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Research Article

Burden of alcohol drinking in Thailand, 2021: Findings from a nationwide estimation using alcohol-attributable fractions

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ABSTRACT

Alcohol is a significant risk factor that contributes to considerable mortality and morbidity, impacting overall public health. This study aims to estimate the burden of alcohol consumption in Thailand for the year 2021**.** Alcohol-attributable fractions by gender were employed using both direct and indirect methods to estimate the number of patients, deaths, and years of life lost (YLLs) attributable to alcohol use. Mortality and morbidity data were retrieved from national health statistic databases. The analysis included patients receiving treatment from both outpatient department (OPD) and inpatient department (IPD). Alcohol-attributable YLLs were estimated based on age-specific year expected to live. In 2021, the total number of alcohol-related outpatient visits was 1,330,095, with 1,261,285 for males and 68,810 for females. Additionally, there were 848,414 inpatient days linked to alcohol, with 766,687 for males and 81,727 for females. In males, hypertensive heart disease contributed to the largest number of OPD patients (231,612), while alcohol use disorders (AUDs) were the leading cause among IPD patients (42,456). In females, AUDs ranked first for both OPD and IPD, accounted for 10,430 and 4,644 patients, respectively. Overall, alcohol consumption led to 22,805 deaths and contributed to 666,393 YLLs. Road injuries were the primary cause of alcohol-related deaths for both men and women, contributing to 4,071 deaths among males and 1,182 deaths among females, leading to 156,708 YLLs for men and 46,826 YLLs for women. These findings highlight the critical need for strengthened alcohol control measures, including gender-sensitive interventions, stricter enforcement of drink-driving laws, and public health campaigns aimed at reducing alcohol consumption.

Keywords:
Burden; Years of life lost; Alcohol; Drinking

1. INTRODUCTION

Alcohol consumption imposed a significant burden, with wide-ranging consequences on both individual drinkers and others in society [1, 2]. In terms of health, it is a significant risk factor contributing to the development of various diseases such as liver cirrhosis, cardiovascular diseases, cancers, and alcohol use disorders (AUDs) [2, 3]. Furthermore, alcohol consumption also contributes to road injuries, crime, and violence [4-6].

According to 2019 data from the World Health Organization (WHO), 44% of the global population

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consumed alcohol, contributing to approximately 2.6 million deaths and 4.6% of the global disease burden measured in disability-adjusted life years (DALYs) [1]. In addition, the global economic impact of alcohol consumption is significant, with the average cost of alcohol accounting for an estimated 2.6% of the gross domestic product (GDP) [7].

Similar to many other countries, alcohol consumption in Thailand presents significant health and economic challenges. In 2021, the prevalence of alcohol use among Thai adults was high, with approximately 28.0% of the population consuming alcohol (46.4% of males and 10.8% of females) [8]. This represents a slight decrease from the 2017 survey, which reported an overall prevalence of 28.4%, with 47.5% for males and 10.6% for females [9]. The annual alcohol consumption per capita (APC) in 2021 was at 7.12 liters per adult, showing a marked increase since 2000 [10]. The negative impacts of alcohol on public health are considerable in Thailand. Alcohol consumption is one of the important risk factors contributing to several non-communicable diseases (NCDs) in Thai population [11, 12]. Previous studies in Thailand reported that alcohol consumption was responsible for 11.8% of deaths and 9.8% of DALY losses in 2019 [13]. Additionally, from 2004 to 2019, the total years of life lost (YLLs) due to alcohol consumption were estimated at 9.4 million years [14]. Furthermore, alcohol is a key contributor to traffic-related harm in the country, playing a substantial role in both injuries and fatalities resulting from road accidents [15, 16].

Alcohol consumption imposes a significant economic burden on Thailand's healthcare system with an estimated cost of 1.65 billion Thai baht in 2021, representing 1.02% of the country's GDP [17]. This estimate marks a reduction from the 1.99% reported in 2006 [18], which may reflect a gradual decline in alcohol consumption prevalence in recent years. Additionally, variations in study methodology, such as differences in the included cost components and sources of input data, further contribute to the gap in these estimates. When compared to the global estimates economic impact of alcohol of 2.6% of GDP [7], the estimates in Thailand was lower. It should be noted that the global estimate was adjusted to account for all omitted cost components (i.e., direct costs such as costs of healthcare, crime, and traffic accidents; indirect costs including costs productivity loss due to hospitalization, work-related absenteeism and presenteeism, unemployment, early retirement, premature mortality, and productivity loss during leisure time; and other costs related to alcohol consumption). On the other hand, the estimate in Thailand, 2021 only includes cost of cost of healthcare, cost of crime, cost of traffic accident, cost of hospitalization, and cost of premature mortality.

Despite growing awareness of the health and social risks attributable to alcohol use, several challenges hinder the implementation of effective policies to reduce alcohol consumption in Thailand [19, 20]. Estimating the burden of alcohol consumption is crucial for understanding its full impact on Thai society and for guiding policy interventions to mitigate the harmful impacts from alcohol consumption. Therefore, this study aims to estimate the burden of alcohol drinking in Thailand for the year 2021, specifically by calculating the number of patients, healthcare utilizations, deaths, and YLLs attributable to alcohol consumption.

2. MATERIALS AND METHODS

2.1 Study design

The analysis included 25 diseases and conditions identified by the WHO's Global Burden of Disease [21] as the alcohol attributable conditions. To estimate the burden of alcohol use in Thailand in 2021, gender-specific alcohol-attributable fractions (AAFs) were calculated for each alcohol-related condition.

2.2 Alcohol attribution

AAFs, which are expressed as percentage, represent the proportion of a specific disease's incidence, healthcare utilization, and mortality that can be attributed to alcohol consumption, serving as a crucial metric for quantifying alcohol-related harm.

This study utilized two main methods (i.e., the direct and indirect methods) to calculate AAFs. Direct method directly reviewed comprehensive reports to quantify the proportion of conditions/events that were caused by alcohol drinking. The direct approach was generally used to quantify the effects of alcohol consumption on AUDs [2], road injury [22], drowning, exposure to mechanical forces, self-harm, and interpersonal violence [18]. For the other alcohol-attributable conditions, where causal effect between alcohol and such conditions could not be quantified from the review of the relevant database, the indirect method was employed. This indirect approach defines AAF as a function of the prevalence of drinking (P) and the relative risk (RR) associated with each condition or using the modeling technique. Abstainers were used as the reference group to measure the risks associated with varying levels of alcohol consumption. AAFs for each disease/condition were calculated using a following formula [23], where "i" represents the alcohol attributable disease/condition and "j" denotes the level of alcohol consumption.

$$AAF_i\ (\%) = \frac{\sum_{j=1}^{k} P_j * (RR_{ij} - 1)}{\sum_{j=1}^{k} P_j * \left(RR_{ij} - 1\right) + 1} * 100$$

Using both methods allows for comprehensive estimation of alcohol-attributable burden. The choice of method was determined based on the availability of data. Therefore, both approaches are complementary. By combining the direct method, where possible, with the indirect method, this study ensures the completeness in estimating the burden of alcohol consumption.

2.3 Data sources

Given that diseases related to alcohol use typically develop over time rather than occurring abruptly, prevalence of alcohol drinking from the year preceding 2021 was adopted to estimate the burden in 2021. In light of the uncertainty regarding the latency period between alcohol intake and disease occurrence, we noted that there is no clear consensus on the appropriate latency period between alcohol consumption and the onset of alcohol-related diseases, a latency period of 4 years was used. Our study adopted prevalence of alcohol drinking from a previous study [24], which was based on the Smoking and Drinking Behavior Survey 2017 [9]. The level of alcohol consumption was classified into four categories based on the grams of pure alcohol consumed daily: light drinkers (women: 0–19.9 g/day; men: 0–39.9 g/day), moderate drinkers (women: 20.0–39.9 g/day; men: 40.0–59.9 g/day), heavy drinkers (women: >40.0 g/day; men: >60.0 g/day), and abstainers. The risks of developing alcohol-related illnesses were collected from the established epidemiological studied and meta-analyses [2, 3, 25]. It is important to note that the global contribution of alcohol consumption to cardiomyopathy, as determined by a previous study [26], was adopted as the AAF for cardiomyopathy, myocarditis, and endocarditis.

As summarized in Figure 1, the morbidity and mortality data, combined with the computed AAFs, were used to estimate the number of alcohol-attributable patients, outpatient department (OPD) visits, length of stay in inpatient department (IPD), and deaths by disease/condition attributable to alcohol. To estimate YLLs, the number of alcohol-attributable deaths for each gender was multiplied by the additional years of life that individuals were expected to live at the age of death, derived from the WHO's Life Table, 2019 [27]. Data on the number of patients for each alcohol-related disease/condition by gender, the number of OPD visits, and IPD length of stay per patient for each of the alcohol-related diseases in 2021 were retrieved from the National Health Security Office (NHSO)'s database. The total number of deaths by age and gender were derived from the Strategy and Planning Division under the Office of the Permanent Secretary, Ministry of Public Health [28]. These figures were adjusted for the proportion of deaths with unidentified causes, based on findings from the Burden of Disease Thailand [29].

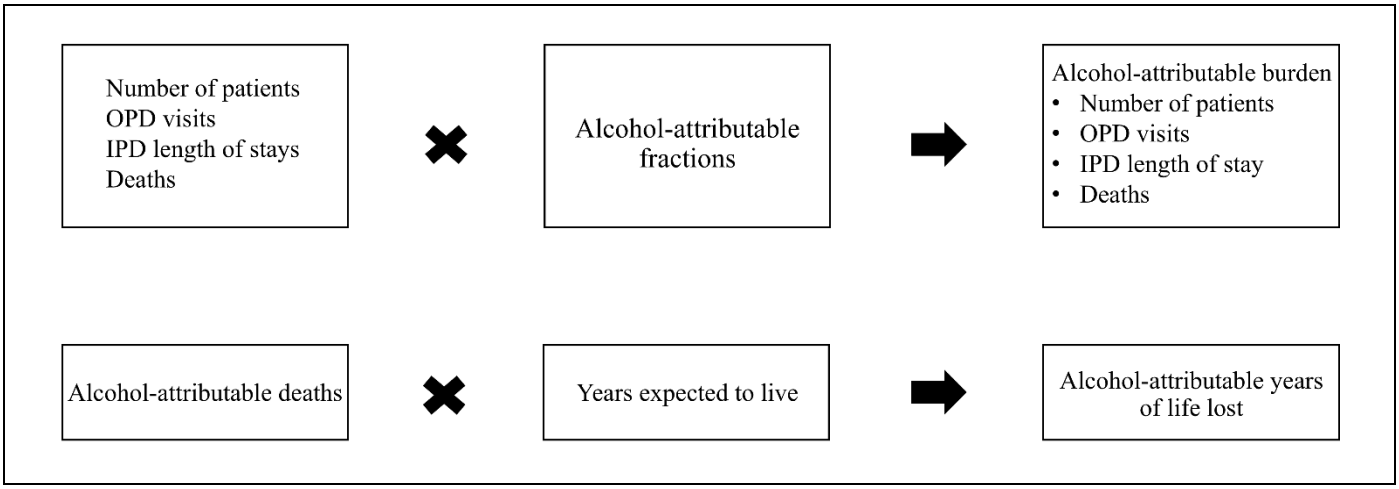

Figure 1. The estimation process

3. RESULTS

The RRs and computed AAFs used in this study are presented in Table 1. As shown in the table, AUDs, which are 100% caused by alcohol had the highest AAF, followed by exposure to mechanical forces (AAF = 73%), and interpersonal violence (AAF = 57%). When focusing on the AAFs estimated from the indirect method, the highest AAF among male was observed for liver cirrhosis at 46%, followed by lip and oral cavity cancers at 36%, and esophageal cancer at 31%. In females, liver cirrhosis also had the highest AAF at 22%, with esophageal cancer and lip and oral cavity cancers having AAFs of 8% and 5%, respectively.

The number of OPD visits and length of stay in IPD attributable to alcohol consumption was shown in table 2. In 2021, the total number of alcohol-related outpatient visits was 1,330,095 (1,261,285 for male and 68,810 for female), with 445,422 individual outpatients (417,819 for male and 27,603 for female). In contrast, there

Table 1. Relative risks (RRs) and alcohol-attributable fractions (AAFs) in Thailand.

Disease (Source of relative risk / AAF)	Male				Female			
	RR			AAF	RR			AAF
	L	M	H	(%)	L	M	H	(%)
Tuberculosis [2]	1.43	2.46	3.65	28	1.20	1.71	2.37	4
HIV/AIDs [25]	1.00	1.00	1.54	4	1.00	1.00	1.54	0.5
Lower respiratory infections: Pneumonia [2]	1.10	1.27	1.41	6	1.05	1.15	1.26	1
Lip and oral cavity cancer [2]	1.61	3.12	4.83	36	1.28	2.03	2.99	5
Other pharyngeal cancers [3]	1.20	2.01	5.33	29	1.00	1.67	5.70	5
Esophagus cancer [2]	1.39	2.35	4.69	31	1.14	2.18	8.32	8
Colon and rectum cancer [2]	1.13	1.37	1.57	9	1.06	1.21	1.35	1
Liver cancer [2]	1.07	1.52	2.40	12	1.01	1.16	1.47	1
Larynx cancer [2]	1.33	1.98	2.58	21	1.16	1.52	1.93	3
Breast cancer [2]	-	-	-	NA	1.11	1.36	1.63	2
Diabetes mellitus [2]	0.83	0.72	0.66	-11	0.68	0.62	0.97	-3
Epilepsy [2]	1.29	1.86	2.44	19	1.14	1.45	1.81	2
Hypertensive heart disease [2]	1.20	1.57	1.92	14	0.56	0.49	0.47	-5
Ischemic Heart Disease [2]	0.79	0.64	1.00	-10	1.03	1.38	1.18	1
Ischemic stroke [2]	1.06	1.23	1.36	5	0.65	0.77	1.06	-3
Hemorrhagic stroke [2]	1.15	1.41	1.64	10	1.16	1.55	2.02	3
Cirrhosis of the liver [2]	1.76	4.06	7.51	46	2.82	5.97	9.55	22
Pancreatitis [2]	1.41	2.38	3.49	27	0.77	0.85	1.49	-2
AAF from the literature review (%)								
Alcohol use disorders [2]	100				100			
Cardiomyopathy, myocarditis, endocarditis [26]	9				3			
Road injury [22]	29				29			
Drowning [18]	12				12			
Exposure to mechanical forces [18]	73				73			
Self-harm [18]	23				23			
Interpersonal violence [18]	57				57			

L: light drinker; M: moderate drinker; H: heavy drinker; NA: not applicable.

were 117,448 inpatients (105,961 for male and 11,487 for female) and a total inpatient length of stay of 848,414 days attributable to alcohol (766,687 for male and 81,727 for female).

Among male OPD patients, hypertensive heart disease caused the highest number with 231,612 patients, followed by AUDs with 71,409 patients, and tuberculosis with 21,335 patients, respectively. Regarding OPD visits for males, hypertensive heart disease led with 740,313 visits, AUDs accounted for 165,644 visits, and tuberculosis contributed to 81,213 visits. In the inpatient care, AUDs had the highest number of male patients with 42,456, followed by pneumonia with 22,973 patients, and liver cirrhosis with 8,830 patients, respectively. For male length of hospital stays, pneumonia ranked first with 234,017 days, followed by AUDs with 222,066 days, and liver cirrhosis with 47,472 days.

Among female OPD patients, AUDs also accounted for the highest number of outpatients with 10,430 patients, followed by liver cirrhosis with 4,494 patients, and exposure to mechanical forces with 2,632 patients, respectively. In terms of OPD visit, AUDs led to 24,194 visits among female, followed by liver cirrhosis at 11,057 visits, and breast cancer at 6,201 visits. In IPD settings, AUDs were the leading cause of female hospitalizations with 4,644 patients, followed by pneumonia with 3,010 patients, and liver cirrhosis with 1,629 patients. In terms of length of hospital stays among female, pneumonia was again the highest with 30,656 days, followed by AUDs with 24,292 days, and liver cirrhosis with 8,759 days, respectively.

As shown in table 3, alcohol was responsible for 22,805 deaths and contributed to 666,393 years of life lost (YLLs). In males, road injury was the leading cause of alcohol-attributable deaths with 4,071 fatalities, followed by liver cirrhosis with 2,990 deaths and tuberculosis with 1,569 deaths. For females, road injury also ranked first with 1,182 deaths, followed by liver cirrhosis with 519 deaths and self-harm with 286 deaths. In terms of YLLs, road injury represented the largest burden among males, with 156,708 years lost, followed by liver cirrhosis at 86,415 years and self-harm at 44,381 years. Similarly, for females, road injury caused

Table 2. Annual number of patients, hospital visits, and length of hospital stays attributable to alcohol consumption in 2021.

Disease	OPD				IPD			
	Number of patients		Number of visits (Time)		Number of patients		Length of stays (Day)	
	Male	Female	Male	Female	Male	Female	Male	Female
Tuberculosis	21,335	1,167	81,213	4,441	7,203	358	73,519	3,654
HIV/AIDS	6,153	707	19,413	2,229	452	35	5,842	451
Pneumonia	14,999	1,675	21,585	2,410	22,973	3,010	234,017	30,656
Lip and oral cavity cancers	2,099	248	10,540	1,244	1,127	102	16,760	1,510
Other pharyngeal cancers	1,119	40	6,511	231	769	15	11,533	226
Esophagus cancer	968	50	5,411	278	1,097	43	18,893	743
Colon and rectum cancers	2,507	276	12,483	1,376	1,512	146	21,650	2,097
Liver cancer	2,147	57	7,950	212	2,012	47	16,392	381
Breast cancer	NA	1,327	NA	6,201	NA	337	NA	2,396
Larynx cancer	700	9	3,708	50	413	4	5,583	54
Diabetes mellitus	NA	NA	NA	NA	NA	NA	NA	NA
Alcohol use disorders	71,409	10,430	165,644	24,194	42,456	4,644	222,066	24,292
Epilepsy	16,532	918	44,736	2,485	4,616	285	18,287	1,128
Hypertensive heart disease	231,612	NA	740,313	NA	2,265	NA	5,394	NA
Ischemic heart disease	NA	694	NA	3,931	NA	285	NA	1,612
Ischemic stroke	9,100	NA	60,154	NA	4,149	NA	27,425	NA
Hemorrhagic stroke	4,460	915	12,801	2,628	2,033	424	13,441	2,805
Cardiomyopathy, myocarditis, endocarditis	1,897	414	4,563	997	713	123	5,576	963
Cirrhosis of the liver	20,725	4,494	50,999	11,057	8,830	1,629	47,472	8,759
Pancreatitis	2,227	NA	4,056	NA	3,341	NA	22,837	NA
Road injury	1,689	1,015	1,808	1,086	0	0	0	0
Drowning	13	3	13	3	0	0	0	0
Exposure to mechanical forces	5,748	2,632	6,986	3,199	0	0	0	0
Self-harm	36	43	38	46	0	0	0	0
Interpersonal violence	344	489	360	512	0	0	0	0
Total	**417,819**	**27,603**	**1,261,285**	**68,810**	**105,961**	**11,487**	**766,687**	**81,727**
	445,422		**1,330,095**		**117,448**		**848,414**	

OPD: outpatient department; IPD: inpatient department; NA: not applicable.

the greatest loss, with 46,826 years, followed by liver cirrhosis at 13,439 years and self-harm at 10,595 years.

4. DISCUSSION

This study highlights the significant impact of alcohol consumption on health outcomes in Thailand. We found that alcohol consumption was responsible for 22,805 deaths and 666,393 YLLs in Thailand 2021. The number of YLLs estimated from this study was similar but slightly higher than the annual average of 588,972 YLLs estimated in another study [14]. However, the number of deaths reported was lower than the 2019 estimate of 43,677 deaths from a previous study in Thailand [13], while this study incorporated slightly higher number of alcohol-attributable diseases into the analysis. This is likely due to the prevalence of alcohol consumption used in calculating the AAFs. This study used the prevalence data from 2017, while the previous study [13] did not specify the source of the prevalence, but it was likely from a year prior to 2017, with a correction factor of 0.8. As alcohol consumption was higher in the past, the AAFs estimated in the previous study [13] were likely greater, leading to higher estimates for mortality.

While the government-imposed restrictions, including lockdowns, and curfews could possibly lead to reduced alcohol availability and consumption during the COVID-19 pandemic in 2021, slightly decrease in the alcohol drinking was identified in Europe during the pandemic [30]. Similarly in Thailand, a comparison between the previous survey in 2017 (pre-COVID) [9] and the 2021 surveys (during COVID) [8] revealed only slight decline in the overall prevalence of alcohol consumption (i.e., from 28.4% in 2017 to 28.0% in 2021). Nevertheless, such government measures, aimed at curbing the spread of COVID-19, may have inadvertently decreased alcohol-related traffic accidents [31, 32, 33], which are major contributors to alcohol-attributable deaths [34]. This could possibly lead to the lower estimates in our 2021 study.

Table 3. Annual number of deaths and years of life lost attributable to alcohol consumption in 2021.

Disease	Number of deaths		Year of life lost	
	Male	**Female**	**Male**	**Female**
Tuberculosis	1,569	87	39,316	2,129
HIV/AIDS	89	6	3,486	258
Lower respiratory infections: Pneumonia	1,394	118	26,146	2,030
Lip and oral cavity cancers	431	34	10,339	662
Other pharyngeal cancers	186	4	4,547	85
Esophagus cancer	531	17	12,667	399
Colon and rectum cancers	276	24	5,549	548
Liver cancer	1,420	30	32,294	653
Breast cancer	NA	87	NA	2,564
Larynx cancer	166	1	3,629	27
Diabetes mellitus	NA	NA	NA	NA
Alcohol use disorders	1,416	159	43,772	4,842
Epilepsy	113	7	3,531	207
Hypertensive heart disease	615	NA	9,558	NA
Ischemic heart disease	NA	112	NA	2,012
Ischemic stroke	662	NA	11,284	NA
Hemorrhagic stroke	1,428	245	35,123	5,307
Cardiomyopathy, myocarditis, endocarditis	101	28	2,556	591
Cirrhosis of the liver	2,990	519	86,415	13,439
Pancreatitis	134	NA	4,034	NA
Road injury	4,071	1,182	156,708	46,826
Drowning	297	64	9,818	2,025
Exposure to mechanical forces	132	23	4,374	801
Self-harm	1,217	286	44,381	10,595
Interpersonal violence	441	93	17,164	3,700
Total	**19,678**	**3,127**	**566,692**	**99,701**
	22,805		**666,393**	

NA: not applicable.

Our study indicated that road injuries were the leading cause of alcohol-attributable mortality in both males and females followed by cirrhosis of liver. This is probably due to the high AAFs as well as the facts that both road injuries and cirrhosis of the liver were leading causes of mortality in the Thai population [35]. Although various measures, such as the "Drink Don't Drive" campaign and strict Driving Under the Influence (DUI) laws, was implemented in Thailand since the early 2000s to address alcohol-related road injuries [36, 37], the burden remains disproportionately high, as evidenced by the leading role of road injuries in alcohol-attributable deaths and YLLs. A national study from 2006 previously reported that alcohol-attributable road injuries caused 8,460 male deaths and 347,379 male YLLs, along with 1,848 female deaths and 78,501 female YLLs [18]. Our 2021 analysis, however, estimated lower figures: 4,071 deaths and 156,708 YLLs for males, and 1,182 deaths and 46,826 YLLs for females. While these figures suggest a significant reduction over time, road injuries continue to represent the most substantial burden among all alcohol-related conditions, both in terms of mortality and YLLs. The high burden may reflect gaps in enforcement, insufficient public awareness, and cultural norms surrounding alcohol consumption. Strengthening existing policies through enhanced law enforcement, increasing the frequency and visibility of checkpoints, and integrating road safety education into school curricula could improve compliance and reduce fatalities.

In terms of morbidity, alcohol consumption led to a total of 1,330,095 outpatient visits, with 445,422 individual outpatients, and 848,414 inpatient days. While the AAFs for AUDs and cirrhosis were higher, hypertensive heart disease ranked as the leading cause of alcohol-related morbidity in outpatient visits among males. This is likely due to the high prevalence of hypertensive heart disease in outpatient settings. It also highlighted the strong link between alcohol use and cardiovascular diseases among male. In fact, research consistently shows that alcohol consumption increases the risk of hypertension, with males being more susceptible than females, even when consuming similar amounts [38]. In contrast, hypertensive heart disease was

not the leading cause of alcohol-related hospital stays, possibly because it typically does not result in inpatient service utilization. On the other hand, AUDs was the leading cause of alcohol-related inpatient hospital stays, likely due to its high AAFs and the higher prevalence of inpatient care utilization among AUDs patients. It should be noted that the pattern of burden in Thailand align with these global patterns, where alcohol contributes significantly to liver cirrhosis, injuries, tuberculosis, and AUDs [21, 39]. When looking at the difference across gender, our findings were consistent with the previous studies [13, 14] which showed that alcohol imposes a greater burden on males than females. This is because the prevalence of alcohol consumption is higher among Thai males than females.

High numbers of outpatient visits, inpatient length of stay, and deaths attributable to alcohol consumption definitely resulted in the strain on healthcare resources. This burden represents a substantial financial challenge for the healthcare system. Unsurprisingly, the economic costs of alcohol consumption in Thailand were substantial [17]. To address this issue, policymakers should prioritize strategies aimed at reducing alcohol-related morbidity and mortality, including early interventions to lower alcohol consumption rates and prevent alcohol consumption.

One of the strengths of this study is that it improves the estimation of AAFs by using updated RRs for varying levels of alcohol consumption from the most recent meta-analysis available [2, 3, 25]. Additionally, the analysis included a comprehensive set of alcohol-related diseases and conditions, based on the latest evidence. In addition, we attempted to classify the cause of death among unidentified causes to get the closer estimates of death for particular diseases. However, there are some limitations to our study. Firstly, we used alcohol prevalence data from 2017, which implies a lead time of four years from alcohol consumption to disease occurrence. Based on current evidence [40], the time until an initial effect can range from immediate to 10 years, while the full effect may take 5 to 20 years to manifest, depending on the specific condition. The lead time for some diseases, such as cancer, may be longer, while for others, like hypertensive heart disease, it may be shorter. Furthermore, the AAF for road injuries was based on statistics recorded during the New Year period, which could be higher than at other times of the year, potentially leading to an overestimation of the AAFs. Additionally, the analysis focused solely on health conditions affecting drinkers themselves, excluding the significant burden caused by others' drinking, such as injuries and fatalities from road traffic accidents or assaults. These omissions may underrepresent the full scope of alcohol-attributable harm in Thailand.

5. CONCLUSIONS

This study highlights the substantial burden of alcohol consumption in Thailand, emphasizing the urgent need for comprehensive and targeted public health interventions aimed at reducing alcohol consumption and its consequences. A coordinated effort involving policymakers, healthcare providers, and the community is essential to reduce the impact of alcohol on health and society. Furthermore, periodic estimates of cost of alcohol using updated behavioral data should be conducted to ensure that future policy decisions are informed by the most current behavioral trends.

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Author contributions

All authors contributed to conceptualization and design of the study. Data collection was performed by CL and MT. Data analysis was carried out by all authors. The first draft of the manuscript was written by CL. All authors read and approved the final manuscript.

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Conflict of interest

None to declare.

Ethics approval

The Institutional Review Board of Mahidol University, Faculty of Dentistry/ Faculty of Pharmacy, has verified that this study does not require ethical approval (COE No. MU-DT/PY-IRB 2022/019.2503).

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