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Alcohol and Homicide in Eastern Europe

A Time Series Analysis of Six Countries

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Few studies have addressed the association between alcohol consumption and homicide rates at the population level in eastern European countries. The aim of the present study was to test hypotheses on how this association may vary across countries with different drinking patterns and for gender specific homicide rates. Time series analysis was used on annual alcohol consumption and homicide rates for six eastern European countries. The estimates were pooled into two groups of countries with more (Russia and Belarus) and somewhat less (Bulgaria, Hungary, Poland, and former Czechoslovakia) hazardous drinking patterns. The overall results showed that annual changes in alcohol consumption were positively and significantly associated with homicide rates and also indicated that the estimates were stronger in countries with a more detrimental drinking pattern. The results suggest that alcohol consumption has an effect on homicide rates in Eastern Europe and that this effect varies with drinking pattern.

Keywords: *homicide; alcohol consumption; Eastern Europe; time series*

Alcohol consumption has been found to be an important ingredient in violent incidents, and an important factor for the prevalence of violence (Pernanen, 2001; Room & Rossow, 2001). Alcohol-related violence is a serious social problem and a substantial threat to public health in many countries (Babor et al., 2003; Room et al., 2002), and it has been estimated that 24% of homicides are attributable to alcohol worldwide (Rehm et al., 2004; World Health Organization [WHO], 2002). In recent years, interpersonal violence has received increased attention both by the public and in research. A number of studies using various designs and methods have demonstrated a positive association between alcohol and violence, and alcohol consumption has been found to

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be a common factor in violent incidents, and an important risk factor for committing violent acts and for victimization (Lenke, 1990; Pernanen, 2001; Roizen, 1997). Alcohol intake and number of heavy drinking episodes have also been shown to increase the risk of being involved in violence (Rossow, 1996; Wells, Graham, & West, 2000).

Several theories address the relationship between alcohol and violence (Parker & Auerhahn, 1998; Parker & Rebhun, 1995; Pernanen, 1991), and it is suggested that alcohol intoxication may play a significant role in enhancing and triggering aggressive behavior and thereby may increase the risk of violent victimization (Pernanen, 1991). Recently, empirical studies have shown that the consequences of alcohol consumption are related to the pattern of drinking as well as to the volume (Rehm et al., 1996), and the importance of drinking pattern is an important aspect of the harm caused by alcohol (Midanik, Tam, Greenfield, & Caetano, 1996; Rehm et al., 1996, 2003; Room, Bondy, & Ferris, 1995; Rossow, 1996; Wells, Graham, Speechley, & Koval, 2005). However, intoxication may not only enhance aggressive behavior but also increase the risk of violent victimization. The likelihood of any bystanders intervening in a violent incident may also be reduced (Pernanen, 1991). Thus, the mechanisms underlying the observed alcohol-violence relationship are complex, and such complexity may be difficult to assess in studies at the individual level. To what extent a given increase in overall alcohol consumption may influence violence rates in society is of considerable interest for public policy, and it has been argued that aggregate time series data is the most feasible approach for this kind of question (Norström & Skog, 2001). Some methodological problems that arise at the individual level, such as selection effects and failure to control for potentially confounding factors, are avoided with this method, although aggregate studies do not completely solve the inference problem of causality.

There are at least three possible mechanisms for the alcohol-violence association at the aggregate level, and the first two mechanisms express a linear association (additive), and the third a semilogarithmic association (multiplicative). First, because studies at the individual level suggest that the association between alcohol and violence is mainly related to acute intoxication (Rossow, 2000), one can hypothesize that an increase in total consumption is followed by an increase in the level of violent behavior. This is based on the assumption that an increase in total consumption would imply an increase in the number of drinking occasions and thereby in the number of events of acute intoxication (Greenfield, Midanik, & Rogers, 2000; Horverak, 2006; Rossow, 2007) in which violent behavior may be triggered, more or less irrespective of societal factors (Rossow, 2004). Second, as the proportion of heavy drinkers increases with an increase in total consumption (Skog, 1980, 1985) the effect may also be due to an increase in the number of heavy drinkers who have a heightened risk of being involved in violent acts (Rossow, 2000). Third, the absolute effect of changes in alcohol consumption on violent behavior may depend on other factors associated with violence, that is, the effect of alcohol consumption on

violent behavior may depend on the level of other factors of importance to violence; for example, the effect of an increase in alcohol consumption on violent behavior may be greater in times of high unemployment or poverty, and it might also depend on the level of informal social control (Parker & Cartmill, 1998; Rossow, 2001). In this case, the alcohol effect would be relative, that is, a nominal increase in alcohol consumption would imply a relative change in the level of violence. Consequently, we would expect that an increase in drinking in the population would lead to an increase in the level of violence. In line with these expectations, several time series analyses of aggregate-level data have demonstrated that an increase in alcohol consumption is followed by an increase in rates of violence (Bye, 2007; Lenke, 1990; Norström, 1998; Rossow, 2004; Skog & Bjørk, 1988). Correspondingly, a reduction in violence has been demonstrated in countries with sudden and large changes in alcohol consumption because of rationing, antialcohol campaigns, and strikes (Lenke, 1990; Nemtsov, 1998; Rossow, 2002).

Differential Associations Between Population Drinking and Violence Rates

Studies have demonstrated that in addition to being associated with the level of consumption, the alcohol-violence association is also mediated by patterns of drinking and cultural expectations about behavior while drinking (Room & Rossow, 2001). This indicates that an increase in per capita consumption of one liter would lead to a larger increase in violence in countries with an intoxication-oriented drinking pattern, compared to countries with a less "explosive" drinking pattern. A comparative study of 14 western European countries (European Comparative Alcohol Study [ECAS]) investigated whether a one-liter increase in per capita consumption implied a larger increase in violence in a country where drinking often leads to intoxication (Northern Europe) as opposed to that in countries with a less-explosive drinking pattern (Southern Europe). The results from this study confirmed the hypothesis of a drinking pattern gradient in the alcohol effect. The strongest association was found in the northern European countries with the most hazardous drinking pattern (13% per liter) and the weakest in the southern European countries with the least hazardous drinking pattern (6%), with mid-Europe in-between (9%; Rossow, 2001). Correspondingly, in the WHO's Global Burden of Disease project, the relative risk for alcohol's role in violence and in injuries was found to vary across countries and subregions by drinking patterns (Rehm et al., 2003). Regarding possible gender differences in alcohol-related violence, studies indicate that both offenders and victims of violent behavior are generally more often men (Pernanen, 1991; Rossow, 1996; Rossow & Hauge, 2004). As men drink more often and more heavily than women (Babor et al., 2003), it is assumed that the association between total consumption and level of violence is stronger for men than for women. This was also supported in the ECAS study, where changes in alcohol consumption were found to have a greater impact on homicide rates for men than on homicide rates for women (Rossow, 2001).

Previous time series studies of the association between alcohol and violence have mostly been confined to western European countries and North America, and there is sparse knowledge about this association in other countries, for example, eastern European countries. The high levels of alcohol consumption in eastern European countries in combination with detrimental drinking patterns would suggest high levels of alcohol-related harms as well as expected strong association between changes in alcohol consumption and violence. Previous cross-sectional and one time-series analysis of Russian data have supported this, and demonstrated a significant association between alcohol consumption and homicide rates (Pridemore, 2002, 2004; Pridemore & Chamlin, 2006).

Thus, although a positive association between alcohol and violence has been found in Western Europe, United States, and Canada, little is known about this association in the eastern European countries, and how the association might differ between these countries and between western European countries. In addition to providing new knowledge about the association between alcohol and violence in several eastern European countries, there are several other reasons why a study of the association between alcohol and violence in Eastern Europe is an issue of great interest. Alcohol consumption and homicide rates are considerably higher in eastern European countries than in western European countries, life expectancy is lower, and mortality rates are higher (Cockerham, 1999). Whereas alcohol consumption is declining in most western European countries, it is rising in the countries of Central and Eastern Europe. The rise in mortality from cardiovascular disease and violence is one of the reasons for the gap in life expectancy between East and West (Bobak & Marmot, 1996).

Another issue is the extensive political, social, and economic changes that have taken place in many of the countries during the years prior to and following the collapse of the Soviet Union. Many of the eastern European countries face severe socioeconomic challenges such as economic recession, falling living standards, and unemployment (Cockerham, 1999). Alcohol consumption and homicide rates have increased in most eastern European countries during the transition period, and it has been shown that countries with higher income and established market economies tend to have lower rates of mortality from homicide than countries with lower income (WHO, 2002). This is clearly seen in Russia where the homicide rate is among the highest in the world. The homicide rate more than tripled between 1988 and 1994. Recent studies in Russia and Eastern Europe suggest that the primary causes of increased alcohol consumption and homicide rates are related to widespread social problems because of social stress and disorganization during the transition to a free market (Gavrilova, Semyonova, Evdokushkina, & Gavrilov, 2000; Kim & Pridemore, 2005; Leon & Shkolnikov, 1998; Pridemore & Spivak, 2003). This is in line with the structural strain perspective introduced by Durkheim, where rapid social changes would create anomic conditions; that is, cause strain in individuals who fail in terms of prevailing social expectations, and this strain could increase the risk of both heavy drinking and alcoholism and thus violence (Messner & Rosenfeld, 1997).

The present study is part of an eastern European project on alcohol-related harm and alcohol policies with a focus on the postwar period. Of the nine countries included in the project, Russia, Belarus, Poland, former Czechoslovakia, Hungary, and Bulgaria had available time series data on alcohol sales and homicides rates. Based on theory and previous empirical studies, the following hypotheses were tested in the present article: (a) Homicide rates in eastern European countries are affected by changes in alcohol consumption, so that an increase in alcohol consumption tends to be followed by an increase in homicide rates. (b) The association between alcohol consumption and homicide rates is stronger in eastern European countries with more detrimental drinking patterns. (c) Changes in alcohol consumption have a greater impact on homicide rates for men than for women. (d) The association between changes in alcohol consumption and homicide is stronger in eastern European countries than in western European countries because of a more detrimental drinking pattern.

Data and Method

The analyses are based on annual statistics on homicide rates and per capita alcohol consumption from the following six countries and time periods: Belarus (1970-2004), Bulgaria (1964-2003), former Czechoslovakia (1953-1989), Hungary (1961-2002), Poland (1959-2002), and Russia (1959-1998). Because of varying availability of data, there is some difference in the time periods for the countries. Figures on homicide rates were obtained from the WHO statistics. Overall homicide rates, and homicide rates for men and women, were age adjusted and given per 100,000 inhabitants (aged 15 years and above). Belarus did not have gender-specific homicide rates, and the total homicide rates were per 100,000 inhabitants (aged more than 15 years).

Annual sales statistics in liters of pure alcohol per inhabitant aged 15 and above were used as a proxy for alcohol consumption. The sales figures were mainly obtained from WHO, Brewers Association of Canada, and World Drink Trends. Only liters of alcohol per capita were available for Belarus, and these figures (from the Ministry of Statistics of Belarus) were provided by Dr Yuri E. Razvodovsky. However, it should be noted that unrecorded consumption is not included in the sales data, which implies that consumption levels generally are underestimated in all countries. In addition, the variation in the unregistered consumption might impair the validity of the temporal development. It is known that for example, in Russia the consumption of *samogon* (home–produced spirit) varied substantially during the period studied in the present analysis (Nemtsov, 2000), and especially during Gorbachev's antialcohol campaign in the 1980s, the large reduction in alcohol sales was partly compensated for by unregistered alcohol (Nemtsov, 1998). However, it is not possible to calculate unregistered consumption for the alcohol sales variable in the present study, with the exception of Russia. Although there are various problems

with the measurement of alcohol consumption in Russia (see Pridemore, 2002; Pridemore & Chamlin, 2006, for details), it is possible to combine existing estimates of per capita consumption including estimates of unrecorded consumption presented by Treml (1982) for the period 1959 through 1979, and by Nemtsov (2000, 2003) for the period 1980 through 1998. Although these estimated series rely on different methods, they give a fairly consistent picture of the period from 1980 to 2000 (Nemtsov, 2003), and thus, the estimates of unrecorded consumption have been added to the Russian data. Previous studies of homicide rates in Russia have used deaths due to alcohol poisonings, or all alcohol-related deaths as proxies for alcohol consumption/heavy drinking, but this kind of measures has limitations (see Pridemore & Chamlin, 2006, for discussion). Moreover, these proxies are indicative of heavy drinking whereas the Russian data used in the present analysis reflect more general alcohol consumption and thus are more suitable for comparison with other countries.

To see whether drinking patterns, in addition to overall alcohol consumption, contribute to differences in homicide rates, a comparison was made between two groups of eastern European countries with different degrees of harmful drinking pattern. Studies from Russia and Belarus on drinking patterns have shown that an intoxication-oriented drinking pattern is widespread (Malyutina et al., 2001; Pomerleau et al., 2005; Simpura, Boris, & Mustonen, 1997) and that nearly one-third of Russian men admit to binge drinking at least once per month (Bobak, McKee, Rose, & Marmot, 1999). An additional study by Bobak and colleagues (2004) also found lower rates of binge drinking in Polish and Czech cities than in a Russian city. Historically, the drinking patterns in Bulgaria, Hungary, and the former Czechoslovakia are characterized by almost daily drinking of alcohol and often drinking with meals, whereas Poland can be characterized by nondaily drinking with irregular binge drinking episodes (Iontchev, 1998).

However, given the relatively sparse comparative research on eastern European drinking patterns, the most useful indicator for different drinking patterns appears to be a recently developed hazardous drinking pattern score, developed by Rehm and colleagues (2003) based on a combination of empirical data and expert judgment. The hazard scores consists of a four-point scale that reflects on *how* people drink and range from 1 (*least harmful*) to 4 (*most harmful*) and combines scores in six dimensions: high quantities of drinking per occasion, frequency of being drunk, festive drinking being common, drinking in public places being common, drinking with meals being uncommon, and low rate of daily drinking. The hazard score measures the degree of hazard associated with each extra liter of alcohol consumed per capita, and the countries included in the present study were assigned with the following hazard scores: Russia = 4; Belarus = 3.6; Poland and Hungary = 3; Bulgaria and former Czechoslovakia = 2. Because drinking patterns have been found to be relatively stable over time (Simpura, 2001), this approach provides meaningful comparisons across countries, and thus, the estimated alcohol effects were compared between these two groups: (a) high hazardous drinking pattern (Belarus and Russia) and (b) less

hazardous drinking pattern (Bulgaria, former Czechoslovakia, Hungary, and Poland). Similar scores for northern European countries were 3 for Northern Europe, and 1 to 2 for mid- and Southern Europe.

To achieve comparable results with previous findings, the methodological approach used in the ECAS project was used as a model (see Norström & Skog, 2001, for details). All estimated effects were based on the technique for time-series analysis developed by Box and Jenkins (1976), often referred to as ARIMA models. This technique was also used in the ECAS study of alcohol and homicide (Rossow, 2001) and thus provides a basis for comparison. Because of the series being nonstationary, the analysis was performed on the yearly changes rather than on the raw data. No assumption of independent error terms is required with the Box and Jenkins method, as the noise term is allowed to have a temporal structure, which is modeled and estimated in terms of autoregressive (AR) or moving average (MA) parameters. The temporal structure of the noise term was considered by estimating AR or MA parameters in the models. The model fit was also evaluated with the aid of the Box-Ljung portmanteau test (diagnostic test for residual correlation) of the first 10 autocorrelations (Q 10), along with visual inspection and normality test of the residuals.

To provide estimates comparable with the ECAS and other time series studies, a semilogarithmic model (multiplicative) was applied (Lenke, 1990; Rossow, 2001; Skog & Bjørk, 1988). This model assumes that the absolute effect of changes in alcohol consumption on violent behavior may depend on other factors associated with violence and that the alcohol effect is relative, that is, a nominal increase in the alcohol variable gives a relative change in the violence variable. As stated in the introduction, the homicide-violence association may also be expressed as a linear association, that is, based on the assumption that the alcohol effect mainly depends on the number of events of acute intoxication in which violence may be triggered. Because both of these hypothesized effects regarding the effect of changes in alcohol consumption on violence have some credibility, linear models will also be applied. It can be argued that the impact of drinking pattern may also be more adequately reflected when comparing effect estimates from linear models (Rossow, 2004). Linear models will also express how the effects from the semilogarithmic models are affected by considerable differences in the absolute homicide rates between the countries.

The models can be written as

Semilogarithmic model:		*Linear model*:
$\nabla Ln(H_t) = \ln(\alpha) + \beta\nabla A_t + \nabla Ln(N_t)$	and	$\nabla(H_t) = \alpha + \beta\nabla A_t + N_t.$

Here ∇ denotes the difference operator, H denotes the output series (homicide rate), while A is the input series (alcohol sales) and β is the estimated regression parameter. In the *semilogarithmic model*, beta can be interpreted as follows: An increase in alcohol consumption of one unit produces a fixed percentage increase in homicide

rates, for example, the parameter β for the alcohol variable will measure the relative increase in overall violence rates when alcohol consumption increases by one liter of pure alcohol per inhabitant 15 years and above (the percentage effect of a change in consumption of one liter is obtained by applying the formula: $[\exp^{(b)}-1] \times 100$). In the *linear model* an increase in alcohol sales of one liter is followed by an absolute increase in the homicide rate corresponding to the value of the parameter β. N is the noise term and represents the unexplained variation in the violence rate due to factors not included in the model. The constant α denotes the mean annual increase (or decrease) in the homicide rate because of other causes.

Poland had missing data for homicide rates for 1980 to 1982 and 1997 to 1998 (linear interpolation was used to compensate for missing data), and thus, dummies were used for these periods. Scatter plots between the differenced alcohol and homicide series were inspected, but no outliers were detected that could distort the relationship between alcohol and homicide. In addition, all countries except Russia and Belarus changed from ICD code 8 to 9 around 1979 and 1980. The potential effect on homicide rates due to changes in ICD versions were modeled by a set of dummy variables and checked in all models, but no such effect was found.

Both theory and empirical studies suggest that the association between alcohol consumption and various forms of violence can only be expected to be positive, that is, a fixed increase in alcohol consumption is followed by an increase in violence rates. Consequently a one-tail significance test was applied for the association between alcohol consumption and homicide rates.

As for the ECAS study (Rossow, 2001), the estimates from the individual countries were pooled within groups (countries with high hazardous drinking pattern versus less hazardous drinking pattern) to provide comparable estimates between the assumed different drinking patterns in the two groups. The standard errors of the estimates are also greatly reduced when pooling the estimates across countries, which is an advantage because the ARIMA method implies an increased risk of Type II error (see Skog, 2001, for details). The formula for the standard errors of the pooled estimates (unweighted) is

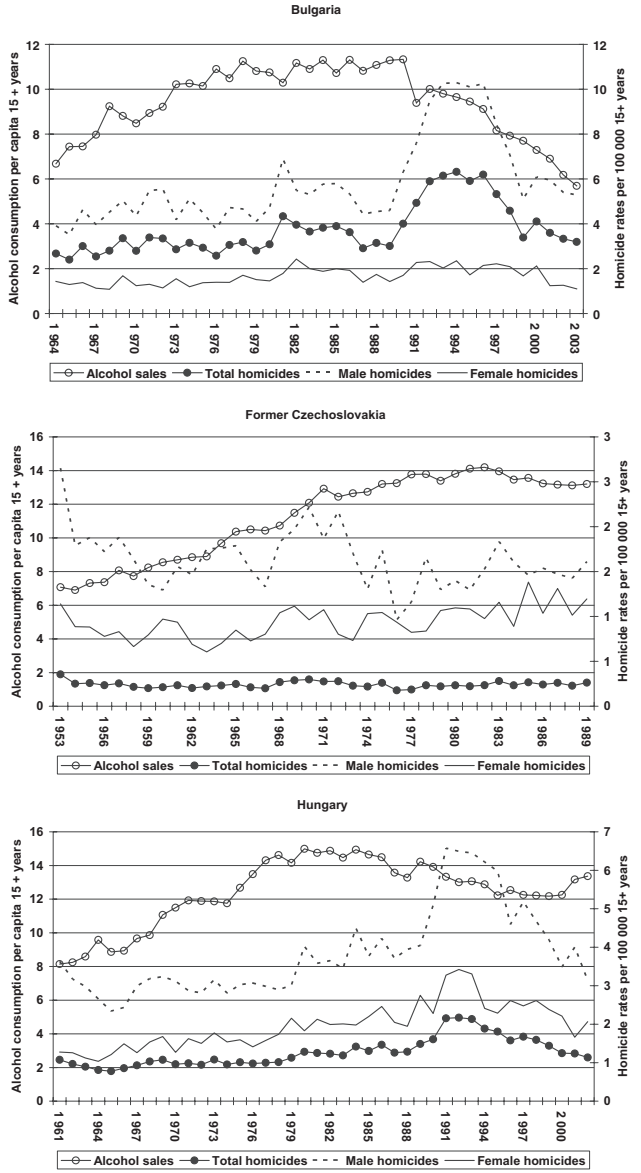
$$SE_{\text{pool}} = \frac{\sqrt{\sum_i SE_i^2}}{n},$$

where n denotes the number of countries.

Results

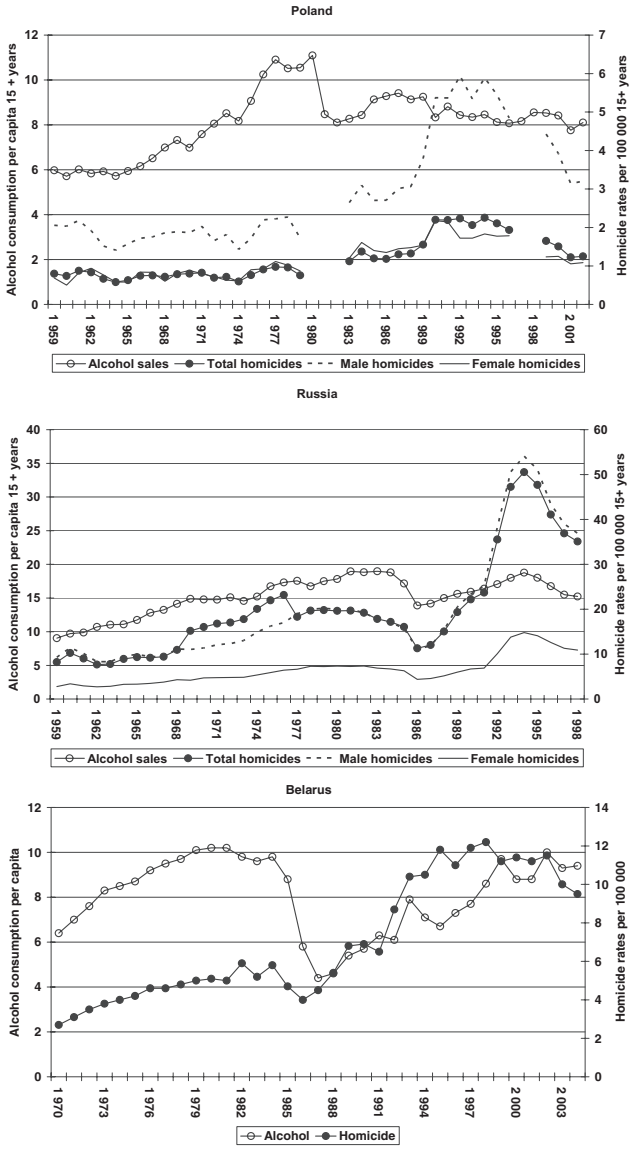
The trends in alcohol sales and homicide rates for each country are shown in Figure 1. As can be seen, Russia and Belarus had an upward trend in both alcohol sales and homicide rates until the antialcohol campaign introduced by Gorbachev in 1985 through 1988. The policy reform included reduction in state production of alcohol and reduced availability, and resulted in a major drop of about 1/3 in registered sales of

Figure 1
Trends in Alcohol Consumption (in Liters of Pure Alcohol Per Inhabitant 15 Years and Above) and Age Adjusted Homicide Rates (Per 100,000 Inhabitants 15 Years and Above) in 6 Eastern European Countries



(continued)

Figure 1 (continued)



alcohol (Nemtsov, 1998). However, after the campaign, consumption and homicide rates started to increase again for both countries. After the collapse of the Soviet Union in 1991, homicide rates increased very steeply in Russia, and before they

Table 1
Mean Total Homicide Rates (Homicides Per 100,000 Inhabitants Aged 15 Years and Above) and Mean Alcohol Sales (in Liters of Pure Alcohol Per Inhabitant Aged 15 Years and Above); Standard Deviation (in Parentheses) and Years of Valid Observations

	Time Period	Total Homicides	Alcohol Sales	Homicide Rates for Men	Homicide Rates for Women
High hazardous drinking pattern					
Belarus[a]	1970-2004	7.07 (3.15)	8.09 (1.70)	—	—
Russia	1959-1998	13.40 (7.65)	15.24 (2.77)	19.88 (12.69)	6.45 (3.25)
Pooled		10.24	11.67	19.88	6.45
Lower hazardous drinking pattern					
Bulgaria	1964-2003	3.73 (1.11)	9.41 (1.61)	5.81 (1.93)	1.65 (0.39)
Former Czechoslovakia	1953-1989	1.29 (0.18)	11.27 (2.46)	1.63 (0.32)	0.94 (0.18)
Hungary	1961-2002	2.90 (0.84)	12.42 (1.99)	3.84 (1.15)	1.96 (0.59)
Poland	1959-2002	2.04 (0.90)	8.12 (1.42)	2.92 (1.39)	1.15 (0.44)
Pooled		2.49	10.31	3.55	1.43
Pooled all countries		5.07	10.76	6.82	2.43

a. Alcohol and homicide not age adjusted for Belarus.

started to decline in 1995, they had increased by 113%. This sharp increase has been shown to be a true change, and not for example, an artifact of new measurement systems (Leon et al., 1997). In Poland, alcohol sales also increased steadily until 1980, when pressures from the Solidarity movement resulted in the government introducing rationing and reduced state production (Moskalewicz, 1993). Sales then dropped by approximately 25% from 1980 to 1981, and then remained fairly stable. Bulgaria, Hungary, and former Czechoslovakia also experienced an increase in alcohol sales until the 1980s, but while sales in Hungary and former Czechoslovakia stabilized after 1980, alcohol sales in Bulgaria started to decline steadily at the beginning of the 1990s. With the collapse of the Soviet Union, Bulgaria lost its major trading partner and the postcommunist period for Bulgaria was characterized by a worsening in the economic situation, high unemployment, and food shortages, which might partly explain the decline in alcohol sales (Cockerham, 1999). However, for all countries, except for former Czechoslovakia, there seems to have been a homicide wave in the period after 1990, which for most countries was reversed in the late 1990s.

The overall mean level for per capita consumption 15 years and above for all countries was 10.8 L of pure alcohol (Table 1), and this corresponds to the mean calculated for Central Europe for approximately the same period as for the present data (Rossow, 2001). Russia stands out with the highest mean consumption (15.2 L), followed by Hungary (12.4) and former Czechoslovakia (11.3). All the homicide rates were substantially higher for the eastern European countries compared to those for

Table 2
Effect Parameters of Alcohol Sales on Total Homicide Rates (Standard Error in Parenthesis) for 6 East European Countries, Pooled for Countries With High and Low Hazardous Drinking Patterns, and for All 6 Countries (Unweighted Means)—Semilogarithmic and Linear Models

	Semilogarithmic			Linear		
	Regression Coefficient	Model Specification[a]	Q[d](lag 10)	Regression Coefficient	Model Specification	Q[d](lag 10)
High hazardous drinking pattern						
Belarus[b]	0.047*	0.1.0	14.88	0.257(*)	0.1.0	13.32
1970-2004	(0.022)		($p = 0.14$)	(0.156)		($p = 0.21$)
Russia	0.097***	0.1.0	15.08	1.040**	1.1.0	3.02
1959-1998	(0.022)		($p = 0.13$)	(0.366)		($p = 0.98$)
Pooled		0.072*** (0.016)			0.649*** (0.199)	
Lower hazardous drinking pattern						
Bulgaria	–0.023[ns]	0.1.0	7.19	–0.065[ns]	0.1.0	10.51
1964-2003	(0.040)		($p = 0.71$)	(0.149)		($p = 0.40$)
Former Czechoslovakia 1953-1989	0.117*	0.1.0	5.27	0.157*	0.1.0	4.63
	(0.067)		($p = 0.87$)	(0.087)		($p = 0.92$)
Hungary	0.022[ns]	0.1.0	14.07	0.047[ns]	0.1.0	13.98
1961-2002	(0.031)		($p = 0.17$)	(0.101)		($p = 0.17$)
Poland	0.032[ns]	0.1.0[c]	4.57	0.039[ns]	0.1.0[c]	7.52
1959-2002	(0.035)		($p = 0.92$)	(0.069)		($p = 0.68$)
Pooled		0.037[ns] (0.023)			0.045[ns] (0.053)	
Pooled all		0.049** (0.016)			0.246** (0.075)	

a. Models are indicated by number of AR parameters, number of differencing, number of MA parameters.
b. Alcohol and homicide not age adjusted for Belarus.
c. Dummies for 1990, 1980-1982, and 1997-1998.
d. Test for residual correlation.
[ns]$p > 0.10$, not statistically significant.
(*)$p < 0.10$. *$p < 0.05$. **$p < 0.01$. ***$p < 0.001$.

most western European countries, and according to the ECAS study, the eastern European countries had homicide rates that were five times as high. Russia and Belarus had the highest mean homicide rates (per 100,000 inhabitants aged 15 years and above), 13.4 and 7.07, respectively. In Western Europe, Finland had the highest mean rate, with a mean of 3.4 for approximately the same period as studied here (Rossow, 2001), and this was more in line with the other countries in the present study. Homicide rates for men and women in the countries that were studied were also much higher than for western countries, and homicide rates were generally three times as high for men as for women.

Overall and Gender-Specific Homicide Rates

The results from overall semilogarithmic and linear models are presented in Table 2. As for previous studies of western European countries and Canada, a positive association between alcohol consumption and homicide was also found for eastern European countries. From the semilogarithmic models, a positive and significant association was found for three of the six countries. The estimates for Russia and former Czechoslovakia were almost the same, indicating that an increase in alcohol consumption of 1 L of pure alcohol per inhabitant per year will, on average, increase the rate of homicide by approximately 10%. For Belarus, the estimate was 5%. However, because of the uncertainty of the proxy for alcohol consumption regarding the level of unrecorded consumption, these estimates must be interpreted with caution.

When pooling the estimates for the two groups of countries, the estimate for the group with high hazardous drinking pattern was significantly higher (7.2%) than for group with lower hazardous drinking pattern (3.7%; $p < 0.05$, weighted data), although the estimate for the latter group was not significant. This result supports the hypothesis that drinking pattern is of importance when studying the association between alcohol and violence and that the alcohol effect tends to be stronger in countries with a more detrimental drinking pattern.

However, the estimates from the semilogarithmic models are not an optimal departure regarding the interpretation of the significance of drinking pattern and the size of the association. The homicide rates are considerably higher in Russia compared with former Czechoslovakia, and thereby a one-liter increase in alcohol consumption in Russia would necessarily give a larger absolute increase in homicide rates in Russia. When estimating the association between changes in alcohol consumption and homicide rates in linear ARIMA models, the impact of drinking pattern was more adequately reflected. As for the semilogarithmic models, the alcohol effect was also higher for the group with high hazard rates (0.65) compared with the lower hazard rates countries (0.045) in the linear models ($p < 0.01$, weighted data). The interpretation of the alcohol effect for former Czechoslovakia indicates that a one-liter increase in alcohol sales would result in an increase of 0.16 homicides per 100,000 inhabitants aged 15 years and above, which corresponds to about 17 additional homicides per year (provided that the alcohol proxy reflects the real situation). However, although the relative alcohol effect in former Czechoslovakia was almost the same as for Russia, and twice as large as the one for Belarus, it can be seen that the high homicide rates for Russia and Belarus resulted in a stronger absolute alcohol effect compared to former Czechoslovakia. The results from the linear models thus support the hypothesis that in addition to the drinking pattern, the level of homicide rates in the different countries is significant for the magnitude of the alcohol effect on absolute homicide rates.

The estimates for the homicide rates for men and women turned out to be significant only for Russia (Table 3), and the relative effect for men and women was approximately

Table 3
Effect Parameters of Alcohol Sales on Homicide Rates for Men and Women (Standard Errors in Parenthesis) for 5 East European countries, Pooled for Countries With High and Low Hazardous Drinking Pattern, and for All 5 Countries (Unweighted Means)—Semilogarithmic Models

	Homicides—Men			Homicides—Women		
	Regression Coefficient Homicides Men	Model Specification[a]	Diagnostics Q[c](lag10)	Regression Coefficient Homicides Women	Model Specification	Diagnostics Q[c](lag10)
High hazardous drinking pattern						
Russia	0.093***	0.1.0	17.32	0.089***	0.1.0	7.77
1959-1998	(0.021)		($p = 0.07$)	(0.018)		($p = 0.65$)
Low hazardous drinking pattern						
Bulgaria	–0.036[ns]	0.1.0	10.16	0.022[ns]	0.1.1	5.76
1964-2003	(0.046)		($p = 0.43$)	(0.046)		($p = 0.84$)
Former	0.101[ns]	0.1.0	11.30	0.032[ns]	0.1.1	4.97
Czechoslovakia	(0.093)		($p = 0.33$)	(0.056)		($p = 0.89$)
1953-1989						
Hungary	0.044[ns]	0.1.0	13.24	–0.014[ns]	0.1.1	11.09
1961-2002	(0.040)		($p = 0.21$)	(0.040)		($p = 0.35$)
Poland	0.032[ns]	0.1.0[b]	6.23	0.032[ns]	0.1.0[b]	11.01
1959-2002	(0.037)		($p = 0.80$)	(0.052)		($p = 0.35$)
Pooled		0.035[ns] (0.028)			0.018[ns] (0.028)	
Pooled all countries		0.047* (0.024)			0.032[ns] (0.020)	

a. Models are indicated by: (number of AR parameters, number of differencing, number of MA parameters).
b. Dummies for 1990, 1980-1982, and 1997-1998.
c. Test for residual correlation.
[ns]$p > 0.10$, not statistically significant.
*$p < 0.05$. **$p < 0.01$. ***$p < 0.001$.

the same, and at the same level as for the overall results. The assumption that the alcohol effect for homicide rates for men would differ from the rates for women was thus not supported.

The association between changes in alcohol consumption and homicide was assumed to be stronger in eastern European countries than in western European countries because of a more detrimental drinking pattern. The estimates of the present study were not at the same magnitude as for the western European regions or for Western Europe as a whole; for example, the relative effect for the countries with the most detrimental drinking pattern (7.2%) was almost half the size of the effect for Northern Europe (13.2%). However, the homicide rates are significantly higher

Table 4
Estimates of Absolute Changes in Homicide Rates for Eastern Europe, Based on Semilogarithmic Models From the Present Study and Estimates From the European Comparative Alcohol Study[a] (ECAS)

Eastern Europe	High Hazardous Drinking Pattern	Low Hazardous Drinking Pattern	Western Europe	Northern Europe	Central Europe	Southern Europe
0.25	0.74	0.09	0.11	0.22	0.08	0.08

a. The absolute changes for Western Europe are based on the coefficients from Rossow (2001, p. 81).

in eastern European countries than in Western Europe and consequently comparisons of estimates based on semilogarithmic models may be problematic. For the purpose of attributing differences in the estimates of the alcohol-violence association to differences in drinking patterns, the estimates based on the semilogarithmic model have been converted into estimates of absolute changes in homicide rates (Table 4). We see that the estimated change in absolute homicide rates due to an increase in alcohol consumption of one liter of pure alcohol for Eastern Europe as a whole was twice as high (0.25) as for Western Europe as a whole (0.11) and that Eastern Europe as a whole was of the same magnitude as Northern Europe. The pooled estimate for the European countries with the most hazardous drinking pattern was more than three times higher than for Northern Europe, which also is characterized by an intoxication-oriented drinking pattern. Eastern European countries with lower hazardous drinking pattern had an estimate similar to that of Central and Southern Europe. Thus, this gives some support to the hypothesis that the association between changes in alcohol consumption and homicide in eastern European countries is stronger than in western European countries because of a more detrimental drinking pattern and high levels of homicide rates.

Discussion

This study is the first to assess the association between changes in alcohol consumption and homicide rates in various eastern European countries. The results revealed a positive and significant relationship for eastern European countries as a whole, implying that a one-liter increase in alcohol consumption would yield a 5% increase in homicide rates on average. Alcohol consumption was found to have a positive and significant relationship with homicide in three of the six countries, and the pooled alcohol effect was stronger ($p < 0.05$) in the countries with the highest hazardous drinking pattern (7.2%) than in countries with less hazardous drinking pattern (3.7%). This is in line with previous findings and supports the hypothesis that the alcohol effect tends to be stronger in countries with more detrimental drinking patterns. Although the relative alcohol effect in former Czechoslovakia was twice as

large as the one for Belarus, which had homicide rates that were seven times higher, the linear model showed that the absolute alcohol effect was stronger for Belarus compared to former Czechoslovakia. The linear model also gave more interpretable results regarding the impact of drinking patterns on levels of homicide rates.

However, Russia had a high coefficient both in the semilogarithmic and linear models. There could be several explanations for this. The coefficients would have been overestimated if the levels of alcohol consumption were systematically underestimated, but because unregistered consumption was included for Russia this does not seem like a probable explanation. However, as noted in the introduction, the high levels of alcohol consumption and homicide rates in Russia have been linked to social stress and anomie due to worsening of the social and economic conditions after the collapse of the Soviet Union. It is therefore possible that an interaction between alcohol consumption and other factors is stronger in Russia compared to, for example, former Czechoslovakia. Thus, it is possible that alcohol leads to more violent behavior when in combination with, for instance, unemployment and poverty as in Russia. Another explanation relates to possible differences between the countries regarding drunken comportment. Alcohol-related aggression is known to vary greatly according to culture because of different drunken behavior and norms concerning drunken comportment (MacAndrew & Edgerton, 1969). There is a social tolerance for heavy drinking in Russia. The bar/pub culture is less developed, and these conditions may result in more drinking in private or semiprivate settings (Pridemore, 2004). In former Czechoslovakia, there is a lack of acceptance of public drinking (Iontchev, 1998), implying that the norms and the internal and informal social control for drunken behavior in Russia is somewhat less present and less restrictive than in former Czechoslovakia.

The assumption that the alcohol effect on homicide rates for men would differ from that for women was not supported, the estimates were of approximately the same magnitude and only significant for Russia. However, the homicide rates both for men and women are much higher in Eastern Europe than in Western Europe. The difference between homicide rates for men and women are also much greater in Eastern Europe than in Western Europe, which may explain why the relative changes in alcohol consumption remained the same for both genders.

There are good theoretical reasons to expect a causal relationship between alcohol consumption and homicide, and a temporal relationship has been demonstrated in several countries (Lenke, 1990; Rossow, 2001). Although direct comparison of these estimates may be problematic because of less accurate measurement of alcohol consumption in Eastern Europe, they may still give an indication of the situation in Eastern Europe as compared to Western Europe. The comparisons of the estimated absolute changes in homicide rates based on the semilogarithmic models showed that changes in alcohol consumption had a larger impact on homicide rates in eastern European countries than in Western Europe. This finding supports the assumption that the alcohol-homicide association would be stronger in eastern European countries than in western countries, and the findings also indicate that the

social cost of alcohol consumption in terms of homicide rates is higher in Eastern Europe. Moreover, the results also indicated that the effect of alcohol in Eastern Europe was similar to the one found in Northern Europe.

There have been some suggestions of a beverage-specific effect on homicide, especially for Russia and Belarus (Pridemore, 2002; Razvodovsky, 2003), that is, that in addition to *how* one drinks, *what* one drinks also matters. The reasoning for this is that the consumption of vodka is argued to result in quicker intoxication, and that this in combination with binge-drinking also would imply more frequent violence (Razvodovsky, 2003). On the other hand, there is a suggestion that beverage-specific effects have more to do with the social definition of the beverage, that is, drinking pattern and social norms, than with pharmacology (Graham, Schmidt, & Gillis, 1996). However, findings from Western Europe are not conclusive on this matter, suggesting that beverage-specific effects appear to be most prominent within drinking cultures where the beverage in question dominates (Rossow, 2001). This is in line with the results from the present study, where associations between alcohol consumption and homicide were found in two spirits-dominated countries (Belarus and Russia) and one beer-dominated country (former Czechoslovakia).

Some limitations of the study should be noted. The main concern is the quality of the proxy for total alcohol consumption related to unrecorded consumption, which is widespread in the eastern European countries. The impact of unrecorded consumption will, however, depend on whether it is strongly positively or negatively correlated with recorded consumption. If there is a positive correlation, then we may have systematically underestimated the level of alcohol consumption, and the alcohol homicide association will be overestimated. Correspondingly, the result may be an underestimation of the alcohol effect if unrecorded consumption is negatively correlated to changes in alcohol sales (see Skog, 1986).

It should also be noted that the estimates of unrecorded consumption that was added for Russia is based on different and fairly uncertain estimation methods for estimating actual consumption for different periods (Nemtsov, 2003; Treml, 1982) and that they are difficult to replicate, and thus, the validity assessment is more difficult. In general, however, the present results should be considered to have fairly good validity in terms of an expected positive association between population drinking and homicide rates, and the present results also correspond with the results from a previous study on alcohol and homicide in Russia where an alternative proxy for heavy drinking was used, namely alcohol-related causes of death (Pridemore & Chamlin, 2006). Another limitation is that there are relatively few observations in the time series, and differencing of the series further implies a risk of Type II errors. Although the estimates were pooled for overall results and two groups with different drinking pattern, and thus to some extent reduced this risk, one should interpret the lack of statistically significant associations with caution. On the other hand, there is also a risk of omitted variable bias, that is, other variables that may systematically vary with annual changes in alcohol consumption. However, there were no obvious candidates for such omitted variables.

The results suggest that alcohol consumption is an important factor when we wish to explain changes in homicide rates over time. The findings from this study are in line with a number of previous studies showing that homicide rates tend to change systematically with changes in alcohol consumption at the population level. The results also support the hypothesis that drinking patterns are of importance when studying the association between alcohol and violence. Moreover, the impact of changes in alcohol consumption tends to be stronger in countries with more detrimental drinking patterns, implying that the relative risk will depend on the patterns of drinking and of behavior associated with drinking in a particular society.

The results of this study indicate that changes in alcohol consumption might have a more dramatic effect on levels of homicide in Eastern Europe than in Western Europe, which also was demonstrated under the antialcohol campaign in Russia (Nemtsov, 1998). Policy strategies such as limiting the availability and increasing the price of alcohol are shown to be effective strategies to reduce alcohol consumption and thereby levels of alcohol consumption and homicide (Babor et al., 2003). Combined with strategies to reduce the pattern of binge drinking, these are control measures that seem to have a significant potential in the eastern European countries for reducing the prevalence of heavy drinking episodes and thereby preventing homicides.

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