

Alcohol and gender gaps in life expectancy in eight Central and Eastern European countries

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ABSTRACT

Background: Gender differences in life expectancy have been traditionally large in Central and Eastern Europe (CEE), and alcohol has been hypothesized to be one of its main determinants. We examined the role of alcohol in gender differences in life expectancy in Estonia, Lithuania, Latvia, Moldova, Poland, Romania, Russia, and Ukraine, and changes in this role from 1965 until 2012.

Methods: We decomposed the gender differences in life expectancy at birth (LE) into alcohol- and non-alcohol-related mortality. We examined causes of death wholly attributable to alcohol over the whole period, and estimated from 1990 onwards additional alcohol-attributable mortality by using alcohol-attributable fractions from the Global Burden of Disease study.

Results: In the eight CEE countries, women's advantage in LE relative to men increased from 7.3 years on average in 1965 to 10.0 years on average in 2012. All alcohol-attributable mortality contributed 1.9 years on average (UI: 1.2-2.5) (18.8%) to the gender differences from 1990 to 2012. Its relative contribution increased in most countries until around 2005, and declined thereafter, resulting in a contribution of at least 15% in 2012. The absolute contribution of alcohol to the LE gender gap was strongly correlated with the overall LE gender differences (Pearson's $r > 0.75$), except in Poland and Estonia.

Conclusions: Despite recent declines, the contribution of sex differences in excessive alcohol consumption to the LE gender gap is substantial, and should not be neglected. Tackling gender differences in alcohol consumption and alcohol-attributable mortality would contribute to further progress in reducing mortality.

Keywords: alcohol, mortality, alcohol harm, cause-specific mortality, gender gap

INTRODUCTION

Around the world, women live longer than men. Gender differences in life expectancy are especially large in Central and Eastern Europe (CEE); in several CEE countries, the life expectancy (LE) gender gap exceeds 10 years (1). These substantial gender inequalities are attributable far less to biological factors (2) than to behavioural factors (2-4). It is therefore important to study these factors in depth to support the formulation of health policies aimed at reducing health and gender inequalities.

It has been argued that the gender gap in alcohol consumption (5,6) is an important contributor to gender differences in health and mortality (4). Especially among middle-aged men in CEE countries, alcohol consumption is highly prevalent, binge drinking is common, and men are more likely than women to prefer vodka and other beverages with very high levels of ethanol (6-9). These patterns have resulted in large gender differences in mortality from causes of death strongly linked to excessive alcohol consumption and binge drinking; i.e., cardiovascular and external causes, especially at working ages (10,11).

Despite the important role alcohol appears to play in the mortality gender gaps in CEE countries, to our knowledge only one existing study has examined the impact of alcohol on gender gaps in life expectancy in CEE countries. McCartney et al. (12) found that alcohol explained about 20-30% of the gender gap in mortality in Eastern Europe in 2003-2005. However, they used a very broad definition of alcohol-attributable mortality, defining all external deaths as alcohol-related deaths, and including very few causes of death from diseases partly attributable to alcohol use. Moreover, they only studied the importance of alcohol at one point in time.

Life expectancy trends have varied markedly between men and women and across CEE countries in recent decades, leading to an overall pattern of divergence (13). Alcohol consumption in these countries also fluctuated over time (8,14), and its impact on mortality in CEE region has been recognized in several studies (e.g. (15-17)). It is therefore essential to study the varying contributions of alcohol to the gender gaps in life expectancy in different CEE countries and different periods of time.

Aim

To examine the role of alcohol in gender differences in life expectancy in Central and Eastern Europe, and changes in this role over time.

METHODS

Setting

We studied gender-specific national populations from Central and Eastern European (CEE) countries for which recent long-term time series of cause-specific mortality data were available: namely, Estonia, Lithuania, Latvia, Moldova, Poland, Romania, Russia, and Ukraine. For most countries, we were able to study the 1965-2012 period. For some countries, longer time series data were available and were used (1955-2014). For Romania, only data from 1980 onwards were available.

We assessed the gender differences in life expectancy at birth (LE), and examined the contribution of i) causes of death wholly and partly related to alcohol over the whole period, and ii) alcohol-attributable mortality from 1990 onwards.

Data

Cause-specific and all-cause mortality data were retrieved by gender, age (0, 1-4, 5-9, ..., 85+) and year from the Human Cause of Death Database (HCD) (18). The HCD is a recent open-source project that offers harmonised data on reconstructed long-term trends in cause-specific mortality.

We distinguished two different groups of alcohol-related causes of death by selecting the diseases related to alcohol from a recent review by Rehm and colleagues (19). The first group included causes of death wholly attributable to alcohol (mental and behavioural disorders due to alcohol use, alcohol liver disease, and poisoning by exposure to alcohol; F10, K70, and X45, respectively). The second group included causes partly attributable to alcohol use: ischaemic heart disease, cerebrovascular disease, alcohol-related cancers, epilepsy, pancreatitis, non-alcoholic cirrhosis, tuberculosis, transport accidents, and other external causes (Table 1). Finally, the remaining causes were considered not attributable to alcohol.

We estimated from 1990 onwards alcohol-attributable mortality by summing the mortality wholly and partly attributable to alcohol. Mortality partly attributable to alcohol was obtained by multiplying the country, year, gender, and age-specific mortality rates from causes of death partly attributable to alcohol (see Table S1) by the corresponding alcohol-attributable fractions. The country-, year-, gender-, age-, and cause-specific alcohol-attributable fractions (and their 95% uncertainty intervals) were obtained from the Global Burden of Disease (GBD) Study 2013 for the years 1990, 1995, 2000, 2005, 2010, and 2013 (20,21). By linear interpolation we obtained the alcohol-attributable fractions for the years in between (data available online: <https://osf.io/av958/>).

<Table 1 about here>

Analysis

Life expectancies (LE) were estimated for each country, year, and gender using standard life table techniques (22). We applied a standard decomposition technique (23) to the gender differences in LE to obtain the contribution of i) the different causes of death, and ii) alcohol-attributable mortality versus non-alcohol-attributable mortality. This decomposition technique involved decomposing the differences in the LE gender gap into the contribution of each specific age group, estimating the cause-specific contribution for each age group, and summing up the age-specific contributions for each country-year combination. We used the Pearson's correlation coefficient (r) to assess the correlation between the absolute contribution of alcohol and the differences in the LE gender gap.

All of the data analyses were performed using R 3.4.0 (24) in R studio 1.00.44 (25).

RESULTS

LE gender differences and trends in these differences

In the eight CEE countries studied in 1965, life expectancy at birth (LE) was, on average, 7.3 years higher for women than for men (Figure 1). In 2012, the female advantage was even larger, at 10.0 years. In five countries, this gap surpassed 12 years at some point in time. The LE gender gap ranged from 4.6 years in Moldova to 9.4 years in Russia in 1965, and from 7.4 years in Romania to 12.0 years in Russia in 2012.

These LE gender differences gradually increased until the early 1990s, except during the Gorbachev period (1984-1987) in the former Soviet republics. In most CEE countries, the largest LE gender gap occurred in the mid-1990s and the mid-2000s. From around 2005 onwards, the LE gender gap generally declined, but remained at a

high level. In the non-post-Soviet states, the LE gender gap either stayed relatively stable (Romania) or slowly declined (Poland) from the 1990s onwards.

Contribution of alcohol-related causes of death to gender differences in LE

In all available country-years analysed from 1955 to 2014, the causes of death wholly attributable to alcohol (mental and behavioural disorders due to alcohol use, alcohol-induced liver disease, and poisoning by exposure to alcohol) explained between 1.1% and 10.3% of the LE gender gap (4% on average).

The causes of death partly related to alcohol explained, on average, 64% of the gender gap in LE. These causes, which included IHD, strokes, and external causes, were also the main contributors to increases over time in the LE gender gap. However, the contribution of alcohol to causes of death partly related to alcohol – and, consequently, the overall contribution of alcohol-attributable mortality – can only be ascertained for the period from 1990 onwards.

<Figure 1 about here>

Contribution of alcohol-attributable mortality to gender differences in LE

Overall, alcohol-attributable mortality (deaths wholly attributable to mortality plus estimates of alcohol-attributable mortality from causes of death partly related to alcohol) contributed 1.9 years on average (UI: 1.2-2.5) (18.8%) to the LE gender gap between 1990 and 2012 (Figure 2, Table 2). The contribution of alcohol to the LE gender gap exceeded 15% in all eight countries in 2012, and in 173 out of 188 country-years analysed between 1990 and 2012. The relative contribution of alcohol to the gender gap in LE ranged from 12.7% (UI: 7.6-16.8%) in Poland in 1990 to 24.1% (UI: 18.2-28.6%) in Lithuania in 2007.

Visual inspection of the time trends in the relative contribution of alcohol to the LE gender gap revealed that in most countries, the gap increased until around 2005, and declined thereafter (Table 2). Exceptions were Latvia and Romania, where the relative contribution of alcohol to the LE gender gap changed little between 1990 and 2012; and Poland, where it increased throughout the period. Visual inspection of the trends in the LE gender gap and in alcohol-attributable mortality revealed that these trends evolved parallel to one another in most CEE countries ($r > 0.75$), except in Poland and Estonia (Figure 2).

<Figure 2 about here>

<Table 2 about here>

DISCUSSION

Summary of results

Our study reported estimates of the contribution of alcohol to the gender gap in life expectancy (LE) trends in eight CEE countries. Women's advantage in LE relative to men increased from 7.3 years on average in 1965 to 10.0 years on average in 2012. Causes of death wholly attributable to alcohol explained 0.4 years on average (4.0%) of the LE gender gap over the 1965-2012 period. Alcohol-attributable mortality as a whole accounted for 1.9 years on average of the LE gender gap (1990-2012), and for at least 15% of the LE gender gap in all countries studied in 2012. Overall, the contributions of alcohol to the LE gender gap and to the size of the LE gender gap were highly correlated ($r > 0.75$), except in Poland and Estonia. The relative contributions of alcohol to the LE gender gap increased in most CEE countries until around 2005, and declined

thereafter. However, the contribution of alcohol to the LE gender gap exceeded 15% in 2012 in all analysed countries.

Strengths and limitations of the study

Our study provided a very detailed examination of the impact of alcohol on LE gender differences in CEE countries by studying time trends from 1965 to 2012 in eight CEE countries, and by using a method to estimate alcohol-attributable mortality that went beyond merely using (underlying) cause-specific mortality data, as was done in the only previous study on the same topic (12).

In our view, the use of cause-specific mortality in combination with alcohol prevalence data and information on the relationship between alcohol consumption and cause-specific mortality (relative risks) leads to more accurate estimates of total alcohol-attributable mortality than methods that use only underlying cause-of-death mortality data.

The use of the GBD estimates based on alcohol prevalence and relative risks also has some limitations, which have been discussed in detail elsewhere (26,27). The estimates for Russia and Ukraine in particular should be interpreted with caution. The GBD used Russian-specific relative risks for Russia and Ukraine to account for potential differences in drinking behaviours between these two countries and the other countries for which world-wide relative risks were used (27). However, the Russian-specific relative risks suffer from several limitations. When we compare the resulting alcohol-attributable mortality levels in Russia and Ukraine with other estimates of alcohol-attributable mortality, the potential for overestimation using this approach becomes apparent, especially for women (27). If alcohol-attributable mortality among women is

overestimated, the sex differences would be smaller, and the contribution of alcohol to the LE gender gap in Russia and Ukraine could be underestimated.

Additionally, some causes of death either wholly or partly related to alcohol could not be included in our estimate of alcohol-attributable mortality because of a lack of mortality data (HCD) or attributable fractions (GBD). In a sensitivity analysis using additional available data on causes of death wholly attributable to alcohol (I426 – alcoholic cardiomyopathy-, G312, K860 and Y15) for Poland, Romania, and Ukraine, we observed that in both 1990 and 2012, the contribution of alcohol to the LE gender gap increased by less than 1% in Romania and Poland, and slightly more in Ukraine (1.4% in 1990; 2.8% in 2012). These findings suggest that the degree of underestimation was small when the causes of death wholly attributable to alcohol were not included; though it was largest in the former Soviet countries where alcoholic cardiomyopathy was high, especially among men (28). The causes of death partly attributable to alcohol that could not be included were hypertensive diseases (I10-I15) and cardiac arrhythmias (I47-I49) (19). However, because mortality from those causes was relatively low (usually below 2% in most country-years), we expect that not including these causes resulted in only a slight underestimation of the contribution of alcohol to the LE gender gap.

Any comparison between countries and over time of alcohol-related cause-specific mortality may be affected by differences in coding practices (29). Because our goal was to examine the role of alcohol in sex differences in LE we do not expect that differences in coding practices have a notable effect on our results.

Taking the abovementioned data issues into account, we believe that our estimates of the contribution of alcohol-attributable mortality to the LE gender differences are actually rather conservative.

Interpretation

The contribution of alcohol-attributable mortality to the LE gender gap exceeded 15% in 2012 in all eight analysed CEE countries. Sex differences in excessive alcohol consumption thus seem to play a substantial role in explaining the LE gender gap. The evidence showing that alcohol consumption levels are higher and alcohol consumption patterns are riskier among men than among women of young and working ages has generally been explained by differences in gender roles (6,9), as well as by differences in strategies for coping with stress (10,30).

Despite the importance of alcohol to the observed LE gender differences, those differences remain very large even after the contribution of alcohol-attributable mortality is excluded. If alcohol-attributable mortality is removed, the LE gender gap still exceeds eight years in Russia, Ukraine, and the Baltic states in 2012, and the peaks in the trends over the study period are less accentuated (i.e., around 1994 in former Soviet countries) (Figure 2). These remaining LE gaps are even larger than the current LE gender gaps of between four and seven years observed in the rest of Europe (31), and to which the contribution of alcohol tends to be smaller than in the CEE countries (around 0.5 years based on the gender differences in potential gains in LE by eliminating alcohol-attributable mortality) (27). Since alcohol alone cannot explain why sex differences in mortality are larger in CEE countries than in other European countries, other factors should be considered when trying to explain the LE gender gap.

Both biological and non-biological factors contribute to LE gender gaps. The main non-biological factors are unhealthy lifestyles (2,3,32-34), of which smoking is the most researched. A recent study examined in detail the contributions of smoking, other non-biological factors, and biological factors to the LE gender gap in 53 industrialised countries over the last 50 years (2). For our eight CEE countries, this study found that smoking accounted for an average of 36% (range: 32-43%), biological factors accounted for an average of 14% (range: 12-17%), and other non-biological factors accounted for an average of 50% (range: 39-55%) of the LE gender gap in 2005/09. Our estimate for the contribution of alcohol in 2012 (15-22%) is close to half of the estimated contribution of smoking, but more than one-third of the estimated contribution of other non-biological factors. Clearly, the role of alcohol should not be neglected when seeking to explain LE gender gaps in CEE countries.

Over the 1990-2012 period, LE gender gaps were strongly correlated with the contribution of alcohol-attributable mortality to those gaps in most CEE countries. Because correlations between the LE gender gap and the contribution to this gap of causes of death wholly attributable to alcohol remained strong over this period for most CEE countries, we can assume that the attributable fraction approaches we applied had only a minor impact on these correlations. Instead, the similarities between the time patterns of and the fluctuations in the contribution of alcohol and the LE gender gap suggest that alcohol indeed influenced the trends in LE sex differences. However, because the time pattern for the contribution of alcohol was less pronounced than the time pattern for the LE sex differences, other determinants of the trends in the LE gender gap should have exhibited similar patterns over time. It therefore appears likely that the overall context, including economic and health conditions, affected several factors (e.g., alcohol, other lifestyles, health care) at the same time.

The contribution of alcohol to the LE gender gap in both absolute and relative terms increased in most former Soviet countries throughout the 1990s, and declined from around 2005 onwards. The increase in the 1990s may have been related to both the end of Gorbachev's anti-alcohol campaign and the severe socioeconomic and health crisis in the early 1990s (35,36). The recent declines in the contribution of alcohol to the LE gender gap (in both absolute and relative terms) could be related to changes in alcohol consumption. Over the last 10 years, alcohol consumption has been gradually declining in most CEE countries, and especially in the former Soviet countries due to the decline of drinking beverages with high levels of ethanol (mainly spirits and unrecorded alcohol) (8,14). This trend is at least partly the result of alcohol policy changes that occurred in most CEE countries from around 2005 onwards (36-38). Men have likely been affected by these developments more than women for the simple reason that men tend to drink more than women. However, in line with the general convergence in the lifestyle behaviours of men and women as a result of changes in the position of women in society (34), women in Russia and worldwide have recently started adopting the alcohol consumption behaviours of men (9,39,40).

Conclusions and policy implications

The contribution of alcohol to the life expectancy gender gap in the eight CEE countries studies, , accounting for at least 15% in 2012, is notable. The recent declines in the contribution of alcohol to the LE gender gap can be partly explained by declining sex differences in alcohol consumption as a result of successful alcohol policies and changes in the position of women in society.

Tackling gender differences in alcohol consumption and alcohol-attributable mortality would contribute to further progress in reducing mortality, and to gender convergence in

life expectancy. However, tackling alcohol alone is not sufficient; other risk factors, and especially smoking, also deserve special attention.

Conflicts of interest

None declared.

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Key points

- The contribution of sex differences in alcohol consumption to the gender gaps in life expectancy is at least 15% in all 8 analysed CEE countries in 2012.
- The contribution of alcohol to the gender gap in life expectancy has been moderately declining in most CEE countries from around 2005 onwards due to overall declines in alcohol consumption.
- Alcohol can importantly contribute to explain the higher gender difference in life expectancy in CEE countries as compared to other European countries.

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Tables

Table 1. Selected causes of death wholly, partly, and not attributable to alcohol

Alcohol	Group of causes	Causes of death	ICD-10 code
Wholly	Wholly attributable to alcohol	Mental and behavioural disorders due to alcohol use	F10
		Alcoholic liver disease	K70
		Accidental poisoning by and exposure to alcohol	X45
		Ischemic heart disease	I20-I25
Partly	IHD or stroke	Cerebrovascular disease	I60-I69, G45
		Transport accidents	V01-V99
	Other non-external alcohol-related causes	Colon and rectum cancer	C18-C21
		Oesophageal cancer	C15
		Larynx cancer	C32
		Lip and oral cavity cancer	C00-C14
		Epilepsy	G40-G41
		Pancreatitis	K85-K86
		Non-alcoholic cirrhosis and other chronic liver diseases	K71-K76
	Other external alcohol-related causes	Tuberculosis	A12-A19, B90
		Other external causes	W00-Y98 (except X45)
No	Remaining causes	Remaining causes	All other codes

Table 2. The absolute and relative contributions of alcohol-attributable mortality to the gender gap in life expectancy at birth in 8 CEE countries, 1990, 2012, and 1990-2012 (only relative contributions)

	1990		2012		1990-2012
	years	%	years	%	Trend (%)
Estonia	1.5 (0.5-2.4)	14.7%	1.8 (1.2-2.3)	17.4%	
Latvia	1.5 (0.5-2.4)	15.0%	1.6 (0.9-2.1)	16.0%	
Lithuania	1.4 (0.5-2.2)	13.9%	2.4 (1.7-3.0)	21.5%	
Moldova	1.2 (0.8-1.5)	17.6%	1.6 (0.7-2.1)	18.0%	
Poland	1.2 (0.7-1.5)	12.7%	1.4 (1.1-1.7)	16.9%	
Romania	1.4 (1.1-1.7)	20.9%	1.4 (1.1-1.7)	19.9%	
Russia	1.9 (1.0-2.6)	17.7%	2.1 (1.1-3.0)	18.6%	
Ukraine	1.4 (0.4-2.2)	14.9%	1.5 (0.3-2.5)	15.1%	

Figures titles and legends

Figure 1. The contribution of causes of death wholly and partly related to alcohol to gender differences in life expectancy at birth (LE) in 8 CEE countries, 1955-2014^b

- a. See Table 1 for further details on causes of death partly related to alcohol.
- b. Data availability by country: Estonia: 1955-2012; Latvia and Lithuania: 1956-2012, Moldova 1965-2014; Poland: 1959-2014; Romania: 1980-2012; Russia: 1965-2014; Ukraine: 1965-2013.

Figure 2. The absolute contribution of alcohol-attributable mortality (with 95% uncertainty intervals) to the gender gap in life expectancy at birth (LE) in 8 CEE countries, 1990-2014^a, and correlations between these two measures^b

- a. Or latest available year: 2012 for Estonia, Latvia, Lithuania, and Romania; 2013 for Ukraine; and 2014 for Poland, Russia, and Ukraine.
- b. Expressed by the Pearson correlation coefficient (r)