked changes in aggregate consumption. Furthermore, the contemporaneous effect of per capita alcohol consumption on stroke mortality provide indirect support for the hypothesis that the high alcohol-attributable stroke mortality in Russia could be attributed to the drinking pattern of irregular heavy drinking. The positive and significant contemporaneous association between alcohol and stroke mortality in present analysis replicates the recent findings from a time-series studies highlighted close temporal association between alcohol and ischemic heart disease mortality in Russia (Razvodovsky, 2012a).

Estimation the proportion of alcohol-attributable fraction suggests that 26.8% of male deaths and 18.4% of female deaths from stroke in Russia are attributable to alcohol. The proportion of alcohol-attributable deaths varied widely between age groups, indicating the difference in alcohol consumption rate. As expected, young and middle age men had the largest proportion of alcohol-attributable deaths with more than half of all deaths attributed to alcohol. This reflects the fact that the level of alcohol-related problems among young and middle aged is especially high and that there is a tendency for alcohol consumption to decrease with aging (Perlman, 2010).

Before concluding, several potential limitations of this study must be mentioned. The present analysis seems to indicate that the interpretation of the trends in stroke mortality in Russia during the last decades is complex because of many factors involved. At a population level, high blood pressure and tobacco use are the most important modifiable risk factors for stroke (Feigin et al., 1998). Hypertension is one of the leading cause of avoidable mortality in Russia (Petruchin et al., 2012). The high prevalence of hypertension is exacerbated by the fact that irregular hypertension treatment continues to be a major problem in Russia (Roberts, Stickley, Balabanova, Haerpfer, & McKee, 2012). However, the recent findings highlighting that in Russia vodka consumption is a strong predictor of hypertension mortality at the aggregate level support an alcohol-related hypothesis (Razvodovsky, 2014).

The high prevalence of smoking among Russian men (about 60%) probably explains a fact of the high stroke mortality rate among yang middle-aged men compared with the female mortality rate (Bobak, Gilmore, McKee, & Marmot, 2006). However, use of tobacco products was relatively stable during 1970s-1980s and has fallen substantially in Russia over the 1990s, suggesting that stroke mortality crisis is not a result of a long-term response to smoking trends (Ramstedt, 2009).

Some experts have underlined the importance of to the effect of the psychosocial distress of economic and political reforms as the main reason for the cardiovascular mortality crisis in Russia in the early 1990s (Leon et al., 2007). In this period Russia faced a deep socioeconomic crisis accompanied by unemployment grows, hyperinflation, dramatic decline in the well being of the majority of the population (Nemtsov et al., 2008). The turmoil associated with socioeconomic and political transition affected Russian peoples and lead to the relatively high prevalence of depression, anxiety and sleeping disorders that were strongly associated with low socioeconomic status, poor nutrition and adverse health behavior such as binge drinking and smoking (Cockerham, Hinote, & Abbott, 2006). It seems plausible that the psychosocial distress was the main cause of increased demand for alcohol at this time. This demand was met by factors that increased supply following the repeal of state alcohol monopoly in 1992 (Nemtsov et al., 2008).

It is likely that increase in stroke mortality in Russia in the 1990s is a consequence of deterioration in the quality of health care system, following the collapse of Soviet Union in late 1991. As command economy collapsed, the public health system faced a financial crisis. Left without proper funding, health care system was unable to maintain needed level of medical care (Field, 2005). The main evidence is from deaths among patients suffering from diabetes. It was reported that deaths from diabetes at age 50 increased about eight-fold in the 1990s in many former Soviet countries (Andreev, Nolte, Shkolnikov, Varavicova, & McKee, 2003). Possible explanation for this rise in deaths from diabetes was suggested in study carried out in Ukraine, where it was found that patients experienced a disruption in supplies of insulin and were unable to obtain specialized care when complications arose (Telishevska, Chenet, & McKee, 2001).

Further, the estimates of AAF for yang and middle-aged women, where heavy drinking is restricted to a relatively small proportion of the population, gives rise to the suspicion of possible measurement error. It should be recognized that ignoring the confounding variables may imply that the alcohol effect is overestimated, leading to upward bias. Nevertheless, there are some indications that Russian women are drinking more now which is likely to be a factor in the narrowing of the male-female alcohol-related mortality rate ratio (Stickley et al., 2007). In his recent study, based on the results of RLMS Perlman highlighted that heavy frequent drinking almost doubled in women between 1994 and 2004 (Perlman, 2010). Furthermore, younger women drank more than their older counterparts, suggesting that more young women are adopting risky lifestyles. There is also suggestive evidence that women have an increased risk of stroke even at the relatively law level of alcohol consumption (Ginter, 1995).

Finally, estimating unrecorded consumption of alcohol in Russia is a challenge, because of the diversity of this fraction of alcohol consumption that ranges from samogon through legal non-beverage alcohol (medical tincture) to counterfeit vodka produced from technical spirits (Razvodovsky, 2010a). We relied on estimated overall level of alcohol consumption across the period. However, the accuracy of assessment of actual alcohol consumption using indirect methods depends significantly on whether the level of alcohol consumption is the only factor influencing the index chosen as the indicator of alcohol-related problems. This represents an essential drawback of such methods, because many other factors influence the level of alcohol-related problems (Razvodovsky, 2010a).

In conclusion, the outcomes of this study provide support for the hypothesis that the high rate of stroke mortality in Russia may be related to alcohol, as indicated by a close aggregate-level association between number of deaths from stroke and overall alcohol consumption per capita. These findings are important because despite the growing literature on alcohol and mortality in Russia there has been no prior time-series analysis of alcohol and stroke mortality in the country. The results from the present study have important implications as regards cerebrovascular 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 detrimental drinking pattern. Given the distribution of alcohol-related stroke deaths, interventions should be focused on the young and middle-aged men and women.

Conflict of interest

None declared.

Acknowledgements

The author would like to thank the anonymous reviewers for their valuable comments and suggestions on an earlier version of this paper.

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