Introduction

In the present article, we will explore whether the ‘public health perspective on alcohol’ is consistent with the experience of tsarist Russia. This perspective has two main tenets (as laid down in, e.g., Bruun et al.).¹ The first one is that an increase in per capita alcohol consumption tends to be accompanied by increased rates of alcohol-related harm,² including chronic outcomes, such as liver cirrhosis and pancreatitis, and various forms of violent death, for example, fatal accidents, homicide and suicide. The second tenet is that per capita consumption responds to changes in the physical and economic availability of alcohol; alcohol taxes are thus generally regarded as the most efficient measure for regulating consumption.³,⁴ The two main principles have received considerable empirical support, mainly from analyses of post-war data pertaining to Western Europe and North America. However, there is also some evidence from Eastern Europe that seems to provide support for this perspective. The potential for alcohol policy to impact on health in this part of the world was clearly seen during the final years of the Soviet regime. Although Gorbachev’s anti-alcohol campaign—which made alcohol less available and drastically more expensive—was ultimately short-lived (1985–87), it has nevertheless been estimated that it saved more than 1 million lives in Russia alone during these years.⁵

A more crucial test of the model, though, would be to subject it to data from a context where the cultural and political conditions are little favourable for its success. A feasible candidate for such a test seems to be tsarist Russia with its deep-rooted drinking culture characterized by ‘heavy periodic excesses’,⁶ scepticism toward the state and its intervention, and the strong readiness to find alternative sources of alcohol to those being made less available.⁶

The current study will thus examine the impact of one important measure that was implemented in tsarist Russia in 1863 to mitigate alcohol-related problems, namely the excise tax system on alcohol. The system meant that alcohol was taxed per gradus, that is, per degree of pure alcohol in each vedro (‘bucket’, equivalent to 12.3 l). The tax increased gradually from 4 kopeks per gradus at its introduction to 11 kopeks per gradus, four decades later.⁷

Previous assessments of the effects of tax policy in this period have been largely negative. Both historical and contemporary commentators have argued that not only did it fail to decrease drinking but that it may have rather been associated with an increase in drunkenness.⁸ Moreover, although official figures suggest that a fall did occur in alcohol consumption during the existence of the excise duty system,¹⁰ it has been argued that it was not due to tax increases. Rather, fluctuations in alcohol consumption arose due to the ‘deeper conditions of the national economy and national life’—a finding reiterated by tsarist officials themselves at that time¹¹ and subsequently by other researchers.¹² However, there is scope for a more rigorous test of the relation between taxes and population drinking; modern statistical tools have not been applied in this context before. But even if such analyses—which will be discussed later in the text—would suggest the existence of a tax effect on consumption, another possibility could also exist. Thus, it has been claimed that as tax increased, so did the growth in contraband alcohol,¹¹ and that the excise system resulted in the illegal sale of (untaxed) vodka on a large scale.⁶

Background: The public health perspective on alcohol comprises two main tenets: (i) population drinking impacts on alcohol-related harm and (ii) population drinking is affected by the physical and economic availability of alcohol, where alcohol taxes are the most efficient measure for regulating consumption. This perspective has received considerable empirical support from analyses of contemporary data mainly from Europe and North America. However, as yet, it has been little examined in a historical context. The aims of the present article are to use data from tsarist Russia to explore (i) the relation between changes in the tax on alcohol and per capita alcohol consumption and (ii) the relation between per capita alcohol consumption and alcohol mortality. Methods: The material comprised annual data on alcohol taxes, alcohol consumption and alcohol mortality. The tax and alcohol consumption series spanned the period 1864–1907 and the mortality data covered the period 1870–94. The data were analysed by estimating autoregressive integrated moving average models on differenced data. Results: Changes in alcohol taxes were significantly associated with alcohol consumption in the expected direction. Increases in alcohol consumption, in turn, were significantly related to increases in alcohol mortality. Conclusion: This study provides support for the utility of the public health perspective on alcohol in explaining changes in consumption and alcohol-related harm in a historical context. We discuss our findings from tsarist Russia in the light of experiences from more recent alcohol policy changes in Russia.

Alcohol tax, consumption and mortality in tsarist Russia: is a public health perspective applicable?

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One way of assessing whether the decrease in official consumption is real is to check to what degree it is matched by a decline in alcohol-related mortality. For instance, the fact that the halving of recorded per capita consumption in France during the post-war period was accompanied by a concomitant decrease in cirrhosis mortality, makes the downward trend in recorded French drinking more credible. By analysing the relation between recorded per capita consumption and alcohol-related mortality during the tsarist period, we may thus shed some light on the authenticity of the downward trend in alcohol consumption.

In light of the situation outlined earlier in the text, the aim of the current study was to use unique data specifically retrieved for the present study, pertaining to tsarist Russia to examine (i) the relation between changes in the tax on alcohol and per capita alcohol consumption and (ii) the relation between per capita alcohol consumption and alcohol-related mortality. In addition, we will estimate the direct effect of changes in the alcohol tax on alcohol-related mortality. Such an analysis is in line with the approach best known from the studies by Cook (see ref. for a review of studies in this research tradition).

Methods

Data on alcohol consumption and alcohol taxes relate to the whole of the Russian Empire. These were obtained from two major works on alcohol, which appeared during the later-tsarist period. Where possible, these data have been cross-checked with other official data. The consumption data relate to the annual per capita consumption of 40° vodka in vedros (i.e. ‘buckets’) that we converted into litres of 100% alcohol. Alcohol taxes, as mentioned earlier, were levied in kopeks per gradus across this period. The alcohol tax series was adjusted for the upward trend in inflation by deflating it with a general price index.

Mortality data pertain to the 50 provinces of European Russia (which covers an area that today coincides with Ukraine, Belarus, Moldova, the Baltic States and the part of Russia that is to the west of the Urals). The data were obtained from the ‘Russian Information Anthology, 1896’—issued by the Central Statistical Committee of the Russian Ministry of Internal Affairs. We used the mortality indicator labelled ‘sudden deaths from drunkenness’. These fatalities, which were supposedly the subject of forensic medical investigation, seem to have comprised deaths from severe alcohol poisoning. We will refer to this measure as alcohol mortality (alcohol being the sole cause). Population data were compiled from multiple sources that were cross-checked for accuracy. The tax and alcohol consumption data span the period 1864–1907, whereas the mortality data were available for a more restricted period i.e. 1870–94.

Statistical analysis

The data were analysed by using the approach developed by Box and Jenkins, often referred to as autoregressive integrated moving average (ARIMA) modelling. The number of observations in the mortality series is on the low side (25) compared with the recommended 30–50 observations. Although having few observations does not induce bias, it does entail a loss of power. However, this can be compensated by high variability in the input series. An example of this is a study by Skog that estimated the effect of per capita alcohol consumption on suicide, on the basis of Danish time-series data spanning 1911–24, that is, only 14 observations. A priori, a fairly weak alcohol effect was expected, but owing to the marked reduction in consumption due to World War 1, it came out as clearly significant. In contrast, Norström’s analysis of this relationship based on a much longer period (1931–80), but with more normal variation in the Danish alcohol series, did not reveal any significant impact of alcohol consumption. Although the alcohol series for the tsarist period is less volatile than the early Danish one, it does contain some changes that are marked, which makes it worthwhile to undertake an analysis. Ultimately, the outcome will show if the power is sufficient to detect any effect.

The presence of strong time trends in the data (figure 1) necessitated some form of filtering to achieve the stationarity required for ARIMA modelling. A simple differencing procedure was sufficient to remove non-stationary trends; that is, rather than using the raw series, yearly changes were analysed. Differencing reduces the risk of obtaining spurious correlations greatly because an omitted variable is more likely to be correlated with the explanatory variable as a result of common trends than due to the synchronization of yearly changes. Further, the noise term, which includes explanatory variables not considered in the model, is allowed to have a temporal structure that is modelled and estimated in terms of autoregressive or moving average parameters. The model residuals

![Figure 1](https://academic.oup.com/eurpub/article-abstract/23/2/340/682419)
should not differ from white noise; this was tested with the Box–Ljung Q statistic.

Alcohol mortality may result from acute intoxication and chronic long-term abuse; even sudden deaths are often associated with a history characterized by excessive drinking. We should therefore expect a lag structure between alcohol and mortality; this was assessed empirically through inspecting the cross-correlations between the two series at different lags. In such an analysis, it is necessary to first remove all structure from the series (pre-whiten), or the cross-correlations will be contaminated by the autocorrelation of the series. The analysis revealed significant correlations at lag 0 (0.46; SE = 0.20) and lag 1 (0.67; SE = 0.20), whereas higher lags were insignificant. As the lag-weights are proportional to the cross-correlations, we constructed a new alcohol series according to:

\[ AW_t = (0.46 \times A_t + 0.67 \times A_{t-1})/1.13 \]

where \( AW_t \) denotes the weighted alcohol series at time \( t \), \( A_t \) is alcohol consumption at time \( t \), and \( A_{t-1} \) indicates alcohol consumption lagged 1 year, that is, at time \( t - 1 \).

We used log-log models (i.e. the dependent and the explanatory variable were logarithmically transformed) for quantifying the relationships at issue. This is the standard model in demand analyses and is thus a feasible specification for estimating the tax effect on consumption. However, this model form seems applicable also for estimating the relation between alcohol consumption and alcohol mortality because it can accommodate the non-linear (accelerating) risk function between alcohol and alcohol mortality, which is documented for several outcomes. The resultant effect measure (the elasticity coefficient) is easy to interpret; it indicates by how many percent the dependent variable is expected to increase if the independent variable increases by 1%. Finally, it should be noted that there was a marked upward shift in the mortality series in 1879. This was captured by including a dummy variable that takes the value 0 before 1879 and 1 otherwise.

The analysis thus comprised the estimation of three separate models: the first one assessing the relation between alcohol taxes and the per capita consumption of alcohol, the second one assessing the relation between consumption and alcohol mortality, and, lastly, one assessing the relation between alcohol taxes and alcohol mortality. Because the mortality data was available for a more restricted time period (1870–94) than the tax and consumption data (1864–1907), the study period was not identical across the three model estimations. SPSS 17.0 was used for the analyses.

### Results

As can be seen in figure 1, the increasing trend in alcohol taxes coincides with decreasing trends in alcohol consumption and mortality. Although this pattern accords with our expectations, graphical evidence of this kind is not compelling and thus we proceeded to the stronger tests provided by model estimations based on the differenced data. As can be seen from table 1, the estimated effect of tax changes on per capita alcohol consumption was statistically significant and in the expected direction, that is, negative; the estimate implies that a 1% tax increase yielded a decrease in consumption of ~0.5%. Also, the estimated effect of consumption on mortality was significant; a 1% increase in per capita consumption was associated with a 1.3% increase in alcohol mortality (table 2). [If the dummy variable for the upward shift in mortality (in 1879) is not included, the estimated alcohol effect increases to 1.88 (SE = 0.40, \( P < 0.001 \)]. On the basis of these results, it was expected that a change in taxes would affect mortality; this was indeed confirmed, which can be seen by the outcome presented in table 3. All models were satisfactory with respect to residual autocorrelation, with no need to include noise parameters.

### Discussion

During the last three decades of the 19th century, population drinking in tsarist Russia was almost halved according to official records; this occurred in parallel with increased alcohol taxes. However, historical experience suggests that attempts by the state to reduce alcohol consumption in this country tend to be undermined by an increased supply of various forms of surrogate alcohol, implying that the downward trend in registered consumption may have been compensated by increased unrecorded consumption. Although some commentators maintain that it is probable that the consumption decline in this period was real, other commentators from that period have suggested that there was no real reduction in the harm caused by alcohol, and that things were instead getting worse. Indeed, it has recently been claimed that none of the previous alcohol systems introduced throughout Russian history have been successful in terms of controlling Russian drinking. The present study is the first to analyse historical data with modern statistical techniques to shed some light on this issue. The outcome does support the notion of a genuine decrease in consumption; first, we identified a plausible cause by establishing a significant association with the increasing alcohol tax. Second, we identified a significant effect of per capita tax on consumption.
consumption on alcohol mortality, and the marked reduction in the latter would hardly have occurred in the absence of lowered population drinking.

**Study limitations**

Before discussing the implications of our findings, it is necessary to point out a number of potential limitations of the study. An obvious concern when working with historical records is the quality of the data relied on. However, previous analyses based on western European nineteenth century time-series data on alcohol consumption and mortality, have yielded sensible results with estimates consistent across countries and time periods, and there is little reason to believe that Russian data would fare worse. Writing recently about statistical data from the nineteenth century, Russia’s leading alcohol researcher, Alexandr Nemtsov, has argued that ‘Russian statistics were reliable for their time’, and the mortality data provided by the Central Statistical Committee was the most complete during these years in terms of the number of deaths recorded. Nevertheless, the marked upwards shift in mortality in 1879 is a reminder of the influence of unidentified factors; the shift is consistent with what one should expect from a change in recording practice, but we have not been able to locate any more specific information on this. Further, the likely presence of unrecorded consumption mentioned earlier may have biased the estimate of the alcohol effect on mortality upwards (if there was a positive correlation between recorded and unrecorded consumption) or downwards (if there was a negative correlation between recorded and unrecorded consumption). There is little information available, however, to assess which, if any, of these forms of bias is most likely.

Lastly, as always in this kind of work, there exist a large number of factors that may have affected the outcome but that are not considered in the analyses due to a lack of data. Examples of such factors include the socio-economic and demographic characteristics of the population under study. However, it should also be kept in mind that we performed the analyses on differenced data, which reduces the risk of omitted variable bias. Thus, a prerequisite for an omitted factor to bias our estimates is that—in addition to affecting the outcome—it is also synchronized with the explanatory variable in the annual changes. Although the existence of such a factor cannot be precluded, it does not seem likely in the present case. It can further be argued that the results from the three separate analyses support each other so that the joint findings are stronger than their constituent parts.

**Policy implications**

On the basis of our findings suggesting that increased alcohol taxes were associated with lowered per capita consumption, which in turn led to a decrease in alcohol mortality, it can be argued that the public health perspective on alcohol seems to apply to the experience in tsarist Russia. This finding seemingly underpins recent research indicating continuity in a harmful drinking culture in Russia across time and which has suggested that what happens in the past may also hold important policy lessons for the present. Indeed, it is striking that the experience from Gorbachev’s anti-alcohol campaign echoes the relation we observed between stricter alcohol policy, falling alcohol consumption and lowered mortality. Further, what can be regarded as the inverse of the process that has been depicted in this article occurred about 100 years later in post-Soviet Russia. During the period 1990–94, the real price of vodka dropped by almost 80% spurring a sharp rise in alcohol consumption and concomitant mortality.

Our findings taken together with these more contemporary experiences suggest that alcohol tax policy may be one mechanism by which the exceptionally high rates of alcohol consumption underpinning the current mortality crisis in Russia can be tackled. To this end, the Russian government has recently introduced a minimum price of 89 roubles for a standard bottle of vodka, and minimal and stepped price increases (depending on alcohol concentration) for all beverages containing 28% alcohol or more by volume. Although this is to be welcomed, two important qualifications need to be noted in this context. First, the sharp growth in both the consumption of ‘samogon’ (moonshine) and alcohol surrogates in recent years, which has been driven by their lower price, also points to the dangers of using alcohol tax in a market that is not fully regulated. This suggests that if price is to be used as a weapon in an attempt to lower drinking in the contemporary period, then the government will have to find a way to regulate the 50% of the alcohol market that it does not currently control in Russia.

Second, although lowering population drinking obviously is expected to impact on rates of harm, the importance of drinking patterns has to an increasing extent come to the fore. At the population level, this is manifested in the way that the association between per capita consumption and rates of harm tends to be stronger in countries where binge drinking and drinking to intoxication characterize the drinking pattern, implying that the harm per litre of alcohol is elevated in such countries. As Russia exhibits the devastating combination of a high level of consumption and detrimental drinking patterns, considerable leverage could be expected from moderating the latter. This points to the necessity of wider interventions, such as improving the poor everyday living conditions that in part seem to underpin harmful drinking or at least its fatal effects. A highly relevant finding in the present context is that the sharp mortality increase after 1990, above all, affected less privileged groups, whereas the mortality of, for example, those with higher education in fact improved.

This study has highlighted how looking at the past may be a useful mechanism to guide policy in the present—despite the multitude of changes that take place in a given society across time. Specifically, the current study has suggested that alcohol pricing policy may be an effective vehicle to reduce both consumption and mortality in Russia—with the proviso that it takes place in a more highly regulated market environment where the capacity to acquire cheaper illegal alcohol alternatives is eliminated to a much greater degree.

**Conflicts of interest:** None declared.

**Key points**

- Although much contemporary empirical evidence has been gathered from Europe and North America, which supports the public health perspective on alcohol, as yet, it has been little researched in a historical context.
- Using data from historical Russia, this study has shown that increases in alcohol taxes were associated with a fall in alcohol consumption, which in turn, was associated with a fall in alcohol mortality.
- Our results highlight the potential utility of the public health perspective in terms of understanding the tax-alcohol consumption relation in a historical context. They also suggest that taxes may be a useful mechanism to reduce the high levels of alcohol consumption in contemporary Russia—provided the alcohol market can be properly regulated.

**References**
