

Contrasts in alcohol-related mortality in Czechia and Lithuania: Analysis of time trends and educational differences

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Abstract

Introduction and Aims. Globally, Czechia and Lithuania are among the top-ranking countries in terms of high alcohol consumption. This study highlights notable contrasts in temporal trends in alcohol-related mortality and identifies country-specific patterns in educational differences. **Design and Methods.** The study uses harmonised cause-of-death series from the Human Cause of Death Database. Mortality disparities by education were assessed using census-linked mortality data. Directly standardised death rates were used to estimate levels of national and group-specific mortality. Relative and absolute mortality differences by education were assessed by range-type measures (Poisson regression mortality ratios and rate differences) and Gini-type measures. **Results.** Between 1994–1995 and 2016, the absolute difference between Czechia and Lithuania in terms of alcohol-related age-standardised death rates (per 1 000 000) decreased from 450 for males and 130 for females to 76 in males and 11 in females. In both countries, alcohol-related mortality was markedly higher among persons of lower education levels. Lithuanian males experienced the highest absolute inequalities measured by rate difference between the low and high educated (740 per million), while Lithuanian females showed the most pronounced relative inequalities (6.70-fold difference between low and high educated). The corresponding figures were less than half for Czechia. **Discussion and Conclusions.** Reducing educational disparities in alcohol-related mortality within both countries would have a substantial impact on overall levels. Policies aimed at targeting the lowest priced and illegal alcohols and reducing levels of harmful drinking should be a priority, especially in Lithuania. [Pechholdová M, Jasilionis D. Contrasts in alcohol-related mortality in Czechia and Lithuania: Analysis of time trends and educational differences. *Drug Alcohol Rev* 2020;39:846–856]

Key words: alcohol-related disorders, differential mortality, educational achievement, social determinants of health, Eastern Europe, Lithuania, Czech Republic.

Introduction

Mortality inequalities favouring advantaged socio-economic groups have been reported in numerous studies [1–10]. Compared to Western and Southern Europe, inequalities tend to be higher in Central and Eastern Europe [4,7,9,10], partly due to more unfavourable mortality trends in disadvantaged population groups before and immediately after the collapse of the socialist bloc around 1990 [4,11]. Despite similarities in political systems based on communist rule, there have been notable differences in political, socio-economic and health patterns between the Central European states and countries of the former Union of Soviet Socialist Republics (USSR). These latter countries, including Lithuania, were more affected by a

prolonged health crisis (starting in the mid-1960s) and problems such as alcoholism and violence that reduced male life expectancy in the 1970s and early 1980s [12,13]. The divergence between the two groups of countries was also visible after the collapse of the USSR: Central European countries underwent earlier and more systematic improvements than former USSR countries, which experienced an unprecedented mortality crisis in the early 1990s. For example, Lithuania, which had a life expectancy that was very close to Czechia until 1990, experienced a massive (almost four years) drop in male life expectancy between 1990 and 1994. This was followed by another period of stagnation or decrease in life expectancy between 2000 and 2007 [12]. The lack of progress of life expectancy in Lithuania coupled with steady improvement in

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Czechia resulted in a difference between the two countries of nine years for men and three years for women in 2007.

It has been shown that alcohol-related mortality played an important role in these negative changes in Lithuania, especially during the economic boom in 2000–2007, which coincided with liberalisation of alcohol control policies and increasing affordability of alcohol [14,15]. Since 2008, life expectancy in Lithuania has been improving, despite the severe effects of that year's financial crisis (causing a 15% decrease in gross domestic product per capita in 2009) and post-crisis austerity [16]. Part of this is accounted for by alcohol control policies introduced in 2008–2009 [12,15], and more recently by further policies introduced in 2016 [17–19]. Nevertheless, the two periods of health deterioration in the 1990s and 2000s created a notable life expectancy gap with Czechia. This is despite the fact that, unlike Lithuania, none of the restrictive policies such as tax increase, availability restrictions or advertising ban were applied in Czechia from 1989 onwards [20]. Importantly, while in Lithuania mortality differences by education increased during the 1990s and 2000s, in Czechia the improvements in mortality over the period did not lead to widening socio-economic differences [6,11–16,21].

Today, Lithuania and Czechia rank among top per capita alcohol consumers in the world [22], but they differ in their drinking patterns. In Czechia, people traditionally consume more beer (54% of total consumption), which is drunk frequently, but not in large amounts on one occasion; whereas in Lithuania, 37% of total volume is consumed in spirits, and alcohol is typically drunk not very frequently but usually in high quantities on one occasion [22–24]. Thus, compared to Czechia, the higher prevalence of heavy episodic drinking in addition to high consumption in Lithuania results in an elevated risk of negative alcohol-related health consequences in the population.

Despite overall reductions in mortality since 2007, Lithuania remains among the leaders in Europe and the world in alcohol-related mortality [24]. Previous studies of Lithuania have shown that lower socio-economic groups had higher alcohol-related mortality [25,26]. In 2001–2004, alcohol-related causes of death explained 8% of the total educational gap in male life expectancy at age 30 [25]. In Czechia, the overall alcohol-related mortality is lower than in Lithuania, but the exact contribution of alcohol to socio-economic differences in mortality has not been estimated.

Numerous studies on socio-economic differences of mortality in Eastern and Central Europe have linked alcohol-related mortality with high social inequality [27–31]. Many of these studies have however relied on

the aggregated population data available from the censuses and the routinely collected statistical information on deaths. However, studies based on death-record information about socio-demographic status often suffer from misreporting of education of the deceased [32,33]. This bias can be avoided if education information comes from the same source in census and death records, which is possible only when death records of individuals are linked to census data.

In this study we, for the first time, use novel datasets based on census-linked death records for both Czechia and Lithuania. This has enabled us to quantify the magnitude of alcohol-related mortality differences by educational classes in both countries and assess their role in the overall mortality disparities. In doing so, we have paid close attention to specific alcohol-related diagnoses and placed these differences in the context of long-term trends in mortality rates. This article thus brings an interesting comparison of two countries both with high alcohol per-capita consumption levels, yet with different histories of alcohol control policies and levels of alcohol-related and overall mortality. Through a comparative synthesis of long-term mortality trends and educational gradients observed at the last census, we aim to highlight the social dimension of the persisting health disparities between the two countries and provide empirically grounded targeting strategies for further policy actions in the field of alcohol control.

Methods

We used annual mortality data for Czechia and Lithuania from 1968 onwards from the Human Causes of Death Database project [34]. These time series were previously reconstructed to mitigate the effects of artefactual changes induced by regular updates of the International Classification of Diseases (ICD). For 2013 onwards, Lithuanian data were extracted from the World Health Organization (WHO) mortality database [35]. Alcohol-related ICD, 10th revision (ICD-10) codes available in this data were alcoholic dependence (F10), alcohol poisoning (X45) and chronic liver disease (K70, K74; the historical data did not provide sufficient detail to distinguish between alcoholic and non-alcoholic liver disease).

Socio-economic disparities were assessed from individual death records linked to the last census of 2011. In Czechia, death records were linked to the census by means of probabilistic linkage based on a combination of several variables, and the follow-up period was one year (between 26 March 2011 and 26 March 2012). In Lithuania, death records were linked deterministically based on personal identification number, with a follow-up period of four years (between 1 March 2011

and 31 December 2015). Data on underlying cause of death were available for full ICD-10 codes, which enabled us to identify alcoholic cardiomyopathy (I42.6). Individuals contributed to person-years of exposure from the date of the census to death or the end of follow-up, whichever was the sooner. In Lithuania, where the follow-up period was longer, emigration was also taken into account.

Educational categorisation was based on the International Standard Classification of Education (ISCED) classification [36] in three levels: primary and lower secondary education (ISCED 0–2); upper secondary education (ISCED 3–4); and tertiary education (ISCED 5 or higher). Analyses were restricted to those aged 30 years or more. Table 1 shows a summary of person-years of exposure and death counts available for analyses.

Death rates were computed as ratios between deaths and person-years of exposure for each population stratum by five-year age groups (30–34, 35–39...85+). Age-standardised death rates (ASDR) per million were estimated for the long-term trends and for each educational category in the census-linked 2011 data, using the WHO European Standard Population [37].

Absolute and relative educational inequalities were estimated. Two measures of absolute inequalities were used: the difference in ASDR between the primary and tertiary educational classes; and an overall measure of mortality dispersion – the average inter-group difference (AID) that summarises population-weighted averages of mortality differences between all possible pairs of educational groups. Unlike the simple difference of rates between highest and lowest education class, the AID takes into account mortality differences across all educational groups, along with their distribution in the population. Relative inequalities were expressed as mortality rate ratios and also in terms of the Gini coefficients. Mortality rate ratios [and their 95% confidence intervals (CI)] for each educational class were estimated by means of Poisson regression. The Gini coefficient was computed as the AID divided by the population-weighted education-specific ASDRs, expressed as a percentage. Inequalities were computed separately for the total of alcohol-related causes of death (F10, I42.6, K70, X45), non-alcoholic liver disease (K73–K74), circulatory diseases (I00–I99 excluding I42.6), external causes of death and accidents (V00–Y98 excluding X45), other causes of death and a total of all causes combined.

Results

Time trends in alcohol-related mortality differed from the all-cause dynamics (Figure 1). In Lithuanian

Table 1. Person-years of exposure and death counts available for analysis from the 2011 census-linked data in Czechia and Lithuania, aged 30 and above

	Person-years of exposure						Deaths								
	Tertiary		Secondary		Primary		Tertiary		Secondary		Primary		Total		
	Abs.	%	Abs.	%	Abs.	%	Abs.	%	Abs.	%	Abs.	%	Abs.	%	
<i>Males</i>															
Czechia	483 660	15	2 352 350	71	489 211	15	3 325 221	4338	9	32 432	66	12 068	25	48 838	25
Lithuania	905 260	22	2 329 400	57	877 796	21	4 112 456	9763	11	36 982	42	40 967	47	87 712	47
<i>Females</i>															
Czechia	402 898	11	2 338 501	65	870 574	24	3 611 973	1374	3	20 440	43	26 054	54	47 868	54
Lithuania	1 426 448	27	2 760 562	51	1 175 006	22	5 362 016	8186	9	27 043	29	59 169	63	94 398	63

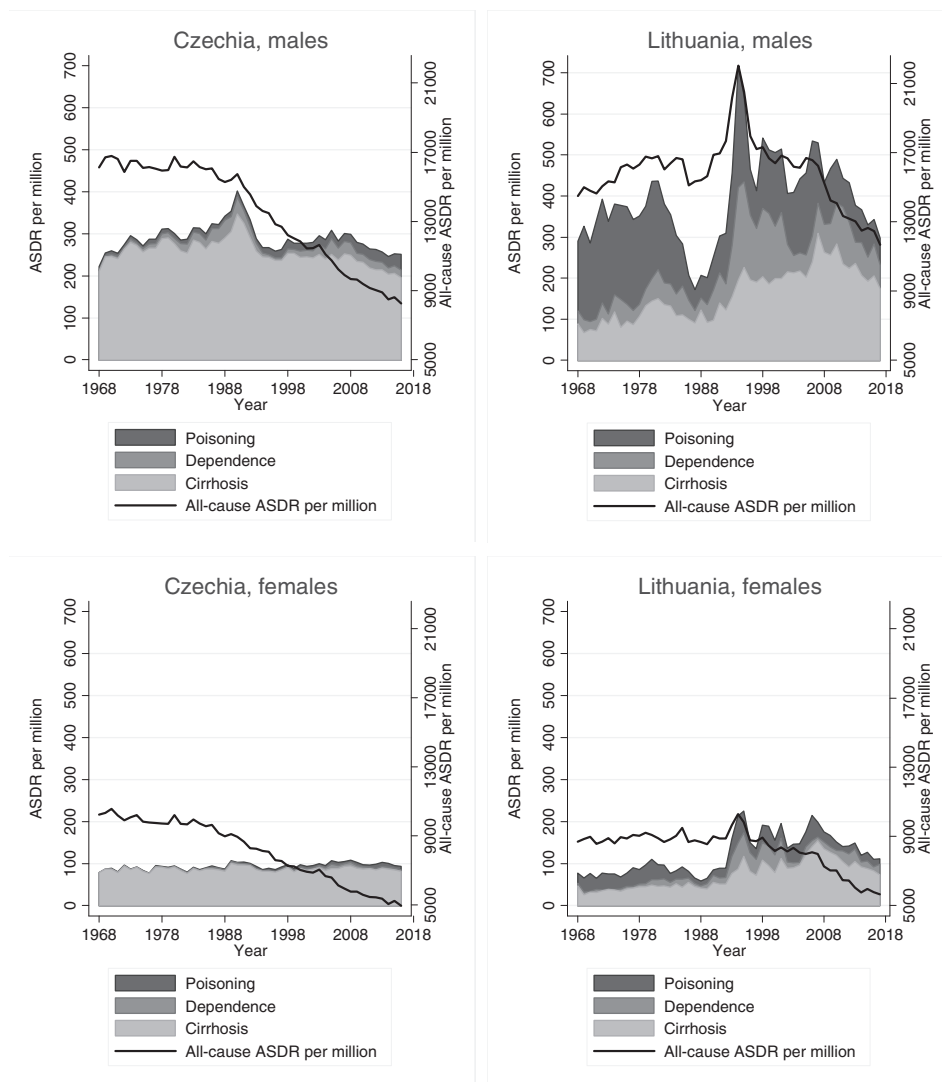


Figure 1. Age standardised death rate (ASDR) due to liver cirrhosis, alcohol dependence and alcohol poisoning combined with all-cause mortality (ASDR per 1 000 000) in Czechia and Lithuania 1968–2017.

males, alcohol-related mortality underwent severe fluctuations throughout the observation period, first driven by Gorbachev's anti-alcohol campaign (1984–1988), then followed by a spectacular peak in 1994, a shaky stagnation until 2008 and then a sustained decline from 2008. Before 1984, male alcohol-related mortality in Lithuania was mainly due to alcohol poisoning, which was also the diagnosis that was most sensitive to the anti-alcohol campaign of 1985 and the mortality crisis of the early 1990s. In more recent years, alcohol poisoning has become a smaller component of the total alcohol-related mortality compared to chronic liver disease. In Lithuanian females, alcohol-related mortality, which was very low before the collapse of the USSR (even lower than in Czech women), increased between 1994 and 2008, but has declined subsequently. Alcohol poisoning was a less important factor

among Lithuanian females: the increase of alcohol-related mortality between 1994 and 2008 was mainly driven by changes in chronic liver disease, as was the subsequent decline. Alcohol-related mortality in Czech males increased between 1968 and 1990. It then declined until 1994, increased again until 2005 and then entered a phase of sustained decline that began around 2008, as in Lithuania. These trends were almost exclusive due to changes in the rate of chronic liver disease, which has been the main component of alcohol-related mortality in Czechia throughout the observation period.

In the critical period of 1994–1995, the absolute difference between Czechia and Lithuania in alcohol-related ASDR (per 1 000 000 person-years) reached 450 for males and 130 for females. The subsequent reductions in alcohol-related mortality in both

countries, more pronounced in Lithuania, have resulted in a narrowing of the alcohol-related mortality gap between them, which dropped to 180 for males and 44 for females by 2011, decreasing further to 76 in males and 11 in females in 2016.

Figure 2 depicts ASDR from individual components of alcohol-related mortality (alcohol dependence, alcoholic liver disease, alcohol poisoning and alcoholic cardiomyopathy) by education category, based on the 2011 census-linked data. A statistically significant educational gradient favouring higher educated groups was observed almost universally. For all educational categories, higher relative and absolute differences were observed in Lithuania than in

Czechia for both men and women. However, these were smallest among the tertiary educated; the observed absolute rate differences were not statistically significant. Almost all the Czech-Lithuanian differences in alcohol-related mortality observed at the population level are thus due to the differences between less educated (secondary and primary education) groups. Alcoholic liver disease was the most commonly reported alcohol-related cause of death in all the educational groups. In Lithuania, alcohol poisoning accounts for 30–40% and cardiomyopathy for 10–15% of all alcohol-related ASDR.

Figure 3 represents the death rates for all alcohol-related causes of death combined by age and

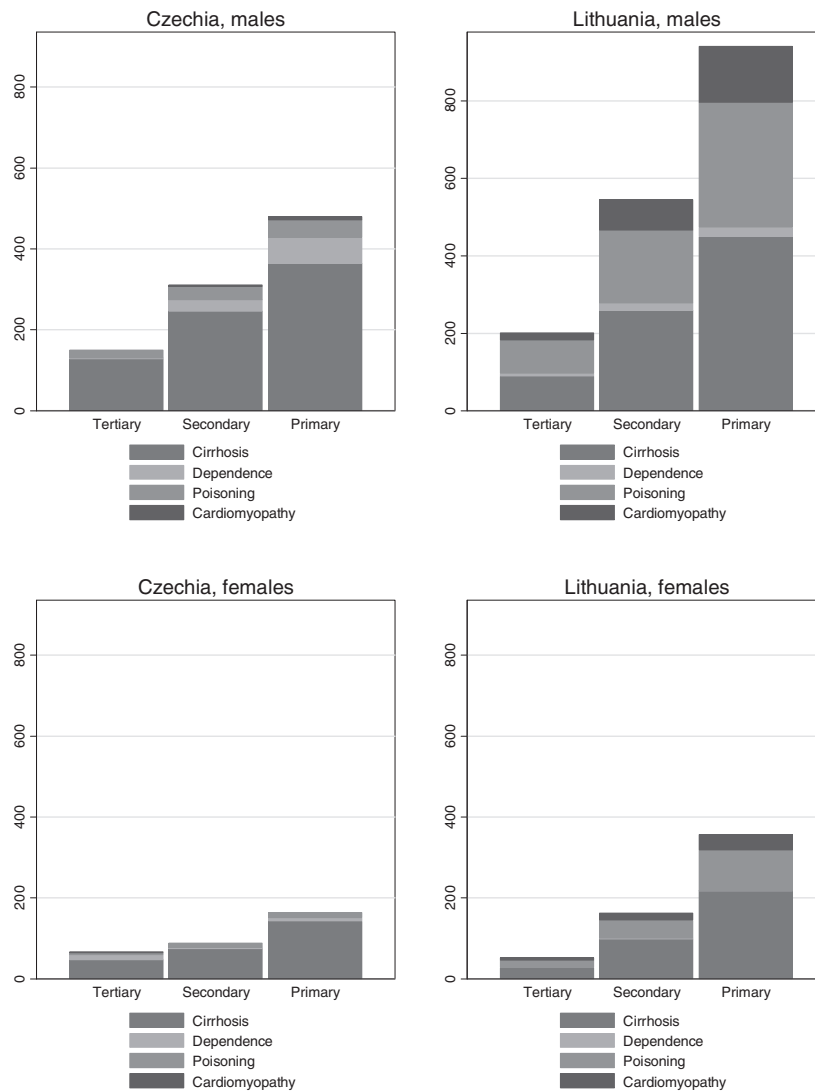
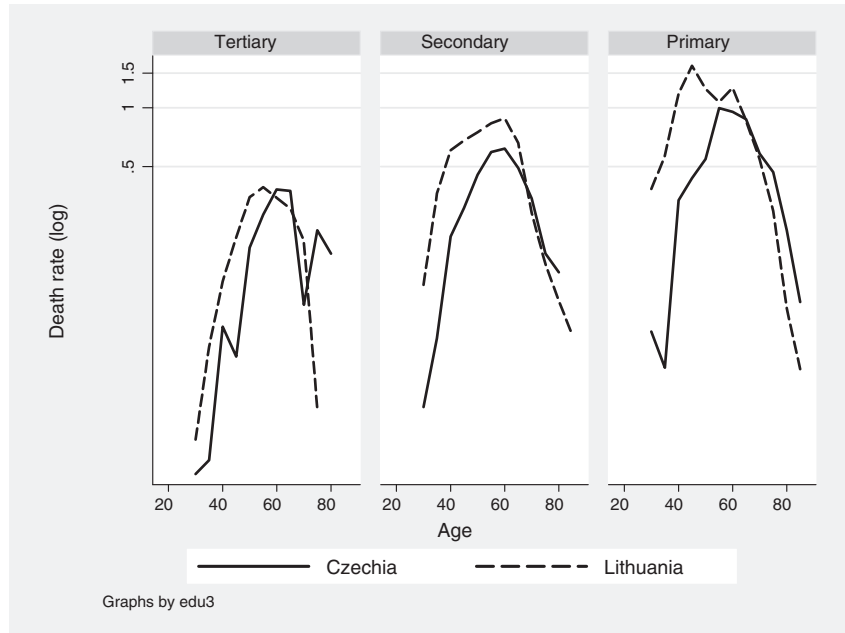
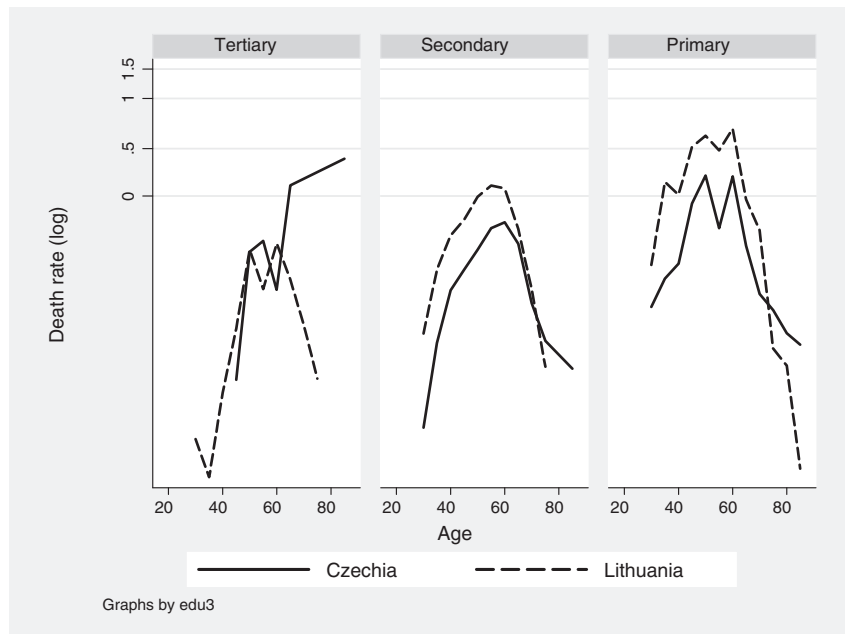


Figure 2. Age standardised death rate due to alcoholic liver cirrhosis, alcohol dependence, alcohol poisoning, and alcoholic cardiomyopathy (age standardised death rate per 1 000 000 person-years of exposure, aged 30 and higher, by educational attainment) in Czechia and Lithuania in the 2011 census follow-up.



(a). Males



(b). Females

Figure 3. Age-specific death rates from alcoholic liver disease, alcohol dependence and alcohol poisoning combined in Czechia and Lithuania according to the 2011 census follow-up.

educational group. The shape of the age-specific curve in almost all educational categories, in both countries and both sexes, is concave (A-shaped), with a steep increase between ages 30 and 60 years and a steep decline thereafter. In all educational categories, higher death rates are observed in Lithuania than in Czechia between ages 30 and 60 years, while the countries tend to converge at older ages.

Table 2 summarises education-specific ASDRs and measures of absolute and relative inequalities for selected underlying causes. All the selected causes show a negative educational gradient. In absolute terms, the biggest disparities are observed among Lithuanian males. In most instances, both relative and absolute inequalities were larger in Lithuania than in Czechia for men and women.

Table 2. Age-standardised death rates by education and inequality measures for selected groups of causes of death in Czechia and Lithuania according to the 2011 census-linked death records, aged 30+ years

Cause	ASDR										Inequality measures			
	Tertiary	(95% CI)	Secondary	(95% CI)	Primary	(95% CI)	Rate ratios	95% CI	G (%)	Rate differences	95% CI	AID		
	Relative			Absolute										
<i>Males</i>														
Czechia	All causes	9.73	(9.45–10.02)	14.67	(14.52–14.83)	21.02	(20.65–21.39)	2.15	(2.08–2.22)	9.47	11.29	(10.82–11.76)	1.41	
	Alcohol-related	0.15	(0.11–0.18)	0.31	(0.29–0.33)	0.48	(0.42–0.54)	3.18	(2.44–4.14)	13.19	0.33	(0.26–0.4)	0.04	
	Liver disease	0.07	(0.04–0.09)	0.09	(0.08–0.1)	0.15	(0.12–0.19)	2.19	(1.45–3.31)	11.07	0.09	(0.04–0.13)	0.01	
	Circulatory	4.54	(4.34–4.74)	6.94	(6.82–7.05)	9.76	(9.51–10.01)	2.16	(2.05–2.28)	9.31	5.22	(4.9–5.54)	0.65	
	External	0.58	(0.51–0.66)	0.91	(0.87–0.95)	1.40	(1.29–1.5)	2.37	(2.06–2.73)	10.92	0.81	(0.69–0.94)	0.10	
Lithuania	Other	4.39	(4.2–4.59)	6.43	(6.32–6.54)	9.23	(8.97–9.48)	2.07	(1.97–2.18)	9.24	4.84	(4.52–5.16)	0.60	
	All causes	11.63	(11.4–11.86)	18.80	(18.6–18.99)	26.28	(25.94–26.62)	2.13	(2.08–2.18)	13.21	14.65	(14.24–15.06)	2.49	
	Alcohol-related	0.20	(0.17–0.23)	0.55	(0.52–0.57)	0.94	(0.85–1.03)	4.61	(3.88–5.47)	22.67	0.74	(0.65–0.83)	0.13	
	Liver disease	0.15	(0.12–0.17)	0.25	(0.23–0.27)	0.34	(0.3–0.39)	2.30	(1.86–2.84)	13.49	0.20	(0.14–0.25)	0.03	
	Circulatory	6.09	(5.92–6.26)	8.97	(8.82–9.12)	12.21	(12–12.42)	1.94	(1.88–2.01)	11.51	6.12	(5.85–6.39)	1.0.04	
Czechia	External	0.89	(0.83–0.96)	1.96	(1.9–2.02)	3.12	(2.97–3.26)	3.48	(3.21–3.78)	19.14	2.22	(2.07–2.38)	0.38	
	Other	4.30	(4.16–4.44)	7.07	(6.95–7.2)	9.67	(9.46–9.88)	2.06	(1.98–2.13)	12.98	5.37	(5.11–5.62)	0.91	
	All causes	6.08	(5.75–6.42)	7.87	(7.76–7.98)	11.16	(10.99–11.33)	1.88	(1.78–1.99)	9.20	5.08	(4.7–5.45)	0.78	
	Alcohol-related	0.07	(0.04–0.1)	0.09	(0.08–0.1)	0.16	(0.13–0.2)	2.41	(1.52–3.82)	15.31	0.10	(0.05–0.14)	0.02	
	Liver disease	0.02	(0–0.04)	0.05	(0.04–0.06)	0.07	(0.05–0.09)	3.53	(1.53–8.13)	12.92	0.05	(0.03–0.08)	0.01	
Lithuania	Circulatory	2.87	(2.62–3.12)	3.81	(3.74–3.88)	5.64	(5.53–5.74)	2.10	(1.92–2.29)	10.31	2.77	(2.5–3.04)	0.43	
	External	0.25	(0.19–0.32)	0.29	(0.27–0.31)	0.44	(0.39–0.49)	1.64	(1.27–2.11)	9.82	0.19	(0.11–0.27)	0.03	
	Other	2.87	(2.65–3.09)	3.63	(3.55–3.7)	4.84	(4.72–4.97)	1.69	(1.56–1.82)	7.73	1.97	(1.71–2.22)	0.30	
	All causes	6.37	(6.24–6.51)	8.84	(8.73–8.94)	13.24	(12.98–13.51)	1.78	(1.73–1.82)	13.50	6.87	(6.57–7.17)	1.24	
	Alcohol-related	0.05	(0.04–0.06)	0.16	(0.15–0.18)	0.36	(0.29–0.42)	6.70	(5.04–8.9)	31.14	0.30	(0.24–0.37)	0.05	
Lithuania	Liver disease	0.06	(0.04–0.07)	0.15	(0.14–0.16)	0.22	(0.17–0.26)	3.63	(2.73–4.83)	21.50	0.16	(0.11–0.21)	0.03	
	Circulatory	3.40	(3.3–3.51)	4.87	(4.79–4.95)	7.27	(7.12–7.42)	1.90	(1.84–1.97)	13.92	3.87	(3.68–4.05)	0.70	
	External	0.27	(0.24–0.3)	0.46	(0.43–0.48)	0.88	(0.79–0.98)	2.48	(2.17–2.82)	21.79	0.61	(0.51–0.71)	0.11	
	Other	2.59	(2.5–2.68)	3.20	(3.13–3.26)	4.52	(4.34–4.7)	1.41	(1.36–1.47)	10.36	1.93	(1.73–2.13)	0.34	

Note: Rate ratios and differences relate to primary and tertiary education. AID, average inter-group difference; CI, confidence interval.

Alcohol-related mortality showed the largest relative educational differences of any cause. Among males, the absolute mortality gradient is three times higher in Lithuania than in Czechia in terms of the AID (0.13 vs 0.04), and more than twice as high for the rate differences. The relative disparities are also higher in Lithuania. This is especially so when disparities are measured by the Gini coefficient, which takes account of differences in the relative size of educational classes in the population: Lithuania has higher shares of the primary and tertiary educated, between whom the differences are the highest.

External causes of death and accidents also show a steeper educational gradient that is more pronounced in Lithuania (mortality rate ratio 3.48, 95% CI 3.21–3.78) than in Czechia (mortality rate ratio 2.37, 95% CI 2.06–2.73). This finding is in line with alcohol being reportedly involved in a certain proportion of accidents and injuries. Finding a stronger gradient in Lithuania may suggest that a higher prevalence of risky drinking, approximately indicated by higher occurrence of alcohol poisoning, results in closer links between alcohol and accidental mortality.

Absolute inequalities in alcohol-related mortality among females are less than half compared to males. Interestingly, Lithuanian women with high education have lower alcohol-related mortality than their Czech counterparts. However, relative educational disparities among Lithuanian females are the highest of all populations under study, those with low educational level being at 6.70 times higher risk of death (95% CI 5.04–8.90) than those with tertiary education, with a Gini coefficient reaching up to 31.14. Like Lithuanian males, Lithuanian females also experience significantly higher disparities in external causes of death and accidents.

Besides alcohol-related deaths declared as such on the death certificate, inequalities were also measured for non-alcoholic liver disease, which is often suspected of including an unknown portion of misclassified alcoholic liver disease deaths. If this were so, a gradient similar to alcohol-related causes would be observed for non-alcoholic liver disease. In both the Lithuanian and the Czech males, this was not so, suggesting that misclassification of alcohol-related deaths as non-alcoholic liver disease is not a substantive issue. However, the situation for females is less clear cut, with relatively large relative differences for non-alcoholic liver disease.

Discussion

Czechia and Lithuania are two former socialist countries of the Central and Eastern Europe, which became

members of the European Union in May 2004. Despite some political and socio-economic similarities related to the period of communist rule, they experienced quite different historical dynamics in the scale and patterns of alcohol-related harm. The fall of communism in Czechia (and in Central Europe generally) was not accompanied by a socio-economic crisis and spike in mortality [38,39]. On the other hand, the political, economic and social upheavals following the collapse of the Soviet Union had a huge impact on overall and alcohol-related mortality in the former member states of the USSR, including Lithuania, resulting in a series of crises and recoveries [12–14,40–43].

Alcohol is also believed to contribute to the change in mortality rates in Central European countries [27], but systematic studies on its exact significance are scarce. Studies of the substantial reductions in mortality in the years following the end of communism in Czechia have emphasized the importance of modernisation of healthcare systems, and the timeliness and effectiveness of treatment of circulatory conditions, suggesting that there were no major fluctuations in alcohol consumption [38]. To our knowledge, ours is the first article to show clearly that there was in fact a transient and sharp increase in alcohol-related mortality in Czechia around the time of the Velvet revolution in 1989–1990. Interestingly, a similar abrupt increase in alcohol-related mortality was observed in East Germany at the time of the reunification in 1990 [44]. It is believed that stress associated with the transition favoured a short-term rise in alcohol drinking, further aided by abandonment of socialist alcohol control policies seen as incompatible with the new concept of civilian freedom [26], and with the market being flooded with cheap and foreign alcohol [27]. From then on, despite a small increase in the overall alcohol consumption and apparent liberalisation of alcohol control (including privatisation of production and sale, unrestricted sale and consumption and considerable increase in affordability [20]), alcohol-related mortality in Czechia increased only slightly, and has even fallen moderately among males since 2008.

In Lithuania, a period of liberalisation of anti-alcohol policies was associated with a sharp increase in alcohol consumption during 2000–2007 [14,15]. However, alcohol control measures introduced since 2008 [19] were followed by reductions in alcohol-related mortality that were steeper than in Czechia, leading to convergence in mortality levels. These observations, along with decreasing shares of alcoholic poisoning, indicate an ongoing homogenisation of drinking patterns and outcomes in the two countries, with Lithuania potentially abandoning the traditional Soviet drinking styles.

Around the last census in 2011, the cause-specific composition of alcohol-related mortality was still notably different between the two countries. However, the vast bulk of the alcohol-related burden in Czechia was alcoholic liver disease, whereas in Lithuania there was an almost equal contribution from acute alcohol poisonings across all categories of education. Studies addressing socio-economic patterning of alcohol consumption in Baltic countries also did not find a clear educational gradient in prevalence of harmful drinking [45]. Assessing the cause-of-death structure of alcohol-related mortality and its differences is essential for anti-alcohol policy design, as measures targeting alcohol poisoning would differ from those aimed at reducing alcoholic liver disease or alcoholism [28]. The alcohol-related mortality gradient and its structure in Czechia fits well with the survey-reported decline in heavy and episodic drinking with increasing education [46,47]. Czech women with high education have mortality levels similar to those with secondary education. This is consistent with findings from an earlier Czech Health Interview Survey, which found highly educated women to be frequent heavy drinkers [48].

In men and women in both countries, alcohol-related mortality shows a stronger connection with educational level than any of the diseases or accidents we have analysed. Similar results were obtained in other studies focusing on socio-economic inequalities in alcohol-related mortality, although the actual figures are not comparable due to differences in period of observation, age range, indicators and data sources [27–31]. Alcohol-related death rates among the tertiary educated are very similar in both countries, but both absolute and relative educational differences were larger in Lithuania. Thus, most of the excess alcohol-related mortality in Lithuania comes from the lower educated.

Alcohol control policies have been proven to affect alcohol consumption [19,49,50], and historical experience from Russia also shows that they can have immediate effects on mortality [13,40,41]. Different types of restrictive measures may impact socio-economic classes differently: while the effects of reducing availability may have a general impact, price-affecting policies are likely to impact the less affluent more – although there is little actual evidence for such effects [51–55]. This study highlights a strong potential of specific policies to address excessive alcohol consumption in both Czechia and Lithuania among the most vulnerable groups. An example of such specific policies is introducing minimal unit pricing, which may target the cheapest alcohol consumed by the least advantaged socio-economic classes [54,55]. Compared to Czechia, lower educated people in Lithuania have been more affected by extreme poverty [56], making them more

prone to consume the cheapest or even illegally imported alcohol. It is also important to note that reductions in alcohol consumption and alcohol-related harm in the disadvantaged groups would lead to notable decrease in the alcohol-related mortality burden for the entire populations. However, the existence of a significant level of alcohol poisonings among the highest educated men in Lithuania underlines the need for general policies and for tighter control of the illegal alcohol market.

The study has a few limitations. The enumeration of alcohol-related harm includes only directly attributable alcohol-related ICD codes, not contributory or indirect mortality. Including indirect conditions would increase the size of the alcohol impact, but it would also decrease the precision of educational gradients estimation. The inequalities were measured for ages 30 years and above. Knowing that the main differences are observed in ages 30–59 years, limiting the analysis to a narrower age range (as in numerous previous studies) would result in larger inequalities. Although all indicators employed in the analyses were age-standardised, we cannot control for changes in selectivity over generations which occur when higher education becomes more available to a broader public, with individuals unable to enter higher education being subject to a stronger negative selection, possibly including by health factors. These changes in negative selectivity can partially contribute to an artefactual increase in mortality differences, especially among younger cohorts. Refining the analyses to the level of detailed causes of death brings in potential bias related to differences in coding systems, particularly when looking at longer-term trends. The period from 1968 onwards was covered by three revisions of the ICD in Czechia and by four revisions of a Soviet classification and two revisions of ICD in Lithuania. The classification changes were accounted for using a best-practice method to adjust the historical series to the current classification and coding system [57–59]. In 2011, both countries used the current revision of the ICD-10, with underlying cause of death suggested by the certifying practitioner on the death certificate and centrally checked using the Automated Classification of Medical Entities decision tables in the respective statistical offices. Although using international standards (ICD, Automated Classification of Medical Entities) assures some level of comparability, the influence of country-specific certification habits or stigmatisation issues remains difficult to measure. Finally, the data rely on linkages to the last Czech and Lithuanian censuses conducted in 2011. To this extent our results on educational differences are not fully up to date, especially in the light of the ongoing improvements in the overall and alcohol-related mortality in Lithuanian and

Czech males. The analyses should thus be repeated and validated against death records linked to the next census in 2021.

Conclusion

Alcohol-related mortality has recently decreased in Lithuania due to effective policies, approaching the levels observed in Czechia and other Central European countries. Educational disparities are larger in Lithuania and responsible for nearly the entire Czech-Lithuanian difference in overall alcohol-related harm. Alcohol control policies should be tailored by complementing general with specific measures targeting groups with elevated risks of alcohol-related deaths.

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Conflict of Interest

The authors have no conflicts of interest.

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APPENDIX

1. The average inter-group difference indicator (AID) was computed as follows:

$$AID = \frac{1}{2} \sum_{i=1}^n \sum_{j=1}^n |ASDR_i - ASDR_j| \rho_i \rho_j,$$

where ρ_i and ρ_j represent relative shares of the educational groups i and j , ranging from 1 to n . In our analyses $n = 3$, ASDR stands for age-standardised death rate.

2. The Gini coefficient was measured as follows:

$$G = \frac{AID}{\sum_{i=1}^n ASDR_i \rho_i} * 100,$$

where education-specific population weights ρ_i sum up to unity.

3. The education-specific mortality rate ratios equal the exponentiated β_1 coefficients resulting from the regressions:

$$\ln(\mu_i) = \ln(E_i) + \beta_0 + \beta_1(\text{edu})_i + \beta_2(\text{age})_i,$$

with the logarithms of the expected death counts (μ_i) as a dependent variable, person-years of exposure (E_i) as offset, and education and age as independent categorical variables.