

# Affordability of Vodka and Liver Cirrhosis Mortality Rates in Russia

Y. E. Razvodovsky

International Academy of Sobriety, Belarus

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**Background:** *There is evidence that the affordability of alcohol is one of the most important predictor of the dramatic fluctuations in Russian mortality rates during the last decades.*

**Objective:** *The aim of the present study was to estimate the relationship between affordability of vodka and liver cirrhosis mortality rates in post-Soviet Russia.*

**Method:** *Trends in mortality from liver cirrhosis and affordability of vodka between 1991 and 2015 were compared.*

**Results:** *The time series analysis suggests a close link between vodka affordability and liver cirrhosis mortality rates in Russia: a 1% increase in affordability of vodka implies a 0.5% increase in male mortality rate and a 1.68% increase in female mortality rate. Conclusions:* *The major conclusion emerging from this study is that affordability of alcohol is one of the most important predictor of liver cirrhosis mortality. These findings provide additional evidence that decreasing in affordability of alcohol is an effective strategy for reducing alcohol consumption and alcohol-related harm.*

**Keywords:** *affordability, vodka, liver cirrhosis mortality, Russia.*

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## 1. INTRODUCTION

Liver cirrhosis is a major cause of deaths in many countries [1]. Over the last decades liver cirrhosis mortality rates have increased in Eastern Europe, particularly in the former Soviet republics [1,3]. The findings from Eastern European countries suggest that binge drinking and deaths rate from liver cirrhosis are positively related phenomena [3,4]. A number of studies have reported close temporal association between population drinking and liver cirrhosis mortality in Eastern Europe [5-7]. In particular, a positive and statistically significant relationship between per capita alcohol consumption and liver cirrhosis mortality was found in eight of nine Eastern European countries [3]. It should be emphasized, that the estimates were stronger in spirits drinking Eastern European countries than in 'non-spirits' countries [3]. Furthermore, a time series analysis based on Russian data indicated that liver cirrhosis mortality have a closer link to spirits consumption than to wine or beer consumption [5]. Mounting evidence suggests, that low price is one of the major driver of alcohol consumption and alcohol-related harm [8-18]. A close relationship between increased taxation and reduced alcohol-related harm has been reported at the aggregate level [8,11,15,18]. Most of these studies indicate a consistent relationship between higher prices and lower cirrhosis mortality [12,18]. Grossman et al. (1998) have concluded that a 10-percent increase in the price of alcohol would reduce cirrhosis mortality by 8.3 to 12.8% [12]. A systematic review of studies examining the effects of alcohol prices and taxes on alcohol-related outcomes yields meta-estimates -0.347 for liver cirrhosis mortality [18]. Several studies have reported that the affordability of particular beverages was related to liver cirrhosis mortality. Cook and Tauchen [12] highlighted that increases in the excise taxes on distilled spirits would significantly reduce mortality from liver cirrhosis: a 1\$ increase in the distilled spirits tax was estimated to lower cirrhosis death rate by 5.4 to 10.8%. Similarly, Gruenewald and Ponicki [13] reported that liver cirrhosis mortality rate was significantly related to taxes on distilled spirits, but not to taxation of wine and beer. Collectively, this research evidence showed clearly that alcohol prices were significantly and inversely related to liver cirrhosis mortality. There is some evidence from Eastern Europe suggesting that liver cirrhosis mortality responds to changes in the economic availability of alcohol [15]. Russian historical perspective also provides evidence that decreasing in vodka affordability by rising taxes is an effective strategy for reducing alcohol-related harm. Using historical data from tsarist Russia Norström and Stickley [19] reported that changes in vodka taxes were significantly associated with alcohol consumption and alcohol-related mortality. Most experts

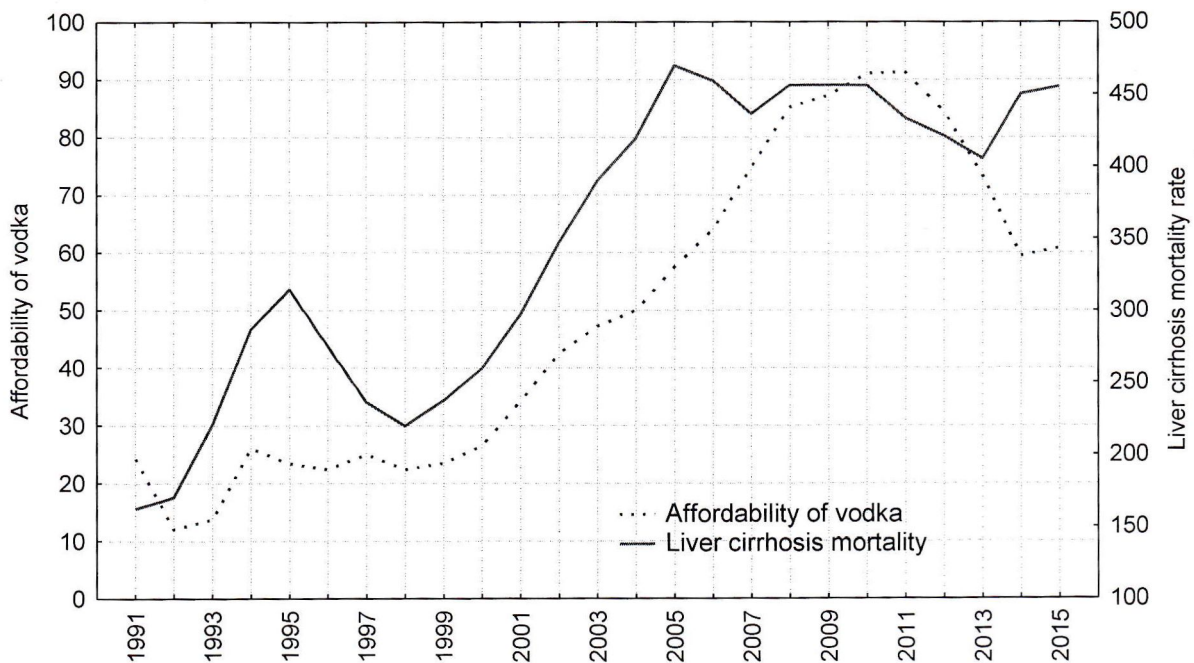
agree that the affordability of vodka is one of the most important predictor of the dramatic fluctuations in Russian mortality during the last decades [2,20]. In particular, the increase in heavy drinking in Russia during transition, which triggered the dramatic rise in alcohol-related mortality, resulted from an increase in the affordability of vodka [20]. Against this background, it would be interesting to evaluate the relationship between affordability of vodka and liver cirrhosis mortality rates in post-Soviet Russia. With this purpose trends in mortality from liver cirrhosis and affordability of vodka between 1991 and 2015 were compared

**2. METHOD**

The data on sex-specific liver cirrhosis mortality rates (ICD-10 code K 70), per 1000.000 of residents are taken from the national statistical agency. Here we specify the number of litres of vodka the average salary could buy as the affordability of vodka. The data on average salary and price of vodka are taken from the national statistical agency. To examine the relation between vodka affordability and liver cirrhosis mortality regression analysis was performed using the statistical package "Statistica".

**3. RESULTS**

The affordability of vodka in Russia has increased significantly since the early 1990s: the average salary in 1992 could buy 12.0 litres of vodka compared with 91.2 litres in 2011. The affordability of vodka decreased substantially in 1992, and then began rising again. Between 1999 and 2005, the affordability of vodka increased dramatically (mostly because of the rapid growth of real disposable incomes as the economy recovered), and then the affordability trend turned down (Figures 1-2).



**Figure 1.** Affordability of alcohol and male liver cirrhosis mortality rate in Russia

The liver cirrhosis mortality rates fluctuated over the period for both sexes: increased substantially between 1991 and 1995; from 1995-1998 there was a fall in the rates before they again jumped dramatically between 1998 and 2005, and then started a downward trend. There was, however, a spike in mortality in the most recent years (Figures 1-2). The trends in affordability of vodka and liver cirrhosis mortality rates are displayed in Figures 1-2. As can be seen, both trends seem to follow each other across the time series. A Spearman correlation analysis suggests a strong association between the two variables for males ( $r=0.85$ ;  $p<0.000$ ) and females ( $r=0.88$ ;  $p<0.000$ ). Therefore, a linear regression model was applied in the further analysis. The relationship between the affordability of vodka and male liver cirrhosis mortality is described by the linear regression equation:  $y = 179.6 + 3.49 \cdot x$ , where  $y$  – liver cirrhosis mortality;  $x$  – affordability of vodka. This model describes 77% of the total dispersion of the dependent variable and is characterized by its high validity ( $p<0.000$ ). The relationship between the affordability of vodka and female liver cirrhosis mortality is described by the linear regression equation:  $y = 65.1 + 2.6 \cdot x$ . This model describes 85% of the total dispersion of the

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dependent variable and is characterized by its high validity ( $p < 0.000$ ). So, we should expect that the increase in vodka affordability would result in the growth in the liver cirrhosis mortality rates. This case can be described by the elasticity coefficient which derived from the following equations:  $E = B_1 \frac{\bar{x}}{\bar{y}} = 0.5$  for males, and:  $E = B_1 \frac{\bar{x}}{\bar{y}} = 1.68$  for females. According to the equations a 1% increase in affordability of vodka implies a 0.5% increase in male mortality rate and a 1.68% increase in female mortality rate.

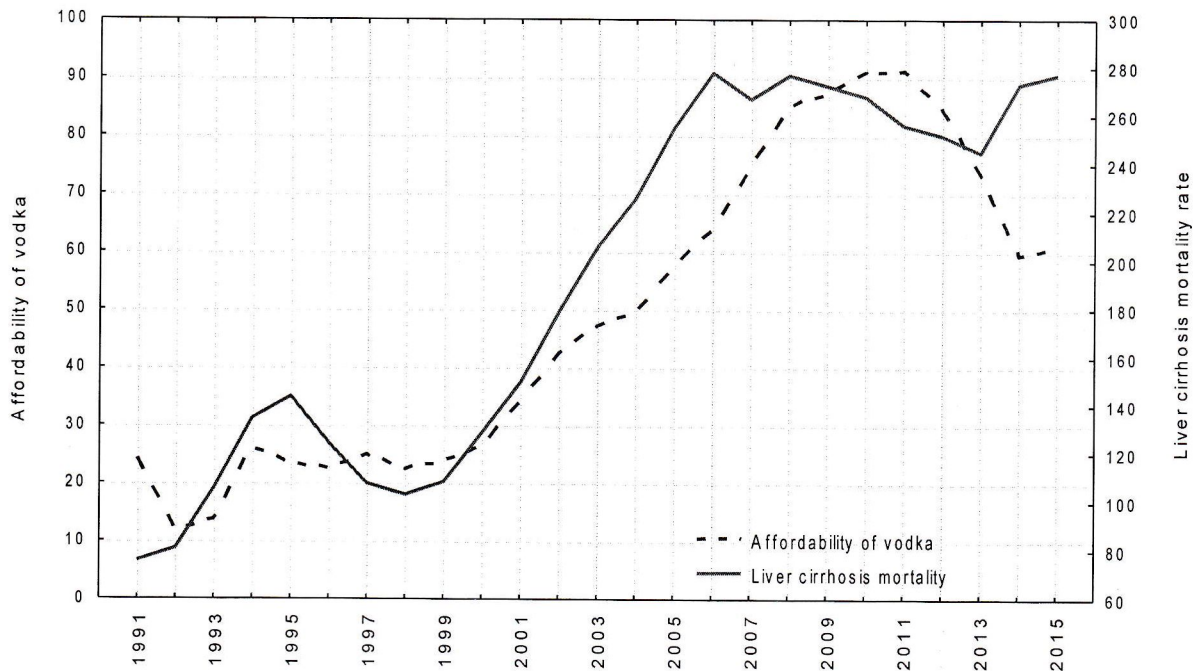


Figure 2. Affordability of alcohol and female liver cirrhosis mortality rate in Russia.

## 4. DISCUSSION

The findings from time series analysis suggest a close link between vodka affordability and liver cirrhosis mortality in Russia. These results replicate previous findings from other settings indicating that alcohol-related mortality is closely related to prices on distilled spirits [12,13,18]. Furthermore, these outcomes are in agreement to the regional-level findings based on Russian data, which suggested that higher vodka prices were associated with lower overall mortality, as well as deaths rates from circulatory diseases and from external causes [20]. Although the results indicate a consistent relationship between affordability of vodka and liver cirrhosis mortality rates, there are substantial gender differences in the estimated strength of this relationship. It seems plausible that women are more sensitive to an increased risk of liver cirrhosis mortality even at the relatively low levels of alcohol consumption [5]. A significant increase in the affordability of vodka appears to have been a major driver of dramatic increase in the liver cirrhosis mortality rates between 1998 and 2005. Although taxes were periodically adjusted for inflation, the real value of the excise has dropped sharply during these years [2]. The downward trend in liver cirrhosis mortality, which started since 2005 might be attributed to the new anti-alcohol laws, introduced by Russian government in 2006 [21]. The first law (102 Federal Law), among other issues, introduced new excise stamps. There was, however, a significant delay with their printing: first stamps were issued only in February 2006. The second law (209 Federal Law) significantly increased nominal capital of alcohol market players, so that the market became free from small and average players in favor of large producers. And all of this has provoked chaos on the alcohol market and the legal alcohol shortages [22]. It seems plausible that decrease of physical availability of legal vodka has played a role in the liver cirrhosis mortality decrease between 2005 and 2007. One of the negative consequences of the legal alcohol shortages was appearance of additional amounts of toxic alcohol substitutes on the market [23]. The latter led to the increase of toxic hepatitis incidence [22], which, however, has not translated into excess deaths from liver cirrhosis. During the recent years, the Russian government has adopted a comprehensive range of measures designed to reduce alcohol-related harm. Specifically, minimum price on vodka was introduced in 2010 [21]. Further, a new set of amendment to the 171 Federal Law was adopted in

2011 [22]. Most importantly, excise tax rates on vodka in Russia have increased 2.7 times (from 34 to 93 rubles per liter of pure alcohol) between 2011 and 2015 [23]. As a result, the affordability of vodka decreased by 34%. At the same time, facing economic crisis the Russian government reduced minimal price on vodka by 16% from 1 February 2015, which means an increase in the affordability of vodka [22]. Before concluding, it is necessary to address some potential limitations of the study that may have affected the outcome. In particular, after 2005 the liver cirrhosis mortality was falling, even though the affordability of vodka was increasing. It is clear that the downward trend in mortality rates between 2005 and 2011 is not related to the affordability of vodka. Although the exact nature of this apparent paradox remains uncertain, one potential explanation may be particularly relevant in this context. It appears likely that the shift in the structure of consumption from vodka towards beer as a result of alcohol control measures have had a positive impact on bringing down the liver cirrhosis mortality rates in Russia during recent decade. Indeed, official sales statistics and data from population survey indicate that there have been favorable changes in the structure of alcohol consumption (substitution of vodka by beer) and drinking pattern [21]. In relation to this, it is important to acknowledge that alcohol affordability is just one factor that may affect alcohol consumption and alcohol-related harm and that may be the multiple confounders in this association including social and cultural variables. Therefore, additional confounding variables which may relate to the liver cirrhosis mortality (availability of treatment, prevalence of virus hepatitis, nutritional factors) should be included into analysis. In conclusion, the results from this study suggest positive aggregate-level association between vodka affordability and liver cirrhosis mortality rates. The major conclusion emerging from this study is that affordability of alcohol is one of the most important predictor of alcohol-related mortality. The current study suggests that alcohol pricing policy may be an effective vehicle to reduce alcohol-related mortality in Russia.

**Conflict of Interest:** None declared

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