LITHUANIAN UNIVERSITY OF HEALTH SCIENCES

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THE IMPLEMENTATION OF ALCOHOL CONTROL POLICY AND ITS IMPACT ON ALCOHOL-RELATED MORTALITY AND VIOLENCE IN LITHUANIA

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CONTENTS

LIST OF ABBREVIATIONS

APC – Alcohol per capita consumption
BAC – Blood alcohol concentration
CI – Confidence interval
EU – European Union
ICC – Intraclass correlation coefficient
ID – Identity document
NCDs – Noncommunicable diseases
NGOs – Non-governmental organizations
WHO – World Health Organization

INTRODUCTION

Alcohol consumption is considered as a serious challenge to public health. It is a major risk factor that has a variety of negative consequences for both drinkers and those around them. Alcohol consumption contributed to an estimated 2.6 million deaths worldwide in 2019, accounting for 4.7% of all deaths that year. Based on current evidence, the global burden of disease and injury attributable to alcohol consumption can be measured across 31 health conditions, reflecting alcohol's role in their development, occurrence, and outcomes. Although the problem affects many countries around the world, it is particularly acute in the European region. According to the World Health Organization (WHO), specifically in this region, the highest number of alcohol-related deaths per 100,000 population and the highest alcohol consumption is observed [1]. And it is also one of the health burden factors in Lithuania, significantly contributing to mortality and morbidity rates, especially among the working-age male population. WHO data showed that in 2016, Lithuania had one of the highest per capita alcohol consumption in the world, averaging 15 litres per capita (15+) (in litres of pure alcohol) [2]. This alarming figure marked a turning point in national public and political attention to alcohol-related harm and placed the country at the forefront of global concern.

Understanding the urgency and scale of the problem, the countries must take effective measures to control alcohol. Since the early 1990s, alcohol control policy in Lithuania has undergone various changes – from a liberal approach to firm restrictions. And in recent years Lithuania's alcohol control framework has continually incorporated measures recommended by the WHO. This of course arose as a response to a critical public health situation and to several shocking events related to drunk driving or drinking related events, with the goal of reducing both alcohol availability and the harmful consequences of its consumption in the society [3]. Recent reforms implementing all the WHO "best buys" interventions [4] such as taxation, ban on alcohol advertising, legal age limits for purchase and time restrictions aim to reduce alcohol-related harm.

Since 2016, the APC in Lithuania had been rapidly decreasing, 2017 – 12.3 litres, 2018 – 11.2 litres, 2019 – 11.1 litres [5]. However, this positive trend was interrupted during the COVID-19 pandemic, when general consumption patterns changed and alcohol-related mortality increased, which was partly explained by a polarisation of drinking habits: Lighter drinkers reduced their consumption, while heavy drinkers increased it [6]. In 2022, the situation stabilised and we started to observe once again a decline in alcohol consumption (by 2024, alcohol consumption had declined to 10.2 litres per capita), possibly

reflecting the impact of strengthened alcohol control measures [7]. Although a positive trend is observed, Lithuania remains among the highest alcohol consuming countries in the European Union (EU), and the impact of alcohol - particularly in terms of violent mortality, remains significant [8]. This suggests that the existence of laws alone does not guarantee success, and it becomes important to evaluate the enforcement and effectiveness of alcohol control policies.

First, it helps to determine whether the measures implemented are resulting in the intended public health outcomes, such as reducing mortality or the number of alcohol-related violent incidents. Without such evaluation, there is a risk of relying on assumptions or unjust political arguments rather than evidence – particularly in a policy area where business interests often clash with public health objectives. Understanding what works and under what conditions can inform future policy decisions, particularly in countries facing similar alcohol-related problems.

Finally, measuring effectiveness allows researchers and policymakers to identify implementation gaps or unintended impacts, helping to refine policies over time. With this in mind, it is important to assess not only what policies exist, but also how they work in practise. This dissertation fills this gap by examining how Lithuanian alcohol control policies has evolved, how it is applied in practise and what impact it has actually had over time. The focus is not only on the enforcement of the policy, but also on its effectiveness in harm reduction.

In order to better understand the effectiveness of Lithuania's alcohol policy and the challenges in its implementation, this dissertation combines several sources of data and methods. It offers a literature review of legal changes introduced between 2001 and 2023, paying close attention to key milestones in policy development. Using interrupted time series and other statistical analysis approaches, the dissertation explores whether the timing of major policy reforms corresponds with significant changes in mortality and violence related statistics. A mystery shopper and an advertising ban study investigate the real-world enforcement of availability restrictions. The research also includes an analysis of homicide cases with alcohol presence being identified as one of the factors, which provides a specific legal angle on alcohol-related harm. This combination of approaches allows for a more grounded understanding of how policy translates from law to real outcomes.

This dissertation was prepared within the scope of the international project *"Evaluation of the impact of alcohol control policies on morbidity and mortality in Lithuania and other Baltic states"*, funded by the United States National Institute on Alcohol Abuse and Alcoholism (NIAAA) [Award Number 1R01AA028224] for the period 2020–2025. While developed as

part of this research initiative, the dissertation represents a unique direction, contributing original evidence relevant specifically to the Lithuanian context and it is particularly significant for national policymakers, public health authorities, and society at large.

Practical relevance and novelty

By linking separate policy components, implementation, and impact to health indicators, this study aims to contribute to both the Lithuanian evidence for policy making and the international literature on the effectiveness of alcohol control policies. The results show not only the successes but also the remaining challenges, especially in relation to enforcement. Using a multidisciplinary approach, the thesis aims to provide evidence for the future development of alcohol policies in countries with high alcohol consumption. It also aims to contribute to a broader discussion on how regulation can be made more effective and which policy measures bring measurable benefits. The study is novel in its multidisciplinary approach: it is the first systematic analysis in Lithuania to combine an analysis of legal cases, epidemiological data, interrupted time series analyses and regulatory enforcement studies. In particular, it represents the very first mystery shopping study to assess compliance with the minimum legal age for the purchase of alcohol and one of the first assessments of the implementation of a comprehensive alcohol advertising ban. Importantly, it also assesses implemented policy measures that have not previously been systematically assessed either in Lithuania or internationally. Together, these elements position the thesis as a unique and timely contribution to both Lithuanian and international evidence on alcohol control policy.

THE AIM AND THE MAIN OBJECTIVES

Aim: To assess the implementation of alcohol control policies aiming to reduce alcohol availability in Lithuania and to evaluate their impact on alcohol-related mortality and violence.

Objectives:

1. To evaluate the implementation of restrictions on the availability of alcoholic beverages in Lithuania.
2. To evaluate the impact of alcohol control policies on mortality and violence in the country.
3. To assess the link between alcohol use, mortality from external causes and violence.

THE LAYOUT OF THE DISSERTATION

This doctoral thesis is prepared based on seven published articles (listed in section List of scientific papers) and is composed of three major parts corresponding to each objective of a dissertation (see Figure 1): (1) evaluation of the effectiveness of implementation of adopted policies, using as an example of restrictions on the sale of alcoholic beverages and minimal legal purchasing age; and advertising ban (A1; A2); (2) evaluation of the impact of alcohol control policies on overall mortality, violence (A3; A4); (3) assessment of the link between alcohol intoxication and mortality from external causes also violence (A5; A6; A7). Publications related to studies are published in peer-reviewed journals referred in Web of Science: European Journal of Public Health, International Journal of Environmental Research and Public Health, Journal of Public health, Journal of Scientific Reports, and Medicina.

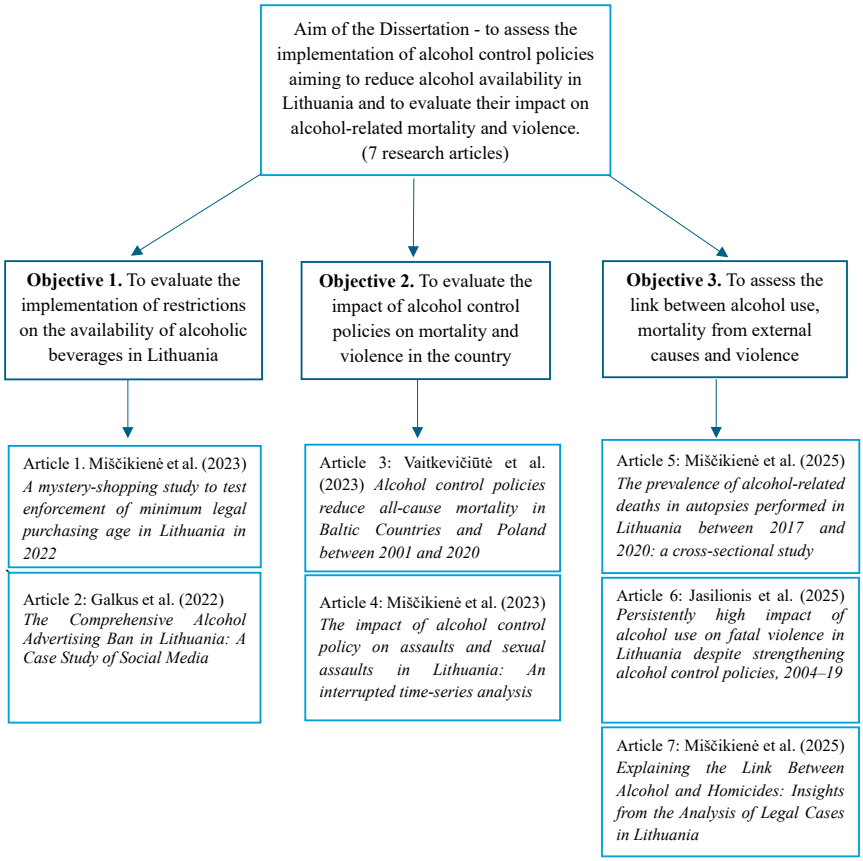

Fig. 1. *Layout of the Dissertation*

LIST OF SCIENTIFIC PAPERS

Publications related to the results of the dissertation in order of below-described results:

A1: **Miščikienė, Laura;** Tran, Alexander; Petkevičienė, Janina; Rehm, Jurgen; Vaitkevičiūtė, Justina; Galkus, Lukas; Lange, Shannon; and Štelemėkas, Mindaugas. (2023). A mystery-shopping study to test enforcement of minimum legal purchasing age in Lithuania in 2022. European Journal of Public Health. Oxford: Oxford University Press, 2023, Vol. 33, No. 2., 317-322. [**Impact factor: 3.7**, aggregate impact factor: 3.259, quartile: Q1]

A2: Galkus, Lukas; Lange, Shannon; Liutkutė-Gumarov, Vaida; **Miščikienė, Laura**; Petkevičienė, Janina; Rehm, Jürgen; Štelemėkas, Mindaugas; Tran, Alexander; Vaitkevičiūtė, Justina. The Comprehensive Alcohol Advertising Ban in Lithuania: A Case Study of Social Media // International Journal of Environmental Research and Public Health. Basel: MDPI, 2022, vol. 19, no. 19, p. 1-14, ISSN 1660-4601.

A3: Vaitkevičiūtė, Justina; Gobiņa, Inese; Janik-Koncewicz, Kinga; Lange, Shannon; **Miščikienė, Laura;** Petkevičienė, Janina; Radišauskas, Ričardas; Reile, Rainer; Štelemėkas, Mindaugas; Stoppel, Relika; Telksnys, Tadas; Tran, Alexander; Rehm, Jurgen; Zatoński, Witold A.; and Jiang, Huan (2023). Alcohol control policies reduce all-cause mortality in Baltic Countries and Poland between 2001 and 2020. Scientific Reports. London: Nature Publishing Group, 2023, Vol. 13, No. 1., 1-8. [**Impact factor: 3.8,** aggregate impact factor: 5.68, quartile: Q1]

A4: **Miščikienė, Laura;** Jiang, Huan; Tran, Alexander; Rehm, Jurgen; Štelemėkas, Mindaugas; and Lange, Shannon. (2025). The impact of alcohol control policy on assaults and sexual assaults in Lithuania: An interrupted time-series analysis. Public Health, 242, 319-323. [**Impact factor:** 3.9 aggregate impact factor: 3.259, quartile: Q1]

A5: **Miščikienė, Laura;** Štelemėkas, Mindaugas; Petkevičienė, Janina; Rehm, Jurgen; Lange, Shannon; and Trišauskė, Justina. (2024). The prevalence of alcohol-related deaths in autopsies performed in Lithuania between 2017 and 2020: a cross-sectional study. European Journal of Public Health, 34(5), 979-985. [**Impact factor: 3.7,** aggregate impact factor: 3.259, quartile: Q1]

A6: Jasilionis Domantas, **Miščikienė Laura**, Lange Shannon, Jiang Huan, Stumbrys Daumantas, Meščeriakova Olga, Štelemėkas Mindaugas, Rehm Jürgen. Persistently high impact of alcohol use on fatal violence in Lithuania despite strengthening alcohol control policies, 2004–19, European Journal of Public Health, Oxford: Oxford University Press, 2025. [**Impact factor:** 3.7, aggregate impact factor: 3.259, quartile: Q1]

A7: **Miščikienė, Laura;** Trišauskė, Justina; Štelemėkas, Mindaugas; and Astromskė, Kristina. (2025). Explaining the Link Between Alcohol and Homicides: Insights from the Analysis of Legal Cases in Lithuania. Medicina, 61(4), 1-13. [**Impact factor: 2.4**, aggregate impact factor: 3.324, quartile: Q1]

PHD CANDIDATE CONTRIBUTIONS

Contribution of author Laura Miščikienė is presented below in respect to the each of publications related to the dissertation (A1-A7 listed in List of scientific papers).

A1: the author was responsible for the study's conception and design, she coordinated and implemented the mystery shopper intervention (field work), conducted data processing and analysis; drafted and revised the manuscript; also coordinated communication among co-authors and contributed to the interpretation of findings.

A2: contributed to development of the manuscript, formal analysis, writing, review and editing; and received full approval from the corresponding author to include this article in the dissertation.

A3: the author contributed to obtaining data for Lithuania's case analysis; development of the manuscript; review and editing; and received full approval from the corresponding author to include this article in the dissertation.

A4: the author was responsible for the study's conceptualization, methodology, data collection, implemented formal analysis, prepared original draft, revised the manuscript; also coordinated communication among co-authors and contributed to the interpretation of findings.

A5: the author was responsible for the study's conception and design, coordinated the acquisition of data from the Institute of Hygiene, conducted data processing and analysis; drafted and revised the manuscript; also coordinated communication among co-authors and contributed to the interpretation of findings.

A6: contributed to development of the manuscript, conceptualization, preparation original draft: writing, review and editing; and received full approval from the corresponding author to include this article in the dissertation.

A7: the author was responsible for the study's conception and design, coordinated the acquisition of data, conducted data processing; drafted and revised the original manuscript; also coordinated communication among co-authors and contributed to the interpretation of findings.

CO-AUTHORS' CONTRIBUTION

A1: Mindaugas Štelemėkas: review and editing; Janina Petkevičienė: review and editing; Jurgen Rehm: review and editing; Shannon Lange: review and editing; Justina Trišauskė: conceptualization, data curation and analysis, writing original draft, review and editing.

A2: Lukas Galkus: conceptualization, methodology, formal analysis, data curation, original draft preparation, review and editing; Vaida Liutkutė-Gumarov: conceptualization, methodology, formal analysis, original draft preparation, review and editing; Mindaugas Štelemėkas: conceptualization, review and editing; Justina Vaitkevičiūtė: conceptualization, methodology, formal analysis, review and editing; Janina Petkevičienė: methodology, review and editing; Jurgen Rehm: review and editing; Shannon Lange: review and editing; Alexander Tran: review and editing.

A3: Justina Vaitkevičiūtė: conceptualization, data curation, writing original draft, review and editing; Inese Gobina: data curation, review and editing; Kinga Janik-Koncewicz: data curation, review and editing; Shannon Lange: review and editing, funding acquisition; Janina Petkevičienė: review and editing, funding acquisition; Ričardas Radišauskas: review and editing, funding acquisition; Rainer Reile: data curation, review and editing; Mindaugas Štelemėkas: conceptualization, data curation, review and editing, supervision, project administration, funding acquisition; Relika Stoppel: data curation, review and editing; Tadas Telksnys: data curation; Alexander Tran: methodology, review and editing; Jurgen Rehm: conceptualization, methodology, review and editing, supervision, project administration, funding acquisition; Witold Zatonski: data curation; Huan Jiang: conceptualization, methodology, software, formal analysis, writing original draft, review and editing.

A4: Huan Jiang: review and editing; methodology and data analysis; Alexander Tran: review and editing; Jurgen Rehm: review and editing; Mindaugas Štelemėkas: review and editing; Shannon Lange: conceptualization, methodology, original draft preparation; review and editing.

A5: Mindaugas Štelemėkas: review and editing; Janina Petkevičienė: review and editing; Jurgen Rehm: review and editing; Shannon Lange: review and editing; Justina Trišauskė: conceptualization, data curation and analysis, writing original draft, review and editing.

A6: Domantas Jasilionis: conceptualization, original draft preparation, review and editing; methodology and data analysis; Jurgen Rehm: original draft preparation, review and editing; methodology and data analysis; Mindaugas Štelemėkas: original draft preparation, review and editing; methodology and

data analysis; Shannon Lange: review and editing; Huan Jiang: review and editing, methodology and data analysis; Daumantas Stumbrys: review and editing, data curation; Olga Meščeriakova: data curation.

A7: Justina Trišauskė: formal analysis, review and editing; Kristina Astromskė: formal analysis, review and editing; Mindaugas Štelemėkas review and editing.

CONFERENCE PRESENTATIONS

1. Oral presentation. Miščikienė, Laura. The enforcement of alcohol control policies: do we put enough effort to follow the regulation? A mystery-shopping study to test enforcement of minimum legal purchasing age in Lithuania. Rethinking Addiction: Policy, Prevention, and Progress - NordAN Conference 2023: October (4) 5-6, Tallinn, Estonia / Nordic Alcohol and Drug Policy Network (NordAN). (1–, p. 1-7). NordAN, 2023.
2. Poster presentation. Miščikienė, Laura; Štelemėkas, Mindaugas; Vaitkevičiūtė, Justina. Mystery Shopping Method for Monitoring Underage Alcohol Sales. First European Conference on Law Enforcement and Public Health - LEPH 2023: 21-24 May 2023, Umea, Sweden.
3. Oral presentation (online). Miščikienė, Laura. A Mystery - Shopping Study in Lithuania: Results and Future Recommendations. Conference: Sharing insights: the power of mystery shopping. October 23, 2024, Slovenia.

1. LITERATURE REVIEW

The search for scientific literature was conducted in PubMed, Google Scholar, the Lithuanian academic electronic library eLABa, and the electronic databases of publications of the Lithuanian University of Health Sciences, using the following key words and combinations: *"alcohol" "alcohol control", "alcohol control policy", "best buys", "interventions for the prevention and control of alcohol", "availability", "legal drinking age", "minimal drinking age", secret shopper", "mystery shopper", "drunk driving", "alcohol marketing", "alcohol advertising", "alcohol pricing", "alcohol taxation", "licensing", "retail sale", "sale hours", "legal age", "excise duty", "blood concentration limit", "driving", "alcohol related mortality", "alcohol and homicide" "alcohol and perpetrator of a crime", "alcohol and autopsy" "alcohol and murder", "violent crimes and alcohol", "alcohol and victim", "alcohol and victimization".* The search covered publications available up to August 2025 and was carried out between June 1 and August 31, 2025.

1.1. Alcohol control policy

Alcohol control policy is a set of public health strategies and legal measures aimed at reducing alcohol consumption and its associated health, social, and economic consequences [9,10]. These policy measures are based on evidence-based interventions and are designed to influence the availability, affordability, marketing, and consumption patterns of alcohol [11]. The WHO defines alcohol control policy as a versatile approach that aims to reduce harmful alcohol consumption through coordinated action at the national and international levels. The main objective are to prevent and reduce alcohol-related harm [12–14].

Although alcohol control policies are typically implemented at the national level, the issue exceed borders due to the influence of global trade, marketing, and international alcohol corporations. Alcohol control is therefore increasingly recognized as a global public health priority requiring international cooperation [15,16]. The WHO Member States adopted resolution on global strategy to reduce the harmful use of alcohol, which stresses the need for joint, coordinated action and highlights the role of governments, civil society and international organizations in developing effective measures [12]. It is important to mention WHO, and other UN bodies often use the term "harmful use of alcohol" instead of explicitly calling for reduced overall consumption as political compromise that accommodates different national perspectives and interests of alcohol industry rather than a purely scientific choice. In official WHO terminology, this concept emerged as a way to secure

agreement among countries with widely differing positions and as noted in recent analyses of global health governance, wording of this type illustrate how international health diplomacy often results in softened terminology in order to avoid strong opposition from influential stakeholders [17]. This helps to understand why, unlike tobacco control, where a binding international treaty WHO Framework Convention on Tobacco Control (FCTC) was adopted, global alcohol policy remains less coherent and relies more on national action [18].

The WHO along other interventions to address noncommunicable diseases (NCDs) provided a list of "best buys" and recently some of the policies are defined also as "quick buys" [19]. Those policies are highly cost-effective measures to reduce alcohol-related harm. It includes recommendations of increasing excise taxes on alcoholic beverages; restricting availability to retail alcohol sales; banning or restricting alcohol advertising across various media platforms. These measures have been shown to have significant public health benefits and are considered essential elements of any national alcohol control strategy [11,20]. Despite their proven effectiveness, their implementation varies greatly due to political, economic, and cultural factors [21].

Countries such as Lithuania and Ireland have demonstrated that strict, evidence-based alcohol policies can significantly reduce alcohol consumption and related harm [9,10,22]. However, differences in policy implementation and enforcement remain a challenge, especially in low and middle-income countries [23,24].

One of the main obstacles to the effective implementation of alcohol policies is the influence of the alcohol industry, which actively seeks to shape public opinion, obstruct or delay regulation, and in such a way defend its commercial interests. Similar to the tobacco industry, alcohol producers use various tactics to undermine public health initiatives [25]. Strategies used include lobbying against regulatory measures, particularly those related to sale restrictions, pricing policies and labelling requirements [26]. Also known is the tactic of the appropriation of public health narratives. Organizations and associations funded by the industry often present themselves as stakeholders in health promotion, and under the guise of this, subtly promote policies that suit their commercial goals [27]. Sometimes it is proposed to involve industry in forming regulation, such as alcohol labelling, but it poses a significant conflict of interest and undermines the credibility of public health messages [28]. Overall, these strategies contribute to a situation and environment in which evidence-based interventions are delayed, weakened, or rejected, which of course has a negative impact on public health goals and does not contribute to reducing alcohol-related harm.

In addition to industry interference, effective alcohol policy implementation is further hampered by a number of structural and systemic barriers [29]. According to the WHO, limited financial and human resources, legal gaps and weak enforcement mechanisms also allow harmful practices to persist, even when policies exist only on paper. Another challenge is the perception of public. In many societies, alcohol is deeply embedded in cultural and social practices, which can lead to resistance against the restrictive policies [30,31].

In sum, while international guidelines provide a solid foundation for action, translating them into effective national policies remains uneven and often debatable. The interaction of industry influence, cultural norms, and structural limitations continues to hinder the consistent application of evidence-based alcohol control measures across countries. Furthermore, despite global recommendations, there is currently a lack of political will to pursue binding international agreements on alcohol control, such as those achieved under the WHO Framework Convention on Tobacco Control.

1.2. Alcohol control policy in Lithuania

To evaluate Lithuania's alcohol control policy, it is important to assess the historical context in which the entire control system was created and developed and then identify most important time points. Therefore, this section will discuss the development of alcohol control between 1990 and 2025. The period indicated was chosen considering the historical development of the state, i.e., from the declaration of independence in 1990 to the present day.

With the Lithuanian independence on March 11, 1990, the pre-occupation Constitution (1938) was restored and state declared that any foreign constitutions or laws were considered illegal. This temporarily created a situation where almost all aspects of state regulation of alcohol production, import and trade were inoperative until the adoption of the Law on Alcohol Control in 1995. The lack of legislation, poor border control and financial benefits from alcohol sales led to a dramatic increase in alcohol consumption in the first half of the 1990s. Stabilization was observed after the adoption of the Law on Alcohol Control and the establishment of appropriate control institutions [32]. Thus, Lithuania began to implement an alcohol control policy, which has its own cycles of stricter control and liberalization. A detailed development of alcohol control regulations (1990–2020) is presented in the article by L. Miščikienė et al. [3]. It has been established that the Law on alcohol control is one of the most frequently amended legal acts, therefore, in this dissertation only the most important aspects of legal regulation, in the author's opinion, will be presented and present situation will be introduced, all policy points identified could be find in Figure 1.2.1.

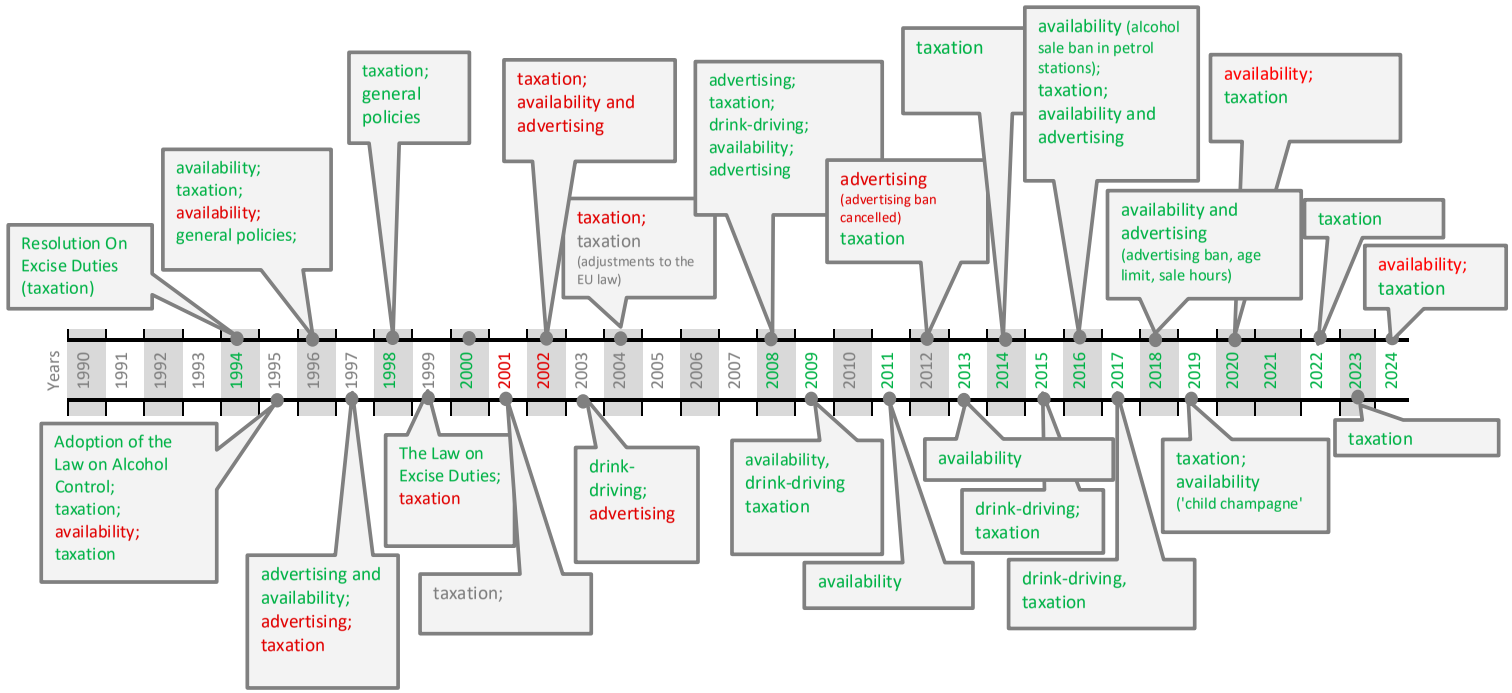

Fig. 1.2.1. Timeline of Lithuanian alcohol control policies listed up by the policy category

Note: green colour indicates stricter policy measures; red – liberalization; grey – uncertain/difficult to attribute. Adapted from Miščikienė et al. 2020 [3].

Lithuania's alcohol control policy is grounded on laws that provide policy objectives, define and describe policy measures, and establishes the framework for their system of implementation. The Law on alcohol control is the main policy document, complemented by some general, non-binding documents and other laws. The implementation of the law, control, and application of sanctions for non-compliance with the norms are ensured by the Code of Administrative Offences and Criminal Code [33,34].

As we will see later in the work, excise duties are an important measure that brings change for public health indicators. On 25 April 1994, a Government Resolution on Excise Duties was adopted, thus establishing the first excise duties. However, the right to regulate was granted to the Government, not the Parliament [35]. Regulation by law began in 1999 [36]. The structure of excise duty has changed over time, from a specific and value-based model in 1994 to a combined form in 1995 and finally to an exclusively specific tax in 1997. In 2001–2002, excise duty was harmonized according to the type of alcohol, and tax relief was introduced for small breweries. In preparation for EU membership, excise tax categories were simplified in 2004 and tax reductions for certain types of products were balanced. Since 2004, when Lithuania joined the EU, excise duty has been increased eight times, with the largest increase occurring in 2017. Following this, an annual increase of excise duty was observed. In a current period, excise duties also began to serve a dual purpose – not only as a public health measure but also as a source of funding for national defence, which generates more public support for higher excise taxes. A three-year plan for increasing excise duty rates on certain excise-taxed goods is established for 2025–2027, with part of the revenue allocated to the Defence Fund of the Republic of Lithuania [37]. Detailed chronological review of the changes of excise tariffs is provided via separate file (see: here).

Following over two years of deliberation, on 18 April 1995, the Parliament of Lithuania adopted the Law on Alcohol Control (Law). It entered into force on 26 May 1995. The purpose of the Law is to reduce alcohol consumption, availability, especially for minors, alcohol abuse, its harm to health and the economy, and to establish the legal principles for granting economic entities the right to produce, sell, import and export alcohol products regulated by the Law. It defined that the Law regulates production, sale, storage, transportation, import, export, consumption, advertising, sponsorship and establishes the foundations of alcohol control in the Republic of Lithuania.

The Law provided a ban on the sale of alcohol to persons under 18 years of age, intoxicated persons, and officials. Sales restrictions apply in health care and educational institutions. Double taxation is introduced for the sale of alcohol after 10 pm. The Law prohibited alcohol advertising, but this ban was

declarative, and its implementation is not ensured in practice. Drunk driving is punishable by administrative liability and may also be subject to criminal liability depending on the consequences of offence committed.

In 1996, to make the policy more effective, it was decided to establish the state institution responsible for the implementation of the Law – Alcohol and Tobacco Control Department. Later on, its functions expanded to prevention and reduction of the harm caused not only by alcohol and tobacco, but also drugs. Current name of the institution – Drug, Tobacco and Alcohol Control Department under the Government of Republic of Lithuania.

In 1997, liberalization of the advertising ban began. Advertising is restricted by establishing separate prohibitions. The amendment to the law defined specific prohibited/restricted practices, such as alcohol advertising aimed at children under 18 years of age and false or misleading information about alcoholic beverages. The amendment also specified what was not allowed in the advertisement itself. Advertising was prohibited in national television and radio programs from 3 p.m. to 10 p.m., and on weekends and school holidays from 8 a.m. to 10 p.m., and in other television and radio programs from 3 p.m. to 10 p.m. to 8 p.m., on weekends and school holidays, from 8 a.m. to 8 p.m. (except for beer and wine with an alcohol content of less than 15%). Outdoor alcohol advertising was permitted [38]. The liberalization phase continued in 2003 and 2004. The law allowed advertising of alcohol with an alcohol content of less than 22% in television and radio programs. Advertising on television and radio programs is prohibited from 3 p.m. to 10:30 p.m., and on weekends and school holidays from 8 a.m. to 10:30 p.m. Outdoor advertising was prohibited only for stronger drinks. Alcoholic beverages were allowed to be displayed in nearly all event venues and gas stations, while brand logos and names were excluded from the legal definition of advertising [39].

Since 2008, important changes have been adopted regarding drink-driving. The regulation is tightened, providing the possible application of criminal liability, confiscation of the car, as a measure for committing a criminal offense. The permissible blood alcohol concentration for young drivers is reduced from 0.4 to 0.2 BAC (blood alcohol concentration) [40]. The same year, it was planned to introduce a complete ban on advertising from 2012. However, on 6 December 2011, this change was cancelled, never entering into force.

A number of important, high-profile measures to strengthen alcohol control were adopted in 2017, with the changes coming into force in 2018. The age limit for purchasing or consuming alcohol has been raised from 18 to 20 years. Persons selling alcohol must ask for an ID if they are not sure whether the buyer is at least 25 years old. Alcoholic beverages are sold outside retail premises from 10 am to 8 pm, Monday to Saturday, and from

10 am to 3 pm on Sundays (exceptions: airports, ferries, train bars/shops). An almost complete ban on alcohol advertising has come into force (including a complete ban on television, radio and online advertising), with the exception of the name and type of drink, the name of the manufacturer, the brand (trade name), the country of origin, the geographical region of origin, the ethanol content, labelling information, price at points of sale, and on manufacturers' and retailers' websites [41].

The decision adopted in 2019 to prohibit the production and/or sale of food products, toys and other goods intended for children and adolescents, the design of which imitates alcoholic beverages and/or their packaging, attracted much public attention [42]. This decision was presented in the press as a ban on the sale of "children's champagne".

From 1 January 2020, a ban on the sale of alcohol on beaches (seasonal alcohol licenses were abolished), in pavilions (nighttime sales in non-commercial premises were more strictly controlled), and alcoholic beverages with an alcohol content of more than 7.5% during public events came into force. Outdoor retail sales of alcohol were allowed only within a 40-metre radius of the seller's building, and municipalities were given the right to impose additional restrictions (applicable to catering establishments). The restriction on sales on beaches was the subject of public debate, and in the same year it was decided to lift the ban, but only for the end of the season, i.e. from August 1 [43].

After period of consistent tightening of alcohol control policies, as measures needed to achieve public health goals, the first liberalizing changes appeared in 2024. Farmers, who provide services in accordance with the requirements of rural tourism and who have certified the alcoholic beverages produced as national heritage products, are allowed to produce traditional alcoholic beverages in rural tourism homesteads not for sale, but only for their own or family needs and/or for tasting on site [44]. Such changes may make it more difficult to control illegal production.

Alcohol control in Lithuania since 1990 has been characterized by the emergence of an alcohol control policy. The Law on Alcohol Control (1995) created the national framework and enforcement institutions. Policy packages of 2008–2009 and 2014–2018 tightened policy with constant excise hikes, increased control of drink driving, restrictions of alcohol marketing leading to a near full ban of alcohol advertising, measures to reduce alcohol availability (such as the minimum legal age raised to 20, and shorter retail hours) - marking a shift to WHO-endorsed, evidence-based controls.

1.3. Enforcement and compliance with alcohol policy

The effectiveness of alcohol control legislation depends not only on the policy itself, but also on how consistently it is implemented. One of the subjects of research in field of enforcement is the regulation of the minimum age at which alcohol can be purchased. Several international studies seek to examine how retailers comply with age restrictions, highlighting the persistent problem of sales to underage or underage-appearing customers without proper identification of person's age.

Evidence from different European countries shows that compliance rates vary widely and are often negligible even years after age-related legislation has been implemented. For example, a study in the Netherlands found that retailer compliance improved one and two years after the minimum age for alcohol sales was raised from 16 to 18 but remained inconsistent: compliance rates increased from 46.5 to 73.9% over two years [45]. Similarly, a quasi-experimental study in Slovenia found that retailers initially had low compliance with age verification requirements, but that this could be improved with targeted interventions [46].

Mystery shopping is widely used to assess how minimum age restrictions are enforced in the real world. For example, studies in Finland and Norway have shown that although staff often ask for identification, actual enforcement is inconsistent and a significant proportion of alcohol can still be purchased without valid proof of age [47]. These findings highlight the inadequacy of legal systems if they are not supported by active monitoring, training and accountability mechanisms.

Compliance studies conducted not only in Europe but also in North and South America have found similar results. A study from Brazil found high levels of unlawful sales to adolescents, with most attempts resulting in sale despite legal restrictions [48]. Controlled interventions in the United States have shown that mystery shopping-based training programs and real-time feedback can significantly improve compliance, especially when combined with technological tools such as identification document (ID) readers [49].

Importantly, the mere presence of an age verification system does not ensure compliance. A study in the Netherlands that assessed the performance of shopping malls found that the passive use of automated ID verification was not significantly superior to manual verification unless it was introduced in a broader culture of compliance [50]. Other interventions, such as public awareness campaigns [51], feedback letters to managers [52], or direct communication with retailers [53], have had mixed success, with more intensive and repetitive interventions generally leading to greater improvements.

The social context in which enforcement takes place also appears to influence employee behaviour. For example, research suggests that vendors may be less likely to require ID when there are fewer customers, perhaps due to a lower sense of social responsibility [54]. Similarly, weekend sales tend to be more likely to result in non-compliance, perhaps due to higher customer numbers and employee workload [55].

Extensive international evidence introduced, but there are no studies that examined age-verification enforcement in the Lithuanian context, where the minimum legal alcohol purchasing age was raised to 20 years in 2018. The lack of systematic monitoring observed and there is no publicly available compliance data in Lithuania, that highlights a significant evidence gap. The mystery shopping study conducted as part of this dissertation directly addresses this need and is the first methodically structured attempt to assess compliance with the statutory age restriction in retail outlets across the country.

The available literature suggests that lack of compliance with minimum legal purchasing age laws may reduce its effectiveness. Without constant enforcement, education and retailer/seller engagement, the protective effects of legal restrictions may be significantly weakened. Experience from other countries shows that compliance can be improved, but this requires a combination of legal clarity, retailer responsibility and created systems for continuous and active enforcement strategies. To ensure long-term effectiveness, countries need not only robust legal frameworks but also systematic monitoring tools, such as regular mystery shopping interventions, to monitor enforcement and address non-compliance issues in real time.

1.4. Alcohol-related mortality

Alcohol consumption remains the leading preventable risk factor for premature mortality worldwide. A large proportion of this burden is attributed to alcohol consumption, i.e. deaths that would not have occurred if alcohol had not been consumed. Alcohol-attributable mortality includes deaths from liver cirrhosis, certain cancers, cardiovascular disease, injuries and other conditions caused or contributed to by alcohol [56].

The proportion of alcohol-attributable mortality varies across regions, genders and age groups. In high-income countries, alcohol remains the one of the leading causes of death in adults, primarily affecting men of economically active age group [57,58]. Current studies have also shown that inequalities in alcohol-related mortality are impacted by socio-economic status and gender. For instance a systematic review found that lower-income populations have higher rates of alcohol-related mortality, frequently as a result of insufficient

access to health services and high-level alcohol consumption [59]. Likewise, gender differences have been found in both alcohol associated harm and consumption patterns: women face higher relative risks for the same levels of alcohol consumption, but men tend to have higher absolute mortality rates [60].

A number of studies have also assessed the effects of alcohol consumption on mortality from specific causes, particularly cancer, cardiovascular disease and injury. A research study estimated that alcohol is contributes to around 5% of all cancer deaths worldwide, with a particularly high risk of colorectal, oesophageal and breast cancers [61–63]. In a similar fashion, consumption of alcohol is associated with a considerable share of cardiovascular deaths, particularly hypertensive and ischemic heart disease [64].

The COVID-19 pandemic has brought additional attention to the role of alcohol in population health. Early data from various countries show an increase in alcohol-related mortality during periods of increased social isolation and lockdowns, specifically among heavy drinkers or individuals with alcohol dependence [65,66].

External causes of death, such as suicides, traffic accidents, drowning, and other injuries, are among the most serious and preventable consequences of alcohol use. Globally, alcohol is the leading cause of these deaths, especially among young and middle-aged adults. Its acute effects on decision-making, coordination, and aggression, as well as its long-term effects on mental health, increase individuals' risk of both unintentional and intentional injuries [67].

Suicide is one of the most widely studied external causes of alcohol-related death. A meta-analysis of 33 studies found that a substantial share of deaths by suicide were associated with drinking, with a 94% increase in the risk of suicide [68]. Country-level studies conducted in countries such as New Zealand [69], Brazil [70], and the United States [71] have shown that alcohol is frequently found in the victims of suicide, with variation in the means used to cause death in association with higher levels of BAC. Furthermore, Lasota et al. (2020) [72] reported that alcohol use was a contributing factor to suicides on railways in Poland, indicated, that observed relationship between age and the presence of alcohol in suicide victims can be the cause of railway suicides.

Similar patterns are observed in road traffic accidents. A systematic review found that alcohol was associated with increased risk for 15 different types of fatal injuries, most commonly in motor vehicle crashes [73]. Mortality data show that drivers involved in nighttime, weekend, or single-car crashes have higher blood alcohol concentrations [74,75].

Drownings are also frequently associated with alcohol use. In a study from Australia, alcohol was detected in a significant portion of coastal drownings [76]. In Poland, an analysis of drowning deaths in the Vistula River showed that nearly half of all victims had detectable blood alcohol levels [77].

Research utilizing autopsy data offers additional insights into the prevalence of alcohol in injury-related mortality [78]. A study based in United States, involving 1,000 injury-related deaths, showed that the majority of deaths among individuals with a known history of alcohol use occurred in circumstances in which alcohol was likely a direct contributing factor [79].

Alcohol-related mortality is a significant and preventable part of the global burden of disease and plays a significant role in many fatal injuries. Its assessment has improved significantly in recent years, but differences between population groups and the impact of policy measures on mortality trends indicate that continuous monitoring and targeted public health action are needed. The reviewed research highlights the importance of alcohol control policies not only as a means of reducing chronic diseases, but also as a mechanism for preventing deaths from external causes.

1.5. Violence linked to alcohol

Evidence from research consistently indicates of an association between alcohol consumption and various forms of violent behaviours, including criminal acts, such as different type of assaults, homicides. Alcohol contributes to both violent acts and victimization by compromising rational decision-making and intensifying impulsivity.

From an individual perspective, alcohol consumption is common among perpetrators of homicide. An Australian study found that the majority of perpetrators of homicide had a history of substance abuse, with alcohol being the most common substance [80]. Regional and longitudinal studies have further supported this link. In Latin America, panel data from 1961 to 2019 showed that increases in per capita alcohol consumption were associated with increases in homicide rates. In countries with riskier drinking habits, the total number of homicides, both male and female, was higher than in those with less risky drinking habits [81]. Similarly, a time series study confirmed that increases in total alcohol consumption were a strong predictor of increases in homicide rates [82]. Findings of a cross-cultural comparison of the relationship in 14 European countries indicates that homicide rates are influenced by alcohol sales and more so in the northern European countries [83]. Forensic and autopsy data further support the link between alcohol and violence. A study of unnatural deaths in Thailand found the rates at which

victims of accidents, homicides, and suicides were alcohol positive were 42.44%, 38.81%, and 33.25%, respectively [84].

Beyond fatal violence, alcohol is also implicated in numerous non-lethal forms of aggression, such as intimate partner violence and sexual assault. A recent review confirmed strong associations between alcohol exposure and firearm-related violence, significant association between alcohol-induced harm in the context of domestic violence and provides evidence of the link between alcohol-induced domestic violence for both victims and perpetrators [85]. In Australia, significant association between alcohol-induced harm in the context of domestic violence from ambulance attendance data was established and provided evidence of the link between alcohol-induced domestic violence for both victims and perpetrators. [Scott et al., 2022], and another study demonstrated that alcohol plays a substantial role in police-reported family domestic violence [86].

Victimization studies from various settings further corroborate the role of alcohol in episodes of physical and sexual violence. In the United States, a nationally representative survey of adults indicated, that victims and perpetrators of sexual violence were often intoxicated at the time of the incident. Among victims of physically forced rape, 26.2% of female and 30.0 % of male victims reported substance use; among male victims who had been forced to penetrate, the figure rose to 44.5%. Most of these victims also reported that the perpetrator had been using alcohol or other substances at the time. Most of the forced rape and being made to penetrate victims reported the perpetrator was using alcohol or drugs [87]. Study of university students, determined, that assault victimization is strongly related to alcohol abuse and dependence diagnoses in both genders [88].

Taken together, evidence from a diverse range of countries, population groups, and research methodologies, support the central role of alcohol in homicide and a spectrum of violent behaviours. These findings support the inclusion of alcohol control strategies in broader violence prevention policies.

1.6. Alcohol-related mortality and violence in Lithuania

In Lithuania, alcohol-related mortality remains one of the most pressing behavioural risk factors contributing to poor health outcomes in the society, especially among working-age men. Over the past two decades, Lithuania has consistently been among the European countries with the highest alcohol-attributable mortality rates [58]. Thus, policy measures implemented likely starting to yield results.

Study on trends of alcohol-attributable deaths in Lithuania 2001–2021, showed, that overall, there has been a downward trend, mainly among men,

linked to the implementation of four years of intensive alcohol control policies in 2008, 2009, 2017 and 2018. In the remaining years, the number of alcohol-related deaths remained stable [58]. Performed time series analysis showed that raising the legal drinking age from 18 to 20 in 2018 significantly reduced all-cause mortality among 18–19-year-olds [89]. Yearly mortality rates for all cardiovascular diseases, ischemic heart disease, cerebrovascular diseases and alcoholic cardiomyopathy have declined in Lithuania between 2001 and 2018, and declining trends were more prominent in women than in men [64].

In Lithuania, and as established in many other countries with high per capita alcohol consumption, alcohol plays a decisive role in mortality from external causes, including suicides, traffic accidents and other injuries. Forensic data further support this connection. Study analysing blood alcohol levels in deceased individuals found that a significant proportion of injury-related deaths involved high concentrations of ethanol, especially among drowning victims, traffic fatalities, and violent deaths [90]. In road traffic fatalities specifically, forensic toxicological evidence shows that alcohol consumption by road users remains a frequent contributing factor [91]. As per fatal violence, implemented study observed a notable link between intentional homicides and alcohol abuse, as more than half of the suspects were under the influence of alcohol [92].

There is some evidence of policy changes implemented promise positive results. A sex - specific time series analysis confirmed that the number of suicides in the country decreased after the implementation of stricter alcohol control policies, analyses showed a significant impact of the 2017 alcohol control policy on suicide mortality for men only. It estimated that in the year following the 2017 policy enactment, approximately 57 deaths by suicide were prevented among men, 25–74 years of age [93].

Although research on alcohol-related mortality and suicide is increasingly being conducted in Lithuania, there is still a lack of research examining the role of alcohol in homicides and interpersonal violence. Most of the existing data are drawn from mortality registries or general injury categories, without detailed analysis of violent incidents. This currently remains as a knowledge gap, especially given the strong international evidence linking alcohol consumption to homicides and assaults.

1.7. Policy-impact studies on mortality and violence

There is growing international evidence confirming the effectiveness of alcohol policies in reducing alcohol-related harm, including mortality and violence. Stricter alcohol control is frequently found to be associated with lower rates of alcohol-related disease, injury, and death.

In the United States, multiple studies have demonstrated that wide-ranging alcohol policy environments are associated with lower alcohol-attributable mortality. For example, a cross-sectional linear regression analysis found that stronger alcohol policies were associated with lower cancer mortality rates for the six cancer types overall and an 8.5% decrease in rates of combined alcohol-attributable cancers [61].

Alcohol policies have also demonstrated measurable effects on violent deaths, including suicides and homicides. A study found that strengthening state-level alcohol policy restrictions is associated with a decrease in the number of homicides [94]. Moreover, research shows that state - level laws regulating driving under the influence may also reduce firearm - related homicides, further highlighting the broader protective effects of alcohol regulation. In states where federal restrictions on firearm purchases were imposed after one or two driving under the influence violations, compared to states without a legal system prohibiting firearms after convictions for drunk driving, firearm-related homicide (victimization) rates were 19% lower among women [95]. An international analysis involving 150 countries found that stricter alcohol control policies that reduce alcohol's affordability and availability through days/hours of sales are associated with lower rates of alcohol - related homicides, independent of income level, indicating the possible effect of the policy on reducing lethal violence [96].

Research also confirms the effectiveness of alcohol policies in reducing suicide rates. A systematic review showed that in the studies monitored, reducing alcohol consumption often led to a decrease in suicidal behaviour [97]. In a similar manner, packages of stricter state alcohol and firearm policies have been associated with lower suicides, indicating that policy interventions interact and influence health outcomes [98].

And evidence from other countries shows that loosening/liberalizing alcohol policies could result in negative consequences for public health. In Hong Kong, the introduction of alcohol tax reductions was associated with a subsequent increase in violence, requiring hospitalization and reports of sexual assault in some age groups [99]. And in contrary another study demonstrated that raising taxes is estimated to reduce consumption of alcohol and alcohol-attributable deaths [100].

Changes in retail environmental policy, such as restrictions on retail access, have also been associated with reductions in interpersonal violence. Literature review of scientific articles showed that reducing the availability of alcohol through direct and indirect means is an effective way to reduce levels of interpersonal violence [101]. Restricting alcohol sales by imposing Sunday sales are associated with reductions in fatal violence. Study on firearm-related homicide and suicide showed that repealing Sunday bans is associated

with an increase in homicides and firearm homicides [102]. In Australia, the introduction of multiple alcohol policy reforms, including a minimum unit price resulted in significant reductions of the number of police-recorded alcohol-related assaults. The analysis using join point regression demonstrated a clear downward trend in injury rates post-policy implementation, underscoring the effectiveness of ongoing, multi-component [103].

In addition, a cross-sectional study of alcohol policies at United States colleges found evidence that stricter state alcohol policies are associated with fewer alcohol-related arrests and disciplinary actions, as well as fewer rapes on college campuses[104].

Newer research also emphasizes the role of alcohol policy in addressing domestic violence. A study examining the evening and night-time economic activity in Australia found that stricter alcohol policies – particularly those targeting late-night trading hours were associated with reductions in domestic violence incidents, suggesting that alcohol availability plays an essential impact on the occurrence and nature of intimate partner violence [105]. Furthermore, an interrupted time series analysis in the United States demonstrated that earlier licensed premises closing hours were linked to significant reductions in violent crime, particularly assaults and aggravated assaults, in impacted communities. These findings underscores the significance of regulating alcohol availability in high-risk settings to diminish harm [106].

When considered as a whole, studies on mortality and violence provide compelling evidence that comprehensive alcohol policies can play an important role in preventing premature mortality and reducing interpersonal violence. They also show that policy instruments targeting prices of alcohol, availability, and strengthening of enforcement can be effectively tailored to specific health outcomes in different contexts.

2. SUMARRY OF MATERIALS AND METHODS

2.1. Ethics statement

Studies involved in the dissertation initially were approved by Lithuanian Bioethics Committee (No. 6B-21-196, 21 October 2021) and followed with the approvals of the Lithuanian University of Health Sciences Bioethics Board (No. 2024-BEC3-T-016, 20 May 2024 and No. 2024-BEC3-T-040, 17 January 2025). Principles of the Helsinki Declaration were followed.

2.2. Data sources and population

This dissertation synthesizes empirical and documentary research to examine the relationship between alcohol control measures and public health outcomes in Lithuania. The data underlying the analysis are drawn from a variety of sources, including official health and crime statistics, forensic and court records, field studies, and legal and policy documents. More detailed descriptions of methodology and supporting information is available in separate published articles A1-A7.

A1. ***"A mystery-shopping study to test enforcement of minimum legal purchasing age in Lithuania in 2022".*** The possible availability of alcoholic beverages to young people was assessed in 2022 through a national mystery shopping study, in which trained young people attempted to simulate purchase of alcohol at retail premises. The sampling was made according to the national alcohol licensing register (8,046 licences issued for off-premises alcohol sales), from which a random sample of 239 outlets was drawn to represent all 10 county centres of Lithuania. The sample included five major grocery-store chains, with the number of outlets per city proportionate to the total number of stores operating there.

Mystery shoppers were eight female university students aged 20–24, legally eligible to purchase alcohol but appearing young enough to trigger a check of an age. An inter-rater reliability test with five adult raters (aged 35–50 years) confirmed that the shoppers' appearance was consistently judged as under 25 (ICC = 0.889, 95% CI: 0.785–0.944).

During each visit, shoppers attempted to buy a randomly selected brand of beer or wine, after visits recorded variables (day of week, time of day, queue length, purchase process).

A2. ***"The Comprehensive Alcohol Advertising Ban in Lithuania: A Case Study of Social Media" (A2).*** Compliance of the total alcohol advertising ban was tested using monitoring of social media. The study was based on monitoring of content published on the two most popular social media

platforms in Lithuania -Facebook and Instagram. A total of 115 social media accounts were selected for observation, including most profitable grocery retailers, specialized liquor chains, shopping malls, alcohol producers, and high-profile social media influencers. Of these, 64 accounts were on Facebook and 51 on Instagram.

Posts from these accounts were reviewed daily over a 60-day period. The final dataset included 2191 posts (1442 from Facebook and 749 from Instagram). Within this number, 163 posts met the inclusion criteria for alcohol-related content, representing the study population for analysis. Additional Instagram stories were also captured, resulting in 121 alcohol-related stories.

The inclusion criteria required that a post mention alcohol or an alcohol look-alike brand, introduced alcoholic or similar beverages, or refer to an alcoholic beverage category. Posts were further grouped into three categories: (1) alcoholic beverage advertisements, (2) zero-alcohol beverage advertisements, and (3) "grey zone" posts containing depictions of alcohol in social contexts.

A3. ***"Alcohol control policies reduce allcause mortality in Baltic Countries and Poland between 2001 and 2020".*** In study analysing the impact of alcohol control policies on all-cause mortality among adults in Estonia, Latvia, Lithuania, and Poland between 2001 and 2020 monthly mortality numbers were obtained from national statistical authorities. For Lithuania mortality data were obtained from the Statistics Lithuania [107] and the State register of death and their causes [108]. These datasets cover the period for 2001–2020, allowing for reliable assessment of trends before and after major alcohol policy interventions.

Population estimates for each country and year were obtained from the Organisation for Economic Co-operation and Development (OECD) [109] and used to calculate mortality rates. Mortality rates were standardized according to EU standard [110]. The study population consisted of all residents aged 20 years and older. The primary outcome measure was the monthly age-standardised all-cause mortality rate per 100,000 population, calculated separately for men and women.

Per study period, 18 policy measures met pre-defined criteria for inclusion. These "best buy" policies included increases in excise taxation and restrictions on retail sale hours that reduced availability by at least 20%. Each measure was coded as an intervention point in the time-series analysis, with its potential effect modelled over the 12 months following implementation.

A4. ***"The impact of alcohol control policy on assaults and sexual assaults in Lithuania: An interrupted time-series analysis".*** For the study examining monthly trends in reported assaults and sexual assaults in Lithuania

from January 2003 to December 2023 data on the number of recorded offences were used. It was obtained from the Criminal Offences Official Register, administered by the Information Technology and Communications Department under the Ministry of the Interior of the Republic of Lithuania [111]. All police-recorded crimes under investigation are processed in this centralised register, ensuring complete national coverage.

The study population comprised all residents of Lithuania, with offence counts converted into monthly population-standardised rates per 100,000 population using national mid-year population estimates. Rates were calculated separately for assaults and sexual assaults.

Three major alcohol control policies were selected for evaluation based on the WHO "best buys" and strict inclusion criteria: (i) pricing policies had to reduce affordability, defined as an increase in alcohol prices outpacing growth in average disposable income; or (ii) availability policies had to limit access for a substantial proportion of the population, for example through reductions in permitted retail hours. The policies assessed were Policy 1 – January 1, 2008: excise tax increases; Policy 2 – March 1, 2017: large excise tax increases, producing a marked reduction in affordability; Policy 3 – January 1, 2018: shortened off-premises sales hours and an increase in the minimum legal purchasing age.

A5. ***"The prevalence of alcohol-related deaths in autopsies performed in Lithuania between 2017 and 2020: a cross-sectional study".*** To investigate the involvement of alcohol in external causes of deaths, detailed information of autopsy reports, from the State register of death and their causes, managed by the Institute of Hygiene [108] was analysed, identifying cases where alcohol was confirmed during toxicology analysis. Study analysed all deaths in Lithuania when an autopsy was conducted between 1 January 2017 and 31 December 2020. The inclusion of this period reflects a regulatory change in 2017, when it became mandatory to record BAC and the presence of medications or psychoactive substances in the national mortality register.

The study population covered individuals of all ages (0–110 years) who underwent an autopsy during the selected period. For each case, information was extracted on sex, age, cause of death, year of death, place of residence, and measured BAC. The causes of death were grouped into five broad categories according to International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Australian Modification (ICD-10-AM): (i) accidents (V00–X59), (ii) intentional self-harm (X60–X84), (iii) assault (X85–Y09), (iv) events of undetermined intent (Y10–Y34), and (v) other causes.

In total, 18,872 autopsies were performed during the study period, of which 7,550 involved deaths from external causes. These cases formed the

main sample for estimating the prevalence of alcohol involvement in external-cause mortality.

A6. ***"Persistently high impact of alcohol use on fatal violence in Lithuania despite strengthening alcohol control policies, 2004–19".*** The study analysing quarterly trends in homicide perpetrators in Lithuania from January 2004 to December 2019, with a focus on the prevalence of alcohol involvement and the potential effects of major alcohol control policies implemented in 2017 and 2018 used data of criminal offences. Data were obtained from the Criminal Offences Official Register [111]. Homicide cases were defined as offences under Articles 129 and 130 (intentional homicide) of Criminal Code [33], corresponding to code 0101 of the International Classification of Crime for Statistical Purposes [112].

For each recorded homicide, the dataset provided information on the date of the offence, date when the suspect was formally charged, the relevant Criminal Code article, and the characteristics of each perpetrator, including sex, age, education, occupation, municipality, and urban–rural place of residence. Crucially, the police records also noted whether the perpetrator was under the influence of alcohol at the time of the offence.

Two outcome measures were derived: (i) the quarterly rate of homicide perpetrators per 100,000 population, and (ii) the quarterly proportion of perpetrators recorded as intoxicated. Two alcohol control policies were examined: year 2017 and year 2018.

A7. ***"Explaining the Link Between Alcohol and Homicides: Insights from the Analysis of Legal Cases in Lithuania".*** Additional insights were gained from a legal analysis of completed homicide court cases from 2019–2023 [113], which provided contextual data on alcohol consumption patterns among victims and perpetrators. This study used a retrospective qualitative review of court case law to analyse alcohol-related homicides committed in Lithuania in 2019. Case data were accessed through the publicly available Lithuanian court database (Liteko) [113], which contains full-text rulings from all court levels, including district and regional courts, the Court of Appeal, and the Supreme Court of Lithuania.

2,607 homicide-related rulings were individually screened following the inclusion criteria, out of which 93 cases met both the time-based inclusion criterion (crime committed in 2019) and explicit mention of alcohol use in the court record and were subject for an in-depth qualitative analysis. After excluding cases where alcohol involvement was possible but unproven, and retaining only final binding judgments, 52 cases were included in the qualitative analysis.

The study population consisted of all individuals convicted of homicide in 2019 whose cases met the alcohol-involvement criteria. No personal

identifiers were collected, and only publicly available legal documents were used, ensuring compliance with data protection and ethical standards.

2.3. Methods of data analysis

Various methodological approaches were used across studies to analyse the relationship between alcohol policies and public c health indicators. Time-series methods, particularly interrupted time-series analysis (ITSA) [114], were employed to evaluate changes in mortality and violent crime (homicide, assaults, sexual assaults) rates following key policy implementations. This method, controlled for underlying trends, seasonality, and autocorrelation, enables the comparison of outcome trends before and after the introduction of a policy, thereby identifying both immediate (level) and longer-term (slope) changes in the indicators. ITSA is particularly suitable for evaluating the effects of alcohol control policies, where outcome data such as mortality and violent crime rates are systematically recorded over time and policy changes are clearly defined.

Descriptive statistics and prevalence estimates were generated for autopsy-based and legal-case data to quantify alcohol involvement in deaths and violent incidents.

In the mystery shopper study, proportions of successful alcohol purchase attempts were calculated, and differences across variables (e.g., store type, urban vs rural setting) were assessed using Chi-square tests.

In addition, a qualitative content analysis of homicide case law was conducted by systematically reviewing court judgments to identify recurring themes, contextual role of alcohol in violent incidents.

Analytical work was carried out using standard statistical packages, including IBM SPSS, Version 27 for Windows and R version 3.6.3, with significance thresholds generally set at $p < 0.05$. All analyses were interpreted in relation to their public health relevance, emphasizing the practical impact of legislation on outcomes rather than statistical results alone.

3. SUMMARY OF RESULTS

Dissertation designed to examine several pathways from policy implementation to health and legal outcomes. The first part focused on policy implementation: a mystery shopper study assessed whether the requirement to verify age before alcohol sales was enforced in practice; the monitoring of social media platforms was dedicated to enforcement of advertising ban. The second part examined policy effectiveness, using population-level data on mortality and violent assaults, including sexual assault, to determine whether strengthened alcohol control measures were associated with reductions in harm. Building on this, the third part investigated alcohol to lethal outcomes by analysing autopsy data to quantify the prevalence of alcohol in mortality from external causes while an in-depth analysis of homicide cases explored patterns of intoxication among victims and perpetrators, the circumstances of offences, and the role of alcohol in fatal violence.

3.1. Mystery shopper study in Lithuania

One of the objectives set was to evaluate how policy measures are implemented in practice. In 2022, first time, a mystery shopping study was conducted across Lithuania to assess compliance with the legal minimum age for purchasing alcoholic beverages. A total of 239 purchase attempts were made at various retail outlets using trained young-looking shoppers (mystery shoppers) aged 20–24. Although all participants were of legal age, their youthful appearance should have triggered sellers to ask for proof of age before completing the sale.

The results revealed significant gaps in the enforcement of legal acts. Almost half (44.8%) of all attempts to purchase alcohol were made without asking for proof of identity (age) and 3.7% of checks where ID was requested but not provided by the mystery shopper resulted in success.

Patterns of non-compliance also differed depending on situational factors. Unverified purchases were significantly higher on weekends than on weekdays (53.3% vs. 39.5%). Furthermore, when mystery shoppers were standing alone at the counter – with no other shoppers around – the likelihood of successfully purchasing alcohol without age verification increased significantly (54.9% vs. 29.5% when at least two people were waiting behind them). These differences were statistically significant and indicate the influence of social and environmental context on employee behaviour.

Table 3.1.1. *Compliance overview in mystery-shopping study*

Measure	**Count (n = 239)**	**% of total**	**Observation**
Successful purchases (no ID check)	107	44.8%	Nearly half of visits resulted in sales without ID request
Situational variations:			
Weekends (vs. weekdays)	-	53.3% vs 39.5%*	Compliance lower on weekends
Queue empty vs. ≥2 customers behind	-	54.9% vs 29.5%*	Compliance reduced when alone in line

* Differences statistically significant ($p < 0.05$).

Intervention of notifying retail outlets about implementation of mystery shopper were introduced in the third phase of the study (May 2022). The same grocery-store chains visited in earlier phases (in Kaunas and Klaipėda) received emails informing them that a mystery-shopping experiment was taking place. A few days later, mystery shoppers visited the same outlets, but with different individuals conducting the purchase attempts. The proportion of successful alcohol purchases without ID verification remained fairly similar to earlier phases (43.8% in Phase 3 vs. 41.1% in Phase 1 and 47.9% in Phase 2), and statistically insignificant ($p = 0.704$).

A follow-up mystery shopping study conducted in 2024 repeated the 2022 protocol to assess whether staff requested proof of age from young-looking legal-age customers (20–24 years). In total, 238 purchase attempts were made, of which 96 (40.0%) were successful without the presentation of ID. The 2024 findings, presented at a conference (Slovenia) and covered in national media closely mirror those of the 2022 study, suggesting no substantial change in compliance levels.

Overall, the study emphasizes systemic weaknesses in the enforcement of legal purchasing age restriction legislation in retail settings. As the first initiative of its kind, using presented method, in Lithuania, findings highlight the need for more effective enforcement strategies, such as regular compliance checks, targeted training for retail staff.

3.2. Enforcement of alcohol advertising ban

To assess the implementation of policy measures in practice, enforcement of the comprehensive alcohol advertising ban was evaluated through systematic monitoring of Facebook and Instagram accounts. During the 60-day monitoring period, 2191 posts were reviewed across the selected social media accounts (1442 on Facebook and 749 on Instagram). Out of these, 163

were identified as alcohol-related, representing 7.4% of all posts. A total of 121 additional alcohol-related Instagram stories were also recorded.

When broken down by category, 30 posts (1.4% of all published content) were classified as direct alcohol advertisements, thus constituting violations of the Lithuanian Alcohol Control Law. Another 26 posts (1.2%) promoted zero-alcohol beverages presented in packaging or branding similar to alcoholic products, while 107 posts (4.8%) fell into the "grey zone" category, where alcohol was depicted in a social context without clear brand identification.

Differences were observed between platforms. Alcohol-related posts accounted for 8.3% of all Facebook content, compared to 5.9% on Instagram ($p = 0.014$). Alcohol producers were the main source of direct advertising (85% on Facebook and 90% on Instagram). Meanwhile, influencers played a particularly prominent role on Instagram, generating nearly half (45.5%) of alcohol-related posts and more than four-fifths (84.3%) of alcohol-related stories.

Overall, the findings demonstrate a relatively high level of compliance with Lithuania's advertising ban, with only a small proportion of posts clearly violating the law.

3.3. Alcohol control policy and its effects on mortality

Another study of this dissertation examined the impact of alcohol control policies on all-cause mortality trends in four countries – Baltic States – Lithuania, Latvia, Estonia; and Poland – over the period 2001–2020. In countries, 18 policy interventions meeting predefined criteria for reducing alcohol affordability or availability were identified, with Lithuania implementing four such measures during the study period. Despite the regional focus of the analysis, its results provide substantive insights into the Lithuanian experience, where alcohol policy reforms were among the most wide-ranging and systematically applied.

For the region, these policies reduced men's mortality by an average of 2.31% (95% CI 0.71% to 3.93%; $p = 0.0045$). In contrast, the reduction among women – 1.09% (95% CI −0.02% to 2.20%; $p = 0.055$) did not reach statistical significance. Cause-specific analysis in Lithuania and Estonia confirmed that most of the decline was due to reductions in ischemic heart disease, injury, stroke, and gastrointestinal disease. Specifically for Lithuania, the study found a significant decline in all-cause mortality that align with the implementation of key alcohol control measures. As in other Baltic countries, Lithuanian men benefited more visibly – likely reflecting their higher baseline alcohol consumption and related harm.

For Lithuania, this regional comparative analysis provides validation of the effectiveness of its alcohol policy strategy and further encourages the maintenance and strengthening of these measures. The study results also highlight the potential public health benefits in other countries that adopt a similar evidence-based approach to alcohol regulation.

3.4. Alcohol control policy and its effects on assaults and sexual assaults

Building on the evidence that alcohol control policies can reduce mortality from alcohol-attributable causes, the next stage of the research examined their potential impact on other outcomes of harm – specifically the most severe forms of non-lethal violence – assaults and sexual assaults were selected. Study examined the impact of alcohol control policies on the number of recorded assaults and sexual assaults in Lithuania. A time-series analysis was used to assess trends before and after the implementation of key policy measures in 2008, 2017 and 2018. These interventions included excise tax increases, restrictions on availability and advertisement, and other measures aimed at reducing alcohol consumption.

The most notable change was observed after the major increase of excise taxation in 2017. After the introduction of this policy measure, the number of quarterly sexual assaults decreased by almost 30% (relative reduction of 29.9%), showing a substantial and statistically significant policy impact.

These results demonstrate an association between alcohol affordability and violence in the Lithuanian context and demonstrates that such policy measures can not only provide health benefits, but also contribute to public safety, especially in the area of sexual and physical violence.

3.5. Relationship between alcohol use and mortality from external causes

The following objectives aim to assess the magnitude of the presence of alcohol among the autopsied deceased population due to an external cause of death within the period when multiple alcohol control policies came into action. Firstly, cross-sectional study examined the prevalence of alcohol use in deaths requiring forensic medical examination in Lithuania over a four-year period from 2017 to 2020. Based on these data, the analysis offers one of the most comprehensive reviews of alcohol-related mortality in Lithuania to date, combining toxicological test results with detailed information from forensic investigations.

Overall, alcohol was detected in 55.0% of all autopsied deaths from external causes during the study period. The prevalence of alcohol-positive

cases in external causes of death was higher among men (43.3%) compared to women (25.5%). A difference was statistically significant ($p < 0.001$), reflecting gender disparities in alcohol-related risk behaviours.

Analysis by cause of death revealed that alcohol was most frequently detected in assault-related fatalities, with 71.5% of those tested showing positive blood alcohol concentrations. Accidental deaths also showed a high level of alcohol involvement (59.7%) and, importantly, had the highest median blood alcohol content, reaching 2.42‰ (interquartile range: 1.86), suggesting substantial intoxication at the time of death in many of these cases.

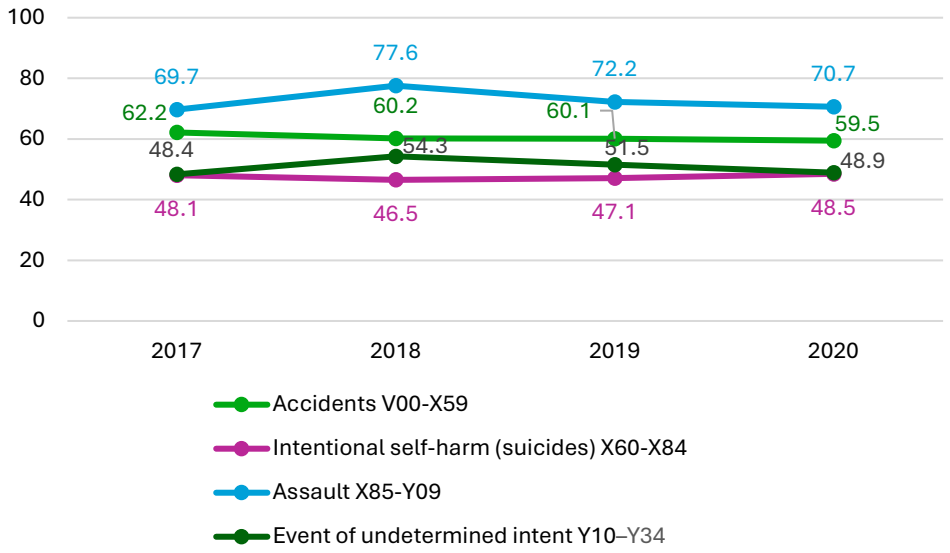

Fig. 3.2.1. *Proportion (%) of ethanol positive cases among different groups of external causes of death in 2017-2020 (age 15+)*

In addition, age-related patterns emerged: the highest number of deaths involving alcohol was found in those aged 20–49 years, suggesting that alcohol-related harm peaks in middle adulthood.

As one of the first studies in Lithuania to systematically quantify the presence of alcohol in forensic deaths, these results highlight that alcohol still poses a threat to public health, particularly in deaths from external causes rather than from serious medical conditions.

3.6. Alcohol related violence

By analysing findings from forensic examinations, we found that there is an evident relationship between external causes of death and alcohol. Particularly, victims of violent crimes stood out, so it was important to further

assess the situation of individuals who commit criminal acts, specifically homicides.

In our study, we examined trends in alcohol-related lethal violence in Lithuania from 2004 to 2019, paying particular attention to how these trends changed in the context of increasingly strict alcohol control policies in recent years. Using national data on perpetrators of homicide, we assessed both the total number of individuals charged with homicide and the proportion of those who were intoxicated at the time of the crime.

Indeed, the total number of homicides and its perpetrators in Lithuania decreased substantially during the study period. In 2004, 338 perpetrators were registered in total, whereas in 2019, the number decreased to 80. However, despite the decline in fatal violence, the proportion of perpetrators who were under the influence of alcohol while committing the crime remained consistently high. In most cases, more than half of homicides were committed when perpetrator was under the influence of alcohol. Even after major alcohol policy reforms in 2017 and 2018, alcohol consumption levels during fatal violence did not decrease significantly with the proportion of homicide perpetrators under the influence of alcohol consistently ranging from 63% to 73%, with policy-related level and slope effects remaining small and statistically non-significant.

The data show an alarming interaction between alcohol consumption and lethal violence. Although we observed the overall declining number of homicides, policy has not significantly reduced the alcohol - related homicides. This suggests that alcohol continues to play a key role in the dynamics of lethal violence in Lithuania and that those most at risk may not respond to implemented policy interventions in the same way as the general population.

These results highlight the complexity of addressing alcohol-related violence and suggest that while general alcohol control policies are necessary and effective in reducing overall harm, they may need to be complemented by more targeted interventions targeting specific high-risk groups.

3.7. Alcohol related homicides

Research has confirmed that high proportion of both the victims and the perpetrators may have been intoxicated during the event of death or a committed crime respectively, so the circumstances surrounding the homicide attracted the attention for a deeper analysis. For the purpose a study examining the relationship between alcohol consumption and homicides in Lithuania, analysing criminal cases of alcohol involved homicides of year 2019 were used. The aim of the analysis was to identify patterns in the circumstances

and characteristics of alcohol-related homicides, providing a qualitative and quantitative perspective on the impact of alcohol on lethal violence.

The results of the study showed that most crimes were committed during a binge drinking event (alcohol consumed by both – victim and perpetrator) – 84.6%. Alcohol-related homicides most often took place at home or among relatives, usually in private domestic environment, and were often escalating from verbal disputes that progressed into violence. These homicides were mostly unplanned, impulsive acts rather than premeditated crimes, which emphasizes the effect of alcohol on decision-making and self-control. Lithuanian courts treat intoxication [115] as an aggravating circumstance, reinforcing the principle of individual responsibility, as voluntary alcohol consumption that could have affected a person's actions.

By reviewing in-depth judicial decisions, the study provided insights that went beyond what is typically captured in statistical datasets. It highlighted that alcohol-related homicides in Lithuania commonly originate from broader social vulnerabilities, such as long-term alcohol dependence, patterns of alcohol abuse, social isolation, marginalization, and that effective prevention strategies must address these underlying factors.

Our findings confirm the importance of conducting research to monitor which control measures are effective. Also combining implemented alcohol control measures with more targeted interventions, such as support services for high-risk individuals, accessible, early treatment for alcohol use disorders, and targeted community violence prevention measures. In the Lithuanian context, where a large proportion of fatal violence cases are alcohol-related, such comprehensive approaches are required to achieve significant and long-term harm reduction.

4. DISCUSSION

This dissertation integrates findings from national-level studies examining enforcement of existing policies, alcohol's relationship with mortality and violence in Lithuania and evaluating the impact of alcohol control policies. The mystery-shopping study addressed practise of enforcement of legal purchasing-age restrictions, pointing to gaps between legislative requirements and real-life environment. Two policy evaluation studies were implemented, the policy evaluation study of all-cause mortality, demonstrated reductions in male all-cause mortality after the 2017–2018 reforms. The study on assaults found declines, particularly in sexual assaults, following the same policy changes. Finally, the forensic autopsy data revealed that 55% of deaths from external - causes involved alcohol, with especially high proportion of intoxicated individuals attributed in groupings of assaults (X85-Y09) and accidents (V00-X59). And although the total number of homicides is decreasing quite significantly across the years, the proportion of individuals who commit crimes while intoxicated remains relatively high and stable. During the period 2004–2019, it was ranging from 63% to 73% throughout the entire timeframe. These findings are supported by an in-depth qualitative legal case analysis establishing a link between use of alcohol, and the sides of victim and perpetrator. Alcohol-fuelled homicides are often result of binge drinking event, are impulsive, domestic in nature, and involve vulnerable populations.

Together, all the findings summarized in this dissertation reveal a three-way circular interaction: persistent enforcement gaps evident from the mystery-shopper study and it could undermine the full potential of implemented policies; implemented evidence-based population-wide policies can significantly reduce certain harms; and high-risk, alcohol-fuelled violence continues to occur often enough, demanding more targeted policy interventions and a continuous monitoring of the enforcement of the policies.

Insufficient enforcement of age restrictions revealed through mystery shopping aligns with findings from similar studies [46,47] where substantial proportions of cases were considered successful when purchasing alcohol. Our study is the first to provide research based compliance data in Lithuania, revealing weaknesses in the application of existing laws. Compared to Western Europe, where mystery-shopper feedback systems are sometimes institutionalized, Lithuania lacks both enforcement follow-up and accountability mechanisms. However, our research on the enforcement of the alcohol advertising ban suggests that effective enforcement is achievable. Monitoring of social media in Lithuania demonstrated high compliance with

the comprehensive advertising ban, with only 1.4% of posts constituting clear violations, despite industry claims that regulation of online content would be not reasonable and not fully implemented. This example indicates that, with a clear legal framework, dedicated monitoring, and sanctions, compliance can be achieved.

This research therefore adds both empirical and policy-relevant knowledge by identifying when and where enforcement breaks down.

Previous studies [116] have evaluated the impact of earlier alcohol policies interventions, whereas this dissertation focuses on recent evidence-based, wide-ranging interventions implemented over a short period of time, which could be considered the setting of a so-called natural experiment. The observed decrease in all-cause mortality among men in Baltic states and Poland after the policy reforms is consistent with evaluations of alcohol control interventions [117]. Štelemėkas et al. [118] found a similar marked decline in alcohol-related deaths following previous affordability reductions. These findings also supported by research about mortality from alcohol-related liver disease, established, that restrictive alcohol control policies are promising tools to address the population-level burden [119]. We identified differences between sex, women mortality from all causes has not decreased significantly. Other studies also suggest that the impact of alcohol control policies vary by sex and subtype [120]. In Lithuania, as in other countries with similar drinking patterns, the consistently high consumption of strong alcoholic beverages and heavy episodic drinking among men may partly explain why the decline in all-cause mortality among women was less pronounced. [1].

Although effect sizes varied by crime type, results from study on assaults and sexual assaults builds on existing data by confirming the association between policy measures – particularly those targeting affordability of alcohol – and reductions in violent crime. Similar patterns have been documented in Australia [121] where price increases were linked to drops in alcohol-related assaults. Other policy measures, such as availability restrictions of alcohol could also be chosen to reduce violence [105,122].

It is important to point out that the case of sexual assault as a separate category provides new insights for international research, as it shows changes in specific criminal acts and not just violence in general. Not only does this allow for a more detailed assessment of the impact of alcohol control measures, but it also emphasises the gender aspect – sexual crimes, which most often affect women, have rarely been analysed as a separate category, so our work adds a new and relevant dimension to the international literature.

The forensic autopsy findings echo earlier studies from different countries, which report high levels of alcohol presence in fatalities due to external causes [73,78,123,124]. However, the 55% alcohol involvement rate in Lithuania's

external-cause deaths shows a high alcohol burden. This study to a small but growing body of literature that applies forensic toxicology to evaluate public health risks. The use of BAC levels, combined with cause-of-death classification, provides a more precise picture than registry-based alcohol-attributable fraction estimates.

Studies conducted in other countries indicate a pattern of alcohol consumption in homicide offenders and victims [84,125]. This was also observed in our previous research of homicide perpetrators and forensic autopsy. So, the analysis of legal cases was chosen as rare, qualitative insight into the nature of alcohol-related homicides. Findings establish the evidence that many such cases involve both the perpetrator and the victim being intoxicated, and that the violence is often spontaneous and context dependent [126,127].

However, the continued high share of intoxicated perpetrators of homicides contrasts with the broader improvements seen in other categories of mortality and crime groups such as assaults. These findings are at odds with research indicating positive outcomes from stricter policies [94,102]. Results further underscore the need for additional, targeted interventions in this population, as it could be that heavy drinkers and habitual violent offenders may remain resistant to general policy measures.

This suggests that general alcohol policy may reduce opportunities for such violence to emerge but will not fully prevent it. Additional measures – such as targeting repeat alcohol-related offenders, supporting families at risk of domestic violence, and community-based alcohol treatment – are needed to supplement structural controls.

The findings presented in this dissertation provide several implications for public health policy in Lithuania. First, the results clearly argue in favour of maintaining and strengthening population-wide alcohol control measures. The observed reductions in mortality and sexual assaults, especially after the 2017 reforms, validate the effectiveness of the “best buy” measures recommended by the WHO. Continued taxation and restrictions on availability and mar-keting are necessary to sustain these gains. Specifically, the reduction of sale hours (especially on Sundays) indicates a potential for further reduction in alcohol-related harm, especially due to reduced retail sales hours of alcohol that is likely to be consumed in the home environment.

Second, the mystery shopping study suggests that a more systematic and proactive approach to enforcing the legal purchasing age is currently insufficient and urgently needed. It is important to close a gap between legislation and practise. Priority should be given to establishing a system for continuous random compliance checks. This could be achieved through co-operation between institutions, NGOs and academia. Retailers should also take responsibility for non-compliance, introduce training systems and

change retailers' attitudes. Particular attention should be paid to higher-risk times, such as weekends and evenings, when compliance is typically lower. Another problem in this field should also be considered: The prohibition of selling alcohol to intoxicated persons has not yet been systematically studied in Lithuania. This area remains important for future research and should not be ignored either by enforcement authorities or by researchers evaluating alcohol policy.

Third, the persistently high proportion of alcohol-related homicides suggests that targeted measures need to be added to already existing alcohol control policies. These could include additional alcohol control policies, early intervention for those with alcohol use problems, community-based violence prevention programmes and multi-institutional responses to repeat offenders.

Fourth, the role of alcohol in both unintentional injuries and interpersonal violence require integrated action across all areas. Not only policy measures are needed, but also coordination between health care, law enforcement, and social services to identify those at high risk and prevent escalation. In the Lithuanian context, additional potential lies in the network of municipal public health departments and initiatives such as project "Development of a youth-friendly healthcare service delivery model", which represent unique national resources that are not yet fully utilised in the field of alcohol harm prevention.

Finally, the link between alcohol and gender-based violence, including the high rates of alcohol-related homicide by men and the victimisation of women, requires gender-specific strategies.

One of the strengths of this dissertation is the use of different and complementary methods, from legal analysis to experimental field studies and statistical modelling. The research is based on national-level data and provides a rare opportunity to delve into the harms caused by alcohol in a country with high alcohol consumption and strict policies.

Although this study provides valuable insights and contributes to research field, it is important to acknowledge a number of limitations that may affect the interpretation and generalizability of the findings. First, many analyses rely on legal data, which may be incomplete. For example, some studies, lacked accurate data on alcohol intoxication levels. Second, limitations in the data structure, such as small sample sizes, reliance on single-year data, or the need to aggregate monthly values due to low case numbers, may have limited the statistical power and accuracy of the models. Furthermore, studies such as the mystery shopper experiment were limited in terms of participant diversity, beverage types, and geographic coverage, which may affect the international or national generalizability. Finally, the focus on Lithuania, a country with its own specific cultural, legal, and political context, to some

extent limits the extrapolation of the results to other settings beyond the high-income Western oriented democracies. These limitations underscore the need for caution in interpreting the findings, while also indicating opportunities for future research to build on and expand this work.

CONCLUSIONS

1. The real-life implementation of restrictions on alcohol availability in Lithuania is inconsistent. A mystery shopping study revealed that 44.8% of attempts to purchase alcohol were successful, indicating that sellers were willing to complete the transaction without asking for an identity document to verify the buyer's age. This suggests that age verification controls are insufficient and that the policy regarding the minimum purchasing age is not fully enforced. However, an analysis of the ban on alcohol advertising demonstrated that compliance is achievable in other policy areas when monitoring and enforcement mechanisms are robust.
2. Analysis of alcohol control policies showed that the introduction of the WHO recommended "best buys", such as higher taxation and restrictions on availability, impacted mortality and sexual violence. In the Baltic countries and Poland, its introduction correlated with a 2.3% decrease in age-standardized all-cause mortality among men aged 20 and older. In Lithuania, the implementation of alcohol control policies between period of 2008 and 2018 was associated with an estimated average of 478 men deaths avoided per year. The major excise increase in 2017 was associated with a statistically significant decrease in the number of sexual assaults. While the overall number of homicides and assaults have been steadily declining throughout the last two decades, there was no statistically significant association for a specific policy time points established.
3. Alcohol is a significant factor in mortality related to external causes and fatal violence. Insights from a study on homicide and policy evaluation revealed that most perpetrators were intoxicated at the time of the offense. Furthermore, forensic autopsy data showed a similarly high prevalence of alcohol intoxication among victims of fatal violence. A case law study confirmed that most homicides occurred in the context of binge drinking, with both perpetrators and victims being intoxicated. Typically, these homicides were spontaneous and interpersonal, occurring in domestic settings rather than being premeditated.

PRACTICAL RECOMMENDATIONS

The research conducted in this work allows to provide several significant practical recommendations.

For health policy makers:

- One of the effective ways to monitor the implementation of legislation related to the minimum legal purchasing age is through mystery shopping. Health policy makers should consider systemic, regulatory changes to enable the implementation of such interventions, which is important not only for alcohol control policies, but also tobacco and other age-restricted products.
- The findings of this dissertation show that the burden of alcohol-related violence is still high, and some society groups are affected more. This highlights the need for alcohol control policies, prevention programmes, evidence-based treatment services that not only aim to reduce overall consumption and harm, but also explicitly address social inequalities. Further application of measures, such as taxation and access restrictions, are recommended. One such example is the shorter alcohol sales hours on Sundays; such a restriction could be expanded. It is equally important to assess the social impact of existing alcohol policy measures, further monitor how the situation is changing and how policy measures affect patterns of alcohol-related violence.

For health policy implementers:

- In the current situation cooperation between stakeholders is essential. State institutions should increase the number of random compliance checks, implement systematic approach. Training for alcohol retailers and sellers on legal obligations and public health consequences should be considered.

For researchers:

- Future research should seek to address the limitations identified in this dissertation by improving methodological approaches and expanding the contextual scope. Including multiple countries or regions for comparative studies could also help assess the generalizability of findings beyond the Lithuanian context.
- Ethics boards oversight remains crucial, but in some cases greater flexibility should be shown when assessing important public health issues, especially when other methodological options are not feasible.

Mystery shopping studies are a good example of where strict ethical restrictions may limit realistic assessments of sales to minors. In such cases, the primary safeguard should be compliance with legal requirements, while allowing studies to obtain the evidence necessary to protect public health.

SANTRAUKA

ĮVADAS

Alkoholio vartojimas laikomas rimtu iššūkiu visuomenės sveikatai. Tai rizikos veiksnys, sukeliantis daugybę neigiamų pasekmių tiek alkoholį vartojantiems, tiek juos supantiems asmenims. Apskaičiuota, kad 2019 m. alkoholio vartojimas visame pasaulyje prisidėjo prie 2,6 mln. mirčių, tai sudarė 4,7 proc. visų tų metų mirčių. Remiantis dabartiniais duomenimis, pasaulinė ligų ir traumų našta, susijusi su alkoholio vartojimu, gali būti vertinama pagal 31 sveikatos sutrikimą, atspindintį alkoholio poveikį šių sutrikimų atsiradimui, raidai ir pasekmėms. Nors ši problema paveikia daugelį pasaulio šalių, ji ypač opi Europos regione. Pasak Pasaulio sveikatos organizacijos (PSO), būtent šiame regione stebimas didžiausias su alkoholiu susijusių mirčių skaičius 100 000 gyventojų ir didžiausias alkoholio suvartojimas [1]. Tai taip pat vienas iš žalos sveikatai veiksnių Lietuvoje, prisidedantis prie mirtingumo ir sergamumo rodiklių, ypač tarp darbingo amžiaus vyrų. PSO duomenys rodo, kad 2016 m. Lietuvoje buvo fiksuojamas vienas didžiausių alkoholio suvartojimo rodiklių pasaulyje – vidutiniškai 15 litrų vienam gyventojui (15+ amžiaus) [2]. Šis nerimą keliantis skaičius žymėjo savotišką lūžio tašką visuomenėje, politiniame kontekste ir paskatino diskusijas apie alkoholio sukeliamą žalą.

Suprasdamos problemos mastą, šalys privalo imtis veiksmingų alkoholio kontrolės priemonių. Nuo XX a. dešimtojo dešimtmečio pradžios alkoholio kontrolės politika Lietuvoje patyrė įvairių pokyčių – nuo liberalaus požiūrio iki griežtų apribojimų. Pastaraisiais metais į Lietuvos alkoholio kontrolės sistemą nuolat įtraukiamos PSO rekomenduojamos priemonės. Tam įtakos turėjo tiek aptartas alkoholio vartojimo mastas ir iš to kilusi būtinybė imtis atsako, kad būtų pagerinta visuomenės sveikatos situacija, tiek ir keli visuomenę sukrėtę įvykiai, susiję su vairavimu išgėrus [3]. Naujausiomis reformomis, įgyvendintos visos PSO rekomenduojamas intervencijos, skirtos sumažinti alkoholio daromą žalą srityje [4]. Priemonės apima akcizų didinimą, alkoholio reklamos draudimą, amžiaus alkoholio įsigijimui ir pardavimo laiko apribojimus.

Nuo 2016 m. alkoholio suvartojimas Lietuvoje mažėjo, atitinkamai 2017 m. – 12,3 litro, 2018 m. – 11,2 litro, 2019 m. – 11,1 litro [5]. Tačiau ši teigiama dinamika pakito COVID-19 pandemijos metu, kai pasikeitė bendros vartojimo tendencijos ir išaugo su alkoholiu susijęs mirtingumas, o tai iš dalies lėmė ir vartojimo modelių poliarizacija: mažiau alkoholio vartojantys asmenys sumažino suvartojamo alkoholio kiekį, o daug vartojantys – padidino [6]. 2022 m. situacija stabilizavosi ir pradėjome stebėti alkoholio vartojimo mažėjimą (2024 m. duomenimis, vartojimas sumažėjo iki 10,2 litro vienam

gyventojui), tai gali atspindėti sustiprintų alkoholio kontrolės priemonių poveikį [7]. Nors situacija gerėja, tačiau Lietuva išlieka viena iš daugiausiai alkoholio suvartojančių šalių Europos Sąjungoje (ES), o alkoholio poveikis, ypač kalbant apie mirtis nuo smurto, išlieka reikšmingas [8]. Tai rodo, kad vien įstatymų egzistavimas negarantuoja sėkmės ir teigiamo rezultato, svarbu įvertinti alkoholio kontrolės politikos vykdymą ir jos veiksmingumą.

Pirma, tai padeda nustatyti, ar įgyvendintos priemonės duoda apčiuopiamų rezultatų visuomenės sveikatai, pavyzdžiui, sumažina mirtingumą ar su alkoholiu susijusių smurtinių incidentų skaičių. Neatlikus tokio vertinimo, kyla rizika remtis prielaidomis ar neteisingais politiniais argumentais, o ne įrodymais, ypač politikos srityje, kurioje verslo interesai dažnai prieštarauja visuomenės sveikatos tikslams. Supratimas, kas veikia ir kokiomis sąlygomis, gali padėti priimti politikos sprendimus, ypač šalyse, susiduriančiose su panašiomis su alkoholio vartojimu susijusiomis problemomis.

Galiausiai, efektyvumo įvertinimas leidžia tyrėjams ir politikos formuotojams nustatyti nenumatytą poveikį ar įgyvendinimo spragas, o tai padeda tobulinti egzistuojančią politiką. Atsižvelgiant į tai, labai svarbu įvertinti kaip galiojančios politikos priemonės veikia praktiškai. Šioje disertacijoje galimos įgyvendinimo spragos nagrinėjamos, atsižvelgiant į tai kaip vystėsi Lietuvos alkoholio kontrolės politika, kaip ji taikoma praktikoje ir koks buvo jos faktinis poveikis laikui bėgant. Dėmesys skiriamas ne tik politikos vykdymui, bet ir jos veiksmingumui mažinant žalą.

Siekiant geriau suprasti Lietuvos alkoholio politikos veiksmingumą ir jos įgyvendinimo iššūkius, šioje disertacijoje naudojami keli duomenų šaltiniai ir derinami skirtingi jų analizės metodai. Darbe pateikiama literatūros apžvalga apie teisinio reglamentavimo pakeitimus, įvestus nuo 2001 iki 2023 m., išskiriant pagrindinius politikos kūrimo, įgyvendinimo etapus. Naudojant pertrauktų laiko eilučių ir kitus statistinės analizės metodus, disertacijoje nagrinėjama, ar pagrindinių politikos reformų laikas sutampa su reikšmingais mirtingumo ir su smurtiniais nusikaltimais susijusios statistikos pokyčiais. Slapto pirkėjo ir reklamos draudimo tyrimai nagrinėja realų prieinamumo apribojimų įgyvendinimą. Tyrime taip pat analizuojami smurto, pasibaigusio mirtimi atvejai, vertinant aukos ir kaltinamojo alkoholio vartojimo paplitimą, taip pat konkrečios nužudymų, kurių atveju stebimas alkoholio vartojimas, bylos. Šis skirtingų metodų derinys leidžia geriau suprasti, kaip politika perkeliama iš teisės aktų į realius rezultatus ir ar lemia reikšmingus pokyčius.

Ši disertacija buvo parengta dalyvaujant tarptautiniame projekte „Alkoholio kontrolės politikos poveikio sergamumui ir mirtingumui Lietuvoje ir kitose Baltijos šalyse vertinimas“, finansuojamame Jungtinių Valstijų Nacionalinio alkoholio vartojimo piktnaudžiavimo ir alkoholizmo instituto (NIAAA) [finansavimo numeris 1R01AA028224], 2020–2025 m. laikotarpiui. Nors

disertacija buvo parengta kaip šios tyrimų iniciatyvos dalis, ji atspindi unikalią kryptį, pateikiančią originalių įrodymų, aktualių būtent Lietuvos kontekstui, ir yra ypač reikšminga nacionalinės politikos formuotojams, visuomenės sveikatos institucijoms ir plačiajai visuomenei.

Praktinis aktualumas ir naujumas. Susiejant atskirus politikos elementus, jų įgyvendinimą ir poveikį sveikatos rodikliams, šiuo tyrimu siekiama prisidėti prie įrodymų, kurie gali būti svarbūs Lietuvos politikos formavimui, tiek prie tarptautinės literatūros apie alkoholio kontrolės politikos veiksmingumą. Rezultatai pabrėžia ne tik sėkmes, bet ir nuolatinius iššūkius, ypač susijusius su teisės aktų įgyvendinimu. Disertacija siekiama pateikti įrodymų, kaip ateityje plėtoti alkoholio politiką šalyse, kuriose didelis alkoholio suvartojimas. Taip pat prisidėti prie platesnės diskusijos apie tai, kaip reguliavimą galima padaryti veiksmingesnį ir kurios politikos priemonės duoda išmatuojamos naudos. Tyrimas yra naujas savo daugiadisciplininiu požiūriu: tai pirmoji sisteminė analizė Lietuvoje, kurioje derinama teisminių bylų analizė, epidemiologiniai duomenys, pertrauktų laiko eilučių analizė ir stebėjimo tyrimai. Konkrečiai, jame pristatomas pirmasis slapto pirkėjo tyrimas, kuriuo vertinama, kaip laikomasi minimalaus alkoholio pirkimo amžiaus, ir vienas pirmųjų vertinimų kaip įgyvendinamas alkoholio reklamos draudimas.

Tikslas: Įvertinti alkoholio politikos, kuria siekiama sumažinti alkoholio prieinamumą Lietuvoje, įgyvendinimą ir alkoholio kontrolės politikos poveikį su alkoholiu susijusiam mirtingumui ir smurtiniams nusikaltimams.

Uždaviniai:

1. Įvertinti alkoholinių gėrimų prieinamumo apribojimų įgyvendinimą Lietuvoje.
2. Įvertinti alkoholio kontrolės politikos poveikį bendram mirtingumui ir smurtiniams nusikaltimams šalyje.
3. Įvertinti ryšį tarp alkoholio vartojimo, mirtingumo nuo išorinių priežasčių ir smurtinių nusikaltimų.

Autoriaus indėlis. Žemiau pateikiamas autorės Lauros Miščikienės indėlis, siejamas su kiekviena disertacijos publikacija (publikacijos A1–A7 išvardytos mokslinių straipsnių sąraše).

A1: autorė buvo atsakinga už tyrimo koncepciją ir dizainą, koordinavo ir įgyvendino slaptojo pirkėjo intervenciją (tyrimo veiksmus), atliko duomenų apdorojimą ir analizę; parengė ir peržiūrėjo rankraštį; taip pat koordinavo bendravimą tarp bendraautorių ir prisidėjo prie išvadų interpretavimo.

A2: autorė prisidėjo prie rankraščio rengimo, formalios analizės, rašymo, peržiūros ir redagavimo; ir gavo pirmojo autoriaus pritarimą įtraukti šį straipsnį į disertaciją.

A3: autorė prisidėjo prie duomenų gavimo, Lietuvos atvejo analizei; rankraščio rengimo; peržiūros ir redagavimo; ir gavo pirmojo autoriaus pritarimą įtraukti šį straipsnį į disertaciją.

A4: autorė buvo atsakinga už tyrimo koncepcijos parengimą, metodologiją, duomenų rinkimą, atliko formalią analizę, parengė originalų juodraštį, peržiūrėjo rankraštį; taip pat koordinavo bendravimą tarp bendraautorių ir prisidėjo prie išvadų interpretavimo.

A5: autorė buvo atsakinga už tyrimo koncepciją ir dizainą, koordinavo duomenų gavimą iš Higienos instituto, atliko duomenų apdorojimą ir analizę; parengė ir peržiūrėjo rankraštį; taip pat koordinavo bendravimą tarp bendraautorių ir prisidėjo prie išvadų interpretavimo.

A6: autorė prisidėjo prie rankraščio kūrimo, jo koncepcijos, originalaus juodraščio rengimo: rašymo, peržiūros ir redagavimo; ir gavo pirmojo autoriaus pritarimą įtraukti šį straipsnį į disertaciją.

A7: autorė buvo atsakinga už tyrimo koncepciją ir dizainą, koordinavo duomenų gavimą, atliko duomenų apdorojimą; parengė ir peržiūrėjo originalų rankraštį; taip pat koordinavo bendravimą tarp bendraautorių ir prisidėjo prie išvadų interpretavimo.

Duomenų šaltiniai ir naudoti metodai. Tyrimai, įtraukti į disertaciją, iš pradžių buvo patvirtinti Lietuvos bioetikos komiteto (Nr. 6B-21-196, 2021 m. spalio 21 d.), vėliau gauti Lietuvos sveikatos mokslų universiteto Bioetikos centro leidimai (Nr. 2024-BEC3-T-016, 2024 m. gegužės 20 d. ir Nr. 2024-BEC3-T-040, 2025 m. sausio 17 d.). Laikytasi Helsinkio deklaracijos principų.

Ši disertacija jungia empirinius ir dokumentinius tyrimus, siekiant išnagrinėti ryšį tarp alkoholio kontrolės priemonių ir visuomenės sveikatos rodiklių Lietuvoje. Analizei naudoti duomenys gauti iš įvairių šaltinių, įskaitant oficialią sveikatos ir nusikalstamumo statistiką, atliktų autopsijų duomenis ir teismo nagrinėtas bylas, iš atliktų tyrimų gautus duomenis, bei teisės ir politikos dokumentus. Išsamesni metodikos aprašymai ir papildoma informacija pateikiami atskiruose publikuotuose straipsniuose A1–A7.

A1. *„A mystery-shopping study to test enforcement of minimum legal purchasing age in Lithuania in 2022“.* 2022 m. buvo atliktas „slaptojo pirkėjo“ tyrimas, kuriuo vertinta, ar jaunuoliams yra realiai prieinami alkoholiniai gėrimai. Tyrime dalyvavo specialiai paruošti jauni žmonės, bandę įsigyti alkoholio prekybos vietose. Imtis sudaryta pagal nacionalinį alkoholio licencijų registrą (8 046 išduotos licencijos prekybai alkoholiniais gėrimais ne vietoje), iš kurio atsitiktinai atrinktos 239 prekybos vietos, reprezentuojančios visus

10 Lietuvos apskričių centrų. Į imtį įtraukti penki pagrindiniai šalies prekybos tinklai, jų parduotuvių skaičius kiekviename mieste buvo proporcingas bendram tinklo parduotuvių skaičiui.

Slaptais pirkėjais buvo aštuonios 20–24 m. amžiaus studentės, turinčios teisę įsigyti alkoholio, tačiau atrodžiusios pakankamai jaunos, kad pardavėjai privalėtų patikrinti amžių. Patikimumui įvertinti atliktas įverčių suderinamumo testas (ICC = 0,889; 95 % PI: 0,785–0,944). Kiekvieno vizito metu fiksuoti tokie kintamieji kaip savaitės diena, paros laikas, eilės ilgis, pirkimo procesas.

A2. „*The Comprehensive Alcohol Advertising Ban in Lithuania: A Case Study of Social Media*“. Buvo vertinamas visiško reklamos draudimo įgyvendinimas socialiniuose tinkluose. Stebėti du populiariausi socialiniai tinklai Lietuvoje – „Facebook“ ir „Instagram“. Stebėta 115 paskyrų (64 „Facebook“, 51 „Instagram“), įskaitant didžiausius mažmeninės prekybos tinklus, specializuotas alkoholio parduotuves, prekybos centrus, alkoholio gamintojus ir įtakingus nuomonės formuotojus. Įrašai buvo tikrinami kasdien 60 dienų laikotarpiu. Galutinį duomenų rinkinį sudarė 2191 įrašas (1442 iš „Facebook“ ir 749 iš „Instagram“). Iš jų 163 atitiko įtraukimo kriterijus kaip susiję su alkoholiu. Be to, surinktos 121 alkoholio turinio „Instagram“ istorijos.

A3. „*Alcohol control policies reduce all-cause mortality in Baltic Countries and Poland between 2001 and 2020“* Naudoti mėnesiniai mirtingumo duomenys iš nacionalinių statistikos institucijų (Lietuvoje – Statistikos departamento ir Higienos instituto mirties priežasčių registro). Duomenys apėmė laikotarpį nuo 2001 iki 2020 m., leidžiant patikimai įvertinti politikos įtaką. Populiacijos dydis pagal metus gautas iš EBPO duomenų ir mirtingumo rodikliai standartizuoti pagal ES standartą. Į tyrimą įtrauktos įrodymais grįstos politikos intervencijos (angl. „best buy“) (akcizų didinimas, prekybos laiko ribojimai).

A4. „*The impact of alcohol control policy on assaults and sexual assaults in Lithuania: An interrupted time-series analysis“.* Analizuoti policijos užregistruotų sunkių sveikatos sutrikdymų ir seksualinių nusikaltimų duomenys iš oficialaus Nusikalstamų veikų registro (2003–2023 m.). Vertintos trys politikos priemonės (2008 m. akcizų padidinimas; 2017 m. reikšmingas akcizų padidinimas; 2018 m. trumpinti prekybos alkoholiu laikai ir padidintas minimalus įsigijimo amžius).

A5. *„The prevalence of alcohol-related deaths in autopsies performed in Lithuania between 2017 and 2020: a cross-sectional study“.* Naudoti mirties priežasčių registro duomenys apie visus autopsijomis patvirtintus atvejus. Analizuotos visos mirtys, kurių atveju atlikta autopsija 2017–2020 m. (n = 18 872), iš kurių 7550 buvo siejama su išorinėmis mirties priežastimis. Nuo 2017 m. šalyje tapo privaloma registruoti alkoholio koncentraciją kraujyje ir

kitų psichoaktyvių medžiagų buvimą, todėl šis laikotarpis pasirinktas kaip reprezentatyvus.

A6. *„Persistently high impact of alcohol use on fatal violence in Lithuania despite strengthening alcohol control policies, 2004–19“.* Analizuoti ketvirtiniai žmogžudysčių duomenys iš Nusikalstamų veikų registro. Vertintas kaltinamųjų neblaivumas ir ryšys su pagrindiniais alkoholio kontrolės politikos pokyčiais (2017 ir 2018 m.).

A7. „*Explaining the Link Between Alcohol and Homicides: Insights from the Analysis of Legal Cases in Lithuania*“. Atlikta 2019 m. įvykdytų, su alkoholiu susijusių nužudymų bylų kokybinė analizė. Duomenys rinkti iš viešai prieinamos Lietuvos teismų informacinės sistemos „Liteko“. Iš 2607 sprendimų 93 atitiko įtraukimo kriterijus, galutinėje analizėje liko 52 atvejai. Analizuota alkoholio vartojimo aplinkybės, aukų ir kaltinamųjų santykiai, situacinis kontekstas.

Įvairiuose tyrimuose buvo taikyti skirtingi metodologiniai požiūriai, siekiant išanalizuoti alkoholio politikos ir visuomenės sveikatos rodiklių tarpusavio ryšį. Laiko eilučių metodai, konkrečiai pertrauktų laiko eilučių analizė (ITSA) [114], buvo naudoti vertinant pokyčius mirtingumo ir smurtinių nusikaltimų (nužudymų, sunkių sveikatos sutrikdymų, seksualinių) rodikliuose po pagrindinių politikos priemonių įgyvendinimo. Šie modeliai buvo pritaikyti atsižvelgiant į bendras tendencijas, sezoniškumą ir autokoreliaciją, ir naudoti nustatyti lygio bei krypties pokyčius, susijusius su politikos pokyčiais.

Aprašomoji statistika ir paplitimo įverčiai buvo apskaičiuoti pagal autopsijų ir teismo bylų duomenis, siekiant nustatyti alkoholio įtaką mirčių ir smurtinių įvykių atvejams.

Slaptojo pirkėjo tyrime buvo apskaičiuota sėkmingų alkoholio įsigijimo bandymų proporcija, o skirtumai tarp kintamųjų (pvz., parduotuvės tipo, miesto ir kaimo vietovių) įvertinti taikant Chi kvadrato testą.

Be to, atlikta nužudymų bylų kokybinė turinio analizė, sistemingai peržiūrint teismo sprendimus siekiant nustatyti pasikartojančias temas bei alkoholio kontekstinį vaidmenį smurtiniuose įvykiuose.

Analizė atlikta naudojant standartinius statistinės analizės paketus, įskaitant IBM SPSS (27 versija „Windows“ sistemai) ir R (3.6.3 versija). Reikšmingumo lygis paprastai nustatytas $p < 0,05$. Visos analizės buvo interpretuojamos visuomenės sveikatos kontekste, akcentuojant praktinį teisės aktų poveikį rezultatams, o ne vien tik statistinį reikšmingumą.

REZULTATŲ APŽVALGA

Šioje disertacijoje apibendrinami tyrimų, kuriuose nagrinėjamas galiojančios alkoholio kontrolės politikos įgyvendinimas, alkoholio ryšys su

mirtingumu ir smurtiniais nusikaltimais Lietuvoje bei vertinamas politikos poveikis, rezultatai. Slaptojo pirkėjo tyrimu tikrinta alkoholio įsigijimo amžiaus apribojimų įgyvendinimo praktika, reklamos draudimo įgyvendinimas tikrintas per socialinių tinklų stebėjimo tyrimą, atkreiptas dėmesys į teisės aktų reikalavimų ir realios įgyvendinimo aplinkos skirtumus. Buvo atlikti du politikos vertinimo tyrimai: bendrojo mirtingumo vertinimo tyrimas parodė, kad po politikos reformų sumažėjo vyrų mirtingumas. Sunkių sveikatos sutrikdymų ir seksualinių nusikaltimų tyrimas parodė, kad po 2017 m. politikos pakeitimų sumažėjo šių nusikaltimų skaičius, o statistiškai reikšmingai seksualinių nusikaltimų. Autopsijos duomenų tyrimas atskleidė, kad daugiau nei pusėje mirčių nuo išorinių priežasčių nustatytas alkoholio vartojimo faktas (55 proc.), o didelė dalis apsvaigusiųjų asmenų buvo tarp užpuolimų (X85–Y09) ir nelaimingų atsitikimų (V00–X59) aukų. Nors bendras nužudymų skaičius bėgant metams sparčiai mažėja, asmenų, kurie padarė nusikaltimus apsvaigę, dalis išlieka gana didelė ir stabili. Per 2004–2019 metų laikotarpį šis skaičius svyravo nuo 63 proc. iki 73 proc. Šiuos rezultatus patvirtina išsami nužudymų bylų analizė, nustatanti ryšį tarp alkoholio vartojimo ir aukos bei nusikaltėlio. Nužudymai, kurių atveju nustatomas alkoholis, dažnai siejami su besaikiu alkoholio vartojimu, yra impulsyvūs, įvykdomi artimoje aplinkoje ir apima pažeidžiamas gyventojų grupes.

Visi šioje disertacijoje apibendrinti rezultatai atskleidžia trijų krypčių sąveiką: teisės aktų įgyvendinimo užtikrinimo trūkumai, išryškėję atliekant slaptojo pirkėjo tyrimą, gali pakenkti visam įgyvendintos politikos potencialui; įgyvendinta įrodymais pagrįsta politika, apimanti visą populiaciją, gali žymiai sumažinti tam tikrą žalą; ir alkoholio sukeltas smurtas pasitaiko pakankamai dažnai, todėl reikia tikslingesnių politikos intervencijų ir nuolatinės politikos vykdymo stebėsenos.

Nepakankamas amžiaus apribojimų įgyvendinimo užtikrinimas, nustatytas atliekant slaptojo pirkėjo tyrimą, atitinka panašių tyrimų [46, 47] išvadas, kuriuose didelė dalis atvejų, kai buvo bandoma nusipirkti alkoholinių gėrimų, laikomi sėkmingais. Mūsų tyrimas yra pirmasis tokio pobūdžio atliktas tyrimas Lietuvoje ir jis atskleidžia galiojančių teisės normų taikymo trūkumus. Palyginti su Vakarų Europa, kur slaptųjų pirkėjų intervencijų sistemos kartais yra institucionalizuotos, Lietuvoje trūksta tiek vykdymo užtikrinimo stebėjimo, tiek atskaitomybės mechanizmų. Vis dėlto mūsų tyrimas apie alkoholio reklamos draudimo įgyvendinimą rodo, kad veiksmingas įstatymo reikalavimų įgyvendinimas yra įmanomas. Socialinių tinklų stebėjimo tyrimas parodė aukštą reklamos draudimo laikymosi lygį – tik 1,4 proc. įrašų buvo laikomi įstatymo pažeidimais. Tai prieštarauja pramonės teiginiams, kad internetinio turinio reguliavimas nėra pagrįstas, nes neįmanomas jo tinkamas įgyvendinimas. Šis pavyzdys rodo, kad turint aiškią, apibrėžtą teisinę bazę, atsakingų

institucijų vykdomą stebėseną ir už pažeidimus taikomas sankcijas, reikalavimų laikymąsi galima užtikrinti.

Todėl ši disertacijos dalis ir atlikti tyrimai papildo turimas žinias ir įrodymus, atskleisdami, kada ir kur įstatymo įgyvendinimo užtikrinimas neveikia.

Tyrimai [116] vertino ankstesnės alkoholio politikos poveikį, o ši disertacija daugiausia dėmesio skiria naujausioms, įrodymais pagrįstoms, politikos priemonėms, įgyvendintoms per trumpą laiką ir tai galima laikyti susidarusio natūralaus eksperimento aplinka. Darbe stebėtas bendro vyrų mirtingumo sumažėjimas Baltijos šalyse ir Lenkijoje, po įgyvendintų politikos reformų, atitinka kitus alkoholio kontrolės priemonių vertinimus [117]. Štelemėkas ir kt. [118] nustatė reikšmingą su alkoholiu susijusių mirčių sumažėjimą po įgyvendintų įperkamumo apribojimų (mokesčių didinimas). Šiuos rezultatus taip pat patvirtino tyrimai apie mirtingumą nuo su alkoholiu susijusių kepenų ligų, kurie parodė, kad ribojanti alkoholio kontrolės politika yra perspektyvi priemonė gerinti gyventojų sveikatą, mažinant su alkoholiu susijusią naštą [119]. Nustatėme skirtumus tarp lyčių – bendras moterų mirtingumas reikšmingai nesumažėjo. Kiti tyrimai taip pat rodo, kad alkoholio kontrolės politikos poveikis skiriasi priklausomai nuo lyties ir ligos potipio [120]. Lietuvoje, kaip ir kitose šalyse, turinčiose panašius vartojimo įpročius, tai gali būti susiję su vis dar dideliu stipriųjų gėrimų vartojimu ir gausiu epizodiniu gėrimu, ypač tarp vyrų [1].

Nors poveikio dydžiai skyrėsi priklausomai nuo nusikaltimo tipo, sunkaus sveikatos sutrikdymo ir seksualinių nusikaltimų tyrimo rezultatai sutampa su esamais įrodymais, patvirtindami ryšį tarp politikos priemonių, ypač tų, kurios skirtos alkoholio įperkamumui, ir smurtinių nusikaltimų sumažėjimo. Panašūs rezultatai buvo užfiksuoti Australijoje [121], kur kainų padidėjimas buvo siejamas su užpuolimų, padarytų apsvaigus, sumažėjimu. Kitos politikos priemonės, tokios kaip pavyzdžiui, alkoholio prieinamumo apribojimai, taip pat galėtų būti pasirinktos smurtui mažinti [105, 122].

Svarbu pažymėti, kad nagrinėtas seksualinių nusikaltimų, kaip atskiros kategorijos, atvejis suteikia naujų įžvalgų tarptautiniams tyrimams, nes atskleidžia konkrečių nusikalstamų veikų, o ne tik smurto bendrai, pokyčius. Tai leidžia ne tik detaliau įvertinti alkoholio kontrolės politikos poveikį, bet ir pabrėžti lyties aspektą – seksualiniai nusikaltimai, kurie vis dar dažniau paveikia moteris, iki šiol retai buvo analizuoti kaip atskira kategorija, todėl darbas papildo tarptautinę literatūrą nauju ir svarbiu aspektu.

Autopsijos duomenų analizės rezultatai patvirtina ankstesnių įvairiose šalyse atliktų tyrimų išvadas, jog mirčių dėl išorinių priežasčių atvejais alkoholio vartojimas yra paplitęs [73, 78, 123, 124]. Lietuvoje nustatytas 55 proc. rodiklis rodo ypač didelę alkoholio įtaką šioje srityje. Šis tyrimas papildo dar gana ribotą, bet augantį mokslinių darbų rinkinį, kuriame teismo medicinos

toksikologijos duomenys naudojami visuomenės sveikatos rizikoms vertinti. Nustatytos alkoholio koncentracijos analizė, derinama su mirties priežasčių klasifikacija, suteikia kur kas tikslesnį vaizdą nei tik mirties registrais pagrįsti alkoholio vartojimo paplitimo įverčiai.

Kitose šalyse atliktos analizės rodo alkoholio vartojimo tendenciją tarp nužudymų vykdytojų ir aukų [84, 125]. Tai buvo pastebėta ir mūsų tyrimuose apie kaltinamuosius nužudymų įvykdymu ir atliekant autopsijos duomenų analizę (t. y. vertinant aukos perspektyvą). Todėl, teisinių bylų analizė buvo pasirinkta kaip kokybinė įžvalga apie su alkoholiu susijusių nužudymų pobūdį, aplinkybes, kurių kiti duomenys atskleisti negali. Gauti rezultatai patvirtina egzistuojančius įrodymus, kad daugelyje tokių atvejų ir nusikaltėlis, ir auka būna apsvaigę, o smurtas dažnai būna spontaniškas [126, 127].

Išliekanti didelė nužudymų, padarytų kai kaltinamasis asmuo apsvaigęs, dalis kontrastuoja su reikšmingu bendro mirtingumo ir seksualinio smurto mažėjimu, ir rodo, kad alkoholio kontrolės priemonių poveikis šiai smurto formai buvo ribotas. Šie rezultatai prieštarauja ir tyrimams, kuriuose vertinamos įvestos griežtesnės alkoholio kontrolės politikos priemonės, siejamos su gerėjančiais rodikliais [94, 102]. Gauti rezultatai pabrėžia papildomų, tikslinių intervencijų šioje populiacijoje poreikį, nes gali būti, kad daug geriantys ir nuolat smurtaujantys asmenys išlieka priešiški bendroms politikos priemonėms.

Taigi, bendra alkoholio politika gali sumažinti smurtinių, su alkoholio vartojimu siejamų, nusikaltimų atsiradimo galimybes, tačiau visiškai neužkerta jiems kelio. Siekiant papildyti galiojančią alkoholio kontrolės teisinę sistemą, reikalingos papildomos priemonės, pavyzdžiui, nukreiptos į pakartotinius su alkoholiu susijusius nusikaltimus, paramą šeimoms, kuriose nustatomas galimas, pasikartojantis smurtas artimoje aplinkoje ir plačiau prieinamas gydymas priklausomiems asmenims.

Šioje disertacijoje gautos išvados formuoja keletą svarbių rezultatų visuomenės sveikatos politikai Lietuvoje. Pirma, įrodymai patvirtina, kad reikia išlaikyti ir stiprinti taikomas alkoholio kontrolės politikos priemones. Pastebėtas mirtingumo ir seksualinių nusikaltimų sumažėjimas, ypač po 2017 metų reformų, patvirtina PSO rekomenduojamų intervencijų veiksmingumą. Norint išlaikyti šiuos rezultatus, būtinas tolesnis mokesčių didinimas ir prieinamumo bei reklamos apribojimai. Kaip pavyzdys galėtų būti prekybos valandų sutrumpinimas (ypač sekmadieniais). Ši priemonė gali dar labiau sumažinti su alkoholiu susijusią žalą, kadangi trumpinamos alkoholio pardavimo valandos mažmeninėje prekyboje, kur įsigytas alkoholis dažniausiai vartojamas namų aplinkoje.

Antra, slaptojo pirkėjo tyrimas rodo, kad reikalingas sistemingesnis ir aktyvesnis požiūris į alkoholio pirkimo amžiaus užtikrinimą. Svarbu pašalinti

atotrūkį tarp teisės aktų ir praktikos; pirmenybė turėtų būti teikiama nuolatinių atsitiktinių patikrinimų sistemos sukūrimui. Tai būtų galima pasiekti bendradarbiaujant institucijoms, NVO ir akademinei bendruomenei. Mažmenininkai taip pat turėtų keisti savo požiūrį, prisiimti realią atsakomybę kai stebimi įstatymo nuostatų nesilaikymo atvejai, įdiegti mokymo sistemas pardavėjams. Ypatingas dėmesys turėtų būti skiriamas nustatytiems didesnės rizikos laikotarpiams, pavyzdžiui, savaitgaliais ir vakarais. Taip pat reikėtų atkreipti dėmesį į kitą šios srities problemą – draudimas parduoti alkoholį neblaiviems asmenims Lietuvoje dar nebuvo sistemingai tirtas. Ši sritis išlieka svarbi būsimiems tyrimams ir neturėtų būti ignoruojama nei už vykdymą atsakingų institucijų, nei alkoholio politiką vertinančių tyrėjų.

Trečia, išliekanti didelė su alkoholiu susijusių nužudymų dalis rodo, kad prie jau esamos alkoholio kontrolės politikos reikia pridėti tikslinių priemonių. Tai galėtų apimti papildomą alkoholio kontrolės politiką, ankstyvą intervenciją asmenims, turintiems alkoholio vartojimo problemų, bendruomenės smurto prevencijos programas ir daugiainstitucinį atsaką į pakartotinius pažeidimus.

Ketvirta, alkoholio vaidmuo tirto smurto atvejais reikalauja integruotų veiksmų visose srityse. Reikalingos ne tik politikos priemonės, bet ir sveikatos priežiūros, teisėsaugos ir socialinių tarnybų koordinavimas, siekiant nustatyti didelės rizikos asmenis ir užkirsti kelią eskalavimui. Lietuvos kontekste papildomas potencialas slypi savivaldybių visuomenės sveikatos biurų tinkle ir tokiose iniciatyvose kaip projektas „Jaunimui palankių sveikatos priežiūros paslaugų teikimo modelio sukūrimas“, kurie yra unikalūs nacionaliniai ištekliai, dar nevisiškai išnaudojami alkoholio žalos prevencijos srityje.

Taip pat akcentuotina, kad ryšys tarp alkoholio vartojimo ir smurto lyties pagrindu, įskaitant didelį apsvaigusių vyrų įvykdytų nužudymų bei moterų patiriamos viktimizacijos mastą, reikalauja lyčių aspektu pagrįstų strategijų.

Šios disertacijos stiprybės apima įvairių, tarpusavyje viena kitą papildančių metodologijų taikymą – nuo kokybinės analizės ir eksperimentinių lauko tyrimų iki statistinio modeliavimo. Darbas grindžiamas nacionalinio lygmens duomenimis ir suteikia retą galimybę analizuoti alkoholio daromą žalą šalyje, kuriai būdingas didelis vartojimas ir įrodymais pagrįsta kontrolės politika.

Šis darbas suteikia vertingų įžvalgų ir pateikia naujų įrodymų tyrimų srityje, tačiau svarbu pripažinti keletą apribojimų, kurie gali turėti įtakos išvadų interpretavimui ir apibendrinimui. Pirma, analizės dalis, kuri remiasi teisiniais duomenimis, kai kuriais aspektais gali būti neišsami. Pavyzdžiui, kai kur trūko tikslių duomenų apie apsvaigimo lygį. Antra, duomenų struktūros apribojimai, tokie kaip maži imčių dydžiai, vienerių metų duomenų analizė arba poreikis apibendrinti mėnesines vertes dėl mažo atvejų skaičiaus, galėjo apriboti modelių statistinę galią ir tikslumą. Be to, tokie tyrimai kaip slapto

pirkėjo eksperimentas buvo riboti dėl vykdytojų skaičiaus, pasirinktų gėrimų rūšių ir geografinės aprėpties požiūriu. Analizuotas Lietuvos atvejis, o šalis, turi savo specifinį kultūrinį, teisinį ir politinį kontekstą, tai tam tikru mastu riboja rezultatų pritaikymą kitoms šalims. Išvadas siūloma interpretuoti atsižvelgiant į nurodomus ribotumus, kurie taip pat gali būti svarbūs būsimiems tyrimams plėtojant šį darbą.

IŠVADOS

1. Alkoholio prieinamumo ribojimų įgyvendinimas Lietuvoje išlieka nenuoseklus. Slaptojo pirkėjo tyrimas atskleidė, kad 44,8 proc. bandymų įsigyti alkoholio buvo sėkmingi, t. y. buvo ketinama parduoti alkoholinių gėrimų nepaprašius pateikti asmens dokumento; tai rodo nepakankamą amžiaus patikros kontrolę. Tačiau alkoholio reklamos draudimo analizė parodė, kad galima užtikrinti įstatymo nuostatų laikymąsi, kai tinkamai veikia stebėsenos ir kontrolės mechanizmai.
2. Alkoholio kontrolės politikos analizė parodė, kad PSO rekomenduojamų politikos priemonių (pvz., didesni mokesčiai ir prieinamumo ribojimai), įvedimas buvo susijęs su reikšmingu mirtingumo ir seksualinių nusikaltimų sumažėjimu, taip įrodant Lietuvoje įgyvendintų intervencijų veiksmingumą. Baltijos šalyse ir Lenkijoje šių priemonių taikymas siejamas su 2,3 proc. standartizuoto mirtingumo sumažėjimu tarp 20 metų ir vyresnių vyrų. Lietuvoje alkoholio kontrolės politikos priemonių įgyvendinimas 2008–2018 m. laikotarpiu buvo susijęs su vidutiniškai 478 išvengtų vyrų mirčių per metus. Akcizų didinimas 2017 m. siejamas su reikšmingu seksualinių nusikaltimų sumažėjimu. Nors bendras žmogžudysčių ir sunkių sveikatos sutrikdymų skaičius per pastaruosius du dešimtmečius mažėjo, nebuvo nustatyta statistiškai reikšmingo ryšio su konkrečiomis politikos priemonėmis.
3. Alkoholis išlieka svarbiu veiksniu, turinčiu įtakos mirtingumui nuo išorinių priežasčių ir smurtui, kuris baigiasi mirtimi. Nužudymų ir politikos vertinimo tyrimo rezultatai parodė, kad dauguma kaltinamųjų nusikaltimo metu buvo apsvaigę; teismo medicinos (autopsijų) duomenys parodė panašiai didelę apsvaigimo dalį ir tarp aukų. Teismų praktikos, nužudymų bylose, analizė patvirtino, kad dauguma su alkoholiu susijusių nužudymų įvyksta išgertuvių kontekste, dažniausiai spontaniškai, tarpasmeninėje sąveikoje ir namų aplinkoje, kai apsvaigę būna ir vykdytojai, ir aukos, o veikos nėra iš anksto suplanuotos.

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A mystery-shopping study to test enforcement of minimum legal purchasing age in Lithuania in 2022

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Background: According to the Lithuanian law to prevent the sale of alcohol to customers below the legal minimum purchasing age of 20 years, young adults below 25 years must be asked to show an age-verification document when purchasing alcohol. The aim of this study was to assess whether off-premise outlets comply with the law. **Methods:** In 2022, mystery-shopping study was carried out in three consecutive phases: (i) in a representative sample ($n = 239$) of off-premise alcohol outlets covering all Lithuanian district centres, (ii) after lifting the requirement to wear a mask and (iii) after warning the outlets that a mystery-shopping study was ongoing. Phases 2 and 3 were held in two cities. The mystery shopping involved attempts by young, but legally eligible customers to purchase alcohol. Across the three study phases, we compared compliance with the law by measuring overall success of purchase attempts and included situational characteristics (working day or weekend), time of day and number of customers in line as an additional predictor. **Results:** Out of 239 attempts to purchase alcohol from off-premise outlets in the main phase of the study, 107 (or 44.8%) were considered to be successful (visits in which staff were willing to sell alcohol). There was a significantly higher chance of success to purchase alcohol with no ID request if a mystery shopper was the only customer in a queue and on weekends. **Conclusions:** The results indicate an insufficient level of age-verification control in Lithuania, and that additional action is needed to increase compliance.

Introduction

The period of 2016–18 in Lithuania was marked by the implementation of several significant alcohol control policies. Beginning in 2016, alcohol sales in petrol stations were fully banned, followed by a major increase in excise taxation starting in March 2017. In 2018, a ban on alcohol marketing came into effect (complete ban of TV, radio and digital advertisements with only a few exceptions like memorabilia), along with reduction in off-premise sale hours (from 8:00–22:00 during the week to 10:00–20:00 from Monday to Saturday and 10:00–15:00 on Sunday), and an increase in the minimum legal alcohol purchasing and drinking age, from 18 to 20 years old.[1]

In addition to the increased minimum legal alcohol purchasing age, the retailers were also obligated by the Law on Alcohol Control to verify a purchaser's age if the person appeared to be younger than 25 years old. The increase in minimum legal drinking age, along with the rules associated with age verification, resulted into intense debates between policymakers and various interest groups (health policy advocates, the alcohol industry and retail sale lobbyists). In general, industry was lobbying for more liberal age regulation with respect to the purchasing of alcohol but the planned regulation was implemented as the strengthening of alcohol control policies was one of the electoral promises by the ruling political party at the time.[1] The public surveys tend to show the support for the implemented alcohol control policies, especially for the increased minimum legal alcohol purchase age.[2]

Younger age of drinking onset may contribute to alcohol-related problems, and thus deciding on the minimum legal drinking (purchasing) age is critical,[3–5] and additional regulations, such as age verification is a key to prevent alcohol purchases by minors. The previous study had suggested that there was a significant effect of the minimum legal drinking age on all-cause mortality rates in those 18–19 years old.[6] Although having regulations in place is important, it also must be actively enforced. Currently, in Lithuania, the minimum legal drinking restrictions may be insufficiently accompanied by active enforcement strategies regarding age verification to comply with the law. This sets the background for a mystery-shopping study in Lithuania, a country with no systematic monitoring on its alcohol

purchasing age enforcement practices. No similar studies were carried out in Lithuania.

Compliance with the minimum legal drinking age using the mystery-shopping method has been tested in several other European countries. In a study by Rossow et al.,[7] in Finland and Norway, under-age-appearing 18-year-olds attempted to purchase alcohol in off-premise outlets. Outcomes were measured as to whether or not the buyers were asked to present an ID card and whether or not they succeeded in purchasing alcohol. The mystery shoppers were asked to present an ID card in slightly more than half the attempts, and they succeeded in purchasing alcohol in 48% of the cases.

Van Hoof et al.[8] reported on measuring vendors' compliance and possible changes in the level of compliance with the legal age limits on alcohol sales in the Netherlands in 2011 and 2013. When testing the rate of compliance in 2737 alcohol purchase attempts made in both on- and off-premise outlets as well as from alcohol home delivery services, they found that the ID request increased from 43.9% in 2011 to 54.1% in 2013.[8] Later, Offermans et al.[9] investigated whether raising the minimum legal age for the sale of alcohol had influenced compliance rates among Dutch alcohol vendors. According their results, alcohol sellers' compliance rates increased for 15-year-old buyers from 46.5% to 55.7% and then to 73.9% 1 and 2 years after the policy implementation, respectively.[9]

Another study from Spain reported a possible association between the implementation of a multicomponent intervention to reduce adolescents' alcohol use, and the sale of alcohol to minors. Adolescents conducted test purchases in 2018 (baseline; $n = 73$) prior to the intervention, and again in January 2020 (follow-up; $n = 65$). In the supermarkets with an intervention programme, asking for proof of age significantly increased, from 15.4% to 72.7%.[10]

The aim of this study was to evaluate the level of compliance with existing regulations on age verification in Lithuania, after the legal purchasing age was increased to 20 years of age, for purchasers who appear to be younger than 25 years of age. In addition, based on similar studies conducted in Europe and the results of a pilot study in Kaunas (Lithuania), we tested the following two hypotheses: (i) more than half of supermarkets and grocery stores would not comply with the law to ask the person purchasing the alcoholic beverage to provide an identity document when there a person was potentially under the age of 25. (ii) After an intervention notifying the stores about the existence of a secret shopper experiment, there would be a significant increase in the proportion of supermarkets and grocery stores, which would comply with the law requiring age verification with an identity document when there was a strong possibility that the shopper was under the age of 25.[11]

Methods

Mystery-shopping study protocol

Mystery shoppers. The mystery shopping involved attempts by young, but legally eligible (20–24 years old) customers to purchase alcohol, and to observe whether staff requested ID prior to completing the sale. Although the mystery shoppers were of legal age, they should appear to be young enough to trigger a request for ID. Underage mystery shoppers were not recruited to ensure that attempted purchases posed no legal/ethical conflicts.

Recruitment of mystery shoppers. We recruited University students of chosen age group. Eight female students participated in the research. The mean of the mystery shoppers age 21.13 (SD = 0.593). Training of the mystery shoppers was conducted on alcohol test purchase protocol and questionnaire (see Supplementary appendix 3 table S1). The actions of the mystery shoppers were trained according to the Mystery-shopping decision-making flowchart (see Supplementary appendix 2 figure S2).

Sample. Based on state alcohol licencing data (8046 licences issued for off-premise sales), we randomly sampled 239 off-premise retailers for the study. The sample included five of the biggest grocery-store chains in Lithuania. We chose central cities (Vilnius, Kaunas, Klaipėda, Šiauliai, Marijampolė, Panevėžys, Alytus, Utena, Telšiai and Tauragė) of all 10 counties in Lithuania and determined the number of attempts in each city based on the total number of stores in each city. Grocery stores were randomly selected from all operating stores.

Intervention. Visits were scheduled at various times of day and days of the week. With each visit, mystery shoppers tried to buy a randomly chosen brand of beer, or wine, as it was determined that those are the preferred drinks for women in the selected age range in Lithuania.[12]

When approaching the checkout, mystery shoppers counted the number of customers in the line before them, and, once the store personnel started serving them, the number of customers behind them. If the store personnel asked the shopper's age, mystery shopper answered truthfully. If asked for an ID, the mystery shopper claimed not to have one with them at that time. If the store personnel refused to complete the transaction without an ID, mystery shopper did not insist further and left the store. If the store personnel were willing to complete the transaction without an ID, the mystery shopper stopped the purchase process. Visits in which the store personnel refused to sell alcohol without presentation of valid ID were coded as 'fail', while visits in which store personnel were willing to sell will be coded as 'success'.

No real purchase of alcohol took place, but the unambiguous selling intentions were used as indications of real alcohol sales. Immediately after the store visit, the mystery shopper filled out a checklist (Supplementary appendix S2).

Self-service points were not included in this study to maintain the consistency across the cities and towns and across the supermarkets (the self-service option is more concentrated in bigger stores and the level of development of these services varies across the different grocery-store chains).

Research phases

The mystery-shopper study consisted of three research phases (see Supplementary appendix 1 figure S1): (i) a pilot study was implemented to test the study protocol. The pilot study took place in grocery stores in Kaunas, involved eight secret shoppers, and resulted in 36 purchase attempts in December 2021 with the ID request rate of close to 64% of cases. To test our hypothesis that: more than half of supermarkets and grocery stores would not comply with age-verification laws when there is a doubt that a person is under the age of 25; we had a first phase visits, in February 2022 ($n = 239$). As research was conducted during Covid-19 pandemic, there was a requirement to wear a mask. In order to check if masks could have an effect on store personnel behaviour, the second phase was composed of additional visits to two cities ($n = 73$) as soon as the mask requirement was lifted in a county. Cities were chosen based on the results from the first phase (i.e. one major city with more successful attempts and one with higher unsuccessful purchase rate were identified). Additionally, Phase 3 took place in May 2022, to test the effect of an intervention notifying the communications department of each grocery-store chain about the mystery-shopper experiment. We expected that there would be a significant increase in a proportion of supermarkets and grocery stores, which complied with the law to present age verification when purchasing alcoholic beverages if there was doubt that a person was under the age of 25. We chose the same two cities ($n = 73$) from Phases 1 and 2 to have an exact match across the three phases. At this research phase, emails about the mystery-shopper visits to stores were sent prior to the store visits, to these departments (Supplementary appendix S4) and after a few days the stores were visited. The stores visited were the same in Phases 1 and 2; however, different mystery shoppers were used.

To confirm that the mystery shoppers were of ambiguous legal purchasing age (i.e. appeared to be under the age of 25), we tested

inter-rater reliability, using intraclass correlation coefficient (ICC). Study involved five raters of 35–50 years old (the average age of the employees in the study was ~40 as indicated by the mystery shopper). Raters estimated the ages of random pictures of the mystery shoppers' faces, faces of similar ages and older or younger faces ($n = 32$). Raters estimated the ages of the faces using age categories (first group of people up to 20 years; second=20–24 years old; third=25 years and older). We found the level of reliability among raters for age estimation for the mystery shoppers' faces to be high [ICC = 0.889 with a 95% confidence interval (95% CI) from 0.785 to 0.944]. These findings indicated that the mystery shoppers' faces would reasonably be identified as young people by store personnel, and therefore should have resulted in a request for ID in grocery stores when purchasing alcoholic beverages.

Data and statistical analysis

Statistical data analysis was performed using the statistical package IBM SPSS Statistics for Windows, Version 20.0 (2011 version, IBM Corp, Armonk, NY, USA) and Microsoft Excel 2019 (Microsoft, Redmond, WA, USA). A statistical significance level (P-values) of 0.05 was chosen to test the hypotheses. The qualitative variables were presented as percentages. Differences in qualitative variables were compared using Chi-squared (χ^2) tests. The categorical variables were presented as percentages and compared using χ^2 and Z tests with Bonferroni correction. The Clopper–Pearson interval was used to calculate binomial 95% CIs. ICC estimates and their 95% CIs were calculated based on average-measures, absolute-agreement, two-way mixed-effects model.

Results

The main part (Phase 1) of the study took place between February and March of 2022, and was implemented in 10 county central cities with a total of 239 attempts to purchase alcohol beverages (beer or wine). In total, in 104 (43.5%) of the purchase attempts, the store personnel did not ask the mystery shoppers for their IDs (table 1). In five cases there were successful purchase attempts when ID was requested but not provided by the mystery shopper, and in two cases the sale was refused without the seller requesting ID. There were two successful attempts to buy alcohol when the age of mystery shopper was asked, and 105 successful attempts when the store personnel did not ask the age of the mystery shopper. A significant effect of ID requests and successful attempts of alcohol purchases was observed ($P < 0.001$), which resulted in 107 successful alcohol purchases (44.8% of all attempts) at the main phase (Phase 1) of the study (table 1).

When comparing the other parameters of the purchases, we found that the success rate of purchasing attempts was significantly higher on the weekend ($P = 0.037$), but there were no differences found between times of purchase (see table 1).

Finally, table 1 also summarizes the impact of a waiting line to an overall successful purchase. We observed that the highest proportion of successful attempts was when there were no other customers in line behind the mystery shopper (54.9%; a similar proportion was found for situations where ID was not requested, see table 2). The number of customers in front of the mystery shopper when waiting in a queue did not have an impact on a successful purchase (see tables 1 and 2).

Next, in Phase 2 of the study, we tested the impact of lifting the requirement to wear a mask in a grocery store, and in Phase 3 of the

Table 1 Distribution of successful and unsuccessful attempts to buy alcohol by shopping characteristics (the results of the main phase of the study)

	Successful attempt			Unsuccessful attempt			Total
	N	%	95% CI	*N*	%	95% CI	*n* (%)
Did store personnel ask for ID?							
Yes	5	3.7	1.2–8.4	130	96.3	91.6–98.8	135 (100)
No	102	98.1	93.2–99.8	2	1.9	0.2–6.8	104 (100)
Total	107	44.8	38.4–51.3	132	55.2	48.7–61.6	239 (100)
Chi-squared (χ^2) test				$P < 0.001$			
Did the store personnel ask the age of the mystery shopper?							
Yes	2	10.5	1.3–33.1	17	89.5	66.9–98.7	19 (100)
No	105	47.7	41.0–54.5	115	52.3	45.5–59.0	220 (100)
Chi-squared (χ^2) test				$P = 0.002$			
Time of the day							
Until 17 h	84	45.2	37.9–52.6	102	54.8	47.4–62.1	186 (100)
17 h and later	23	43.4	29.8–57.7	30	56.6	42.3–70.2	53 (100)
Chi-squared (χ^2) test				$P = 0.820$			
Weekday							
Workday	58	39.5	31.5–47.8	89	60.5	52.2–68.5	147 (100)
Weekend	49	53.3	42.6–63.7	43	46.7	36.3–57.4	92 (100)
Chi-squared (χ^2) test				$P = 0.037$			
Customers in line behind mystery shopper							
0	45	54.9[a]	43.5–65.9	37	45.1[a]	34.1–56.5	82 (100)
1	27	40.3	28.5–53.0	40	59.7	47.0–71.5	67 (100)
2	13	29.5	16.8–45.2	31	70.5	54.8–83.2	44 (100)
3 and more	22	47.8	32.9–63.1	24	52.2	36.9–67.1	46 (100)
Chi-squared (χ^2) test				$P = 0.042$			
Number of customers in line in front of mystery shopper							
0	15	46.9	29.1–65.3	17	53.1	34.7–70.9	32 (100)
1	33	50.0	37.4–62.6	33	50.0	37.4–62.6	66 (100)
2	22	39.3	26.5–53.2	34	60.7	46.8–73.5	56 (100)
3 and more	37	43.5	32.8–54.7	48	56.5	45.3–67.2	85 (100)
Chi-squared (χ^2) test				$P = 0.677$			

a: Z-test with Bonferroni correction, significant difference between zero customers in line behind mystery shopper and two customers in line behind mystery shopper ($P < 0.05$).

Table 2 Distribution of request to show ID by number of customers in waiting line (analyzing the results of the main phase of the study)

	Did store personnel asked for an ID?						Total
	No			Yes			
	N	%	95% CI	*N*	%	95% CI	*N* (%)
Number of customers in line behind mystery shopper							
0	45	54.9	43.5–65.9	37	45.1	34.1–56.5	82 (100)
1	24	35.8	24.5–48.5	43	64.2	51.5–75.5	67 (100)
2	14	31.8	18.6–47.6	30	68.2	52.4–81.4	44 (100)
3 and more	21	45.7	30.9–61.0	25	54.3	39.0–69.1	46 (100)
Chi-squared (χ^2) test				$P = 0.037$			
Number of customers in line in front of mystery shopper							
0	16	50.0	31.9–68.1	16	50.0	31.9–68.1	32 (100)
1	29	43.9	31.7–56.7	37	56.1	43.3–68.3	66 (100)
2	22	39.3	26.5–53.2	34	60.7	46.8–73.5	56 (100)
3 and more	37	43.5	32.8–54.7	48	56.5	45.3–67.2	85 (100)
Chi-squared (χ^2) test				$P = 0.811$			

Table 3 Distribution of successful and unsuccessful attempts to buy alcohol by research phases (%)

	Successful attempt			Unsuccessful attempt			Total
	N	%	95% CI	*N*	%	95% CI	*n* (%)
Research phase							
Phase 1 (main phase, using data from Klaipėda and Kaunas only)[a]	30	41.1	29.7–53.2	43	58.9	46.8–70.3	73 (100)
Phase 2 (without masks, in Klaipėda and Kaunas)	35	47.9	36.1–60.0	38	52.1	40.0–63.9	73 (100)
Phase 3 (after notification intervention, in Klaipėda and Kaunas)	32	43.8	32.2–55.9	41	56.2	44.1–67.8	73 (100)

a: Chi-squared (χ^2) test; $P = 0.704$.

study, we tested what impact notification of the mystery-shopping experiment there might be on ID requests and the overall success rate of alcohol purchases. Table 3 summarizes the results. In short, there was no significant difference found between the three different phases of this study [i.e. buying success when comparing purchase attempts in the same two cities in all three phases did not differ significantly ($P = 0.704$)], nor were there any differences between data in each of the three phases ($P = 0.863$). Also, we found no differences between research phases and whether store personnel asked mystery shoppers for ID ($P = 0.876$, see table 4).

Discussion

In Phase 1 (main phase) of this study, with data collected in 10 towns and cities, we found that 44.8% of alcohol purchase attempts were successful. Thus, the final success rate was lower than we had hypothesized. However, nearly one out of two mystery shoppers could have successfully purchased alcohol, despite being within the age range for which ID should have been requested—a situation which would considerably undermine the effectiveness of the legislation. This creates implications for underage shoppers to purchase alcohol when ID is not requested as intended by the requirements of the law. However, this specific aspect cannot be easily tested in the current legal situation in Lithuania, as only dedicated institutions like police have the right to imitate a violation of the law, thus, we only implement a mystery-shopper experiment only by inviting the participants who are slightly above the legal age to purchase alcohol.

When looking to other European countries, compliance and enforcement of age-verification legislation is not an issue in Lithuania alone. In the Netherlands, compliance of age verification has very slowly increased over time. Schelleman-Offermans et al.[9] found that the age-verification compliance (purchasing beer, mix, wine, or spirits) in the Netherlands after the minimum legal age was increased from 16 to 18 years old in 2014 was 46.5%, which increased to 74% 2 years later. In a recent study by Kamin et al. (2021),[13] in Slovenia the rate of compliance (purchasing beer and a snack) was just over 11%; which improved after a compliance-enhancing intervention, to over 20%. In contrast to Europe, the results from the four states in the USA indicated that compliance with the ID check requirement may be above 80%.[14]

Thus, the international experience shows that the compliance may be improved with a compliance-enhancing intervention. We did not observe an impact from grocery-store chain notification in this study, meaning stronger interventions may be required, and this may be an area for future studies. The preliminary results of this study were disseminated to the national control institution, to grocery-store chain communication departments and to media outlets with the aim of informing the general Lithuanian public about the study results.[15] This resulted in a number of national internet media messages, and may be a starting point for a more systematic monitoring initiative in a country. To our knowledge, there was only one attempt to do a compliance experiment in Lithuania prior to this one. In 2015, an underage customer in an unstructured experiment attempted to purchase beer in 17 petrol stations and was successful in 14 of the attempts.[16] The experiment gained significant media attention due to a period of public debate about whether it was necessary to ban sales of alcohol in petrol stations in Lithuania (see Miščikienė et al.[1] for more details).

In addition, we analyzed the impact of the waiting lines, and the biggest proportion of successful attempts was observed when there were no other customers in line behind the mystery shopper (54.9%). This result may be explained from a behavioural psychology perspective where store personnel tend to show more responsible behaviour (according to the legal requirements) when they are seen by a higher number of people.[17] As well, these findings suggest that the pressure of a large customer line-up, and resulting pressure to work faster (i.e. skip the ID verification), may not play a significant role in these scenarios.

There are a number of limitations that need to be considered when interpreting the results. First, the majority of the purchase attempts

Table 4 Distribution of request to show an ID (%)

	Did store personnel asked for an ID?						Total
	No			Yes			
	N	%	95% CI	*N*	%	95% CI	*N* (%)
Research phase							
Phase 1 (main phase, using data from 10 cities/towns)	104	43.5	37.1–50.1	135	56.5	49.9–62.9	239 (100)
Phase 2 (without masks)	30	41.1	29.7–53.2	43	58.9	46.8–70.3	73 (100)
Phase 3 (after intervention)	31	42.5	31.0–54.6	42	57.5	45.4–69.0	73 (100)
Total	165	42.9	37.9–48.0	220	57.1	52.0–62.1	385 (100)
Chi-squared (χ^2) test				$P = 0.933$			
Research phase (in Kaunas and Klaipėda only)							
Phase 1 (main phase, using data from Klaipėda and Kaunas only)	28	38.4	27.2–50.5	45	61.6	49.5–72.8	73 (100)
Phase 2 (without masks)	30	41.1	29.7–53.2	43	58.9	46.8–70.3	73 (100)
Phase 3 (after intervention)	31	42.5	31.0–54.6	42	57.5	45.4–69.0	73 (100)
Total	89	40.6	34.1–47.5	130	59.4	52.5–65.9	219 (100)
Chi-squared (χ^2) test				$P = 0.876$			

were during the period when there was still a requirement for on-premise mask-wearing due to pandemic restrictions. However, we introduced a follow-up study to test the impact of masks, which indicated that there was no effect of mask-wearing on compliance. Second, there were only female mystery shoppers that were study volunteers, and thus future studies should attempt to recruit men and gender-diverse individuals as secret shoppers. Third, the mystery shoppers were instructed to purchase wine or beer only, and this may have provided a different compliance rate than with higher alcoholic-content beverages. Fourth, future studies should include specialized alcohol stores and self-service checkout spaces. Finally, the focus of this study was on purchases in urban centres (large cities and towns), and we mainly focussed on five major grocery-store chains. However, presumably, there would be similar rates in smaller alcohol outlets (where the success of the business is even more dependent on sales numbers). Despite the above limitations, we believe that this study was a rigorous test of the enforcement of age-verification legislation on alcohol purchase attempts and can inform future policy-making and enforcement decisions in Lithuania.

In summary, the study results indicate that there may be an insufficient level of compliance in Lithuania regarding the formal requirement to verify the age if a customer purchasing an alcoholic beverage appears to be younger than 25 years old. The current approach when legal requirement is not led by clear enforcing strategies by the state, may be not sufficient. Circulating simple message to grocery-store chains informing them about the upcoming mystery-shopper experiment did not result into any significant effect, which suggests a need for more comprehensive engagement with the stakeholders in the future.

Supplementary data

Supplementary data are available at *EURPUB* online.

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Conflicts of interest: None declared.

Data availability

The data underlying this article are available in the article and in its online Supplementary material.

Key points

- The study showed that close to 45% of underage mystery shoppers were considered to be successful in purchasing alcohol when ID was not requested.
- Informing store chains about the upcoming mystery-shopper experiment did not result into any significant change in results of the compliance.
- The study has indicated that there is a need for constant monitoring of enforcement of alcohol sales for underage drinkers to increase the awareness in the society, and among the retailers, which may contribute to better compliance and overall improvement of the public health in a country.

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The Comprehensive Alcohol Advertising Ban in Lithuania: A Case Study of Social Media

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Abstract: Alcohol advertising exposure is a risk factor for earlier alcohol initiation and higher alcohol consumption. Furthermore, engagement in digital alcohol marketing, such as liking or sharing an ad on social media, is associated with increased alcohol consumption and binge or hazardous drinking behavior. In light of these challenges, Lithuania has enacted a total prohibition on alcohol advertising, including social media. This study monitored the two most popular social media networks, Facebook and Instagram, to determine compliance with current legislation. In total, 64 Facebook and 51 Instagram profiles were examined. During the 60-day study period, 1442 and 749 posts on the selected Facebook and Instagram profiles, respectively, were published. There were a total of 163 distinct social media alcohol-related posts. Alcohol-related posts accounted for 5.9 percent of total Instagram posts and 8.3 percent of total Facebook posts. Alcohol advertisements accounted for 1.4 percent of all posts (infringement of the Alcohol Control Law). Influencers were responsible for nearly half (45.5 percent) of all observed alcohol-related Instagram posts. The study demonstrates high compliance with Lithuania's total alcohol advertising ban on social media and emphasizes the importance of adequately monitoring the growing prominence of influencers on social media.

Keywords: alcohol advertising; social media; Facebook; Instagram; exposure

1. Introduction

In 2016, Lithuania had the highest per capita alcohol consumption in the European Union (EU) and globally, ranking it highest in the alcohol-attributable mortality and disability-adjusted life years [1]. In response, the Lithuanian government implemented all of the World Health Organization's (WHO) "best buys" within a short time span—a set of alcohol control policies that are the most effective and cost-effective at reducing alcohol-related harm—which include excise taxation, reduced availability and marketing restrictions [2]. Regarding taxation, there was a sharp increase in alcohol excise tax by 28%

on absolute ethyl alcohol (affecting spirits) and 111% on beer and wine between 2016 and 2017. Concerning availability, retail hours for off-premise alcohol sales were shortened from 8 a.m. to 10 p.m. on all days to 10 a.m. to 8 p.m. on Mondays to Saturdays and to 10 a.m. to 3 p.m. on Sundays. Additionally, the minimum legal drinking age was raised from 18 years of age to 20 years of age in 2018 [3].

With respect to marketing restrictions, Lithuania currently stands out as having some of the strictest alcohol advertising laws in the EU [4]. In fact, the WHO deemed Lithuania one of the top three countries in the WHO European region to have the most explicit and probably most effective policies [5]. The Republic of Lithuania Law on Alcohol Control (the Law), enacted on 1 January 2018, provided a comprehensive ban on alcohol advertising, including on all digital media. The official language of the alcohol advertising restriction under Article 29 is provided in Appendix A. In 2020, the WHO reported that they considered the protection of young people with respect to alcohol marketing in Lithuania, Finland and Ireland to be most explicit and probably the most effective in all of the WHO European regions [6]. Yet, it was a long road to reach this point.

Five years after Lithuania declared independence from the Soviet Union on 11 March 1990, the first comprehensive ban on alcohol advertising was adopted with the introduction of the Law. Since its adoption in 1995, the Law has undergone several stricter control and liberalization cycles. In fact, the Law was amended 63 times between 1995 and 2020 [3], including 8 amendments on advertising restrictions alone. A comprehensive timeline and analysis of the Law are published elsewhere [3], whereas the timeline of advertising-related amendments is provided in Table 1.

In their association with public health evidence and ideological positions, alcohol policies were inconsistent since the first time they were introduced. Despite a 1997 decision by the Constitutional Court ruling that alcoholic beverages and tobacco products were "special purpose goods" due to the harm they caused to society, restrictions such as a ban on alcohol advertising could be implemented without being unconstitutional, with the Lithuanian alcohol policy experiencing a lengthy period of liberalization up to 2007. In 2008, for the first time, a comprehensive ban on alcohol advertising was enacted, with a four-year transition period to accommodate the industry. However, after 13 months of intense lobbying by the alcohol industry and its supporters, the ban was revoked 25 days before it went into effect [7]. This illustrated how lobbying and other activities designed to influence policymakers maintained policy environments permissive to alcohol marketing activities [8,9].

Exposure to alcohol advertising is a causal risk factor for earlier alcohol initiation and higher alcohol consumption [10,11]. This potentially incites the industry to gain broad access to younger consumers [12]. An alarming trend in the number of young people exposed to advertisements for alcoholic beverages has been observed over the past several decades as a result of the expansion of alcohol marketing operations on digital platforms. The most recent systematic review concluded that engagement with digital alcohol marketing—such as clicking on an alcohol advertisement (ad), visiting an alcohol-branded website, liking or sharing an ad on social media or downloading alcohol-branded content—is positively associated with increased alcohol consumption and increased binge or hazardous drinking behavior [13]. The alcohol industry stated that social media marketing can reach more consumers than broadcast media, with a 600% return on investments [13].

To this day, to our knowledge, no studies have been conducted investigating the frequency with which alcohol is advertised on social media or determining whether the advertising ban in Lithuania is being adhered to or not. This study aims to determine the compliance of the total alcohol advertising ban on social media by monitoring the two most popular social media networks—Facebook and Instagram. Our hypothesis is that current alcohol advertisement ban legislation and efficient enforcement mechanisms are in place to deter producers and retailers from marketing their goods.

Table 1. Developments of the regulation of alcohol advertising in Lithuania.

Adopted	Came Into Effect	Measures Introduced	"+" in Favor of Public Health "-" against Public Health
18 April 1995	26 May 1995	The first nearly comprehensive ban on alcohol advertising was adopted within the introduction of the Law in 1995. The ban clearly pinpointed the areas for advertisements: locally broadcasted radio and television programs, print media, specialized advertising brochures as well as indirect advertising. However, these measures were not strictly enforced.	+
2 July 1997	16 July 1997	The Law was further amended to redefine areas of the ban of advertisements. A comprehensive ban was narrowed down. The placement of advertisements was prohibited on national television and radio programs from 3 p.m. to 10 p.m., on weekends and school holidays from 8 a.m. to 10 p.m., on other television and radio programs from 3 p.m. to 8 p.m., and on weekends and school holidays from 8 a.m. to 8 p.m. (excluding beer and wine with alcohol strengths of less than 15%). Outdoor alcohol advertising was permitted.Amendments introduced a ban related to the content of ads: prohibition/restriction advertising targeting children under 18, and false or misleading information about alcoholic beverages. The amendment also detailed what is not permitted in the ad itself.	-
20 June 2002	28 June 2002	The Law allowed the advertising of alcohol below a volume strength of 22% on television and radio programs. The placement of advertisements on television and radio programs was prohibited from 3 p.m. to 10:30 p.m., and on weekends and school holidays from 8 a.m. to 10:30 p.m. Outdoor advertising was banned for all alcoholic beverages except for wine, beer and cider.	+/-
1 July 2003	16 July 2003	The display of alcoholic beverages was permitted in nearly all event venues and petrol stations. Trademark logos and names were excluded from the advertisement definition (i.e., permitted to be displayed).	-
21 June 2007	1 January 2008	Alcohol advertising banned on TV and radio during daytime hours (6 a.m. to 11 p.m.).	+
18 April 2008	Did not come into effect. Law was revoked on 6 December 2011	Amendment to the Law for a comprehensive ban on alcohol advertising from 2012 was passed but not implemented.	
17 May 2016	1 November 2016	Amendment prohibited organizing games, actions, competitions or lotteries to promote the purchase or use of alcohol, and alcohol was not to be used as a prize, gift or bonus. The promotion of alcohol price reductions was prohibited.	+
1 June 2017	1 January 2018	A comprehensive ban on alcohol advertising of all forms, including social media, was introduced.	+

2. Materials and Methods

Our study was quantitative and descriptive in design. The choice of such a study method was primarily determined by the intent to observe and describe the current situation of alcohol advertisement on social media without any external interference.

The most popular social media networks in Lithuania [14], Facebook and Instagram, were monitored for alcohol-related posts for 30 consecutive days and 30 days retrospectively. Figure 1 shows the flowchart of the study design process.

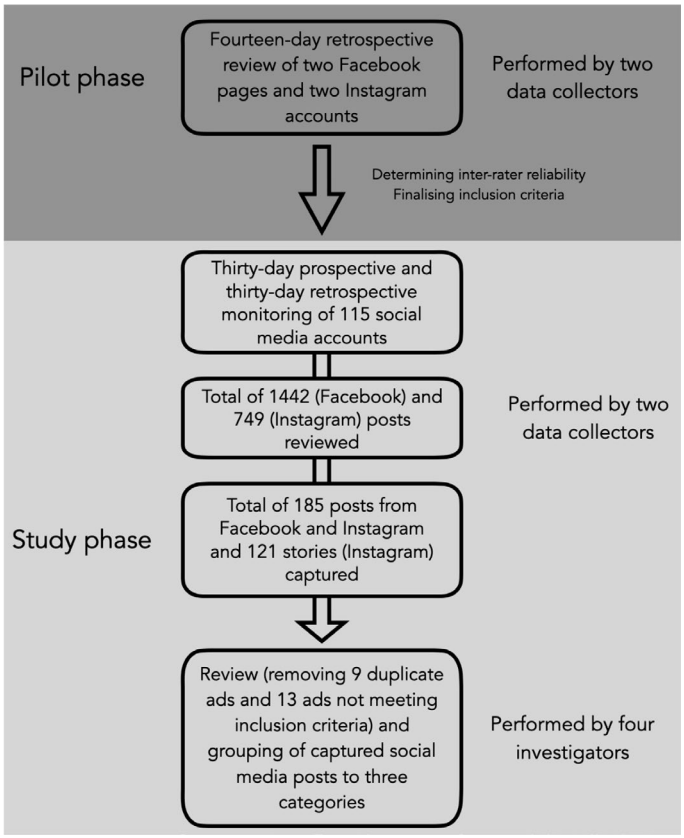

Figure 1. The flowchart of the study design process.

2.1. Pilot Phase and Preparation for Data Collection

In January 2021, two data collectors were introduced to the study protocol and trained to collect data. Before data collection, pilot tasks were given to both data collectors to evaluate inter-rater reliability in assessing potential alcohol ads [15]. The data collectors were given 24 h to independently review the 14-day social media history on two Facebook pages and two Instagram accounts and identify potential alcohol ads. In total, 64 posts were published, of which 5 met the criteria to be captured (criteria described under the section 'Monitoring of Social Media'). The data collectors were instructed not to communicate with each other about the task.

Out of 64 posts reviewed, the first data collector correctly identified (based on the given criteria) all five social media posts as potential alcohol ads and misreported one social media post, and the second data collector classified all social media posts correctly. The evaluation resulted in an overall agreement of 98.4% of all social media posts. Using Cohen's kappa statistic, inter-rater reliability analysis was performed to determine inter-coder reliability. The result ($\kappa = 0.901$) indicated an almost perfect degree of inter-coder agreement.

2.2. Study Phase: Monitoring of Social Media

In total, we monitored five categories of social media accounts: 10 of the most profitable grocery retailers [16], 3 of the most popular specialized liquor chain stores, 10 shopping malls (i.e., all malls operating in Lithuania), 23 alcohol producers and 18 of the most followed influencers [17]. Data collectors reviewed 64 Facebook and 51 Instagram profiles in total (Table 2).

Table 2. Summary of monitored Facebook and Instagram profiles by category.

	Profiles		
Category	Facebook	Instagram *	Total
Grocery retailers	10	7	17
Specialized liquor stores	3	3	6
Shopping malls	10	7	17
Alcohol producers	23	16	39
Social media influencers	18	18	36
Total	64	51	115

* Not all selected retailers, producers or influencers had both Facebook and Instagram profiles. Therefore, the number of monitored Instagram profiles is lower.

The data collectors looked for alcohol-related posts that met at least one of the inclusion criteria: (1) the post mentioned alcohol and alcohol look-alike brand(s); (2) posted an image or video portraying alcohol or alcohol look-alike beverage bottle(s), glass(es), can(s) or had alcohol-related objects (e.g., the cork of a champagne bottle); and (3) the post mentioned a category of alcoholic beverage (e.g., wine, beer, etc.).

Selected profiles on Facebook and Instagram were examined for 30 days, starting from 27 January to 26 February 2021. In addition, on the first day of prospective data collection in the study, researchers examined all posts posted in the preceding 30 days and took screenshots of all potential ads that met at least one of the inclusion criteria. Thereby, a total of 60 days of posts was examined. The data collectors reviewed posts published on social media profiles, including Instagram stories, every day at 4 pm to ensure that posts lasting 24 h were captured. Given that content published on weekends and holidays was examined on the first following business day, Instagram stories were not captured from approximately 4 pm on Friday to 4 pm on Sunday due to only being accessible for 24 h, nor were they collected in a retrospective data collection.

Data collection was performed in Microsoft Excel, reporting on the date of the post, day of the week the post appeared, brand name, type of alcoholic beverage, type of zero-alcohol beverage, social media site, hyperlink to the post and a screenshot of the post. The principal investigator was available via telephone and email for specific queries from the data collectors during the entire study.

For all captured posts, the number of 'likes', 'comments' and 'shares' (on Facebook posts) was recorded. These indicators were not recorded for Instagram, as 'shares' are not available on Instagram and the 'likes' count is hidden in Lithuania.

2.3. Study Phase: Reviewing and Grouping of Social Media Posts

Four investigators independently grouped alcohol-related posts into one of the following three categories: (1) alcoholic beverage ad, (2) zero-alcohol beverage ad (in this study defined as beverages that looked alike to alcoholic beverages in terms of packaging and display, and likely to be advertised because of similarity to alcoholic counterparts) and (3) "grey zone", such as product placement in a social setting, for example. The categorization took place when at least three out of the four investigators designated a particular post to the same category. All cases where less than three investigators agreed on the categorization were discussed until a consensus was reached.

The research team established the abovementioned categories to reflect local alcohol industry marketing tactics. Social media posts in the first category contained alcoholic

beverage brand names (written or pictorial) and were considered a potential infringement of the current regulation. The second category included ads for zero-alcohol beverages, such as alcohol-free beer, alcohol-free wine, etc. Alcohol producers started to exploit legal loopholes by labelling and packaging both categories of drinks similarly after the introduction of the TV ad restrictions in 2007, which became more evident after the total ban in 2018. Posts were categorized as being in the "grey zone" when they showcased alcohol in a positive social context or displayed alcoholic drinks, but no brand could be identified.

After the primary screening, investigators removed nine ads that were duplicates and 13 that did not fit under any of three categories due to a lack of strong association with alcohol (e.g., an ad portraying an empty wine glass among other objects with no alcohol-related text).

Differences in the distribution of posts between Facebook and Instagram were assessed using the Chi-square ($\chi 2$) test. p-values of less than 0.05 were considered as statistically significant.

3. Results

Within the 60-day study period, 1442 and 749 posts were published on the selected Facebook and Instagram profiles, respectively. In total, 163 distinct social media posts constituted our final sample of alcohol-related posts (Table 3). Similar to the total number of screened posts, the number of alcohol-related posts was higher on Facebook. Alcohol-related posts composed 5.9% (n = 44) of total posts on Instagram and 8.3% (n = 119) on Facebook (p = 0.03). In addition, 121 alcohol-related stories were posted on Instagram.

Table 3. Summary of key results by weekday (n = 163).

Weekday	Total *n* (%)	Total Alcohol-Related *n* (%)	Category 1 (Alcoholic Beverage Ad) *n* (%)	Category 2 (Zero-Alcohol Beverage Ad) *n* (%)	Category 3 (Grey Zone) *n* (%)
Facebook posts					
Monday	185 (12.8)	20 (16.8)	1 (5.0)	10 (40.0)	9 (12.2)
Tuesday	258 (17.9)	15 (12.6)	1 (5.0)	4 (16.0)	10 (13.5)
Wednesday	236 (16.4)	28 (23.5)	5 (25.0)	6 (24.0)	17 (23.0)
Thursday	249 (17.3)	28 (23.5)	6 (30.0)	2 (8.0)	20 (27.0)
Friday	267 (18.5)	19 (16.0)	5 (25.0)	1 (4.0)	13 (17.6)
Saturday	137 (9.5)	3 (2.5)	1 (5.0)	1 (4.0)	1 (1.4)
Sunday	110 (7.6)	6 (5.0)	1 (5.0)	1 (4.0)	4 (5.4)
Total	1 442 (100)	119 (100)	20 (100)	25 (100)	74 (100)
Instagram posts					
Monday	107 (14.3)	5 (11.4)	0 (0.0)	0 (0.0)	5 (15.2)
Tuesday	99 (13.2)	11 (25.0)	4 (40.0)	0 (0.0)	7 (21.2)
Wednesday	131 (17.5)	6 (13.6)	0 (0.0)	0 (0.0)	6 (18.2)
Thursday	130 (17.4)	9 (20.5)	2 (20.0)	1 (100.0)	6 (18.2)
Friday	118 (15.8)	5 (11.4)	1 (10.0)	0 (0.0)	4 (12.1)
Saturday	77 (10.3)	4 (9.1)	2 (20.0)	0 (0.0)	2 (6.1)
Sunday	87 (11.6)	4 (9.1)	1 (10.0)	0 (0.0)	3 (9.1)
Total	749 (100)	44 (100)	10 (100)	1 (100)	33 (100)
Facebook and Instagram posts					
Total	2 191 (100)	163 (7.4)	30 (1.4)	26 (1.2)	107 (4.8)

Altogether, out of all published posts, 1.4% (n = 30) of posts was categorized as alcohol ads (infringement of the Law), 1.2% (n = 26) posts as zero-alcohol beverage ads and 4.8% (n = 107) as "grey zone" ads.

Compared to Instagram (5.9%), a greater share of alcohol-related posts was published on Facebooks accounts (8.3%) (p = 0.014). The share of alcohol-related posts pub-

lished during workdays was higher on Facebook (92.4%) compared to Instagram (81.8%) ($p < 0.001$) (Table 3).

By only analyzing alcoholic beverage ads (Category 1), it could be observed that most posts on Facebook and Instagram were posted by alcohol producers, comprising 85.0% and 90.0%, respectively (Table 4). Similarly, if we were to search for accounts with the greatest share of alcohol-related content, on both Facebook and Instagram, the accounts of alcohol producers had more than one in three posts that were related to alcohol (38.6% and 36.5%, respectively).

Almost half (48.0%) of all observed zero-alcohol beverage ads were posted by grocery retailers. Specialized liquor stores and shopping malls posted zero-alcohol beverage ads in very similar proportions, 28.0% and 24.0%, respectively. On Instagram, the highest number (58.9%) of "grey zone" ads was posted by influencers, and, on the contrary, by alcohol producers on Facebook (58.1%) (Table 4).

Although influencers were the most active group on social media in general in terms of the number of posts published, the frequency of alcohol-related posts was relatively low on both platforms (1.6% on Facebook and 3.9% on Instagram). However, even with a low share of published alcohol-related posts among all monitored profiles, influencers posted almost half (45.5%) of all observed alcohol-related posts on Instagram.

Within the study period, alcohol-related posts on Facebook were 'liked' 14,126 times, commented on 9619 times and shared 4691 times. Facebook users interacted the most with ads for zero-alcohol beverages. The engagement with zero-alcohol beverage ads was the highest in terms of all three parameters, with a median 'likes' count of 143 (range 0–1263), a median 'comments' count of 180 (range 0–1800) and a median 'shares' count of 123 (range 0–588). Meanwhile, posts of alcoholic beverages (category 1) were far less popular in terms of 'likes', 'comments' and 'shares' (Table 5).

Table 4. Summary of key results by social media profile category (n = 163).

Category of Social Media Profile	Number of Posts *n* (%)	Number of Alcohol-Related Posts *n* (%)	The Proportion of Alcohol-Related Posts from Total Published Posts (% of Total)	Category		
				Category 1 (Alcoholic Beverage Ad) Posts *n* (%)	Category 2 (Zero-Alcohol Beverage Ad) Posts *n* (%)	Category 3 (Grey Zone) *p n* (%)
Facebook posts						
Grocery retailers	464 (32.2)	24 (20.2)	5.2	0	12 (48.0)	12 (16.2)
Specialized liquor stores	44 (3.1)	13 (10.9)	29.5	2 (10.0)	7 (28.0)	4 (5.4)
Shopping malls	282 (19.5)	14 (11.9)	5.0	0	6 (24.0)	8 (10.8)
Alcohol producers	158 (11.0)	60 (51.3)	38.6	17 (85.0)	0	43 (58.1)
Influencers	494 (34.2)	8 (6.7)	1.6	1 (5.0)	0	7 (9.5)
Total	1442 (100)	119 (100)	8.3	20 (100)	25 (100)	74 (100)
Instagram posts						
Grocery retailers	123 (16.4)	0	0	0	0	0
Specialized liquor stores	12 (1.6)	0	0	0	0	0
Shopping malls	44 (5.9)	1 (2.3)	2.3	0	0	1 (2.9)
Alcohol producers	63 (8.4)	23 (52.3)	36.5	9 (90.0)	1 (100.0)	13 (38.2)
Influencers	507 (67.7)	20 (45.5)	3.9	1 (10.0)	0	19 (58.9)
Total	749 (100)	44 (100)	6	10 (100)	1 (100)	33 (100)

Influencers generated the most alcohol-related stories, with more than 8 out of 10 alcohol-related stories (84.3%) posted on their profiles (Table 6). There were only 11 alcoholic beverage ads posted as stories, with the majority (81.8%) posted by alcohol producers. Similar to posts on Instagram, the highest number (93.1%) of "grey zone" ads was posted by influencers.

Table 5. Number of 'likes, 'comments' and 'shares' per alcohol-related post category on Facebook within 60 days.

Category of Alcohol-Related Post	'Likes' (n)					'Comments' (n)					'Shares' (n)				
	Min	Max	Percentiles			Min	Max	Percentiles			Min	Max	Percentiles		
			25	50	75			25	50	75			25	50	75
Category 1 (Alcoholic beverage ad)	0	702	6	29	63	0	31	0	1	6	0	11	0	1	3
Category 2 (Zero-alcohol beverage ad)	0	1263	0	143	346	0	1800	0	180	356	0	588	0	123	285
Category 3 (Grey zone)	0	1713	8	25	61	0	368	0	0	1	0	250	0	0	3
Total	0	1713	5	25	100	0	1800	0	0	6	0	588	0	1	7

Table 6. Summary of alcohol-related stories by Instagram profile category (n = 121).

	Total Alcohol-Related Stories Count *n* (%)	Category 1 (Alcoholic Beverage Ad) Count *n* (%)	Category 2 (Zero-Alcohol Beverage Ad) Count *n* (%)	Category 3 (Grey Zone) Count *n* (%)
Grocery retailers	1 (0.8)	0	1 (14.3)	0
Specialized liquor stores	3 (2.5)	1 (9.1)	1 (14.3)	1 (1.0)
Shopping malls	1 (0.8)	0	0	1 (1.0)
Alcohol producers	14 (11.6)	9 (81.8)	0	5 (4.9)
Influencers	102 (84.3)	1 (9.1)	5 (71.4)	96 (93.1)
Total	121 (100)	11 (100)	7 (100)	103 (100)

4. Discussion

This was the first study examining compliance with a comprehensive alcohol advertising ban on social media in Lithuania. Overall, 1.4% of all published posts on Instagram and Facebook that we reviewed was categorized as alcohol ads, violating legal restrictions, and most of them were posted by alcohol producers. If zero alcohol beverage and 'grey zone' ads are included, there were 7.4% of all the posts published having some link or appearing to be an alcohol ad. User engagement with advertisements for alcoholic beverages was lower than their engagement with advertisements for zero-alcohol beverages or with posts displaying drinking behavior. Even though the number of alcohol-related posts published by influencers was very low (considering the fact that influencers generate a large number of posts regularly), overall, those posts accounted for almost half of all alcohol-related posts on Instagram among the analyzed profiles.

Current legislation in Lithuania forms a strong restrictive marketing environment not commonly found in other countries and in the area of research. The already published studies analyzing the role of social media mostly focused on examining patterns of alcohol producers, retailers and influencers using social media to promote alcohol, as well as studies exploring the content of alcohol ads, while researching compliance and the enforcement of a total ban was likely under-researched purely due to the fact that there are only a few countries (Kazakhstan, Kyrgyzstan, Norway and the Russian Federation) with such regulations. As there may be growing support for tighter regulations [18–20], it is likely that marketing restrictions could also become a more important research topic.

One of the most frequent arguments used by the alcohol industry and its allies in 2011, when lobbying to revoke a comprehensive alcohol advertising ban, was that there were no existing instruments capable of regulating content on social media [7]. At the time, one of the industry's key groups, the Lithuanian Free Market Institute, stated that "young people are best reached by advertising on the internet", and that "it is uncertain whether and how the advertising ban will affect alcohol consumption in this age group" [21]. Such arguments were no longer utilized in June 2021, when a group of parliamentarians filed a change to the Law to allow alcohol producers and retailers to advertise alcohol on their social media accounts if the posts were not sponsored [22]. This was the most recent and

unsuccessful attempt to loosen the restrictions on alcohol advertising, which was met with strong opposition from national and European public health organizations [23].

Our findings contradicted the industry's claims of the impracticability of enforcing a total advertising ban, as only 1.4% of the 2191 posts was classified as alcoholic beverage ads. Furthermore, according to the Drug, Tobacco and Alcohol Control Department, which oversees the implementation of the ban, alcohol advertising accounted for only 1.7% of all identified infringements of the Law in 2018 [24]. The share of infringements remained relatively low in the following years, at 4.2% in 2019, 4.9% in 2020 and 2.1% in 2021 [24]. Even with a small team of five civil employees working on this issue in the Drug, Tobacco and Alcohol Control Department, it appeared that enforcing a total ban is possible. The Drug, Tobacco and Alcohol Control Department focuses on retailer education and tries to prevent the infringement of new regulations by providing between 3500 and 4500 alcohol advertising consultations to businesses and issuing approximately 90 warning letters each year [25]. Compliance specialists also monitor social media networks. In 2019, 240 unique profiles were examined for compliance, and 300 in 2020 [25]. High compliance may be related to a few other reasons. The controlling authority is allowed to block noncompliant websites or social media profiles and levy civil penalties ranging from EUR 2896 to EUR 21,721 (EUR 6019 on average) [24]. Moreover, social media networks have their internal advertising policies that are developed in accordance with local laws. For example, on Facebook, ads are automatically reviewed by the system for violations of advertising policies [26] and are deleted if they are in violation of current legislations.

According to our study's findings, a similar number of alcohol ads and zero-alcohol beverage ads were posted on Facebook and Instagram (30 and 26, respectively). In 2008, when new restrictions on alcohol advertising were introduced, businesses started promoting zero-alcohol beverages that looked almost identical to alcoholic drinks. Zero-alcohol beers and kvass, which were sold in the same containers and with the same labels as ordinary beer, were promoted by alcohol manufacturers. Later, the industry cited this as an example of inadequate regulation to argue for the liberalization of the legal framework. Producers of the spirits openly expressed their concern that beer producers continued to promote actual beer brands by promoting alcohol-free beer, and that this was how they exploited regulatory loopholes [27]. Moreover, the market for zero-alcohol beverages nearly doubled in 2018 compared to the previous year, with zero-alcohol cider sales increasing by 160% and beer and wine sales increasing by 90% [28]. Due to the market for zero-alcohol beverages currently expanding and with sales of all types of alcohols shrinking in Lithuania since 2014, it is difficult to predict whether advertisements for zero-alcohol beverages can be utilized (as demonstrated before) to take advantage of regulatory gaps in the future and to revert the current trend.

The Supreme Administrative Court of Lithuania (the Court) has now twice, in a highly contentious manner, interpreted civil penalties imposed by the Department for potentially utilizing zero-alcohol beverages to promote alcoholic beverages. A well-known spirit producer started the production of cranberry soft drinks that were labelled as "Čepkelių zero-alcohol nonbitter", but that was visually almost identical to "Čepkelių cranberry bitter, 36% volume", and the Supreme Administrative Court of Lithuania ruled that the producer had violated the law by marketing a beverage that was visually identical to an alcoholic spirit drink and, thus, indirectly promoting it [29]. Meanwhile, when the beer producer advertised "Utenos" zero-alcohol beer cans, the appearance of which was identical to the alcoholic beer cans, the Supreme Administrative Court of Lithuania reversed the decision of the regional administrative court and concluded that the Law did not prohibit the advertising of zero-alcohol beverages, nor were there any requirements for the trademark of zero-alcohol beverages, and the element of alcohol advertising in the dispute was purely hypothetical [30]. Such contradictory court rulings fail to provide legal precedent for evaluating the use of zero-alcohol beverages to promote alcoholic beverages. The lack of consistency in legal practice caused this to become an important area for future studies.

One of the main objectives for further research on this subject is to elucidate how sales of alcoholic and zero-alcohol beverages (such as alcohol-free beer) changed when advertising was banned. Such studies should aim to clarify whether zero-alcohol beverage advertising can be both indirectly advertising alcoholic beverages and advertising encouraging the consumption of alcohol-free versions of those beverages, which should in theory result in a sharp increase in zero-alcohol beverage sales. These findings would facilitate the development of more specific recommendations for decision makers regarding the need to amend (or maintain the status quo) current legislation to avoid advertising ban loopholes. Although such an analysis would be of benefit to this field, it was beyond the scope of our study.

According to the data of this study, influencers posted half (45.5%) of all alcohol-related posts on Instagram and 84.3% of all Instagram stories. However, only two (10% of posts and 9.1% of stories on Instagram) of these cases were categorized as alcohol ads, since they clearly displayed the brand. The remaining were categorized as being in the "grey zone" category, which refers to photos, videos or live broadcasts that did not contain any direct or indirect allusions to a specific alcohol brand, but rather focused on a positive social drinking environment. A study conducted in the Netherlands [31] showed similar results on influencers actively posting about alcohol. This is disturbing because influencers are proven to be popular among children and minors [32], and influencer marketing elicits less opposition than traditional means of advertising [33]. Fully aware of the growing use of celebrities and influencers by the alcohol industry [25], the Lithuanian Drug, Tobacco and Alcohol Control Department published guidelines for influencers to help them determine whether the information they plan to post on social media could be considered an alcohol ad [34]. Similar practices of the industry financially engaging influencers to promote alcohol brands and make drinking more desirable were recorded elsewhere [35]. As evidence of social media's influence on alcohol intake and attitudes continues to mount [36], it is necessary to find new ways to regulate activities of this kind in order to safeguard public health.

This study had some limitations. First, the data were collected over a short period of time. Consequently, it was impossible to compare the data and identify patterns. In addition, the data were collected during the COVID-19 pandemic with strict lockdown measures in Lithuania. In the presence of dining, indoor gathering and night club restrictions, it could be assumed that alcohol-related posts were published less frequently compared to a restrictions-free setting. On the other hand, studies showed an increase in alcohol consumption during the pandemic lockdown in Lithuania [37]. It could be argued that the lockdown could have been used by retailers and producers to promote alcoholic beverages as part of leisure activities whilst at home. Additionally, the categorization of alcohol-related posts was based on local realities and the method of allocating posts to different categories was not validated. In addition, not reviewing social media pages on weekends may have precluded the capture of posts that were quickly removed after they were published. The same was applicable to Instagram stories, which disappeared from the feed and profile after 24 h. Furthermore, even though we were able to record ads for alcoholic beverages, due to the characteristics of Facebook and Instagram, we were unable to determine what was the actual engagement of posts published (i.e., their 'reach' or the amount of 'views'). To account for this limitation, we evaluated the popularity of captured Facebook posts in terms of 'likes', 'comments' and 'shares'. The popularity of captured posts, however, was likely to continue to increase with time with potentially more people encountering the post and, therefore, could not be fully recorded.

Despite these constraints, our study provided valuable insight into the extent of alcohol ads on social media in the setting of a comprehensive alcohol advertising ban. As long as the Law remains one of the most frequently amended legal acts in Lithuania, more in-depth independent research is of paramount importance to help proban groups to prevent the further liberalization of the Law. Future studies should seek to better understand the content of published alcohol-related posts and what the characteristics are that increase user engagement on social media. In addition, future research should attempt to evaluate the effects of the total ban on the advertising of alcohol in Lithuania.

5. Conclusions

Data from our study were encouraging in terms of demonstrating compliance of alcohol producers, retailers and influencers with Lithuania's total alcohol advertising ban on social media. Moreover, our study highlighted the need for regulatory responses towards zero-alcohol beverages that were nearly identical to alcoholic beverages of the same brand. Additionally, there is a need to properly continuously monitor the expanding prominence of influencers' social media accounts, as they likely contribute significantly to posts that potentially promote positive associations with drinking. Future studies should consider exploring these nuances and potential tactics of alcoholic beverage advertisers to identify potential gaps within the efficient enforcement of a total advertising ban.

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Appendix A

Article 29. Restriction of Alcohol Advertising

1. Alcohol advertising shall be prohibited in the Republic of Lithuania.

2. Information about alcoholic beverages in information announcements which are intended only for the specialists engaged in alcohol business, also the registered names of the undertakings, European legal persons and their branches which produce or sell alcoholic beverages (if the name of the producer of the alcoholic beverages is an integral part of the registered name of these undertakings, European legal persons or their branches) and trademarks, where these names and trademarks are displayed on signboards on the building of the headquarters or division of these undertakings, European legal persons or their branches and on the vehicles managed by them shall not be treated as advertising. The registered names or trademarks of the undertakings, European legal persons or their branches producing or selling alcoholic beverages, when these names or trademarks are seen irregularly and unexpectedly during the programmes broadcast or rebroadcast by the broadcasters and rebroadcasters under the jurisdiction of the Republic of Lithuania and where images of these names and trademarks are auxiliary compared to images of the programme broadcast or rebroadcast as well as the labelling particulars and other labelling information on an alcoholic beverage and/or its primary (commercial) or secondary (group) packaging as established by legal acts of the Republic of Lithuania, display of alcoholic beverages (placing for sale), the group, subgroup, category of an alcoholic beverage, the country of origin, geographical indication, region of an alcoholic beverage, names and registered trademarks of manufacturers of alcoholic beverages or undertakings trading in alcoholic beverages, the price of an alcoholic beverage when this information is available at retail outlet or catering establishments where alcoholic beverages are sold to the consumer or on the websites of undertakings manufacturing or selling alcoholic beverages.

3. Compliance with the requirements set out in this Article shall be controlled by the Drug, Tobacco and Alcohol Control Department.

4. The Drug, Tobacco and Alcohol Control Department, having carried out an investigation in accordance with the procedure laid down by the Government of the Republic of Lithuania or an institution authorized by it and having determined that alcohol advertising intended for the market of the Republic of Lithuania is electronically disseminated, shall be entitled to issue binding instructions to an information hosting service provider to urgently remove the information stored by the information hosting service provider which is used to disseminate alcohol advertising or to eliminate the possibility of access to such information.

5. The Drug, Tobacco and Alcohol Control Department must, in order to perform the actions specified in paragraph 4 of this Article, submit a request for authorization to perform the actions to the Vilnius Regional Administrative Court. The request for authorization to perform the actions must state the name and surname or the business name of the person who committed the suspected violation, and if the name and surname or the business name of such person cannot be determined or the determination of such data requires disproportionately high costs, the business name of the person/persons for whose benefit or interest alcohol advertising is disseminated, as well as the type of the suspected violations and envisaged actions. The Vilnius Regional Administrative Court examines the request for authorization to perform the actions and adopts a reasoned order to grant or reject the request for authorization to perform the actions. The request for authorization to perform the actions must be examined and the order adopted not later than within three working days from the submission of the request for authorization to perform the action. If the Drug, Tobacco and Alcohol Control Department disagrees with the order of the Vilnius Regional Administrative Court to reject the request for authorization to perform the actions, it shall have the right to appeal against this order to the Supreme Administrative Court of Lithuania within seven working days after the adoption of such an order. The Supreme Administrative Court of Lithuania must investigate the complaint regarding the order of the Vilnius Regional Administrative Court to reject the request for authorization to perform the actions not later than within seven working days from the acceptance of the complaint of the Drug, Tobacco and Alcohol Control Department. A representative of the Drug, Tobacco and Alcohol Control Department shall be entitled to participate in the examination of the complaint when the complaint is examined in the oral proceedings. The ruling adopted by the Supreme Administrative Court of Lithuania shall be final and not subject to appeal. When examining requests and complaints regarding the granting of authorization to perform the actions, the courts must ensure the confidentiality of information provided and the actions planned.

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Alcohol control policies reduce all-cause mortality in Baltic Countries and Poland between 2001 and 2020

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Alcohol consumption in the Baltic countries and Poland is among the highest globally, causing high all-cause mortality rates. Contrary to Poland, the Baltic countries have adopted many alcohol control policies, including the World Health Organization (WHO) "best buys". The aim of this study was to evaluate the impact of these policies, which were implemented between 2001 and 2020, on all-cause mortality. Monthly mortality data for men and women aged 20+ years of age in Estonia, Latvia, Lithuania, and Poland were analysed for 2001 to 2020. A total of 19 alcohol control policies, fulfilling an a-priori defined definition, were implemented between 2001 and 2020 in the countries of interest, and 18 of them could be tested. Interrupted time-series analyses were conducted by employing a generalized additive mixed model (GAMM) for men and women separately. The age-standardized all-cause mortality rate was lowest in Poland and highest in Latvia and had decreased in all countries over the time period. Taxation increases and availability restrictions had short-term effects in all countries, on average reducing the age-standardized all-cause mortality rate among men significantly (a reduction of 2.31% (95% CI 0.71%, 3.93%; $p = 0.0045$)). All-cause mortality rates among women were

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not significantly reduced (a reduction of 1.09% (95% CI − 0.02%, 2.20%; $p = 0.0554$)). In conclusion, the alcohol control policies implemented between 2001 and 2020 reduced all-cause mortality among men 20+ years of age in Baltic countries and Poland, and thus, the practice should be continued.

Alcohol is one of the main risk factors for non-communicable disease and injury, with more than 200 health conditions causally impacted[1,2]. In the World Health Organization (WHO) European Region, 10.1% of all deaths were attributable to alcohol use in 2016[2]. Alcohol-attributable fractions (AAF) are the highest in the WHO European Region, compared to other WHO regions[3]. AAFs were especially high in Central, Eastern Europe and Baltic Countries[4].

However, alcohol-attributable deaths and all-cause mortality could be reduced and life expectancy increased through the implementation of effective alcohol control policies[5,6]. Three policies have been highlighted by the WHO to be especially effective, cost-effective, and easy to implement; and have been labelled as "best-buys". These measures include increasing taxes on alcoholic beverages, enacting and enforcing bans or comprehensive restrictions on exposure to alcohol advertising across multiple types of media, and enacting and enforcing restrictions on the physical availability of alcoholic beverages, for example, via reduced hours of sale[7]. Recent evidence corroborated this recommendation[8]. However, even though alcohol tax policies have been proven to be an effective tool in reducing alcohol harm, and there was strong evidence demonstrating the benefits of alcohol control fiscal policies[9–11], they have been generally under-implemented in the European region[4,12].

When evaluating the effectiveness of alcohol control policies, it is important to consider the influence of other factors related to alcohol consumption, such as changes in alcohol affordability due to the economic situation, inflation, purchasing power, growth of salaries and gross domestic product (GDP). For example, the economic crisis, which started in 2008, may have had an impact on the population's alcohol consumption due to the decline in income[13].

The three Baltic countries implemented different levels of alcohol availability, affordability, and marketing restrictions in the past 20 years[14,15], meanwhile Poland established only a taxation increase in 2020, and even loosened control in 2002 via a decrease in alcohol excise taxation[15]. Some of these effects have been evaluated such as the 2017 alcohol control policy of increased excise taxation implemented in Lithuania[11,16]. However, a single evaluation of an alcohol control policy is subject to potential confounding by other events and conditions which may have happened at the same point in time[17]. Thus, we need to introduce as much control as possible; analysing several interventions in different countries in the same region allows for such control, and aids in determining the general impact of policies by aggregating effects across various time points and conditions. As the Baltic countries and Poland differ in the strictness of implemented alcohol control policies and the time points when the policies were adopted, they constitute unique conditions to evaluate such effects, where the other countries can serve as control conditions.

Concretely, we identified all policies that had been implemented within a timespan of two decades, which fulfilled clear a priori defined criteria of decreased affordability and availability [see[15]]. Simultaneously measuring their average effect allowed for: (a) more generalizable estimates on average effect sizes of such policies; (b) better control for secular trends across the region, since we can use the other countries as control conditions for each policy effect; (c) better control of all other factors, as it is highly unlikely that, at exactly the same time of all 18 alcohol control interventions other events occurred which triggered the effects.

Thus, the aim of this study was to evaluate the impact of alcohol control policies applied by Poland and the three Baltic countries—Estonia, Latvia, and Lithuania—on all-cause mortality rates among the adult population (20+ years of age) between 2001 and 2020. All-cause mortality was selected as the main outcome rather than alcohol-attributable mortality, as it is the most important endpoint from a public health point of view. Even though, this endpoint appeared only once in the meta-analyses of Wagenaar and colleagues[18], it has been shown that in high-consuming countries of the WHO European Region, it can be affected by effective alcohol-control policies (e.g.,[5,6,11]). To ascertain, that the effect was indeed based on causes of death related to alcohol we conducted a decomposition based on data from Lithuania and Estonia, where we had cause-specific data. Concretely, we hypothesized that the alcohol control policies implemented reduced all-cause mortality in the Baltic countries and Poland in 2001–2020 in the adult population.

Methods

Data. The data for 2001–2020 (with exception of Poland, for which data covered the years 2001–2019) was obtained for Estonia from Statistics Estonia[19], for Latvia from the Official Statistics of Latvia[20], for Lithuania from Statistics Lithuania[21] and The State Register of Death Cases and Their Causes[22] and for Poland from the National Statistical Office[23]. To avoid including the impact of the coronavirus 2019 pandemic, data for December 2020 were excluded from the analysis, given its high impact in this month, and the fact that it was the last month of the series, which should not impact on the overall evaluation. Population data were used to convert mortality count data to rates were obtained for each country from the Organisation for Economic Co-operation and Development (OECD)[24]. Mortality rates were standardized according to EU standard[25].

Outcomes. The dependent variable was monthly age-standardized all-cause mortality rate per 100,000 population for individuals 20+ years of age for men and women. A decomposition of changes by cause of death was undertaken for Lithuania and Estonia, as we had obtained cause of death data for these two countries. Deaths were calculated 12 months before ("pre-policy") and 12 months after ("post-policy") the implementation of the policy by country and sex (and summed up over all the policies in the respective country for Table 2, details in Supplementary Table S7).

Intervention (alcohol control policies). A total of 18 policies, classified as "best buys" and expected to have an immediate effect, were applied in the study period based on the following criteria[15]: (1) taxation increases should decrease affordability of alcoholic beverages (affordability was measured by data on alcohol prices, inflation and disposable income); and (2) availability restrictions should reduce availability by at least 20% (decrease in opening hours at least 20%). Prior analyses showed that these policies had an impact on consumption level[26]. In Estonia, eight policies were selected; Latvia, five policies; Lithuania four policies; and in Poland, one policy (see Table 1; for detailed description of policies see Supplementary Tables S1–S4). The policy implemented in Poland could not be tested due to a lack of data for 2020 for this country. The effect was modelled to last for one year after implementation, and to test, whether other events at the same time in the country of implementation were impacting on the effect of the policy, we tested interaction terms between the countries and policies. One year was chosen as the time reference, as inflation and disposable income were expected to have an impact on affordability to diminish the impact of tax increases, and as we expected people to develop coping strategies to deal with availability restrictions. However, we tested a sensitivity analysis with a longer lasting but diminishing impact of the policies. For this sensitivity analyses, we set the full effect at 100%, and then reduced it by 10% per year in the following years (see Supplementary Table S6).

Potential confounding variables. The effect of intervention was adjusted by the effects for level of mortality in countries and economic recession on mortality. The latter was defined by a decrease in GDP based on purchasing power parities (GDP-PPP) based on data from OECD[24]. This operationalization was country-specific, as the recession of 2008 affected the countries studied differently (see Supplementary Table S5).

Statistical analyses. To test our hypothesis that alcohol control policies led to a reduction in all-cause mortality in the Baltic countries and Poland, we performed interrupted time-series analyses by employing a generalized additive mixed model (GAMM) for both men and women[27]. Both GAMM models controlled for the economic recession using a dummy coded variable, coded as 1 during the months which were associated with the recession, and 0 for all other time points. All four countries were included in the analyses and represented by a categorical variable, with Poland as the reference category. That is, the coefficients of country effects could be interpreted with respect to Poland. The log-transformed standardized all-cause mortality rates were approximately normally distributed, allowing for the use of linear models, and easy transformation into percentage change[28]. Seasonality was adjusted for by adding smoothing splines representing monthly and yearly patterns. Residuals were examined with plots of the autocorrelation function and the partial autocorrelation function to determine the orders of autoregressive and moving average series.

For both men and women, we presented a full model and a reduced model. In the full model, the linear time trend and policy effects were investigated, adjusted by economic recession, the countries and the interactions between policies and countries, in addition to the smooth terms. Akaike information criterion (AIC) and R-squared were used to assist with selecting the most appropriate model[29]. A lower AIC value indicates a better fit; as such, the model with the lowest AIC was selected. The reduced model was created by optimizing the full model, which involved removing any non-significant covariates that did not improve the model's fit. At last, Chi-square difference tests were used to evaluate if the full model fits significantly better or worse than the reduced model[30]. All analyses were performed using R version 3.6.3[31].

Diagnostic graphs for the full and reduced models for both men and women can be found as Supplementary Figs. S1–S4.

Year	Estonia	Latvia	Lithuania	Poland
2002		*June 14* Availability reduced		
2008	*January 1* Taxation increase, *July 1* Taxation increase, *July 14* Availability reduced	*February 1*, *July 1* Taxation increase	*January 1* Taxation increase, Marketing restricted	
2009			*January 1* Availability reduced	*March 1* Taxation increase
2010	*January 1* Taxation increase	*February 1* Taxation increase		
2016	*February 1* Taxation increase			
2017	*February 1*, *July 1* Taxation increase		*March 1* Taxation increase	
2018	*February 1* Taxation increase		*January 1* Availability reduced, Marketing restricted	
2019		*March 1* Taxation increase		
2020				*January 1* Taxation increase*

Table 1. Summary of alcohol control policies implemented in Baltic countries and Poland 2001–2020. *This policy was not included in data analysis, because 2001–2019 Poland data were used. More details about all policies published before[14,15,26].

Results

A total of 240 months of data were included in the analyses. Figure 1 shows the standardized mortality rates over time, which show a downward trend and evidence of seasonal variation. For both men and women, GAMM confirmed that the standardized mortality rates decreased over time after adjustment (see Tables 2 and 3).

Effects of policy. The policy effects estimated in the full and reduced models were similar (Table 2). For example, the estimate for the policy effect for men was − 0.024 in the full model compared to − 0.023 in the reduced model (Table 2), despite the fact that standard errors were larger in the full model due to more variables included. In the final reduced model, alcohol control policies had a significant effect on the all-cause mortality rate among men (0.0228 (95% CI 0.0071, 0.0385; p = 0.0045)), which transformed into a reduction of 2.31% (1− exp(0.0228)*100%, 95% CI 0.71%, 3.93%) in all-cause mortality rate (Table 2). Given the different numbers of deaths in the countries, this corresponds to average effects of about 172, 317, 478, and 4340 deaths avoided per year for Estonia, Latvia, Lithuania, and Poland, respectively.

For females, the effect was not significant (0.0108; 95% CI − 0.0002, 0.0218; p = 0.0554), however because it approached a p < 0.05 threshold, we computed its effect, which transformed into 1.09% (1− exp(0.0108)*100%, 95% CI − 0.02%, 2.20%), corresponding to average effects of around 84, 159, 218, and 1892 deaths avoided per year for Estonia, Latvia, Lithuania, and Poland, respectively (Table 3).

Effects of countries. For men, Latvia had a higher age-standardized all-cause mortality rate than Poland (by 38.82% = exp(0.328) − 1)) (Table 2). Estonia and Lithuania also showed higher mortality than Poland: Estonia by 16.01% (exp(0.1485) − 1) and Lithuania by 27.26% (exp(0.2411) − 1). The interaction effects of countries with alcohol control policies in the full model were not statistically significant, which reflected that the policies did not change all-cause mortality rates differently among the four countries.

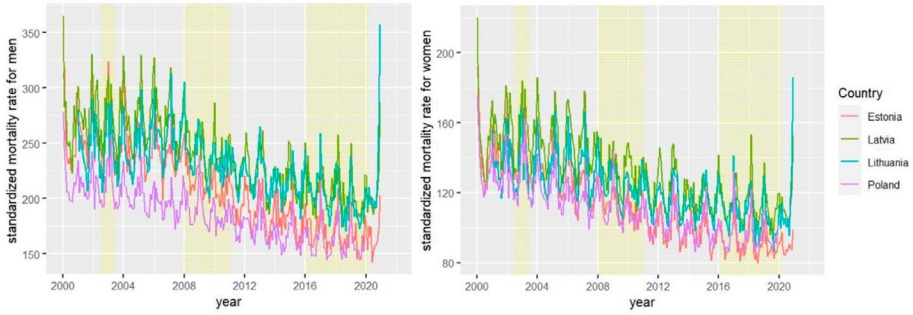

Figure 1. Standardized all-cause mortality rates (per 100,000) across time: the yellow shadow represents the occurrence of policy interventions.

	Full model				Reduced model			
	Estimate	Std. Error	95% CI	Pr(>|t|)	Estimate	Std. Error	95% CI	Pr(>|t|)
(Intercept)	5.365	0.013	(5.34, 5.39)	< 0.001	5.387	0.014	(5.359, 5.415)	< 0.001
Time (months)	− 0.001	0.000	(− 0.001, − 0.001)	< 0.001	− 0.001	0.000	(− 0.002, − 0.001)	< 0.001
Estonia	0.149	0.018	(0.114, 0.183)	< 0.001	0.130	0.010	(0.11, 0.149)	< 0.001
Latvia	0.328	0.015	(0.299, 0.357)	< 0.001	0.269	0.009	(0.251, 0.287)	< 0.001
Lithuania	0.241	0.011	(0.219, 0.263)	< 0.001	0.228	0.008	(0.213, 0.244)	< 0.001
Policy Intervention	− 0.024	0.016	(− 0.055, 0.008)	0.145	− 0.023	0.008	(− 0.038, − 0.007)	0.005
Recession	0.000	0.009	(− 0.017, 0.016)	0.978				
Estonia*policies	0.013	0.018	(− 0.022, 0.047)	0.478				
Latvia*policies	0.007	0.018	(− 0.028, 0.042)	0.694				
Lithuania*policies	0.006	0.018	(− 0.03, 0.041)	0.748				
	AIC = − 2787				AIC = − 2695			

Table 2. Model statistics for the effects of the alcohol policies on age-standardized all-cause mortality rate for men.

	Full model				Reduced model			
	Estimate	Std. Error	95% CI	Pr(>|t|)	Estimate	Std. Error	95% CI	Pr(>|t|)
(Intercept)	4.904	0.016	(4.874, 4.934)	< 0.001	4.904	0.015	(4.874, 4.934)	< 0.001
Time (months)	− 0.001	0.000	(− 0.001, − 0.001)	< 0.001	− 0.001	0.000	(− 0.001, − 0.001)	< 0.001
Estonia	0.194	0.012	(0.171, 0.216)	< 0.001	0.194	0.011	(0.172, 0.215)	< 0.001
Latvia	0.086	0.015	(0.057, 0.114)	< 0.001	0.086	0.014	(0.058, 0.114)	< 0.001
Lithuania	− 0.047	0.017	(− 0.081, − 0.013)	0.007	− 0.047	0.017	(− 0.081, − 0.014)	0.006
Policy Intervention	− 0.010	0.009	(− 0.027, 0.008)	0.295	− 0.011	0.006	(− 0.022, 0)	0.055
Recession	− 0.008	0.009	(− 0.026, 0.01)	0.384				
Estonia*policies	− 0.002	0.013	(− 0.027, 0.023)	0.875				
Latvia*policies	0.004	0.013	(− 0.021, 0.029)	0.769				
Lithuania*policies	− 0.013	0.019	(− 0.05, 0.025)	0.509				
	AIC = − 2739				AIC = − 2745			

Table 3. Model statistics for the effects of the alcohol policies on age-standardized all-cause mortality rate for women.

For women, compared with Poland, Estonia and Latvia also had higher age-standardized all-cause mortality rate: Estonia by 21.40% (exp(0.1939) − 1) and Latvia by 8.93% (exp(0.0855) − 1) (Table 3). Lithuania, on the other hand, had a significantly lower age-standardized all-cause mortality rate, by − 4.57% (exp(− 0.0468) − 1) on average. Similar to men, the interaction effects between countries and policies in the full model were not statistically significant.

Figure 2 shows the mortality gains summed up over the 11 interventions in total and by broad causes of death. Overall, men showed markedly more gains than women. Differentiating by cause of death, ischemic heart disease had the largest mortality gains in mortality followed by injury, stroke and gastrointestinal disease. All of these categories are causally linked to alcohol[1], and all of them are expected to change abruptly with changes in exposure, as evidenced by the changes in mortality due to the Gorbachev reforms[32]. As expected, there had been only minor changes in cancer mortality, in total comprising less than 5% of the total decrease (see Supplementary Table S7). While certain cancers have been identified as causally impacted by alcohol use, this relationship has a long lag-time, so no immediate changes of the alcohol control measures were expected[32].

To test the impact of the assumption of an impact lasting one year, a sensitivity analysis was performed assuming that policies have longer lasting effects: after the first year, the effect decreased by 10% each year to account for inflation, higher disposable income, and adaptation to availability restrictions. With this assumption,

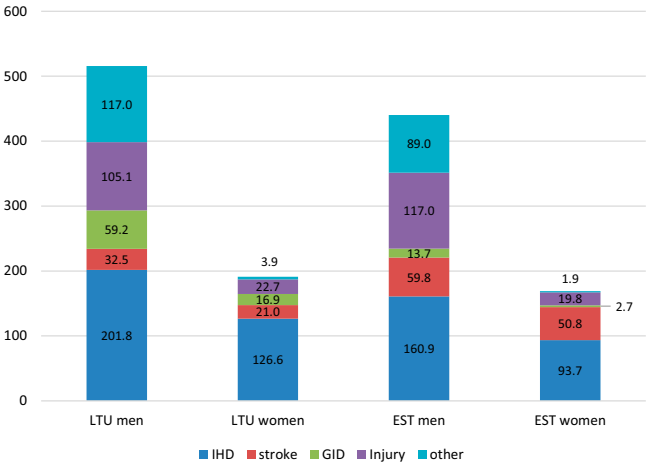

Figure 2. Mortality gains in age-standardized all-cause mortality rates per 100,000 population in the 11 interventions in Lithuania and Estonia, by broad causes of death. *LTU* Lithuanian, *EST* Estonian, *IHD* ischemic heart disease, *GID* gastrointestinal diseases.

the effect for policy was no longer significant (details in the Supplementary Table S6). While the overall policy was not significant anymore, the policy in Estonia and Lithuania did show significant reductions in mortality.

Discussion

The alcohol control policies implemented in the Baltic countries and Poland were effective in significantly reducing all-cause mortality among men. Given the difference in the number of deaths across countries, the reduction corresponds to average effects of about 172, 317, 478, and 4340 deaths avoided per year for Estonia, Latvia, Lithuania, and Poland, respectively. Analyses by cause of death in a subsample confirmed that the reduction was indeed based on alcohol-attributable causes of death.

With respect to all-cause mortality among women, the impact of implemented alcohol control policies was in the right hypothesized direction (i.e., a reduction); however, it was not statistically significant. As such, the results of the data analysis partially confirm our hypothesis.

The results of this study contribute to other previous studies showing the effectiveness of alcohol control policies in reducing all-cause mortality[6,11], when the WHO "best buys" alcohol control policies were adopted[7].

There are several explanations for the differential impact on men and women. Men are more likely than women to consume alcohol, they consume more alcohol when they consume, they have a higher prevalence of alcohol use disorders, and they are more prone to behavioural problems associated with acute alcohol consumption[33]although women have a shorter time period between initiation of regular alcohol use and problem use compared to men[34] and the gap between need and receipt of treatment is larger for women than for men[35]. In the WHO European Region the consumption of pure alcohol was four times higher among men compared to women in 2016, as a result the proportion of alcohol-attributable deaths was 12.3% among men and 7.8% among women[4]. It is possible that the stronger relationship between policies and all-cause mortality in men compared with women may be because alcohol accounts for a larger proportion of total mortality in men than in women. Although alcohol control policies of taxation increase and availability reduction in the Baltic countries and Poland have been found to be effective in reducing alcohol per capita consumption of pure alcohol per year[26], future evaluation of the impact of these policies on specific population groups such as men and women would be important.

Life expectancy is determined by many factors, including demographic, economic, social, health system, and environmental factors. Also, health behaviours (like alcohol consumption) could have an impact on the average life expectancy of a country's population[36]. The average life expectancy of men and women also varied between the Baltic countries and Poland, the inequalities being particularly large in Baltic countries, for instance in 2019 the average life expectancy difference between men and women in Lithuania was 9.6 years (men—71.6 years, women—81.2 years), for comparison in Poland difference was 7.8 (men—74,1 years, women—81.9 years)[37]. As Stumbrys and colleagues indicated, positive changes in Lithuanian's men life expectancy in 2007–2017 were result of decreased mortality from external causes of death, cardiovascular diseases and alcohol-related disorders[38]. These causes are clearly related to alcohol consumption, and therefore alcohol control policies are expected to have an impact on them. Changes in women's mortality were less related to alcohol consumption and mortality from external causes of death, therefore alcohol control policies had less influence on them[38]. As a result, due to alcohol control policies implemented in Lithuania between 2008 and 2018, men's age-standardized mortality decrease was higher compared to women[11]. On the contrary, increase in alcohol consumption in Poland between 2002 and 2019 was found to be a feasible cause of slow down and then halted increase of life expectancy[39].

We would like to point out potential limitations. All-cause mortality could be affected by various factors that is difficult to identify and control (prevention programs, health care funding, economic crisis, other policies, coronavirus 2019 pandemic, etc.). These factors were not controlled in this study. Therefore, we can assess the associations of policy and mortality indicators but cannot specifically imply on causality. However, in order to give alternative explanations of the results, these factors must have occurred exactly at the same months as the alcohol control policies in each or at least most of the 18 instances, which is unlikely. While we controlled for interactions between country and policies, we did not control for three-way interactions (i.e., time, country, policy). Also, we relied on the assessment that implementation of the taxation increases which reduced affordability and availability restrictions had similar effect sizes. This assumption was based on expert judgement only[15]. Therefore, different policies and the different number of policies included in the analysis could have an impact on cross-country comparisons. Finally, we modelled the effect of alcohol control policies to last one year. While the effects of such policies clearly will diminish due to factors such as inflation, increases in disposable income for taxation, and adaptation of consumers for availability restrictions (e.g.,[40]), the 1-year assumption is likely an underestimate. However, a sensitivity analysis with longer lasting effects, showed different effects by country, with the effects only being significant in Lithuania and Estonia.

Against our hypotheses, the economic crisis of 2008 which affected the Baltic countries at slightly different times (see above) contributed to a reduction of affordability of alcoholic beverages and was associated with a reduction of alcohol per capita consumption[26]. However, within an economic crisis or other crisis situation there may also be an increase in heavier drinkers despite the overall volume of alcohol going down[13,41–43]. Economic crisis has affected funding for the health systems by decreasing public expenditures on health care, which may have affected health indicators (life expectancy, all-cause mortality etc.) and public health was particularly affected in countries with highest recession[44].

It is important to mention that uniqueness of this study is that it evaluates the impact of immediately acting "best buy" alcohol control policies implemented in Estonia, Latvia, and Lithuania, on a broad measure, all-cause mortality, without distinguishing between policies and countries. Poland was included in the analyses, but as a control country only, as the only alcohol control policies that met the a priori defined criteria implemented between 2000 and 2020 was outside the range of data available for analyses. Since we included all instances of

policy change, and still found impact on all-cause mortality, this indicates, that the "best buy" policies of taxation increases, and availability restrictions are still very valid and should be used more often to decrease all-cause mortality.

This study has demonstrated that alcohol control policies were associated with a reduction in all-cause mortality among men in the Baltic countries between 2001 and 2020. All-cause mortality among women also decreased, but not significantly so.

Data availability

Mortality data of the countries is held by government institutions and is not publicly available. Data can be provided by the responsible government institutions of the countries upon request (National Statistical Office of Poland, Official Statistics of Latvia, Statistics Estonia, Statistics Lithuania and The State Register of Death Cases and Their Causes, Lithuania).

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Author contributions

All authors contributed to development of the manuscript and approved the submitted version. J.V.: Conceptualization, Data Curation, Writing Original Draft, Review and Editing; I.G.: Data Curation, Review and Editing; K.J.K.: Data Curation, Review and Editing; S.L.: Review and Editing, Funding acquisition; L.M.: Review and Editing; J.P.: Review and Editing, Funding acquisition; R.Radišauskas: Review and Editing, Funding acquisition; R.Reile: Data Curation, Review and Editing; M.Š.: Conceptualization, Data Curation, Review and Editing, Supervision, Project administration, Funding acquisition; R.S.: Data Curation, Review and Editing; T.T.: Data Curation; A.T.: Methodology, Review and Editing; J.R.: Conceptualization, Methodology, Review and Editing, Supervision, Project administration, Funding acquisition; W.Z.: Data Curation; HJ: Conceptualization, Methodology, Software, Formal analysis, Writing Original Draft, Review and Editing.

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Competing interests

The authors declare no competing interests.

Additional information

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Original Research

The impact of alcohol control policy on assaults and sexual assaults in Lithuania: An interrupted time-series analysis

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ABSTRACT

Objectives: The aim of the current study was to test the impact of three alcohol control policy enactments (in 2008, 2017 and 2018) on assaults and sexual assaults in Lithuania. The hypothesis tested was that alcohol control policy implementation is associated with a reduction in the occurrence of both assaults and sexual assaults.
Study design: An interrupted time-series analysis.
Methods: To estimate the unique impact of three alcohol control policies, interrupted time-series analyses were conducted. Three alcohol policy enactments, based on the World Health Organization "best buys" framework, and the following stringent criteria: (1) pricing policies had to have resulted in decreased affordability, defined in terms of the price of alcohol increasing at a higher degree than average disposable income; or (2) availability policies that aimed to reduce alcohol use for a large portion of the general population were selected for evaluation.
Results: The alcohol control policy implemented in 2017 was statistically significantly associated with a reduction of 29.9 % (exp(-0.35379)-1) in the rate of sexual assaults, after adjusting for the financial recession and COVID-19-related lockdowns and smooth functions of time.
Conclusions: Study provides evidence that alcohol control policies, particularly those focusing on major alcohol tax increases that reduces alcohol affordability can contribute to reducing rates of sexual assault. The current findings, along with the consistent evidence linking alcohol use to sexual violence, supports the need for comprehensive strategies for mitigating violence to include alcohol.

1. Introduction

Over the past two decades, Lithuania has seen a notable decrease in registered violent crimes, particularly assaults and sexual assaults. For instance, in 2004 there were 403 cases of assault reported, while in 2023 there were only 123 cases.[1] Similarly, sexual assaults fell from 388 to 246 cases over the same period.[1] These downward trends clearly underscore Lithuania's relative success in curbing violent crime; however, in countries of the World Health Organization European Region, Lithuania was still markedly above the regional average in experiencing physical violence from others' drinking in 2019 for both men and women.[2]

While the absolute level may still be high, trends go into the right direction contrary to the trends across the European Union (EU). In 2022, there were 231,456 sexual violence offenses reported across the EU—up 10.3 % compared to the year prior, 2021.[3] The rate of sexual

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violence increased between 2021 and 2022 in 21 of the 27 EU member states.[3] Notably, Lithuania, along with Denmark, Estonia, Croatia, Cyprus, and Sweden, reported decreases in sexual violence, albeit only over a one-year period, setting it apart from the broader regional pattern.

The relationship between alcohol consumption and violent behaviors, including assaults and sexual assaults, is well established in the scientific literature.[2,4] Alcohol use, particularly excessive use, is known to impair judgment and reduce inhibitions. When faced with aggression-inducing situations, intoxicated individuals are more likely to engage in violent behavior.[5] A population-based study from the United States by Liang and Chikritzhs[6] examined the link between heavy alcohol use and assaults and used the proxy outcome method to control for unknown or unmeasured confounders. These investigators found that even after adjusting for unknown/unmeasured confounders, the association between heavy alcohol use and risk of violence remained significant. Their findings provide evidence that heavy alcohol use is not merely correlated with violence, but rather can cause violence. In a recent study in Australia, between 24 % and 54 % of family and domestic violence incidents reported to police were classified as alcohol-related. Alcohol-related family and domestic violence incidents were found to be twice as likely to involve severe physical violence, including life-threatening injuries.[7] While in the current study domestic and non-domestic violence are not differentiated, it is important to acknowledge that alcohol is a well-established risk factor for various forms of violent crime. The broader context is relevant when considering the potential impact of alcohol control policies on interpersonal violence in general.

Alcohol use has also been linked to sexual violence, particularly as a factor in both the perpetration of and being a victim of sexual assault. A study by Kilpatrick et al.[8] found that alcohol was frequently involved in drug facilitated, incapacitated rape cases (98 % in general population). A study from Turin, Italy, spanning 2008–2019, examined 1481 cases of reported sexual violence and found that victims who consumed alcohol were often younger (18–25 years) and experienced assaults in public spaces or acquaintances' homes. These victims also exhibited higher rates of concurrent drug use and sustained more severe injuries compared to non-drinking victims.[9]

Alcohol control policies, in particular availability restrictions, play a crucial role in mitigating alcohol-related harm, including violent crimes such as assaults and sexual assaults.[10] Mair et al.[11] investigated the impact of modifications to the alcohol retail environment on interpersonal violence. Their findings demonstrated that reducing alcohol availability was associated with declines in interpersonal violence rates. Similarly, Kowalski et al.[12] concluded that implementing late-night alcohol restrictions was associated with a significant reduction in the rate of domestic violence. For taxation and other pricing policies, the evidence is sparse (for exceptions see Ref. [13]).

Several recent studies have examined the effects of Lithuania's alcohol control policies on alcohol-related harms, including mortality and emergency department visits.[14–16] While these studies provide important insights into broader health outcomes, our study specifically focuses on the impact of these policies on interpersonal violence, particularly assaults and sexual assaults.

In summary, while there is evidence supporting the link between alcohol consumption and violent behaviors, fewer studies have directly examined the effectiveness of alcohol control policies in reducing specific forms of violent crime, such as assaults and sexual assaults. Examining the role of such policies in reducing instances of assault and sexual violence is crucial for shaping evidence-based policy decisions.

Lithuania has one of the highest levels of alcohol consumption *per capita* in Europe; as a result, the government enacted a range of stricter alcohol control measures beginning in 2008.[17] The objective of the current study was to test the impact of three alcohol control policy enactments (in 2008, 2017 and 2018) on assaults and sexual assaults in Lithuania. Two out of three policy time points involved an increase of alcohol taxation, therefore it is important to highlight that Lithuania currently stands among those countries with relatively higher than average alcohol taxation shares when compared with other European region countries.[18] The hypothesis tested was that alcohol control policy implementation is associated with a reduction in the occurrence of both assaults and sexual assaults.

2. Methods

2.1. Measures

Data on the number of reported assaults and sexual assaults committed per month between January 1, 2003 and December 31, 2023 were obtained from Information Technology and Communications Department (ITCD) under the Ministry of the Interior of the Republic of Lithuania. In Lithuania, all the crimes committed/under investigation are collected and processed by the Criminal Offenses Official Register operating at the ITCD. The number of assaults and sexual assaults per month were converted to population-standardized monthly rate per 100,000 population.

Three alcohol policy enactments, based on the World Health Organization "best buys" framework for which the majority of effects via a reduction in the level of alcohol use will begin immediately (i.e., pricing and availability policies),[19] and the following stringent criteria: 1. pricing policies had to have resulted in decreased affordability, defined in terms of the price of alcohol increasing at a higher degree than average disposable income; or 2. availability policies that aimed to reduce alcohol use for a large portion of the general population, e.g., by restricting hours of sale for alcoholic beverages.[20] Accordingly, policies implemented on January 1, 2008 (Policy 1, an increase in excise tax by 10–20 % that reduced alcohol affordability), March 1, 2017 (Policy 2, an increase in excise tax by 112 % for beer, 111 % for wine, 93 % increase for intermediate products, and 23 % for ethyl alcohol that reduced alcohol affordability) and January 1, 2018 (Policy 3, reduced off-premises sales hours, as well as an increase of legal minimum drinking age with increased enforcement) were selected for evaluation. For additional details, see Rehm et al.[20]

The following (potentially confounding) dummy-coded covariates (with 1 for each of the respective months impacted, and 0 for all other months) were also included: the global financial recession, which impacted Lithuania from August 1, 2008 to December 31, 2009, "lockdowns" that took place during the coronavirus 2019 (COVID-19) pandemic, which occurred from March 16, 2020 to June 16, 2020, and from November 7, 2020 to June 30, 2021.

2.2. Statistical analysis

To estimate the unique impact of three alcohol control policies, we conducted interrupted time-series analyses by employing a generalized additive mixed (GAM) model[21] on monthly assault and sexual assaults rates (per 100,000 population) from January 2003 to December 2023, adjusting for the financial recession in 2008, COVID-19-related lockdowns, and smooth functions of time and month. A GAM model was chosen as it does not assume a linear form of relationship, and can be used to estimate non-linear effects of the covariate on the dependent variable. Each policy intervention was dummy coded, with 1 for the month in which the policy was implemented for a total of 18 months post implementation, and 0 for all other months. The policies were modeled separately as we wanted to evaluate their independent effects. The assault and sexual assaults rates were log transformed to produce a distribution that approximated a normal distribution. All statistical analyses were conducted using R version 4.2.3.[22]

3. Results

The rate (per 100,000 population) of assaults and sexual assaults in Lithuania between 2003 and 2023 are presented in Fig. 1. As shown, both assaults and sexual assaults demonstrated a declining trend over the two decades, with some variability across specific years.

The impact of the three alcohol policies on the rates of assaults and sexual assaults are presented in Table 1. Among the three policies, the alcohol control policy implemented in 2017, which included a significant increase in alcohol taxation and measures to reduce alcohol affordability, was associated with a statistically significant reduction of 29.9 % (exp(-0.35379)-1) in the rate of sexual assaults. This association remained robust after adjusting for potential confounding factors, including the financial recession, COVID-19-related lockdowns, and smooth temporal trends. Possibly reflecting the impact of price sensitivity on high-risk behaviors associated with alcohol consumption.

The financial recession was associated with a decrease in the rate of both assaults and sexual assaults; however, it was only statistically significant in the analyses on the rate of assaults. The COVID-19 lockdowns were not statistically significantly associated with the rate of assaults or sexual assaults. While the pandemic introduced significant changes in social behavior, mobility, and alcohol consumption patterns, these shifts did not translate into measurable changes in violent crime rates during the study period.

4. Discussion

The current study examined the impact of three alcohol control policy time points in Lithuania, providing insight into the relationship between alcohol consumption and violent crime. Thus, the current study contributes to the broader understanding of the effectiveness of alcohol control policies in reducing alcohol-related harm. The results suggest that alcohol control policies impacting price may be effective in reducing sexual assaults, but not necessarily assaults. Specifically, the 2017 policy was significantly associated with a decrease in the rate of sexual assaults. However, the 2008 policy, a policy also targeting alcohol pricing, was not. This finding is consistent with what was found for other outcomes (e.g. suicide), and is possibly a reflection of the magnitude of the taxation increase, and the temporal proximity and partial overlap with the global financial recession.[23] The taxation increase of 2017 resulted in a 6.74 % decrease in alcohol affordability, while the 2008 policy only resulted in a decrease of 2.02 %.[24] Further, as indicated, the taxation policy of 2008 overlapped, at least partially, with the global financial recession of 2008–2009, which in practice should have pushed the affordability of alcohol down due to the decline in population income, but may have created other confounders (e.g. stress, unemployment, increased emigration) contributing to the change in assaults or sexual violence that were not possible to control for.

The finding of significance of 2017 policy (major increase in excise taxation which reduced alcohol affordability) could not be overstated as this time point was also identified in other studies as a major impact factor for all-cause mortality, and several cause-specific mortalities.[25,26] It is important to highlight that we observe the additional reduction of alcohol related harms beyond the secular declining trends while the major increase in excise taxation was implemented during a stable period of modest economic growth before the poly-crises starting since 2020.

Interestingly, the COVID-19-related lockdowns were associated with a reduction in assault and sexual assault rates in the majority of analyses (all except for the analyses on the 2017 policy for sexual assaults), but the association was not statistically significant. During the COVID-19-related lockdowns, there was a shift away from on-premise consumption to off-premise consumption, specifically consumption of alcohol in the home. Given these circumstances, we would expect the COVID-19-related lockdown to be associated with an increase in domestic violence[27] and a decrease in non-domestic violence.[28,29] This is something that could in part explain the null findings here, and should be explored in the near future.

4.1. Limitations

This study has several limitations which should be acknowledged. First, the study focuses on three specific policy interventions within a particular country and its context, which may limit the generalization of the findings to other countries or regions. The dataset used captures only those assaults and sexual assaults that resulted in an official police report, and therefore may capture more severe assaults and sexual assaults. It is also important to highlight that a period between 2008 and 2019 is marked with many more relatively smaller increases in excise taxes for alcohol or other alcohol policies (e.g. ban in alcohol sales in petrol stations in 2016) which may have contributed to the long-term declining trend in assaults and sexual assaults. Lastly, the 2017 and 2018 policy time points are relatively close, possibly resulting in the effect of 2017 policy to be overestimated.

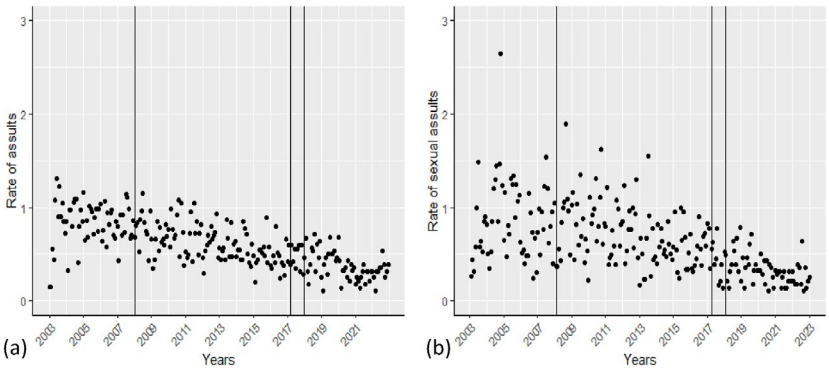

Fig. 1. The rate (per 100,000 population) of assaults (a) and sexual assaults (b) in Lithuania, 2003 to 2023
Note. The vertical lines represent the time in which each of the three alcohol control policies were implemented: January 2008 (Policy 1), March 2017 (Policy 2), and January 2018 (Policy 3).

Table 1
The impact of the 2008, 2017 and 2018 alcohol control policy on assaults and sexual assaults in Lithuania.

Variable	Assaults			Sexual assaults		
	Estimate	95 % CI	p-value	Estimate	95 % CI	p-value
Intercept	−0.580	−0.626, −0.535	<0.001	−0.620	−0.680, −0.559	<0.001
2008 alcohol policy	0.045	−0.180, 0.270	0.695	0.063	−0.212, 0.338	0.654
COVID-19 lockdowns	−0.225	−0.462, 0.012	0.064	−0.044	−0.328, 0.240	0.762
Financial recession	**−0.248**	**−0.481, -0.015**	**0.038**	−0.034	−0.316, 0.247	0.812
R-squared	0.583	–	–	0.484	–	–
Intercept	−0.578	−0.624, −0.531	<0.001	−0.590	−0.653, −0.526	<0.001
2017 alcohol policy	−0.003	−0.222, 0.215	0.975	**−0.354**	**−0.660, -0.047**	**0.025**
COVID-19 lockdowns	−0.223	−0.462, 0.015	0.068	0.086	−0.248, 0.419	0.616
Financial recession	**−0.235**	**−0.456, -0.013**	**0.039**	−0.110	−0.421, 0.200	0.486
R-squared	0.583	–	–	0.509	–	–
Intercept	−0.562	−0.611, −0.514	<0.001	−0.621	−0.684, −0.558	<0.001
2018 alcohol policy	−0.178	−0.413, 0.057	0.140	0.038	−0.197, 0.274	0.749
COVID-19 lockdowns	−0.218	−0.461, 0.025	0.080	−0.035	−0.325, 0.255	0.814
Financial recession	**−0.274**	**−0.502, -0.045**	**0.020**	−0.0002	−0.235, 0.234	0.999
R-squared	0.589	–	–	0.484	–	–

Bolded text indicates statistical significance at $\alpha = 0.05$.

4.2. Conclusion

In conclusion, this study provides evidence that alcohol control policies, particularly those focusing on major alcohol tax increases that reduces alcohol affordability can contribute to reducing rates of sexual assault. The current findings, along with the consistent evidence linking alcohol use to sexual violence, supports the need for comprehensive and multi-faceted strategies for mitigating violence to include alcohol control measures.

Author statements

Ethical approval

This study received ethical review from the Ethics Board of Lithuanian University of Health Sciences. This study utilized fully anonymized secondary data, and no identifiable personal information was collected or used.

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Competing interests

The authors declare no competing interests.

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The prevalence of alcohol-related deaths in autopsies performed in Lithuania between 2017 and 2020: a cross-sectional study

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Background: Consumption of alcohol is a risk factor for non-communicable and infectious diseases, mental health problems, and can lead injuries and violence. The aim of this study was to evaluate the prevalence of alcohol-involved deaths among decedents who died of external causes and underwent autopsy in Lithuania. **Methods:** Study includes age persons of any age (from 0 to 110 years) who died and were autopsied in Lithuania from 1 January 2017 to 31 December 2020. Data were obtained from the Lithuanian State Register of Deaths and Their Causes. **Results:** Among external causes of death, the presence of alcohol was detected in 55.0% of cases. Male decedents had a significantly higher number of positive BAC level recorded, at 46.6%, compared with female decedents (32.1%; $P < 0.001$). The highest incidence of deaths where the alcohol was detected in the deceased's blood was found when the decedent was listed as being in the victims of assault group (71.5%, 95% CI 65.4–77.2). However, the highest median BAC score was found for those in the accidents group (59.7%, 95% CI: 58.2–61.2, BAC 2.42 ‰, IQR 1.86). **Conclusions:** The findings of this study suggest that alcohol use may be a contributing factor in a wide range of fatal incidents, including accidents, injuries, and cases of violent intent. Inequalities between males and females were identified, with a higher proportion of males with alcohol detected in blood at the time of death.

Introduction

Consumption of alcohol has a harmful effect on individual and population health. It is a risk factor for non-communicable and infectious diseases, mental health problems, and can lead to injuries and violence.[1,2] The harmful use of alcohol resulted in 3 million deaths (5.3% of all deaths) worldwide in 2016. Of all deaths attributable to alcohol consumption worldwide, 28.7% were due to injuries, 21.3% due to digestive diseases, 19% due to cardiovascular diseases, 12.9% due to infectious diseases and 12.6% due to cancers.[3]

Alcohol affects various human cognitive functions, including divided attention, focused attention, and visuo-motor control,[4] all of which increase the risk of 'unintentional' injuries. Unintentional injuries can be categorized as transport and non-transport depending on whether a vehicle of some kind was involved when the injury was sustained,[1] and alcohol use is a risk factor for both non-transport and transport injuries.[1] According to Lasota et al.,[5] 72.2% of fatal pedestrian victims during the period of 2009–13 in Warsaw (Poland) were individuals under the influence of ethyl alcohol. Since alcohol use affects drivers' attention, intoxicated passengers can distract drivers, and intoxicated pedestrians or cyclists can fall in the roadway, alcohol consumption is considered a risk factor for injuries for all road users.[6,7] Other unintentional non-transport accidents are falls, drowning, poisoning, etc.[1] Based on emergency room data from 28 countries, both frequent and heavy drinking was a predictor of injuries related to falls.[8] In Sweden from 1992 to 2009, 38% of drowning victims tested for alcohol use had a positive blood alcohol concentration (BAC).[9] Similar results were found in a meta-analysis—on an average 49.5% of fatal drownings involved the use of alcohol.[10] Alcohol intoxication was also reported as common among incidents of accidental hypothermia.[11]

It is well known that 'intentional' injuries resulting from interpersonal violence and suicides can also be caused by persons under the influence of alcohol.[1] For instance, it was found that individuals had an ∼7-fold increased risk for a suicide attempt soon after consuming alcohol, and this risk further increased to 37 times the average risk following the heavy use of alcohol ('heavy drinking' levels across studies varied from >100 g pure alcohol to BAC ≥ 0.10 mg/dl and 4+ drinks for females/5+ drinks for males)[12] (underlying drinks here defined as 14 grs pure alcohol). It is not only drinking during the suicide event itself that increases risk, chronic heavy drinking is also linked to suicide risk. A meta-analysis found that

individuals with an alcohol use disorder had a significantly higher risk of suicidal ideation, a suicide attempt, and death by suicide,[13] compared with individuals without an alcohol use disorder.

Alcohol consumption also increases the risk of becoming a 'victim' of violence, assault.[14] In the USA, 41.1% of homicide decedents had a positive BAC, and 27.7% had a BAC≥0.08 g/dl.[15] Another study from the USA showed that over one third of firearm injury decedents (homicides and suicides) had consumed alcohol (any amount) prior to their deaths and that over one fourth of these had heavily consumed (blood–alcohol concentrations 0.08 g/dl or comparable amount indicated 'heavy alcohol use') alcohol prior to their deaths.[2]

Lithuania differs from other European countries in terms of both alcohol consumption habits and high mortality rates from external causes. Recorded alcohol consumption per person aged 15 and older was 11.2 l of absolute alcohol in 2022.[16] However, consumption of alcohol in Lithuania has decreased in the past decade, and this decrease was one of the highest among OECD countries.[17] The decrease in alcohol consumption in Lithuania and improvement in other related health indicators may be associated with the alcohol control policies implemented in the country, however Lithuania still remains among the countries with a high level of alcohol consumption.[17,18] According to the Official Statistics Portal of Lithuania, deaths from external causes were recorded at 89.7 per 100 000 population, deaths from intentional self-harm (suicides) were recorded at 21.7 per 100 000 population, and deaths from transport crashes were recorded at 7.7 per 100 000 population in 2020.[16] In the same year, fully alcohol-attributable mortality was reported at 21.8 per 100 000 population.[19] Deaths in Lithuania decreased steadily from external causes over the 2000–20 period (from 145.8 per 100 000 population in 2000). Deaths from transport accidents have also been higher in the past, reaching 22.0 per 100 000 population in 2000. Intentional injuries rates were higher as well, for instance the suicide rate was 46.6 per 100 000 population. The assault and homicides rate declined from 9.9 per 100 000 in 2000–2.4 per 100 000 in 2020.[16]

For many years in Lithuania, when an autopsy examination was performed due to an external cause of death, a BAC score was not recorded in the mortality statistics. The State Register of Deaths and Their Causes (the Register) in Lithuania began operating only relatively recently, in 2010. The decision that information on concentrations of alcohol, medication and/or psychotropic substances was needed in this register was only made only in 2017, however.[20,21] As a result of this decision, forensic data on the intoxication of deceased persons (including quantitative indicators of intoxication) were integrated into the register, and the State Forensic Medicine Service became the provider of this data. The State Forensic Medicine Service performs an autopsy for almost all deaths involving external causes (over 90%) and some deaths due to disease (∼16% of all deaths in Lithuania are investigated via autopsy).[22]

The aim of the current study was to evaluate the prevalence of alcohol-involved deaths in autopsied deaths in Lithuania between 2017 and 2020. We hypothesized that a greater proportion of decedents of external causes of death had consumed alcohol prior to their death, compared with those who died of other causes.

Methods

This study includes persons of all ages (from 0 to 110 years) who died and were autopsied in Lithuania from 1 January 2017 to 31 December 2020. This period of time was selected due to the timing of the legal decision, as discussed above, to have information on the concentration of alcohol, medication and/or psychotropic substances included in the registry in 2017. Data were obtained from the Institute of Hygiene, which manages the register. The register contains data drawn from medical death and medical perinatal death certificates as well as other supporting documents.[23]

An autopsy is required by law under the following circumstances: a sudden or unexpected death, including those where violence is suspected; the cause of death is unclear; family members have requested one; cases where law enforcement is involved; deaths from injury, poisoning; and when the deceased is not identified. Further, if a person dies in an health care institution, a pathological examination is performed if there is demand of the family members or legal representatives, death was sudden or unexpected, the cause of death is unclear, if someone dies after surgical intervention, diagnostic, and treatment procedures, if someone dies (or is suspected to have died) from an occupational or infectious disease, a newborn or child (person under 18) dies, a pregnant woman or a woman who has recently given birth dies, a person dies who had been hospitalized for <24 h, and in other cases defined by law (as specified above). Upon the death of a person, a forensic medical examination, for purpose of pre-trial investigation shall be performed if the death occurs due to injury, poisoning or criminal abortion, the identity of the deceased is unknown, the cause of sudden death is suspected to be violence, the cause of death cannot be determined in other ways, and in other cases defined by law, upon the request of law enforcement authorities.[24]

The causes of death as recorded in the medical death certificate used in Lithuania corresponds to the World Health Organization (WHO) recommendations. Since 2011, the register uses the International Statistical Classification of Diseases and Related Health Problems 10th Revision (Australian Modification) (ICD-10-AM) for coding causes of death.[25] The main (primary) cause of death is selected according to the ICD-10 coding rules set out in the methodological guidelines for classification (ICD-10).[23]

According to the register, in 2017, autopsies were performed in 14.9% of deaths, 14.9% in 2018, 14.4% in 2019, and 12.9% in 2020[23,26–28] (number of cases provided in Supplementary table S1). However, in 18%, of these cases, alcohol was not evaluated (Supplementary table S2), and these cases were therefore not included in the data analysis of this study.

Deaths were analysed by sex, age, main cause of death, year of death, place of residence, and BAC level. The BAC was measured in permilles of on either volume or on grams (‰), depending on what was available for testing. The causes of death were divided into five main groups: accidents V00-X59, intentional self-harm (suicide) X60-X84, assault X85-Y09, event of undetermined intent Y10-Y34, and other causes. For a more detailed analysis, the causes of death were divided into 21 groups (tables 3–6). Analyses by year are provided in Supplementary tables S1–S3.

Statistical methods

The Kolmogorov–Smirnov test was used to determine whether the distributions of quantitative data met the normality assumption. Abnormally distributed variables were described by median, minimal, maximal values, and interquartile range (IQR). The Mann–Whitney *U* test was used to compare two, and the Kruskal–Wallis to compare three and more independent samples. The categorical variables were presented as percentages, with confidence intervals (CIs), and compared using a chi-squared (χ^2) test. Differences between groups in tables 1 and 2, and Supplementary table S5 were analysed using a *Z*-test with Bonferroni correction. Statistical significance was set at <0.05. All statistical analyses were performed using IBM SPSS, Version 27 for Windows.

Results

Over the course of four years (2017–20), 18 872 autopsies were performed in Lithuania, and alcohol was detected in 42.7% of these cases (table 1). For cases of external causes of death, alcohol was detected in 55% of cases. A significantly higher proportion of male decedents had a positive BAC, at 46.6%, compared with female decedents (32.1%; $P < 0.001$). The highest proportion of deaths involving alcohol was found in those aged 20–49 years, where it was detected in over half the cases. A significantly higher number

Table 1 Distribution of positive autopsy cases by causes of death, demographic characteristics, season, death years, presence of alcohol in blood (*n*, %) and concentration of alcohol in blood (‰)

Characteristics	Total autopsies, *n*	Positive ethyl alcohol *n* (%)	Positive ethyl alcohol CI %	Median (min–max) (g/l)	Interquartile range
Total	18 872	8066 (42.7)	42.0–43.5	1.78 (0.10–8.74)	1.89
External causes V00-Y98	7550	4155 (55.0)	53.9–56.2	2.15 (0.15–8.74)	1.53
Other causes*	11 322	3911 (34.5)	33.7–35.4	1.19 (0.10–7.76)	1.86
P		<0.001		<0.001	
Sex					
Male	13 880	6464 (46.6)	45.7–47.4	1.81 (0.10–8.74)	1.86
Female	4992	1602 (32.1)	30.8–33.4	1.66 (0.14–6.97)	2.06
P		<0.001		0.003	
Age group					
0–19	293	46 (15.7)	11.7–20.4	1.09 (0.16–3.40)	1.29
20–34	1273	696 (54.7)	51.9–57.4	1.89 (0.15–6.62)	1.52
35–49	3409	1940 (56.9)	55.2–58.6	2.1 (0.15–8.28)	1.90
50–64	7089	3478 (49.1)	47.9–50.2	1.87 (0.1–8.74)	1.92
65 and more	6808	1906 (28.0)	26.6–29.1	1.29 (0.14–6.32)	1.83
P		<0.001		<0.001	
Type of residence					
City	11 758	4794 (40.8)	39.9–41.7	1.62 (0.1–6.97)	1.93
Rural	7114	3272 (46.0)	44.8–47.2	1.99 (0.15–8.74)	1.80
P		<0.001		<0.001	
Years					
2017	4915	2087 (42.5)	41.1–43.9	1.82 (0.14–8.28)	1.81
2018	4777	2042 (42.7)	41.3–44.2	1.79 (0.1–6.89)	1.83
2019	4484	1908 (42.6)	41.1–44.0	1.76 (0.14–6.97)	1.93
2020	4696	2029 (43.2)	41.8–44.6	1.75 (0.15–8.74)	2.01
P		0.887		0.366	
Season					
Spring (March–May)	4823	2115 (43.9)	42.4–45.3	1.81 (0.14–6.97)	1.88
Summer (June–August)	4387	1934 (44.1)[a]	42.6–45.6	1.73 (0.14–8.28)	1.93
Autumn (September–November)	4457	1836 (41.2)	39.7–42.7	1.78 (0.1–7.76)	1.90
Winter (December–February	5205	2181 (41.9)	40.6–43.3	1.82 (0.12–8.74)	1.87
P		0.009		0.005	

Blood alcohol concentration (BAC) refers to the percent of alcohol (ethyl alcohol or ethanol) in a person's blood stream.
BAC by volume—1 permille (‰).
*: Other causes—causes except V00-X59, X60-X84, X85-Y09, Y10-Y34.
a: Difference between summer and autumn.

of deaths with a positive BAC was found among individuals living in a rural setting compared with those living in an urban setting ($P < 0.001$). There were no differences in the proportion of alcohol-positive cases between the years analysed and only one difference was noted between seasons (between summer and autumn) (table 1).

Among cases with a positive BAC, the BAC median was 1.78 (0.10–8.74) ‰ (table 1). The largest proportion (53.4% of male and 67.9% of female $P < 0.001$) had a BAC of 0‰, however, around one-third of the deceased had a BAC≥0.8 ‰ (table 2). Many significant differences between BAC groups were found for the different age groups, and some differences were noted between seasons (table 2). More detailed distributions of alcohol-positive cases and BAC scores of alcohol by sex and cause of death each year are presented in Supplementary table S3. Analyses by more specific BAC groups (0.1–0.39 ‰, 0.4–0.89 ‰, 0.9–1.39 ‰,1.4–1.99 ‰, 2.0–2.99 ‰, and 3.0 ‰ and more) are provided in Supplementary table S4.

The highest incidence of deaths where alcohol was detected in the deceased's blood was found in individuals whose cause of death was categorized in the victims of assault group (71.5%, 95% CI 65.4–77.2). However, the highest median BAC level was found for the accidents group (59.7%, 95% CI: 58.2–61.2, BAC 2.42 ‰, IQR 1.86). Except for accidental poisoning by alcohol and exposure to alcohol, 94.7% (95% CI: 92.6–96.3, median 3.64‰, IQR 1.17). The highest BAC value was detected in cases in the group of individuals recorded as having died as a result of being an 'occupant of car injured in transport accident V40-V79'—8.74 ‰ (table 3).

Among all cases of external causes of death, the largest proportion of cases had a BAC value ≥0.8 ‰ (47.9%). This was also the case for deaths resulting from accidents, cyclists injured in transport accidents, other accidents, accidental drownings and submersions, deaths due to the effects of smoke, fire, and flame, exposure to excessive natural cold, accidental poisoning by and exposure to noxious substances, accidental poisoning by and exposure to alcohol, and assault (table 4).

Alcohol was detected in 59.7% cases of accidents (table 3). Of these, 63.8% cases were men and 46.5% were women (Supplementary table S6). Among decedents of intentional self-harm (suicides; X60-X84), 52.6% of males and 26.4% of females had a positive BAC. The most commonly recorded type of intentional self-harm was reported as self-harm by hanging, strangulation, and suffocation. For this cause of death, alcohol was found in 54.1% of men and 26.7% of women. Alcohol was detected in half the cases in the undetermined intent category, in 55.4% of men and 36.1% of women. In the rest of the cases, alcohol-positive cases accounted for 34.5% (table 4), 37.1% of men, and 28.2% pf women (Supplementary table S6).

Significantly more male decedents had a positive BAC compared with female decedents for most of the deaths due to external causes. Among men and women, the highest BAC median was found when the cause of death was accidental poisoning by and exposure to alcohol, 3.64 (range 0.16–6.62) and 3.65 (range 0.16–6.97), respectively (Supplementary table S6). In males, a very high proportion of positive BAC scores (BAC≥0.8 ‰) were found among cases of death due to the effects of smoke, fire, and flame (X00-X09)a at 72.9%, accidental poisoning by and exposure to noxious substances

Table 2 Distribution of autopsy cases by causes of death, demographic characteristics, season, death years, presence of alcohol in blood (*n*, %) and concentration of alcohol in blood (‰)

Characteristics	Total autopsies, *n*	BAC group, *n* (%)		
		0‰	**0.1–0.79‰**	**≥0.8‰**
Total	18 872	10 806 (57.3)	2046 (10.8)	6020 (31.9)
External causes V00-Y98	7550	3395 (45.0)[a]	542 (7.2)[a]	3613 (47.9)[a]
Other causes*	11 322	7411 (65.5)	1504 (13.3)	2407 (21.3)
P		0.001		
Sex				
Male	13 880[b]	7416 (53.4)[b]	1588 (11.5)[b]	4876 (35.1)[b]
Female	4992	3390 (67.9)	458 (9.2)	1144 (22.9)
P		<0.001		
Age group				
0–19	293	247 (84.3)[c]	16 (5.5)[d]	30 (10.2)[e]
20–34	1273	577 (45.3)	120 (9.4)	576 (45.3)
35–49	3409	1469 (43.1)	380 (11.1)	1560 (45.8)
50–64	7089	3611 (50.9)	837 (11.8)	2641 (37.3)
65 and more	6808	4902 (72.0)	693 (10.2)	1213 (17.8)
P		<0.001		
Type of residence				
City	11 758[f]	6964 (59.2)[f]	1364 (11.6)[f]	3430 (29.2)[f]
Rural	7114	3842 (54.0)	682 (9.6)	2590 (36.4)
P		<0.001		
Years				
2017	4915	2828 (57.5)	492 (10.0)	1595 (32.5)
2018	4777	2735 (57.3)	504 (10.6)	1538 (32.2)
2019	4484	2576 (57.4)	503 (11.2)	1405 (31.3)
2020	4696	2667 (56.8)	547 (11.6)	1482 (31.6)
P		0.210		
Season				
Spring (March–May)	4823	2708 (56.1)	530 (11.0)	1585 (32.9)
Summer (June–August)	4387	2453 (55.9)[g]	553 (12.6)[g]	1381 (31.5)
Autumn (September–November)	4457	2621 (58.8)	464 (10.4)	1372 (30.8)
Winter (December–February	5205	3024 (58.1)	499 (9.6)	1682 (32.3)
P		<0.001		

Blood alcohol concentration (BAC) refers to the percent of alcohol (ethyl alcohol or ethanol) in a person's blood stream.
BAC by volume—1 permille (‰).
*: Other causes—causes except V00-X59, X60-X84, X85-Y09, Y10-Y34.
a: Difference between external V00-Y98 and other causes.
b: Difference between male and female.
c: Difference between 0–19 and 20–34, 0–19 and 35–49, 0–19 and 50–64, 0–19 and 35 and more, 20–34 and 50–64, and 20–34 and 65 and more, 35–49 and 50–64, 35–49 and 65 and more, 50–64 and 65 and more;.
d: Difference between 0–19 and 35–49, 0–19 and 50–64, 50–64 and 65 and more.
e: Difference between 0–19 and 20–34, 0–19 and 35–49, 0–19 and 50–64, 0–19 and 35 and more, 20–34 and 50–64, and 20–34 and 65 and more, 35–49 and 50–64, 35–49 and 65 and more, 50–64 and 65 and more;.
f: Difference between city and rural.
g: Difference between summer and autumn, summer and winter.

(X40-X49) at 74.2%, accidental poisoning by and exposure to alcohol (X45) at 91%, and assault (X85-Y09) at 72.4%.

The female proportion of cases of external causes of death was lower compared with male. In females, the proportion of cases where the BAC was ≥0.8 ‰ was lower. Significant differences between male and female in BAC groups provided in Supplementary table S5.

Discussion

The findings of this study emphasize the significant relationship between alcohol consumption and external causes of death based on Lithuanian autopsy data. The evidence presented suggests that alcohol use may be a contributing factor in a wide range of fatal incidents, including accidents, injuries, and cases of violent intent. We found that among external causes of death, alcohol was detected in 55% of deaths autopsied.

Results of this research showed inequalities between males and females, with a higher proportion of males having alcohol detected in blood at time of death. For instance, among cases of intentional self-harm (suicides), 52.6% of males autopsied had alcohol in their system, while alcohol was found in only 26.4% of females autopsied.

Our research corroborates the well-established link between alcohol use and an increased risk of accidents as the impairment of cognitive and motor skills under the influence of alcohol is a contributing factor to motor vehicle accidents, falls, and other unintentional injuries.[5,29] In our study, in more than half the cases where the cause of death was recorded as an accident (59.7%), assault (71.5%), event of undetermined intent (50.3%), and about half of the cases of intentional self-harm (47.4%), alcohol was detected in the blood of decedents autopsied. In the context of violent deaths, our study also highlights the role of alcohol. We identified that alcohol was detected in 71.5% of assault-related deaths (i.e. victims). Kuhns et al.[14] also determined the same link in their meta-analysis, but the proportion they found was 48%. Individuals under the influence of alcohol are more likely to engage in aggressive and violent behaviours, and this can increase the risk of homicides and assaults.[30]

However, Lithuanian police statistics show that perpetrators commit more than half of homicides when intoxicated by alcohol.[31,32]

Table 3 Descriptive statistics and distribution (*n*, %) of positive alcohol cases by cause of death

Main cause of death	Total autopsies, *n*	Positive ethanol		Ethanol, median (min–max)	Interquartile range
		n (%)	CI		
External causes V00-Y98	**7550**	**4155 (55.0)**	**53.9–56.2**	**2.15 (0.15–8.74)**	**1.53**
ACCIDENTS V00-X59	4035	2410 (59.7)	58.2–61.2	2.42 (0.15–8.74)	1.86
of which:					
***Transport accidents* V00-V99**	*719*	*293 (40.8)*	*37.1–44.4*	*2.15 (0.15–8.74)*	*1.58*
Pedestrian injured in transport accident V00-V09	233	123 (52.8)	46.2–59.3	2.3 (0.16–3.98)	1.14
Pedal cyclist injured in transport accident V10-V19	41	23 (56.1)	39.7–71.5	2.15 (0.25–3.23)	1.56
Motorcyclist injured in transport accident V20-V39	58	9 (15.5)	7.3–20.7	2.16 (0.19–2.96)	1.30
Occupant of car injured in transport accident V40-V79	299	103 (34.4)	29.1–40.1	2.1 (0.15–8.74)	1.12
***Other accidents* W00-X59**	*3316*	*2117 (63.8)*	*62.2–65.5*	*2.48 (0.15–6.97)*	*1.64*
Falls W00-W19	431	172 (39.9)	35.3–44.7	2.09 (0.17–4.41)	1.46
Accidental drowning and submersion W65-W74	545	336 (61.7)	57.4–65.8	2.31 (0.15–4.43)	1.13
Effects of smoke, fire, and flame X00-X09	136	89 (65.4)	56.8–73.4	2.49 (0.16–4.18)	1.09
Effects of natural forces X30-X39	513	310 (60.4)	56.0–64.7	1.74 (0.16–5.13)	1.24
Exposure to excessive natural cold X31	512	310 (60.5)	56.2–64.8	1.74 (0.16–5.13)	1.24
Accidental poisoning by and exposure to noxious substances X40-X49	1083	868 (80.1)	77.6–82.5	3.16 (0.15–6.97)	1.91
Accidental poisoning by and exposure to narcotics X42	188	106 (56.4)	49.0–63.6	1.34 (0.16–3.68)	1.12
Accidental poisoning by and exposure to other and unspecified drugs, medicaments and biological substances X44	16	7 (43.8)	19.8–70.1	1.45 (0.25–3.08)	1.79
Accidental poisoning by and exposure to alcohol X45	601	569 (94.7)	92.6–96.3	3.64 (0.16–6.97)	1.17
Intentional self-harm (suicides) X60-X84	2556	1212 (47.4)	45.5–49.7	1.79 (0.15–8.28)	1.22
Intentional self-harm by hanging, strangulation and suffocation X70.0	2249	1100 (48.9)	46.8–51.0	1.78 (0.15–8.28)	1.19
ASSAULT X85-Y09	239	171 (71.5)	65.4–77.2	2.31 (0.18–4.08)	1.19
Event of undetermined intent Y10-Y34	716	360 (50.3)	46.6–54.0	1.95 (0.15–5.81)	1.76
Other causes*	11 326	3913 (34.5)	33.7–35.4	1.19 (0.1–7.76)	1.86
Total	18 872	8066 (42.7)	42.0–43.5	1.78 (0.10–8.74)	1.89

*: Other causes—causes except V00-X59, X60-X84, X85-Y09, Y10-Y34.

Table 4 Distribution (*n*, %) of positive alcohol cases by cause of death and BAC group

Main cause of death	Total autopsies, n	BAC group, *n* (%)		
		0‰	0.1–0.79‰	≥0.8‰
External causes V00-Y98	**7550**	**3395 (45.0)**	**542 (7.2)**	**3613 (47.9)**
ACCIDENTS V00-X59	4035	1625 (40.3)	264 (6.5)	2146 (53.2)
of which:				
***Transport accidents* V00-V99**	*719*	*426 (59.2)*	*43 (6.0)*	*250 (34.8)*
Pedestrian injured in transport accident V00-V09	233	110 (47.2)	14 (6.0)	109 (46.8)
Pedal cyclist injured in transport accident V10-V19	41	18 (43.9)	4 (9.8)	19 (46.3)
Motorcyclist injured in transport accident V20-V39	58	49 (84.5)	1 (1.7)	8 (13.8)
Occupant of car injured in transport accident V40-V79	299	196 (65.6)	14 (4.7)	89 (29.8)
***Other accidents* W00-X59**	*3316*	*1199 (36.2)*	*221 (6.7)*	*1896 (57.2)*
Falls W00-W19	431	259 (60.1)	29 (6.7)	143 (33.2)
Accidental drowning and submersion W65-W74	545	209 (38.3)	29 (5.3)	307 (56.3)
Effects of smoke, fire, and flame X00-X09	136	47 (34.6)	4 (2.9)	85 (62.5)
Effects of natural forces X30-X39	513	203 (39.6)	48 (9.4)	262 (51.1)
Exposure to excessive natural cold X31	512	202 (39.5)	48 (9.4)	262 (51.2)
Accidental poisoning by and exposure to noxious substances X40-X49	1083	215 (19.9)	64 (5.9)	804 (74.2)
Accidental poisoning by and exposure to narcotics X42	188	82 (43.6)	24 (12.8)	82 (43.6)
Accidental poisoning by and exposure to other and unspecified drugs, medicaments and biological substances X44	16	9 (56.2)	2 (12.5)	5 (31.2)
Accidental poisoning by and exposure to alcohol X45	601	32 (5.3)	17 (2.8)	552 (91.8)
Intentional self-harm (suicides) X60-X84	2556	1344 (52.6)	196 (7.7)	1016 (39.7)
Intentional self-harm by hanging, strangulation and suffocation X70.0	2249	1149 (51.1)	172 (7.6)	928 (41.3)
ASSAULT X85-Y09	239	68 (28.5)	17 (7.1)	154 (64.4)
Event of undetermined intent Y10-Y34	716	356 (49.7)	65 (9.1)	295 (41.2)
Other causes*	11 326	7413 (65.4)	1504 (13.3)	2409 (21.3)
Total	18 872	10 806 (57.3)	2046 (10.8)	6020 (31.9)

*: Other causes—causes except V00-X59, X60-X84, X85-Y09, Y10-Y34.

Thus, violence and homicides seem to be caused by alcohol-fuelled situations where violence escalates, as both victim and aggressor are too intoxicated to find other solutions. This suggests that homicides may often happen during binge-drinking occasions and further analysis on the escalation of the dynamics involved is needed. High BAC levels have been consistently associated with a higher likelihood of being involved in accidents that result in fatal outcomes.[33] Among all cases of external causes of death, around half (47.9%) happened when the BAC was 0.8 ‰ or higher.

When assessing external causes of death, alcohol concentration is not always recorded in mortality statistics, and this was the case in Lithuania for many years. The state forensic medicine agency did not always systematically collect this data for the analysis of alcohol influence. Until 2017, the data analysis was based on individual forensic experts. For instance, Benošis evaluated the association between external causes of deaths and alcohol (BAC) by analysing the Lithuanian forensic data for the period 1985–2014. Over those 29 years, 137 884 cases of external death were evaluated. A total of 77 718 deaths, or 56.5%, of those who died from external causes of death had consumed ethyl alcohol and were intoxicated at the time of their deaths.[34]

The objective data on level of alcohol intoxication serve for the international research community as an additional source of information allowing us to establish the extent of intoxication by alcohol in the deaths by external causes category in Lithuania. As Lithuania can be seen as an example of a natural experiment in the field of alcohol control,[18] the now more thorough autopsy database, reviewed over a longer time period, will create opportunities to analyse the role and effects of alcohol in society, to assess the impact of alcohol control policies, as well to study the effects of the pandemic and post-pandemic periods on alcohol consumption in Lithuania.

The strengths of the study lie in the fact that due to current legislation, most (over 90%) deaths resulting from external causes undergo an autopsy, and this autopsy includes a requirement to record a BAC score. This study provides findings based on objectively measured indicators, unlike studies based on self-reported or the use of indirect data. However, it is important to acknowledge the limitations of this study. Our research focused on a specific time-period in one country, which may limit the generalizability of the findings. In some cases, when determining the cause of death, samples are not taken for alcohol testing (e.g. skeletonized corpses, burned, charred, long-term hospitalizations, etc.). The majority of autopsies is performed when there are external causes of death, and, thus, these data do not include other causes of death. We cannot determine causality of alcohol presence and cause of death by assessing immediate outcomes of fatalities associated with alcohol intake.

In conclusion, male decedents of external causes of death were more often intoxicated (i.e. had a BAC >0.8%) compared with their female counterparts. The prevalence of alcohol in deaths with performed autopsies in Lithuania is an important source of information in identifying the proportion of alcohol-attributable deaths in deaths resulting from external causes, and this study may serve as a base for future studies. The evidence presented highlights the importance of comprehensive efforts to address the role of alcohol in fatal incidents and ultimately to reduce the burden of these preventable tragedies on individuals and society as a whole.

Supplementary data

Supplementary data are available at *EURPUB* online.

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Conflicts of interest: None declared.

Data availability

The data underlying this article are available in the article and in its online supplementary material.

Key points

- Among external causes of death, alcohol was detected in 55.0% of cases.
- A significantly higher proportion of male decedents had a positive BAC, compared with female decedents.
- Research provides insights into the role of alcohol in accidental deaths and intentional injuries and may serve as a base for future studies to identify any emerging patterns or changes.

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Persistently high impact of alcohol use on fatal violence in Lithuania despite strengthening alcohol control policies, 2004–19

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Abstract

A strong association between alcohol and violence and homicide has been well established. Much less is known about the relationship between alcohol policies and the perpetration of alcohol-involved homicides, especially in the Central and Eastern European region. Despite recent progress, Lithuania still has one of the highest alcohol per capita consumption and homicide rates in the European region. Using quarterly data on homicide perpetrators in Lithuania for 2004–19, interrupted time-series were performed to evaluate whether the 2017 and 2018 alcohol control policies had an impact on the rate of perpetrators of homicide and the proportion of perpetrators under the influence of alcohol using a generalized additive model and generalized linear model, respectively. Although a rapid decline was observed in both the absolute numbers of homicides and rates of homicide perpetrators between 2004 and 2019, the proportion of homicide perpetrators under the influence of alcohol remained high. The analyses revealed that there was no significant effect of either of the two alcohol control policies on the rate of homicide perpetrators or the proportion of perpetrators under the influence of alcohol. The problem of persistently high occurrence of alcohol-involvement in homicides cannot be addressed by implementing alcohol control policies alone and thus, requires more inter-sectorial policy actions. More research is needed to understand homicide contexts and factors from both the victim and perpetrator perspectives.

Introduction

Prior evidence has consistently suggested a robust positive association between alcohol use and violence. Studies using various designs and methods have consistently reported that alcohol consumption is a common determinant for violent incidents, committing violent acts, and victimization in this context [1–3]. Alcohol use is closely related to the worst cases of violence—homicides. There is an extensive literature on levels of alcohol consumption and homicides [4–8]. For example, Latin American countries with higher alcohol consumption levels and more prevalent risky alcohol consumption patterns such as binge drinking maintain higher homicide rates than countries from the same continent with less harmful consumption patterns [9]. The same relationship was also found in the Central and Eastern European region [5, 10].

Despite there being solid existing evidence about alcohol involvement in homicides, relatively little is known about the relationship between alcohol control policies and alcohol-involved homicides, especially in the Central and Eastern European region. Trangenstein *et al.* [11] found that countries with policies that reduce alcohol's affordability or days/hours of sales tend to have fewer alcohol-attributable homicides, regardless of their income level. Among the countries of the former USSR, the most consistent and well-documented policy effect on violent deaths is Gorbachev's anti-alcohol campaign, leading to a remarkable decrease in alcohol-related violent deaths, including homicides [12, 13].

Despite recent progress, Lithuania still has one of the highest alcohol per capita consumption in the European region. The latest World Health Organization estimate for Lithuania for 2017–19 was 11.8 liters of absolute alcohol per adult (15+ years of age) [14]. Statistics Lithuania provides a more recent figure of 11.0 liters of recorded alcohol per adult over 15 years of age in 2023 [15]. At the same time, despite reaching the lowest level since 1981, the age-standardized homicide rate (2.1 per 100 000 population) in 2019 remained much higher than in Western European countries or even compared to Central European countries such as Poland (0.6 per 100 000 population) [16]. Prior research on Lithuania highlighted the important role of excessive alcohol consumption in explaining high mortality due to external causes of death. For example, a prior autopsy-based study found that over half (57%) of

victims dying from external causes of death during 1985–2014 had alcohol in blood [17]. More recent autopsy data on victims for 2020 suggests an even a higher figure (63.2%) [18]. Two Lithuanian studies confirm that the majority of both victims and perpetrators were under the influence of alcohol [19, 20]. Several recent studies also found significant associations between the implementation of alcohol control policies and declining mortality due to traffic accidents and suicide [21, 22]. Yet, such associations have never explored the potential role of alcohol control policies in reducing alcohol involvement in homicide perpetrators. To our knowledge, the vast majority of international findings on the relationship between alcohol control policies and violence rely on the victim's perspective. Using time series quarterly data on homicide perpetrators in Lithuania for 2004–19, this study aimed to explore:

a. The trends in annual homicide rates and quarterly rates of homicide perpetrators over time;
b. whether there were any significant changes in the proportion of perpetrators under the influence of alcohol; and
c. whether the 2017 and 2018 alcohol control policies had an impact on the rate of homicide perpetrators and the proportion of perpetrators under the influence of alcohol.

Methods

The dataset on quarterly perpetrator numbers and their characteristics (including information about detected alcohol in the blood) comes from the dataset provided by the Information Technology and Communications Department (ITCD) under the Ministry of the Interior of the Republic of Lithuania. In Lithuania, data on all the crimes committed/under investigation are collected and processed by the Criminal Offenses Official Register operating at the ITCD. The data provided have been restricted to the officially registered crimes with known exact dates and suspects (perpetrators) under a criminal investigation. The data on homicides refer to paragraphs 129 and 130 of the Criminal Code of the Republic of Lithuania, corresponding to code 0101 of the International Classification of Crime for Statistical Purposes code 0101 (intentional homicide). The data on each recorded crime include the information on the date of crime, the date of starting criminal investigation (assigning the status of a suspect), and the assigned article of criminal code. The data also include the major characteristics of each suspect assigned to the recorded crime, including age, sex, education, professional background, urban–rural place of residence, and municipality. In addition, all records also included information on substance use (including alcohol) for perpetrators at the time the crime was committed, according to the police records. The final dataset includes 64 time points (quarters) covering January 2004—December 2019.

In order to investigate the potential impact of alcohol control policies, we used two characteristics as dependent variables: (i) quarterly rates of homicide perpetrators per 100 000 population and (ii) quarterly proportions of perpetrators under the influence of alcohol from the total number of perpetrators. Following the Interrupted Time Series (ITS) requirements (at least 50 data points before intervention) and evidence from the prior Lithuanian studies, we selected the two most important alcohol control policies: (i) 1 March 2017 (the first quarter of 2017) and (ii) 1 January 2018 (the first quarter of 2018) [23, 24]. The first policy, implemented on 1 March 2017, aimed at increasing excise taxation (112% for beer, 111% for wine, and 23% for ethyl alcohol) and reducing alcohol affordability [23]. The second policy implemented on 1 January 2018, further increased taxation but also reduced alcohol availability by increasing the legal age for purchasing and consuming alcohol and further restricting off-site alcohol sales [23, 24].

A few initial analytical steps for checking the data were necessary to choose statistical models (Supplementary Material S1). First, dependent variables were checked for normal distribution. Following the Shapiro–Wilk normality tests [25] and QQ plots, we conclude that both the rates of homicide perpetrators and proportions of perpetrators under the influence of alcohol follow a normal distribution (Fig. S1). Second, to check the stationarity of the time series, we run Augmented Dickey–Fuller tests [26]. The tests turned out to be statistically significant ($P < 0.05$) suggesting that that the both series are stationary. Third, the Autocorrelation Function (ACF) and Partial Autocorrelation Function (pACF) plots [27] suggested the presence of autocorrelation in the series for rates of homicide perpetrators (Table S1, Figs S2–S4). This evidence was further confirmed using the Ljung–Box tests [28] ($P < 0.001$). Generalized addictive model (GAM) was selected to investigate the autocorrelation and possible nonlinear relationship of time (smoothed seasonality term). On the basis of these modeling results, we confirmed that for rates of homicide perpetrators, models should include autoregression (AR) and moving average (MA) terms (Table S1). Since outcomes of the initial (baseline) GAM models with the smooth term suggested that it is not statistically significant for the rates of perpetrators under the influence of alcohol, to improve model simplicity and interpretability, smooth term was removed. Thus, the final GAM models for rates of homicide perpetrators are adjusted for (i) AR and MA terms an autocorrelation-moving average correlation structure (corARMA) and (ii) linear trends (quarters). Differently from rates of homicide perpetrators, the ACF and pACF plots of proportions of perpetrators under the influence of alcohol did not show any significant autocorrelation nor nonlinear trend of time. Therefore, as the final model in this case we applied a simple generalized linear model [27]. The residuals of the final models were inspected for normality and stationarity.

Separate models were estimated for assessment of immediate level change and slope change (sustained effect) following each of the two policies. The two variables reflecting immediate level change related to the 2017 and 2018 policies were coded with "0" for all quarters before intervention and "1" for all quarters after intervention. The corresponding two variables reflecting slope change were coded as continuous variables, with "0" for all quarters before intervention and incrementally increasing by one unit with each quarter after intervention. Being under the influence of alcohol at the time the homicide was committed may also depend on other confounding factors such as economic factors such as unemployment and general economic performance or wealth. For example, increase in unemployment and decreasing in GDP are generally associated with increasing violent and homicide mortality [29]. In order to control for these economy-related factors, at least partially, our models also included quarterly series of GDP per capita and unemployment rates from Statistics Lithuania as confounders [15]. All analyses were performed using R version 4.3.2. [30] and modified R scripts from prior ITS analyses on alcohol control policy effects in Lithuania [22, 31].

Results

Figure 1 shows annual trends in age-standardized logarithmized homicide rate in Lithuania, Latvia, Estonia, and Poland, and the average of the 15 EU member countries (EU member states before 2004) from 1981 until 2019. One may observe that higher homicide rates in Lithuania (and the other two Baltic countries) were inherited from the period of Soviet rule. The Lithuanian disadvantage against Poland and EU-15 decreased following 1986 Gorbachev's anti-alcohol campaign, but it peaked again in the mid-1990s, reaching striking levels of 4–11 times, respectively. Homicide rates in Lithuania started declining again in the second half of the 1990s, but this progress stalled in the first half of the 2000s. This stagnation was responsible for losing an advantage against Latvia and (especially) Estonia, which had, in the beginning 1990s, higher rates than Lithuania. Since 2005, the decline in the homicide rate has been more rapid and systematic, especially from 2015 onwards. Despite this progress, the excess homicide rates in the Baltic countries compared to other EU countries, remain very high. According to the data for 2019, Lithuania's homicide rate was still 3.5 and 4.1 times higher than in Poland and EU-15, respectively.

The declining trend can also be observed by exploring crude quarterly rates of homicide perpetrators in Lithuania (Fig. 2). Due to large fluctuations in the observed data, it is difficult to identify the exact magnitude of this decline. The LOESS smoothed homicide rates suggest a more than four times decrease in these rates during the period 2004–19. In 2004, the quarterly crime rates fluctuated between 9.6 and 10.7 per 100 000, whereas they showed much lower values (between 2.0 and 3.9) in 2019. The yearly absolute numbers also declined substantially from 338 perpetrators in 2004 to a low of 80 perpetrators in 2019. Contrary to the progress in declining rates of homicide perpetrators, there were no visible changes in the proportion (percentage) of perpetrators under the influence of alcohol (Fig. 2). These proportions (percentages) remained remarkably high (63%–73%) throughout the entire period.

Model fit statistics provided in Table 1 suggest a better fit (adjusted R2 terms equal to 0.73) for the models for rates of homicide perpetrators, whereas the models for proportions of perpetrators under the influence of alcohol returned very low R^2 values. Finally, the Log-likelihood tests show that including two socioeconomic control variables does not improve initial models.

None of the 2017 and 2018 policy effects reflecting immediate level change or sustained effects as reflected by slope changes turned out to be statistically significant. Only the 2017 policy seems to be at least producing the immediate level change in rates of homicide perpetrators in an expected direction (decrease). Including GDP and unemployment makes the level change more pronounced but still statistically insignificant. The 2018 policy seems to show the opposite result, suggesting the increasing tendency in the rates of homicide perpetrators (Table 1). Meanwhile, in the case of proportions of perpetrators under the influence of alcohol, the level and slope effects were very small.

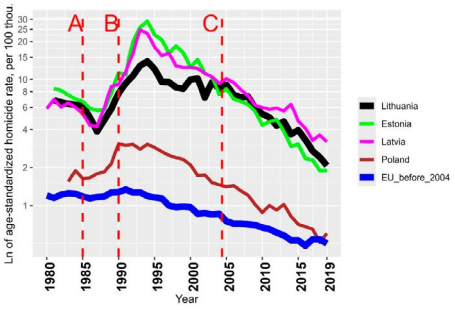

Figure 1. Annual age-standardized homicide death rates (per 100 000 population) in Lithuania, Latvia, Estonia, Poland, and 15 EU (before 2004) countries, 1990–2019 [16, 32].

Discussion

This study utilized police data on all known homicide perpetrators in Lithuania, and provides the first evidence about the changes in quarterly rates of homicide perpetrators and corresponding

Table 1. Effects of the 2017 and 2018 alcohol control policies on (A) rates of homicide perpetrators and (B) proportions of perpetrators under the influence of alcohol. Lithuania, 2004–19

	Unadjusted models Estimated effects and *P*-values	Adjusted[a] models Estimated effects and *P*-values
a) Rate of homicide perpetrators		
2017 Policy		
Level change	−0.371 ($P = 0.703$)	−0.487 ($P = 0.634$)
Sustained effect	0.027 ($P = 0.827$)	0.015 ($P = 0.912$)
AIC	234.18	237.75
BIC	244.97	252.87
Log Likelihood	−112.09	−111.88 (LR test: $P = 0.808$)
Adjusted R^2	0.733	0.726
2018 Policy		
Level change	0.716 ($P = 0.547$)	0.639 ($P = 0.603$)
Sustained effect	−0.114 ($P = 0.610$)	−0.124 ($P = 0.598$)
AIC	233.96	237.79
BIC	244.75	252.90
Log Likelihood	−111.98	−111.90 (LR test: $P = 0.919$)
Adjusted R^2	0.734	0.726
b) Proportion of perpetrators under the influence of alcohol		
2017 Policy		
Level change	0.048 (p = 0.310)	0.048 (p = 0.341)
Sustained effect	−0.007 (p = 0.255)	−0.007 (p = 0.312)
AIC	−146.97	−143.81
BIC	−138.33	−130.85
Log Likelihood	77.486	77.903 (LR test: p = 0.659)
Adjusted R^2	0.021	0.034
2018 Policy		
Level change	0.041 (p = 0.487)	0.033 (p = 0.594)
Sustained effect	−0.012 (p = 0.290)	−0.012 (p = 0.312)
AIC	−147.04	−143.90
BIC	−138.40	−130.94
Log Likelihood	77.519	77.947 (LR test: p = 0.651)
Adjusted R^2	0.022	0.035

a: Additionally controlling for unemployment and GDP.

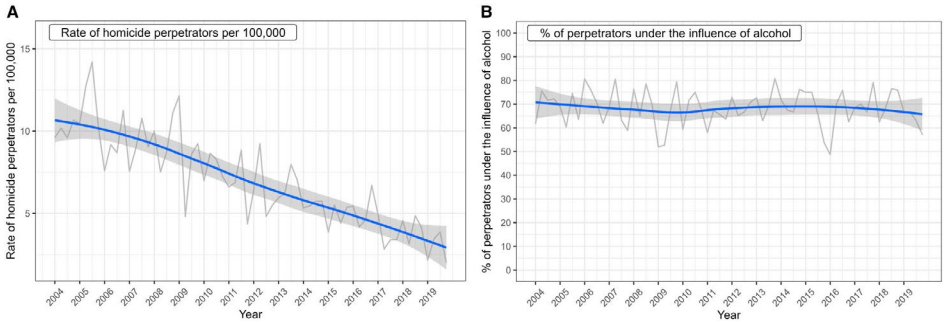

Figure 2. Unsmoothed and smoothed quarterly crude rates of homicide perpetrators (per 100 000 population) (A) and quarterly percentage of perpetrators under the influence of alcohol (B), 2004–2019.

proportions of perpetrators under the influence of alcohol. In particular, we aimed to explore the potential role of two different alcohol control policy implementations (one in 2017 and another in 2018). The findings suggest that the continuous decline in homicide rates, rates of homicide perpetrators, and absolute homicide numbers between 2004 and 2019 were not accompanied even by a moderate decline in the proportions of perpetrators under the influence of alcohol.

Between 2004 and 2019, homicide rates declined almost four times from 8.7 to 2.2 homicides per 100 000 population. Meanwhile, despite numerous alcohol control policies implemented since 2008, the proportions of perpetrators under the influence of alcohol remained high during some quarters, sometimes exceeding 70%. Thus, although at a smaller absolute level, homicides likely continued to be mainly committed in heavy alcohol consumption settings, often involving both perpetrators and victims. This assumption stems from other prior studies indicating exceptionally high percentages of victims of violence being under the heavy influence of alcohol [17, 20, 33]. This pattern inherited from the Soviet past seems to prevail in Lithuania [20].

Interrupted time series analyses did not show any significant effects of the two different (combating affordability and availability) alcohol control policies on both the rates of homicide perpetrators and proportions of perpetrators under the influence of alcohol. This finding is quite different from a prior study showing the important impacts of alcohol control policies on reducing alcohol-related trafc harm in Lithuania, including proportions of alcohol-related collisions and crashes, injuries, and deaths [21]. Finally, another study on suicides in Lithuania also reported a significant effect of the 2017 alcohol control policy in reducing suicide mortality, among males in particular [22].

Different from traffic accidents and suicides, homicides in Lithuania seem to be driven more by health and social selection effects [20, 34]. Prior evidence suggests that homicide victims and perpetrators seem to be mainly concentrated within increasingly smaller and marginalized population groups, characterized by extremely high alcohol consumption levels [20]. Therefore, our findings tentatively suggest that implementing universal alcohol control measures may be much less effective in reducing both homicide rates and involvement of alcohol among perpetrators because heavy alcohol consumption habits may be driven by many other, often complex, and nuanced contextual and individual factors. Scarce evidence from Lithuania reports important differences in the age and sex of perpetrators in terms of their victims [34]. For example, the study by Dobrynina *et al.* [34] found that younger males (90% of perpetrators) tend to commit homicides in a group, and their victims tend to be predominantly nonrelatives. In contrast, older perpetrators tend to target relatives, including spouses. The same study also highlights specific motives by younger male perpetrators committing crimes in a group—such as striving to be recognized [34]. This aspect of committing homicide crimes may be related to the prevailing masculinity culture in certain disadvantaged male groups [35]. In the contexts of persisting strong stigmas towards mental health and low family and social support, disadvantaged male groups are very prone to various forms of (auto)aggression, such as suicide and homicide [36].

Limitations

This study has several important limitations which should be considered before interpreting the results. First, the data on perpetrators and homicide crimes exclude a small number of homicide cases with unknown perpetrator. For example, there were only six homicides with unknown perpetrator(s) in 2019. Second, it is unknown whether the perpetrator was ultimately convicted by court for committing homicide. Third, establishing the involvement of alcohol may not always be precise, especially in cases when a perpetrator gets arrested after some time. Therefore, it is possible that the proportion of homicides wherein the perpetrator was under the influence of alcohol at the time of the incident may be underestimated. Fourth, the original data were classified by month. However, extremely low or zero monthly numbers of perpetrators under the influence of alcohol lead to large fluctuations, poor model fit (as reflected by negative R^2 values of the GAM models), and excessive noise. Applying aggregated quarterly values led to more stable trends and better model fit, although this approach may have hidden some specific policy-related changes across months within quarters. In addition, both monthly and quarterly approaches produce similar results. We also tested a Poisson distribution, but the goodness of fit and other tests rejected this option. It is possible that applying more complex distributions or statistical models that rely on stronger assumptions may lead to a better fit. However, it is unlikely that such models will change the overall conclusions drawn here. Finally, the time points after the policy interventions may have been too few to show significant effects [37].

Conclusion

Both a strong reduction of homicide harm and the implementation of strong alcohol control policies in Lithuania were not accompanied by a corresponding decrease in the proportion of homicides wherein the perpetrator was under the influence of alcohol. Despite reductions in alcohol consumption and alcohol-related harm, some very selective segments of Lithuanian society continue to suffer from heavy alcohol consumption and violence. This problem does not seem to able to be addressed by the implementation of alcohol control policies alone and may require more inter-sectorial policy actions. More research is needed to understand homicide determinants from both the victim and perpetrator perspectives. Further studies should explore the associations between alcohol use and homicide in more diverse contexts, also including countries without alcohol policies as controls.

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Author contributions

Conceptualization: D.J., J.R., M.Š., and L.M.; writing—original draft preparation: D.J. and L.M.; writing—review & editing: D.J., M.Š., L. M., S.L., D.S., H.J., and J.R.; methodology and data analysis: D.J., H. J., S.L.; data curation: O.M. and D.S. All authors have read and agreed to the published version of the manuscript.

Supplementary data

Supplementary data are available at *EURPUB* online.

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Data availability

The original anonymized data on perpetrators comes from the ITCD under the Ministry of the Interior of the Republic of Lithuania. Due to the agreement terms and data protection rules these data cannot be passed to the third party and should be requested directly from the ITCD. The R code used for analyses, will be shared on reasonable request to the corresponding author.

Key points

- There is a lack of evidence about the potential use of alcohol control policies for reducing alcohol-involved homicides in the Central and Eastern European region.
- The rapid decline in homicide rates in Lithuania was not even accompanied by a moderate decline in the proportion of perpetrators under the influence of alcohol.
- The results suggest that introducing alcohol control policies alone cannot combat the persistently high impact of alcohol use on fatal violence.
- In order to develop effective inter-sectorial policies, more research is needed to better understand homicide determinants.

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Explaining the Link Between Alcohol and Homicides: Insights from the Analysis of Legal Cases in Lithuania

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Abstract: *Background and Objectives*: Alcohol consumption has been a longstanding public health concern and known link to violence. The aims of this study were to analyze alcohol-related homicide cases in Lithuania, focusing on the prevalence of binge drinking among perpetrators and victims, the situational and behavioral patterns leading to violence, and the legal outcomes of these cases. *Materials and Methods*: This study employed a retrospective analysis of court case law of criminal cases of the year 2019. The analysis was conducted by combining qualitative and quantitative analytical approaches. *Results*: The findings revealed that 84.6% of homicides occurred during binge drinking events. Alcohol intoxication was prevalent among both perpetrators (92.3%) and victims (86.5%), emphasizing the dual role of alcohol in homicide cases. Interpersonal violence was the primary pattern of homicide (78.8%), while planned homicides accounted for 21.2%. Thematic content analysis of the cases revealed that Lithuanian courts consistently regard alcohol consumption as an aggravating factor that contributes to the commission of violent crimes and influences the severity of criminal punishment. This reflects a judicial position that voluntary intoxication does not lessen legal responsibility, despite its effects on impairing judgment, heightening aggression and impulsivity, and escalating conflicts into deadly violence. *Conclusions*: Our findings revealed that the majority of alcohol-involved homicides occurred during binge drinking events, in a domestic environment, and because of unplanned acts of interpersonal violence. Targeted public health interventions should focus on strengthening alcohol control policies and enforcing stricter regulations to discourage binge drinking environments.

Keywords: homicide; alcohol; victim; perpetrator; binge drinking

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1. Introduction

In 2019, alcohol was responsible for approximately 2.6 million deaths worldwide, with 700,000 of these deaths attributed to injuries. According to the World Health Organization (WHO), alcohol consumption contributes to a substantial number of deaths globally, with a notable portion resulting from injuries, including interpersonal violence such as homicides [1]. In Lithuania, alcohol consumption has been a longstanding public health concern, with previous studies indicating alcohol prevalence in violent deaths and a link between intentional homicides and alcohol abuse [2,3].

Homicidal crimes represent one of the most severe instances of interpersonal violence, affecting individuals, families, and societies. Understanding the contributing factors to

these crimes is critical for developing targeted interventions and effective prevention strategies. When considering those elements, alcohol consumption has consistently been identified as a driver of violent behavior; it can impair the judgment and escalate conflicts, increasing the likelihood of interpersonal violence [4–6].

Alcohol's role in homicide extends beyond perpetration—it also influences victimization. Intoxicated individuals are more likely to place themselves in risky situations, misinterpret social cues, or be unable to defend themselves [7–9]. Thus, alcohol-related homicides often involve two or more intoxicated individuals, with violence escalating unpredictably in the context of impaired decision making and heightened emotional responses [10]. This dual influence of alcohol on both the perpetrator and the victim underscores the importance of analyzing alcohol-related homicide dynamics in greater detail.

Article 19 (1) of the Lithuanian Criminal Code stipulates that individuals who commit a criminal offense while under the influence of alcohol or narcotic, psychotropic, or other psychoactive substances are not exempt from criminal liability [11]. Lithuanian jurisprudence clarifies that, regardless of the degree of intoxication, voluntary substance use does not absolve an individual of criminal responsibility, as it does not eliminate culpability or legal capacity in the commission of a crime. The underlying rationale for this principle is that individuals, being aware that alcohol or other substances can significantly impair judgment, self-control, and behavioral regulation, voluntarily consume them. As a result, they enter a state in which cognitive distortions may arise, altering their perception of reality and potentially leading to a loss of behavioral control [12].

Our earlier research [3,13] revealed a high prevalence of alcohol use among both victims and perpetrators in violent crimes, particularly homicides. These findings suggest that alcohol consumption is a significant factor in fatal violent encounters. Based on this evidence, we hypothesized that most alcohol-involved homicides occur during binge drinking episodes and predominantly involve interpersonal violence rather than premeditated offenses. However, to rigorously test this hypothesis, it is essential to examine the specific circumstances surrounding these incidents—such as the context of alcohol consumption, the relationship between the individuals involved, and the situational triggers of violence.

Despite substantial research on alcohol-related violence, most existing research focuses on epidemiological data or public health policy rather than case-specific legal analysis, where circumstances surrounding homicides, and legal outcomes can be found [14,15]. In Lithuania, no comprehensive legal case analysis has been conducted to explore how alcohol contributes to homicide cases and how courts interpret these incidents. This study aims to analyze alcohol-related homicide cases in Lithuania, focusing on the prevalence of binge drinking among perpetrators and victims, the situational and behavioral patterns leading to violence, and the legal outcomes of these cases.

2. Materials and Methods

2.1. Study Design

This study employs a retrospective analysis of court case law of criminal cases from the year 2019. The data were accessed through a publicly accessible court database in Lithuania, including rulings from all Lithuanian courts [16]. District and regional courts, The Court of Appeal, and The Supreme Court of Lithuania included covering cases adjudicated between January 2019 and December 2023 to collect the latest court rulings. Official court rulings were included; these decisions contained detailed judicial reasoning, evidence assessments, and documented alcohol involvement when relevant. For cases that were appealed, only the final binding judgment was considered in the analysis. This ensured that all cases analyzed reflect the final legal outcome and judicial interpretation. The year 2019 was chosen for the analysis to reflect the situation as accurately as possible, without external

circumstances, specifically the COVID-19 pandemic or any impacts of the continuous polycrisis afterwards. Also, having assessed the terms for courts decisions, possible appeal process, the case collection up to the year 2023 ensured that all rulings for homicides occurring in 2019 would be accessible.

The study was based on content analysis of the cases. The analysis was conducted by combining qualitative and quantitative analytical approaches to capture both statistical trends and nuanced judicial reasoning.

2.2. Data Collection

The data were collected between November 2024 and January 2025. The researchers reviewed the files and collected data using the data collection forms. Reliability was tested by having 2 researchers review the same cases. The authors entered the data into an Excel file. In the first stage of data collection, all homicide cases from Lithuanian courts (Criminal Code paragraphs 129, 130, 131) [11] that were adjudicated between January 1, 2019 and December 31, 2023 were identified (N = 2607). However, this total includes homicides from multiple years, while the focus of this study is exclusively on cases where the crime occurred in 2019. To ensure that only 2019 homicides were included, we applied both a time-based criterion (year of offense = 2019) and alcohol-related keywords ("alcohol", "intoxicated", "drinking", "per mille", "binge drinking"). This process resulted in a subset of 93 cases where alcohol use was explicitly mentioned in court records and the homicide occurred in 2019.

Each case was reviewed manually, and relevant information was systematically extracted into a structured database, including variables such as alcohol involvement, perpetrator and victim demographics, incident circumstances, and judicial outcomes. Cases were dismissed when alcohol consumption was possibly present but not proven. If the same case was heard in higher courts, the final effective judgements, decisions, and rulings were considered for analysis. The final count included into analysis was 52 cases, which represent homicides in 2019.

In this study, binge drinking events refer not only to instances of heavy alcohol consumption, as commonly defined in the public health literature (e.g., consuming a large quantity of alcohol within a short period) [17], but also to cases where the exact amount of alcohol consumed is unclear. In such cases, a binge drinking event is inferred based on court-established facts confirming that individuals involved in the crime had consumed alcohol. Specifically, case documentation was reviewed for explicit references to high levels of alcohol consumption, intoxication states, witness testimony regarding drinking behavior, and contextual factors (e.g., prolonged drinking sessions, multiple parties drinking together, etc.).

The study used publicly available case law, ensuring compliance with data protection and ethical research standards. No personal identifying information was collected (Table 1).

Table 1. Data Collection and Filtering Process.

Step	Description	Number of Cases (N)
Initial Data Collection	All homicide cases categorized under Criminal Code Paragraphs 129, 130, 131 from 1 January 2019 to 31 December 2023 were gathered.	2607
Inclusion/Exclusion Criteria Applied	Cases containing keywords: "year 2019" "alcohol", "intoxicated", "drinking", "per mille", or "binge drinking" were identified. Cases excluded if they didn't match year of 2019, focused only on sentencing or procedural issues, or lacked documented alcohol involvement.	93
Final Case Selection	Cases were dismissed where alcohol involvement was not proven; final cases were selected after analyzing final judgments and rulings.	52

2.3. Statistical Analysis

Statistical analyses were performed using IBM SPSS, Version 27 for Windows. Microsoft Excel was used for data management. Statistical significance was set at <0.05. Qualitative variables are described in percentages (%) and compared using Fisher's Exact Test. The Shapiro–Wilk Test was used to determine whether the distributions of quantitative data met the normality assumption. Approximately normally distributed quantitative variables were described by mean and standard deviation (SD), and non-normally distributed variables were described by median and 25th–75th percentiles. One-Sample Proportion Test was used to evaluate 95% CI for probability proportion.

3. Results

When assessing statistical data in 2019 in Lithuania, 98 homicides were registered, of which 89 were referred to the courts [18]. When assessing court decisions, we identified 52 separate cases with observed involvement of alcohol consumption.

3.1. Qualitative Part

A thematic analysis of all case materials was conducted to identify recurring themes related to the discourse on alcohol consumption, particularly in the context of judicial assessments of the subjective elements of the offense and the determination of appropriate sentencing for the perpetrators.

Four main themes emerged from the content analysis of the cases (coding provided in Appendix A): (i) the influence of alcohol on the behavior and criminal act (in all cases except C14, C17, C31, C36, and C49), (ii) alcohol's role in forming criminal intent (C1, C16, C17, C19, and C21) (iii), the impact of alcohol on the emotional state of the perpetrator (C1, C2, C6, C8, C14, C16, C18, C19, C20, C22, C27, C29, C30, C32, C35, C36, C40, C41, C42, C45, C48, and C51), and (iv) the connection between alcohol consumption and loss of control (C1, C5, C6, C7, C15, C16, C19, C20, C23, C24, C25, C27, C28, C29, C34, C35, C39, C44, C48, C50, and C51).

Theme I: The influence of alcohol on the behavior and criminal act

In nearly all cases, the courts established a direct link between the perpetrator's alcohol consumption and the subsequent act of murder. The standard judicial reasoning emphasized that the offense was committed under the influence of alcohol, which significantly contributed to its occurrence:

> *"[. . .] While under the influence of alcohol and psychotropic substances, which influenced the commission of the offense, acting as part of a group of accomplices, and without any justification, the perpetrator sought to assert themselves in front of others, displaying contempt toward them. Through insolent behaviour, they demonstrated a clear lack of respect for others. Motivated by hooliganism, they forcibly broke down the door of a dwelling and entered the apartment. [. . .] Acting together with intent, they murdered P.V., while O.R. also threatened to kill S.J. or cause serious harm to her health."* (C30)

Furthermore, intoxication is considered an aggravating factor when determining the appropriate punishment, like in the case where the perpetrator inflicted fatal injuries on the victim and left without any attempt to provide aid or mitigate the harm:

> *"The Court of First Instance also identified an aggravating circumstance in the case of the convicted person, P.S.: he committed the offense while under the influence of alcohol, which contributed to his criminal behaviour. [. . .] The court also reasonably noted that P.S. struck the victim at least 12 times during a mutual conflict triggered by a trivial incident—the spilling of vodka. Despite the victim remaining conscious after sustaining*

injuries and attempting to clean his wounds, the convicted person made no effort to mitigate the consequences of his actions and instead left the scene." (C25)

In only a few cases did the courts refrain from attributing significant influence on alcohol consumption on the perpetrator's behavior and the criminal act. In these instances, the courts either did not consider intoxication at all or indicated that the level of intoxication was insufficient to have directly contributed to the events leading to the murder:

"[. . .] It is evident from the judgment under appeal that, in establishing the aggravating circumstance, the Regional Court merely acknowledged the fact of the convicted person's intoxication without assessing whether it had any actual influence on the commission of the offense. According to the case materials, the crime occurred on May 14, 2019, at approximately 4:45 a.m., while V.K.'s level of intoxication was tested at 5:30 a.m. on the same day. The test results indicated a low level of intoxication, measuring 0.78 g of alcohol. (Volume 1, page 15). While the fact of alcohol consumption is undisputed, the court, considering the relatively low level of intoxication and the fact that the last recorded alcohol consumption occurred five hours before the murder, concluded that the primary factor influencing the crime was O.M.'s provocative behaviour rather than V.K.'s intoxication." (C3)

Also, there has been a case where a crime was committed by a person who was not intoxicated but was provoked by a heavily intoxicated victim:

"The convicted person, while defending against a dangerous attack by F.M., who was heavily intoxicated with alcohol and drugs and had drawn a firearm during the conflict, struck the victim with a knife five times in vital areas of the body. By using a weapon and exerting intense violence, the convicted person clearly exceeded the limits of necessary self-defence." (C26)

Regarding murder victims, the vast majority were also intoxicated to some degree (86.5%). Courts recognize that this factor can influence the consequences of the crime and the severity of harm suffered by the victim. However, a victim's intoxication is not considered a mitigating factor when sentencing the offender:

"The fact that the victim was intoxicated and that this may have influenced her health or contributed to complications does not negate the causal link between the defendant's actions and the death of Ms. A.P. The evidence in the case confirms that the violent actions of the defendant, A.M., directly led to the victim's death. By striking the victim in the head, a vital organ, A.M. foresaw that his actions could cause serious injury, potentially leading to complications and, ultimately, death. Although he did not intend for such an outcome, he knowingly accepted the risk of it occurring." (C24)

Theme II: alcohol's role in forming criminal intent

Since intent is a fundamental criterion for establishing criminal liability, courts also consider the motives behind the intent and its nature—whether direct or indirect—when determining the most appropriate punishment for the perpetrator. In several cases, the courts have specifically addressed the moment when the intent was formed and its connection to alcohol consumption:

"O.B. herself admitted that the idea of committing the crime arose after she had consumed alcohol" (C1)

and

"A.H. was under the influence of alcohol prior to the formation of the intent to commit the offense, which impaired his self-control and fundamentally distorted his assessment of the situation." (C16)

In most cases, the intent to commit murder was classified as indirect, largely due to the nature of the conflicts, which often arose from domestic environments, close personal relationships, and distorted perceptions of reality caused by intoxication.

> *"At the same time, considering that the convicted person and D.K. were friends, that they had been drinking alcohol together, and that D.K. claimed to have injured himself upon the arrival of the ambulance, the Court of First Instance reasonably concluded that the convicted person acted with indirect intent and did not intend to kill D.K."* (C17)

and

> *"He deeply regrets what happened; he did not want to, nor did he have any intention of killing T.T. They were good friends, and everything occurred as a result of excessive alcohol consumption and a conflict."* (C19)

Theme III: the impact of alcohol on the emotional state of the perpetrator

To attribute responsibility and understand the dynamics of a crime, courts assess the emotional state of perpetrators to determine whether the offense was a direct result of intoxication-related cognitive distortions or if other underlying factors—such as pre-existing animosity, provocation, or even medical conditions—played a more significant role:

> *"J.J. admitted to drinking beer with his partner, L.J., prior to the incident, which led to arguments and heightened his feelings of anger and frustration. This state of emotional instability, compounded by alcohol consumption, directly contributed to his violent reaction during the conflict with L.J."* (C6)

Similarly:

> *"The offense was motivated by anger stemming from an inappropriate relationship while intoxicated. Prior to committing the crime, the accused was habitually drunk, unemployed, and not registered with the employment service, demonstrating a disregard for social values."* (C20)

However, courts also consider cases where the perpetrator's emotional state may have been influenced by alcohol consumption on the part of the victim. For instance:

> *"[. . .] It has been indisputably established in the case that D. M. was driven to commit the crime by anger stemming from long-term psychologically traumatic relationships with his parents, his individual psychological characteristics, and the prevailing situation related to the persistent alcohol abuse of A. M. and N. M."* (C45)

Theme IV: The connection between alcohol consumption and loss of control

While perpetrators may lose control over their emotions when intoxicated, it is crucial to determine whether they were still capable of rationally understanding the consequences of their actions and exercising control over them. Courts approach this assessment with great caution, relying on forensic expert reports, as voluntary intoxication is considered an aggravating factor that does not eliminate criminal culpability:

> *"The spontaneity and intoxication did not deprive the convicted person of the ability to comprehend the severity of the violent acts committed in this case. According to the forensic psychiatry and forensic psychology expert report, conducted between 29 October and 27 November 2019, A.M.'s mental and behavioural disorders resulting from alcohol consumption did not impair his capacity to understand the nature of his actions or to control them (vol. 3, pp. 2–5)."* (C23)

Similarly:

> *"The forensic psychiatric and forensic psychology expert report concluded that G.M. was capable of understanding and controlling her actions at the time of the offense. Although she experienced intense anger during the commission of the crime, this emotional state*

did not hinder her ability to perceive and regulate her behaviour. The report further noted that the alcohol consumed, with a measured blood alcohol level of 1.87 per mille, ruled out the possibility of a physiological affective state." (C27)

3.2. Quantitative Part

The overview of various characteristics of alcohol involved homicide cases, including information on perpetrators, victims, and contextual factors, is presented in Table 2. The analysis of quantitative data of homicide cases revealed several notable aspects. The majority of incidents were predominantly committed by male perpetrators (88.5%), and most victims were male also (71.2%). During criminal incidents where alcohol consumption was involved, 86.5% of victims and 92.3% of perpetrators were intoxicated. About two third of the incidents occurred on a weekday (64.7%) and during the night (61.1%). 34.6% of criminal cases were classified as domestic, and in 30.8% of incidents, the victim was a family member. The crimes largely occurred at home (75%) and involved physical force (53.8%) or stabbing (38.5%). Interpersonal violence was the primary pattern of homicide (78.8%), while planned homicides accounted for 21.2%.

Table 2. Characteristics of the cases (n = 52).

Characteristics of the Cases		*n*	Percentages (%)
Sex of perpetrator	Male	46	88.5
	Female	6	11.5
Sex of the victim	Male	37	71.2
	Female	14	26.9
	Several victims	1	1.9
Intoxication of the victim	Yes	45	86.5
	No	7	13.5
Intoxication of the perpetrator	Yes	48	92.3
	No	4	7.7
Binge drinking event [1]	Yes	44	84.6
	No	8	15.4
Drug use involved in the case	Yes	1	1.9
	No	51	98.1
Day of the week [2]	Weekday	33	64.7
	Weekend	18	35.3
Time of day of the crime	Day	20	38.5
	Night	32	61.5
Victim was a family member	Yes	16	30.8
	No	36	69.2
Victim's relationship with the perpetrator	No family connection	36	69.2
	Father	2	3.8
	Mother	1	1.9
	Partner	10	19.2
	Child	2	3.8
	Cousin	1	1.9
Domestic violence	Yes	18	34.6
	No	34	65.4
Place of the crime	Public place	12	23.1
	Home	39	75.0
	Other	1	1.9

Table 2. *Cont.*

Characteristics of the Cases		*n*	Percentages (%)
Pattern of homicide	Interpersonal violence	41	78.8
	Premeditated	11	21.2
Lethal Force Type	Blunt Force Traum	28	53.8
	Sharp Force Trauma (stabbing, cutting)	20	38.5
	Other	4	7.7
Paragraph of criminal code	Intentional homicide	29	55.8
	Homicide with qualifying circumstances	23	44.2

[1] Binge drinking events include not only heavy alcohol consumption occurrences, but also cases where the amount of alcohol consumed is unclear, but the circumstances established by the court confirm that all parties related to the crime consumed alcohol. [2] $n = 51$, in other characteristics—$n = 52$

One of the most important identified results was that the majority crimes occurred during a binge drinking event—84.6%, with 95% CI for probability between 74.8% and 94.4%. Comparing the sample proportion (84.6%) of binge drinking events to the identified value of 92%, it is concluded that significantly less than 92% of cases in Lithuania end up in a binge drinking event ($Z = -1.963$, $p = 0.025$).

Data analysis showed considerable levels of alcohol consumption in both victims and perpetrators, with mean alcohol levels of 2.19‰ (SD 0.99) and median 1.87‰ (25th percentile—1.39 ‰, 75th percentile—2.5 ‰), respectively (Table 3). The median sentence of analyzed crimes was 10 years (Table 3).

Table 3. Descriptive statistics of quantitative variables.

Variable		Mean	SD
Alcohol level determined in the victim (‰) ($n = 23$)		2.19	0.99
Variable	**Median**		**25th–75th percentiles**
Alcohol level determined in the perpetrator (‰) ($n = 18$)	1.87		1.39–2.5
Sentence (years) ($n = 52$)	10		9–12

Table 4 shows the distribution of binge drinking event by characteristics of the case. However, significant association was found only between the binge drinking event and the pattern of homicide. Binge drinking was significantly more common in cases classified as interpersonal violence (92.7%) compared to cases of premeditated homicides (54.5%).

Table 4. Distribution of binge drinking events during the crime by characteristics of the case.

Characteristics of the Cases		Binge Drinking Event ("Yes")		Binge Drinking Event ("No")		*p* Value #	Total	
		n	%	*n*	%		*n*	%
Sex of Perpetrator	Male	39	84.8	7	15.2	1.0	46	100
	Female	5	83.3	1	16.7		6	
Sex of the Victim	Male	32	86.5	5	13.5	0.668	37	100
	Female	11	78.6	3	21.4		14	
Intoxication of the Victim	Yes	40	88.9	5	11.1	0.064	44	100
	No	4	57.1	3	42.9		7	

Table 4. *Cont.*

Characteristics of the Cases		Binge Drinking Event ("Yes")		Binge Drinking Event ("No")		*p* Value #	Total	
Intoxication of the Perpetrator	Yes	40	83.3	8	16.7	1.0	48	100
	No	4	100	0	0		4	
Drugs	Yes	0	0	1	100	0.154	1	100
	No	44	86.3	7	13.7		51	
Day of the week	Weekday	29	87.9	4	12.1	0.430	33	100
	Weekend	14	77.8	4	22.2		18	
Time of Day of the Crime	Day	16	80	4	20	0.695	20	100
	Night	28	87.5	4	12.5		32	
Victim was a family member	Yes	14	87.5	2	12.5	1.0	16	100
	No	30	83.3	6	16.7		36	
Domestic Violence	Yes	15	83.3	3	16.7	1.0	18	100
	No	29	85.3	5	14.7		34	
Place of the crime	Public place	10	83.3	2	16.7	1.0	12	100
	Home	33	84.6	6	15.4		39	
Pattern of homicide	Interpersonal violence	38	92.7 *	3	7.3 *	0.007 *	41	100
	Premeditated	6	54.5	5	45.5		11	
Lethal Force Type	Blunt Force Trauma	25	89.3	3	10.7	0.251	28	100
	Sharp Force Trauma (stabbing, cutting)	15	75.0	5	25.0		20	
Paragraph of Criminal Code	Intentional homicide	25	86.2	4	13.8	1.0	29	100
	Homicide with qualifying circumstances	19	82.6	4	17.4		23	

Comparisons were performed between values of case characteristics; * statistical significance compared to "Premeditated".

4. Discussion

This study provides insights into the characteristics of alcohol-involved homicides, highlighting the significant role of binge drinking events in violent crime. Our findings revealed that 84.6% of homicides in 2019 in Lithuania occurred during binge drinking events, demonstrating the influence of alcohol consumption on lethal violence. Courts also qualify that alcohol significantly contributed to the offense occurrence. In court decisions, forensic psychiatric and psychological expert reports often highlight that perpetrators under the influence of alcohol exhibit heightened aggression and diminished impulse control, which courts identify as key factors in the escalation to violence. This underscores how alcohol is recognized not only for its physiological effects but also for its role in triggering impulsive, violent reactions in situations that might otherwise have been de-escalated. Furthermore, our analysis showed that alcohol intoxication was prevalent among both perpetrators (92.3%) and victims (86.5%), emphasizing the dual role of alcohol in homicide cases. Alcohol consumption may not only increase aggression in perpetrators but also may impair victims' ability to de-escalate or avoid confrontation.

Notable findings included that homicides were predominantly unplanned acts of interpersonal violence (78.8%), with only 21.2% classified as premeditated crimes. This aligns with previous research indicating that alcohol-related homicides are often spontaneous, triggered by interpersonal conflicts in social or domestic settings [19,20]. And binge drinking events were more common in cases classified as interpersonal violence

(92.7%) compared to premeditated homicides (54.5%). This supports the argument that alcohol-induced emotional reactivity makes individuals more likely to commit impulsive violent crimes [19,21].

Our results also indicate that most homicides occurred at home (75.0%), and the proportion of cases (34.6%) were classified as domestic homicides, which supports previous studies linking alcohol consumption to domestic violence and household conflicts [22,23]. These findings highlight the need for targeted interventions to prevent alcohol-related aggression in domestic settings.

As noted, alcohol-involved homicides are characterized as double-sided, and the relevant association identified in this study was between binge drinking events and victim intoxication. Among intoxicated victims, 88.9% were involved in a binge drinking event. Furthermore, our and other research data show that victims are often intoxicated by alcohol [3,24]. The qualitative analysis revealed that while the perpetrator's intoxication is often regarded as an aggravating factor, the victim's intoxication is generally not considered a mitigating circumstance when determining the offender's punishment. Instead, courts view the victim's alcohol consumption as part of the broader context of the crime, acknowledging its potential influence on the dynamics of the incident but without reducing the offender's legal responsibility. This suggests that alcohol consumption is not only a risk factor for perpetrating violence but also for victimization. It aligns with previous research suggesting that alcohol as a contributing factor for homicide victimization [25,26]. This association raises important public health and policy considerations: while much attention is given to alcohol-related aggression in perpetrators, the role of alcohol in victim vulnerability also warrants further investigation. Preventive strategies should focus on reducing excessive alcohol consumption among high-risk groups, particularly in social and domestic settings.

Our study also revealed a gendered pattern in alcohol-involved homicides, with 88.5% of perpetrators and 71.2% of victims being male. This is consistent with European trends showing that men are more likely to be both perpetrators and victims of homicide ([27]). The high prevalence of male victims may suggest that many homicides arise from male-on-male confrontations, which often occur in the context of binge drinking and disputes escalated by alcohol consumption.

While this study provides valuable insights into the role of alcohol in homicide cases, it has some limitations. Firstly, the study focuses only on Lithuania, and the findings may not be directly generalizable to other countries with different drinking cultures and legal frameworks. However, our findings contribute to a broader understanding of the circumstances surrounding alcohol-involved homicides and how alcohol intoxication is treated in legal contexts, which may be useful for comparative studies. Additionally, our definition of binge drinking relied on court-reported evidence; data on alcohol intoxication levels were not always available, and thus the findings may not always accurately reflect the full extent of alcohol involvement. We analyzed homicides only for year 2019, to avoid influence of external circumstances (COVID-19), and due to the small number of cases (sample size), the possibilities for statistical analysis were limited.

This study provides insights into alcohol-involved homicides, and the combination of qualitative and quantitative methods allows for a multilayered understanding of these events. Future studies could explore comparative analyses across countries with varying alcohol control policies and taking into account the psychosocial and economic factors underlying binge drinking in homicide cases; this would provide further insights into the effectiveness of measures in reducing alcohol-related violence.

5. Conclusions

Our findings revealed that most alcohol-involved homicides occurred during binge drinking events and because of unintended acts of interpersonal violence. These results have several implications for alcohol control policies and homicide prevention strategies. Given the high prevalence of binge drinking in homicide cases, targeted public health interventions should focus on strengthening alcohol control policies and enforcing stricter regulations on primarily domestic binge drinking environments. Raising awareness about the risks of binge drinking and its role in violence could help reduce alcohol-related harm at the societal level.

Even though we are focusing on Lithuania as a case study, this research contributes to the more comprehensive understanding of the relationship between substance use by both victims and perpetrators and violence, homicide, and criminal liability.

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Conflicts of Interest: The authors declare no conflicts of interest.

Appendix A. Analysed Cases

Case ID	Case No. in Liteko Database
C1	1-204-654/2019
C2	1A-418-318/2019
C3	1A-102-518/2020
C4	1A-112-449/2020
C5	1-34-581/2020
C6	1-43-350/2020
C7	1A-164-654/2020
C8	1-40-768/2020
C9	1A-202-518/2020
C10	1A-192-307/2020
C11	1A-208-518/2020
C12	1A-174-1076/2020
C13	1A-199-654/2020
C14	1A-264-616/2020
C15	1A-253-518/2020
C16	1A-185-616/2020
C17	1A-282-870/2020
C18	1-166-966/2020
C19	1-217-348/2020
C20	1-229-245/2020
C21	1A-318-870/2020
C22	1A-369-654/2020

Case ID	Case No. in Liteko Database
C23	1A-329-318/2020
C24	1-88-574/2020
C25	1A-331-487/2020
C26	1A-76-1076/2021
C27	1A-131-654/2021
C28	1-29-581/2021
C29	1-18-531/2021
C30	1A-115-654/2021
C31	1A-118-487/2021
C32	1A-110-449/2021
C33	A-147-1076/2021
C34	1A-92-487/2021
C35	1A-62-487/2021
C36	1A-237-487/2020
C37	1A-202-579/2021
C38	1A-157-1076/2021
C39	1A-184-318/2021
C40	1A-218-1076/2021
C41	1A-261-487/2021
C42	1A-272-307/2021
C43	1-28-383/2022
C44	1A-65-1020/2022
C45	1A-262-307/2021
C46	1A-61-1076/2022
C47	1A-77-626/2022
C48	1-29-519/2022
C49	1-45-317/2022
C50	1-216-530/2022
C51	1A-329-870/2022
C52	1-8-360/2023

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