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Alcohol Consumption and Gender Gap in All-cause Mortality in Russia

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Abstract

Background: There is extensive research literature that claims women have a mortality advantage compared to men in all developed countries. Russia has one of the highest differences in mortality between the sexes when compared to European Union countries.

Objective: This study aims to test the hypothesis of alcohol consumption as a risk factor in regards to the gender gap in all-cause mortality in Russia.

Method: Time-series Analytical Modelling Techniques (ARIMA) was used to examine the relation between the gender gap in all-cause mortality and trends in alcohol consumption per capita.

Results: The results of the analysis also suggest that 54.6% of the difference in all-cause mortality rates between males and females in Russia could be attributed to alcohol.

Conclusion: The outcomes of this study provide indirect support for the hypothesis that alcohol is a major contributor to the high gender gap in all-cause mortality and its dramatic fluctuations in Russia during the last few decades.

Keywords: Alcohol consumption; Gender gap; All-cause mortality; Russia

Introduction

There is extensive research literature that claims women have a mortality advantage compared to men in all developed countries [1-5]. Social, biological, and behavioural factors have been proposed to explain the male-female health-survival paradox [6-8]. Epidemiological evidence suggests that the magnitude of differences in mortality between men and women differ across various geographic settings [3]. The size of the male-female gap in mortality has been found to be smaller in Western Europe countries than in the eastern European countries [6].

Russia has one of the highest differences in mortality between the sexes when compared to European Union countries [6]. This is primarily due to high rates of male death from external causes, cardiovascular and alcohol-related diseases [9-11]. In Russia, death rates from alcohol-related causes are about four times higher for men than for women [12]. It has also been reported that Russian men have considerably higher levels of alcohol consumption than women [9]. This evidence suggests that alcohol consumption may play an important role in explaining the pronounced gender gap in all-cause mortality in Russia.

This study aims to test the hypothesis of alcohol consumption as a risk factor in regards to the gender gap in all-cause mortality in Russia by analysing the pattern of differences between male and female mortality rates and comparing it to trends in alcohol consumption per capita.

Material and Methods

Data

The data on age-adjusted sex-specific all-cause mortality rates (per 1000.000 of the population) between 1956 and 2015 are taken from the Russian State Statistical Committee (http://www.gks.ru). The overall level of alcohol consumption (in litres of pure alcohol) in Russia has been estimated using the indirect method based on alcohol poisonings mortality rate and employing ARIMA (autoregressive integrated moving average) model. This method is based on the difference between the observed level of alcohol-related harm and level estimated from recorded alcohol consumption [13-15].

Statistical analysis

To examine the relation between changes in alcohol consumption and gender gap in all-cause mortality across the study period a time series analysis was performed using the statistical package "Statistica 12 StatSoft". The dependent variable was the gender gap in all-cause mortality and the independent variable was aggregate 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 [16]. 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.

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 [16] who first proposed this particular method for undertaking a time series analysis, and it is commonly referred to as ARIMA modelling. We used this model specification to estimate the relationship between the time series gender gap in all-cause mortality and alcohol consumption rates in this paper. In line with previous aggregate studies [17], we estimated semi-logarithmic models with logged output.

The effect of alcohol consumption on gender gap in all-cause mortality rates will be expressed in terms of Alcohol-attributable Fraction (AAF), which can be calculated from the estimates obtained in ARIMA models according to formula: AAF=1-exp(-bX), where X is alcohol consumption per capita in the study period and b is the estimated effect parameter [18].

Results

The time series of all-cause mortality rates for both sexes are displayed in Figure 1. The graphical evidence suggests that the pattern of all-cause mortality for men and women was rather similar. The trends of all-cause mortality fluctuated dramatically over time: it increased from 1964 to 1980, decreased markedly between 1980-1982, dropped sharply between 1984-1989, than jumped dramatically between 1992 and 1994. From 1994-1998 there was a fall in rates of before they again rose between 1998 and 2003 and then finally started to decrease. The pattern of gender gap in all-cause mortality resembles those of sex-specific all-cause mortality rates. The graphical evidence also suggests that the temporal pattern of gender gap in all-cause mortality fits closely with changes in alcohol consumption per capita (Figure 2).

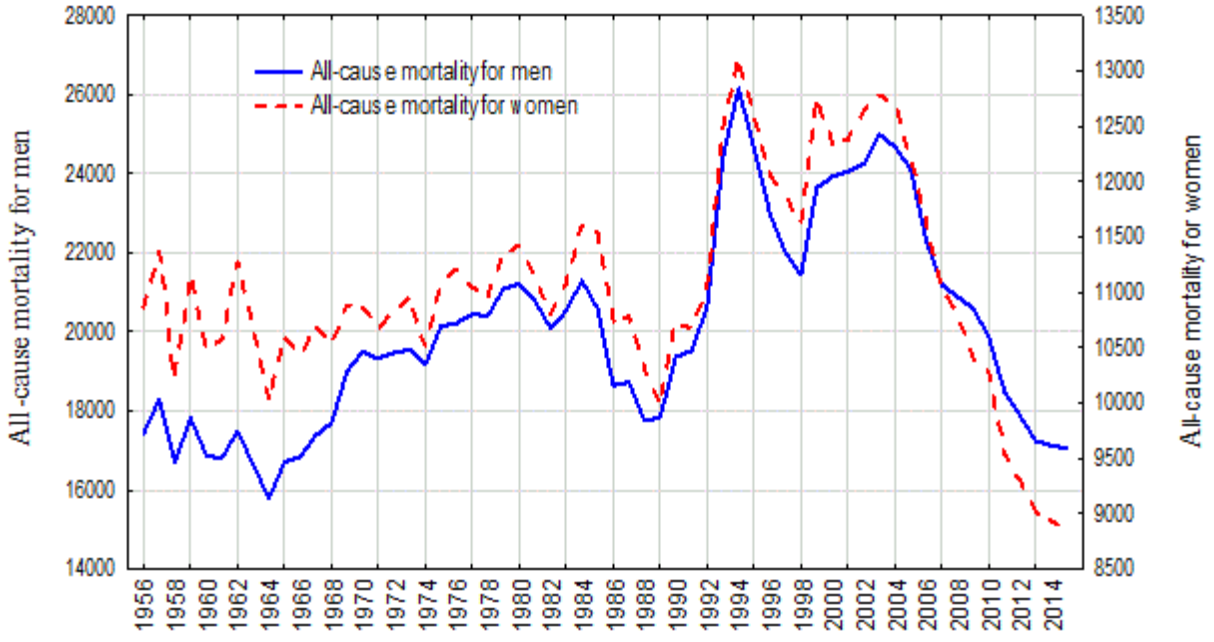

Figure 1: Trends in male and female all-cause mortality rates in Russia between 1956 and 2015.

A Spearman correlation analysis suggests a strong association between the gender gap in all-cause mortality and alcohol consumption per capita (r=0.86; p<0,000). There were sharp trends in the time series data across the entire study period. These systematic variations were well accounted for by the application of first-order differencing and the specification of a first order moving average parameter (Figure 3). After pre-whitening the cross-correlations between alcohol consumption and gender gap in all-cause mortality rates, time series were inspected. The outcome indicated statistically significant cross-correlation between the two variables at lag zero (r=0.81; Standard error=0.13). According to the results of ARIMA analysis, alcohol consumption is a statistically significant factor associated with gender gap in all-cause mortality rate in Russia, implying that a 1-L increase in consumption per capita is associated with an increase in the difference between male and female mortality rates by 6.0%. The results of the analysis also suggest that 54.6% of the difference in all-cause mortality rates between males and females in Russia could be attributed to alcohol.

Discussion and Conclusion

The dramatic fluctuations in the gender gap of all-cause mortality rates throughout the past 60 years in Russia suggest that the determinants cannot be purely biological, but might also reflect changes in sex-specific, modifiable lifestyle risk factors. It is well established in Russia that behavioural risk factors alone, primarily binge drinking and smoking, account for extremely higher rates in male mortality [1,4]. Therefore, the alcohol-related hypothesis may help in explaining the high gender gap in mortality and its dramatic variations in Russia during the last few decades.

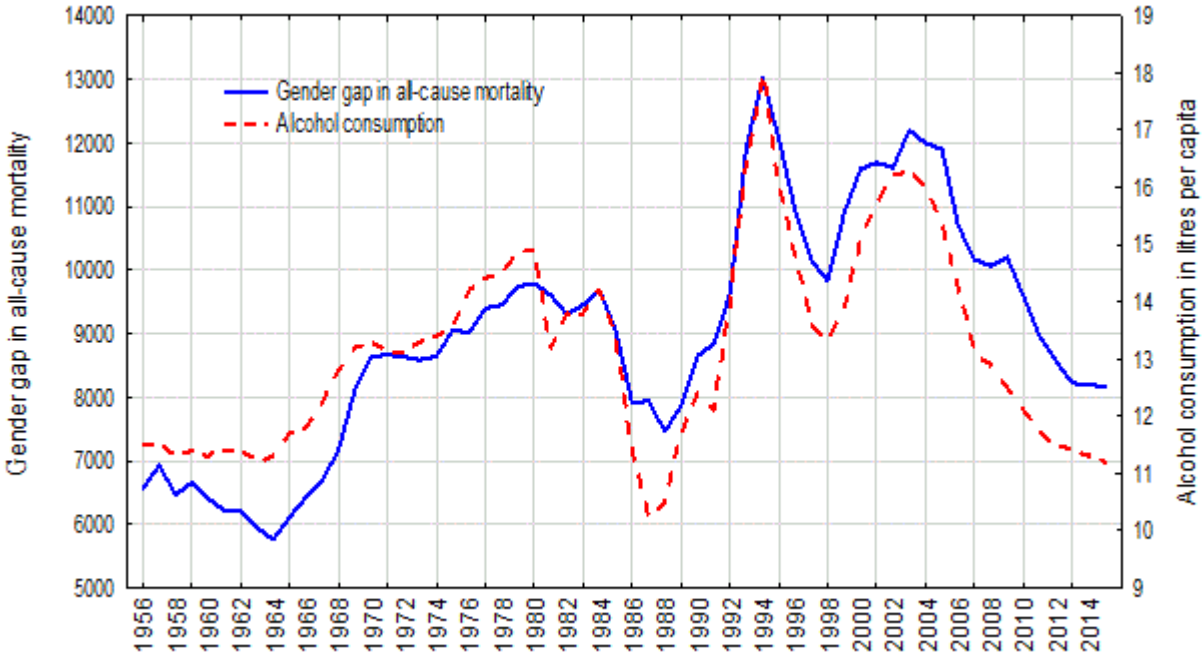

Figure 2: Trends in the gender gap in all-cause mortality and alcohol consumption per capita in Russia between 1956 and 2015.

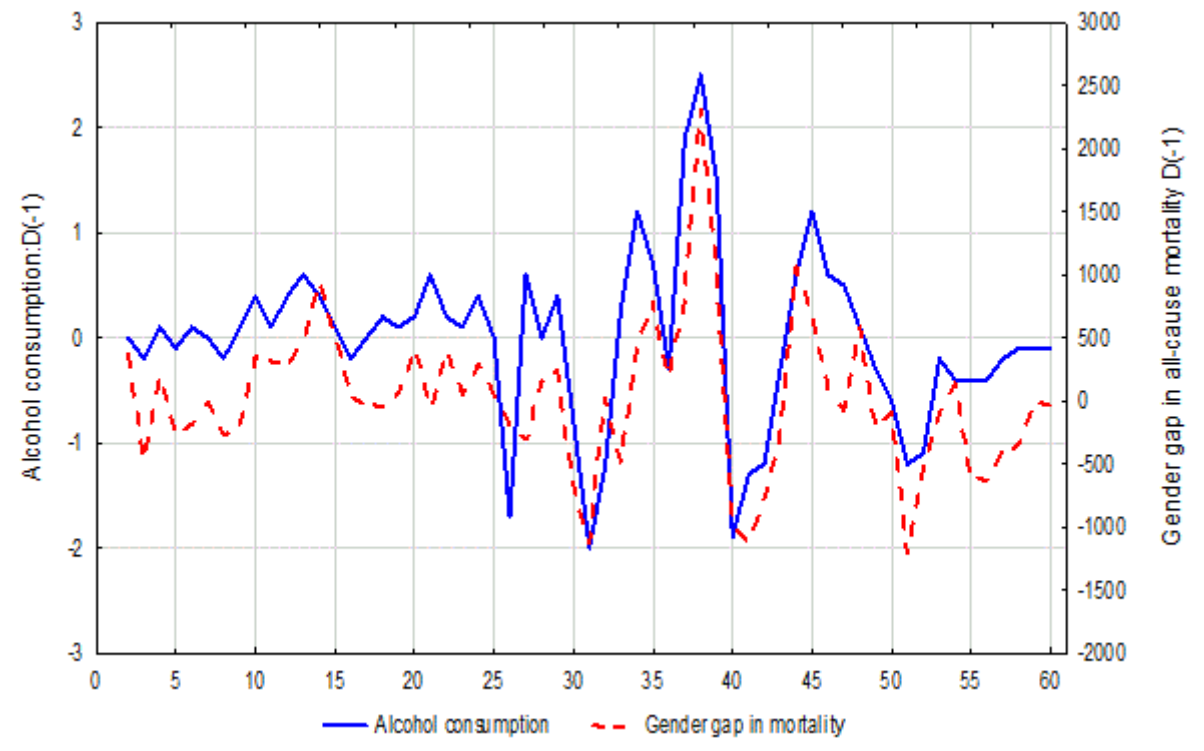

Figure 3: Trends in the gender gap in all-cause mortality and alcohol consumption per capita in Russia between 1956 and 2015 after differencing procedure.

The results of the time series analysis, which suggest positive and statistically significant effects of alcohol consumption per capita on gender gap in all-cause mortality rate in Russia between 1956 and 2015 indirectly supports this alcohol-related hypothesis.

Before concluding, some potential limitations of this study must be mentioned. It should be recognized that ignoring the confounding variables may imply that the effect of alcohol on sex differences in all-cause mortality is overestimated, leading to upward bias. It can be assumed that the alcohol consumption effect on gender gap in all-cause mortality is a spurious indicator of the impact of other powerful risk factors such as smoking. There is general agreement that cigarette smoking is a major contributor to the sex difference in all-cause mortality in developed countries [7]. In European Union, for example, smoking accounts for 40-60% of the gender gap in mortality [6]. However, taking into account the fact that smoking has a long term effect on mortality, this factor alone cannot explain the trajectories in the gender gap in Russian mortality rates during the last decades.

In conclusion, the outcomes of this study provide indirect support for the hypothesis that alcohol is a major contributor to the high gender gap in all-cause mortality and its dramatic fluctuations in Russia during the last few decades. These findings also suggest that the sex differences in all-cause mortality may be used as a measure of population drinking in this country.

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