


RESEARCH

Open Access



# Economic costs of alcohol consumption in Thailand, 2021

Chaisiri Luangsinsiri<sup>1,2</sup>, Sitaporn Youngkong<sup>3,4</sup>, Usa Chaikledkaew<sup>3,4</sup>, Oraluck Pattanaprteep<sup>5</sup> and Montarat Thavorncharoensap<sup>3,4\*</sup> 

## Abstract

**Background** Alcohol is one of the leading risk factors contributing to avoidable economic loss worldwide. Estimates from the economic cost of alcohol consumption studies play an important role in prioritizing healthcare resource use, supporting policy decisions, and justifying budgets for alcohol policy. This study aimed to estimate the economic burden associated with alcohol consumption in Thailand in 2021.

**Methods** Prevalence-based cost of illness methodology was employed. The following costs were included in the analysis: healthcare costs; cost of law enforcement; cost of property damage due to road traffic accidents; cost of premature mortality; and cost of absenteeism from out-patient hospital visits and hospitalization. Human capital approach was adopted. All costs were presented in Thai baht, 2021.

**Results** Alcohol consumption incurred a total estimated economic cost of 165,450.5 million baht, equivalent to 1.02% of Gross Domestic Product (GDP) and 2500 baht per capita. Cost of premature mortality was estimated at 157,918.7 million baht and accounted for the largest proportion of the total cost (95.45%). Healthcare cost was found to be the second highest share representing 4370.1 million baht (2.7% of the total cost). The number of premature death attributable to alcohol consumption in 2021 was estimated at 22,804.

**Conclusions** Alcohol continues to impose a substantial economic burden in Thailand. Enforcement of existing well-formulated alcohol control policies is urgently required to mitigate the economic impact of alcohol consumption in the country.

**Keywords** Cost-of-illness, Economic burden, Alcohol, Cost, Drinking

\*Correspondence:

Montarat Thavorncharoensap  
montarat.tha@mahidol.ac.th

<sup>1</sup> Doctor of Philosophy Program in Social, Economic, and Administrative Pharmacy, Department of Pharmacy, Faculty of Pharmacy, Mahidol University, Bangkok, Thailand

<sup>2</sup> Department of Clinical Pharmacy, Faculty of Pharmacy, Srinakharinwirot University, Nakhon Nayok, Thailand

<sup>3</sup> Mahidol University Health Technology Assessment (MUHTA) International Graduate Program, Mahidol University, Bangkok, Thailand

<sup>4</sup> Social and Administrative Pharmacy Excellence Research (SAPER) Unit, Department of Pharmacy, Faculty of Pharmacy, Mahidol University, 447 Sri-Ayudhaya Rd., Rajathewi, Phayathai, Bangkok 10400, Thailand

<sup>5</sup> Department of Clinical Epidemiology and Biostatistics, Faculty of Medicine Ramathibodi Hospital, Mahidol University, Bangkok, Thailand

## Background

In 2016, alcohol drinking was the 7th leading risk factor for death and disability-adjusted life year (DALY) globally [1]. Although commonly viewed as personal choice alcohol consumption not only affects the health of individual drinkers but also contributes to productivity loss as well as many social problems such as drunk driving, crime, and domestic violence. As a result, existing evidence consistently indicated that alcohol was one of the key risk factors contributing to avoidable economic loss worldwide [2–4].

The estimates from the economic cost of alcohol consumption studies provide essential information for



© The Author(s) 2023. **Open Access** This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

several purposes: to raise public awareness of the burden of alcohol on society, to guide policy decision making and public health planning for alcohol control initiatives, to justify budgets for alcohol-related policies, and to provide baseline measures to determine the efficacy of the alcohol policy or program. Based on the recent systematic review [2], the average cost of alcohol use per adult after adjusting for the omission of cost components in the analysis was estimated at 1306 Int\$ or accounted for 2.6% of Gross Domestic Product (GDP). Notably, of the 29 studies included in the review, 25 were conducted in high-income countries. Given that the economic impact of alcohol drinking depends on various factors including prevalence and pattern of drinking, economic status, and characteristics of population and health system [5], country-specific studies on economic impact of alcohol consumption are necessary.

Thailand is a middle-income country located in mainland South-East Asia. According to the National Health Examination Survey (NHES), the prevalence of alcohol drinking in Thailand decreased from 72.6% in 2003/4 [6] to 55.9% in 2014 [7] in males and 35.1–23.0% in females. However, the prevalence in 2019/2020 was slightly increased to 59.0% and 31.0% in males, and females, respectively [8]. In 2021, the excise tax from alcoholic beverages in Thailand was 140,667 Million baht, representing 0.87% of the country's GDP [9]. It should be noted that in 2014, alcohol was identified as the primary risk factor for attributable DALYs in males, causing 12% of DALY losses in the country [10]. To date, studies on the economic costs of alcohol consumption in Thailand have been conducted in 2006 [11], 2011 [12], and 2017 [13]. These studies showed that the economic burden of alcohol ranged between 0.56 and 1.99% of Thailand's GDP. Due to the changes in the prevalence of drinking and epidemiological changes in alcohol-related diseases along with its costs, an update of the estimates of alcohol-attributable costs is needed to reflect the current situation for supporting evidence-based public health policy decision making in the country. Therefore, the objective of this study was to estimate the economic cost of alcohol consumption in Thailand, in 2021.

## Methods

### Study design and sample

To estimate gross costs of alcohol consumption in Thailand, 2021, a prevalence-based cost-of-illness methodology was employed. Cost-of-illness, also known as economic cost-of-illness or economic cost [14], is a summary of the costs of a particular disease or condition to society [15]. Cost-of-illness aimed to measure the economic burden of the disease or condition imposed on

society [14, 16]. The terms economic burden and economic costs are frequently used interchangeably.

A societal perspective was adopted for the analysis. Both direct and indirect costs were estimated. All costs were presented in Thai baht, 2021 (36.14 baht=1 US\$). Then, the estimates were displayed as a percentage of the country's GDP to facilitate the cross-country comparison without the intention to measure the impact of drinking on the growth of the economy.

In this study, 25 diseases/conditions attributable to alcohol identified by the World Health Organization (WHO) Global Burden of Disease 2020 [17, 18] were included in the analysis. To estimate the number of patients and deaths attributable to alcohol consumption, alcohol-attributable fractions (AAFs) were calculated for each disease, using the following formula [19]:

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

where  $P_j$ =Prevalence of alcohol consumption at drinking level  $j$ ,  $RR_{ij}$ =Relative risk (RR) of developing alcohol-related disease  $i$  at drinking level  $j$  compared to non-drinker.

In this analysis, the prevalence of alcohol consumption by drinking categories was adopted from the previous study [13], which was estimated from the Smoking and Drinking Behavior Survey 2017 [20]. The drinking categories were classified based on consumption of pure alcohol, measured in grams per day into (1) light alcohol drinking (female >0 – <20 g/day, male >0 – <40 g/day), (2) moderate alcohol drinking (female 20 – 40 g/day, male 40 – 60 g/day), (3) heavy alcohol drinking (female >40.0 g/day, male >60.0 g/day) [21]. Information on the RRs of diseases caused by alcohol consumption was derived from the relevant meta-analyses [11, 17, 22–25]. The AAFs estimated in this study are displayed in Table 1.

### Cost estimates

#### Direct costs

In this study, direct care costs included healthcare costs, costs of law enforcement, and cost of property damage due to road traffic accidents.

**Healthcare costs** Healthcare costs consisted of the cost incurred in the out-patient department (OPD) and the cost incurred in the in-patient department (IPD). Healthcare cost attributable to alcohol was estimated as the product of the number of alcohol-attributable patients and the disease-specific unit cost of treatment. To determine the number of patients attributable to alcohol in 2021, the number of patients with each disease in 2021

**Table 1** The Alcohol-attributable Fraction (AAF) used in the study

|    | Disease                                   | AAF (%) |        | Sources of relative risk (RR)  |
|----|---|---------|--------|--|
|    |   | Male    | Female |  |
| 1  | Tuberculosis                              | 28      | 4      | Rehm et al. [17]   |
| 2  | HIV/AIDS                                  | 4       | 0      | Rehm et al. [22]   |
| 3  | Lower respiratory infections: Pneumonia   | 6       | 1      | Rehm et al. [17]   |
| 4  | Lip and oral cavity cancers               | 36      | 5      | Rehm et al. [17]   |
| 5  | Other pharyngeal cancers                  | 29      | 5      | Bagnardi et al. [23]   |
| 6  | Esophagus cancer                          | 31      | 8      | Rehm et al. [17]   |
| 7  | Colon and rectum cancers                  | 9       | 1      | Rehm et al. [17]   |
| 8  | Liver cancer                              | 12      | 1      | Rehm et al. [17]   |
| 9  | Breast cancer                             | 0       | 2      | Rehm et al. [17]   |
| 10 | Larynx cancer                             | 21      | 3      | Rehm et al. [17]   |
| 11 | Diabetes mellitus                         | -11     | -3     | Rehm et al. [17]   |
| 12 | Alcohol use disorders                     | 100     | 100    | Rehm et al. [17]   |
| 13 | Epilepsy                                  | 19      | 2      | Rehm et al. [17]   |
| 14 | Hypertensive heart disease                | 14      | -5     | Rehm et al. [17]   |
| 15 | Ischemic heart disease                    | -10     | 1      | Rehm et al. [17]   |
| 16 | Ischemic stroke                           | 5       | -3     | Rehm et al. [17]   |
| 17 | Hemorrhagic stroke                        | 10      | 3      | Rehm et al. [17]   |
| 18 | Cardiomyopathy, myocarditis, endocarditis | 9       | 3      | Mathey et al. [24]   |
| 19 | Cirrhosis of the liver                    | 46      | 22     | Rehm et al. [17]   |
| 20 | Pancreatitis                              | 27      | -2     | Rehm et al. [17]   |
| 21 | Road injury <sup>a</sup>                  | 29      | 29     | The Secretariat of the Prime Minister 2021 [25]                              |
| 22 | Drowning                                  | 12      | 12     | Thavorncharoensap et al. [11]  |
| 23 | Exposure to mechanical forces             | 73      | 73     | Thavorncharoensap et al. [11]  |
| 24 | Self-harm                                 | 23      | 23     | Thavorncharoensap et al. [11]  |
| 25 | Interpersonal violence                    | 57      | 57     | Thavorncharoensap et al. [11]  |
| 26 | Offences against sexuality, body and life | 31      | 31     | Laixuthai et al. [35]  |
| 27 | Offences against Property                 | 3       | 3      | Laixuthai et al. [35]  |
| 28 | Offences relating to criminal damage      | 7       | 7      | Laixuthai et al. [35]  |
| 29 | Road traffic accident                     | 33.7    | 33.7   | Office of the National Economic and Social Development Council 2021 [37, 38] |

<sup>a</sup> the proportion of road injuries attributable to alcohol during New Year festival, 2021

was multiplied by the corresponding alcohol-attributable fraction (AAF). The total number of patients for a particular disease and the disease-specific unit cost of treatment in 2021 were derived from the database of National Health Security Office (NHSO), according to the ICD-10 codes. This database covered information on patients under the Universal Health Coverage (UHC) scheme in Thailand. The assumption that the total number of patients covered under the UHC program represented 70% of the overall patient population in the country was employed to estimate the total number of patients in Thailand.

**Costs of law enforcement** In this analysis, the costs of law enforcement attributable to alcohol consumption included justice system costs incurred at police stations,

court of justice, office of the attorney general, and prison. The costs were calculated by multiplying the number of crimes and offenses attributable to alcohol consumption with the unit cost per case of each state agency.

To estimate the unit cost per case, the annual budget related to the justice work allocated to each agency by the Budget Bureau in 2021 [26–30] was divided by the number of crimes and offenses prosecuted by the agency in the same year. The number of prosecuted crimes and offenses in 2021 was obtained from the annual report of the following agencies: the Royal Thai Police, the Court of Justice, the Office of the Attorney General, and the Department of Corrections, Ministry of Justice [31–34]. On the other hand, the proportion of crimes and offenses attributable to alcohol

consumption was derived from the previous study in Thailand [35], as shown in Table 1.

**Cost of property damage due to road traffic accidents** In this study, the cost of property damage due to road traffic accidents attributable to alcohol consumption was estimated by multiplying the total cost of property damage due to road traffic accidents in 2021, which was reported by the Royal Thai Police [36] with the proportion of road traffic accidents attributable to alcohol during New Year and Songkran festival in Thailand, 2021, which reported by the Office of the National Economic and Social Development Council [37, 38].

#### **Indirect costs**

Indirect costs included in the analysis were cost of premature mortality and absenteeism from out-patient hospital visits and hospitalization.

**Cost of premature mortality** In this analysis, premature mortality was defined as death that occurs before the expected life expectancy of the Thai population. Human capital approach was adopted to estimate the cost of productivity loss due to premature mortality. To estimate the number of alcohol-attributable deaths for each disease, the total number of deaths by age and gender for each disease was multiplied by the corresponding disease-specific AAF. Information on the number of deaths by age and gender was derived from the Strategy and Planning Division, Office of the Permanent Secretary, Ministry of Public Health [39] and was adjusted by the proportion of unidentified causes of death based on the recent study in Thailand [40]. The cost of premature mortality was, then, estimated by multiplying the number of alcohol-attributable deaths, by age and gender with the present value of lost earnings by age and gender. As recommended by the Guideline for Health Technology Assessment in Thailand, Gross National Income (GNI) per capita in 2021 (232,176 baht) [41] was used. The growth rate of 2.94% per year, which was the average growth rate between 2000 and 2020 was applied [42]. The number of years lived beyond each certain age up to the life expectancy was obtained from the WHO life table for Thailand [43]. To convert the future cost into the present value, the discount rate of 3% was adopted [44].

**Costs of hospital-related absenteeism** Costs of absenteeism from out-patient hospital visits and hospitalization attributable to alcohol consumption were estimated by multiplying the number of patients attributable to alcohol by the average number of absent days from out-patient visits and hospitalization per patient by the daily wage. The information on the annual number of disease-

specific out-patient visits and in-patient length of stay per patient in 2021 was derived from the database of NHSO, which contained ICD-10 codes for each hospital visit. For our study, one out-patient visit was set to a half day loss. Meanwhile, the number of absent days due to hospitalization was assumed to be equal to the length of stay.

#### **Sensitivity analysis**

One-way sensitivity analyses were performed to examine the extent to which the results are affected by the choice of parameters and method used in the estimations. In the analyses, discount rates of 0% and 6% were used, as recommended by the Thai Guideline for Health Technology Assessment [45]. The alteration of the prevalence of alcohol consumption ( $\pm 10\%$ ,  $\pm 20\%$ ) and the use of net estimation approach was also examined in the analyses. In addition, the alternative assumptions used in evaluating productivity loss were also explored. At present, Thailand's official retirement age is 60 years old. Nevertheless, data from Thailand's Labor Force Survey 2022 [46] shows that slightly less than 50% of Thais aged 60 years and over are in the labor market. In the sensitivity analyses, we, therefore, assumed a 50% drop in income after aged 60 years old. In the analyses, we also assumed that there was no productivity loss after the age of 65 years old, as there is a proposal to extend the retirement age in the country from 60 to 65 years.

#### **Results**

As summarized in Table 2, the economic cost of alcohol consumption in Thailand for the year 2021 was calculated at 165,450.5 million baht. This was equivalent to 1.02% of Thailand GDP's and accounted for 2500 baht per capita. Indirect costs made up the largest proportion of the total cost (96.32%) with an estimate of 159,358.8 million baht while direct costs were evaluated at 6091.7 million baht.

For the indirect costs, the cost of premature mortality was found to be the major cost component, representing 95.45% of the total cost with estimates of 157,918.7 million baht (134,424.7 million baht in males and 23,493.9 million baht in females). In 2021, premature death attributable to alcohol consumption's number was estimated at 22,804 (male = 19,678, female = 3127), resulting in 666,393 years of life loss. As shown in Table 3, the five leading causes of premature mortality costs were road injuries (47,821.9 million baht), followed by cirrhosis (23,740.0 million baht), self-harm (12,944.3 million baht), alcohol use disorder (11,535.6 million baht), and tuberculosis (9873.9 million baht), respectively. When focusing on morbidity-related

**Table 2** Summary of the economic cost of alcohol consumption in Thailand, 2021

| Cost category               | Economic cost (million baht) | Percentage (%) |
|-----------------------------|------------------------------|----------------|
| <b>Direct costs</b>         | <b>6,091.68</b>              | <b>3.68</b>    |
| Health care cost            |                              |                |
| Total                       | 4370.13                      | 2.64           |
| Out-patient                 | 1422.25                      | 0.86           |
| In-patient                  | 2947.88                      | 1.78           |
| Cost of law enforcement     |                              |                |
| Total                       | 1704.34                      | 1.03           |
| Police                      | 144.44                       | 0.09           |
| Court                       | 519.68                       | 0.31           |
| Attorney                    | 275.00                       | 0.17           |
| Prison                      | 765.22                       | 0.46           |
| Cost of property damage     | 17.21                        | 0.01           |
| <b>Indirect costs</b>       | <b>159,358.77</b>            | <b>96.32</b>   |
| Cost of premature mortality | 157,918.66                   | 95.45          |
| Cost of absenteeism         | 1440.12                      | 0.87           |
| Total cost                  | 165,450.45                   | 100.00         |

productivity loss, cost of absenteeism was estimated at 1440.1 million baht (0.87% of the total cost).

Among the direct costs which were estimated at 6091.7 million baht (3.7% of the total cost), healthcare cost was estimated at 4370.1 million baht (2.7% of the total cost) while justice system cost was estimated at 1704.3 million baht (1.03% of the total cost), and cost of property damage was estimated at 17.2 million baht (0.01% of the total cost).

Healthcare costs attributable to alcohol drinking in Thailand in 2021 by gender and disease are also shown in Table 3. Our analysis found that the five leading causes of healthcare cost were lower respiratory tract infection (1434.4 million baht), followed by hypertensive heart disease (686.5 million baht), alcohol disorder (463.2 million baht), cirrhosis (280.7 million baht), and tuberculosis (252.7 million baht), respectively.

As for the costs of law enforcement, the cost incurred at prison represented the largest proportion (765.2 million baht), followed by the costs incurred at court of justice (519.7 million baht), and the office of attorney general (275.0 million baht), respectively.

As shown in Table 4, the estimates of sensitivity analyses ranged between 81,148.1 million baht (−50.95% change from baseline) and 299,487.8 million baht (+81.01% change from baseline). The choice of discount rate had the highest impact on the result, followed by the assumption of no productivity loss beyond the age of 65 years old.

## Discussion

Alcohol consumption incurred substantial economic impacts on Thai society, representing 1.02% of Thailand's GDP. Indirect costs accounted for the largest proportion, representing 96.32% of the total cost. Our estimate was lower than that of the recent systematic review [2], which indicated that the costs of alcohol use were equal to 2.6% of the GDP but were consistent in that the indirect costs were the major share of the total cost. This could be partly explained by the fact that the estimates from the previous study [2] were adjusted for the omission of cost components in the analysis.

As compared to the estimates from the previous study in the country, which was conducted in 2006 [11], this recent estimate was lower (1.99% vs 1.02% of the GDP). This is probably due to the lower prevalence of drinking in this analysis. In this study, the proportion of current drinkers was 47.5% and 10.6% in males, and females respectively. Albeit, the proportion of current drinkers used in the previous study [11] was 72.6% and 35.1% in males and females, respectively. Furthermore, it is worth noting that the methodology, cost components, and source of information used in this study and previous studies in the country [11–13] were slightly different. For example, the previous study in 2006 [11] included the presenteeism costs while the others did not. In addition, the source of income and assumption used in the estimation of indirect costs varied across studies. Therefore, a direct comparison of the findings across the studies should be carefully considered.

It should be noted that there is no consensus on the latency period between alcohol consumption and the year of disease occurrence. Based on the available evidence [47], the time to the first effect varied from immediately to 10 years while the time to get the full effect ranged from 5 to 20 years, depending on the type of disease. Due to the availability of data, the lag time of 4 years was adopted in this study. Given that the time to get the full effect ranged from 5 to 20 years, the use of 4 year-lag time in our analysis might result in the overestimation of the cost.

Although our findings indicated that alcohol imposed a substantial economic burden on society, this analysis was more likely to be underestimated due to several reasons: (1) some of the diseases were not included in the analysis, such as depression, low-birth weight, ethanol toxicity, (2) cost of productivity loss due to disability resulted from road traffic accidents was not included, (3) absenteeism cost only included cost due to hospital-related absence, (4) presenteeism cost, informal care cost, and intangible cost were not included, and (5) the costs were estimated during the COVID-19 pandemic period when healthcare utilization [48], the number of road traffic accidents, and

**Table 3** Health care cost, cost of hospital-related absenteeism, and cost of premature mortality attributable to alcohol in Thailand, 2021, by disease and gender

|    | Disease                                   | Health care cost |        | Cost of absenteeism |        | Cost of premature mortality |           | Total cost     |           |
|----|---|------------------|--------|---------------------|--------|-----------------------------|-----------|----------------|-----------|
|    |   | (Million baht)   |        | (Million baht)      |        | (Million baht)              |           | (Million baht) |           |
|    |   | Male             | Female | Male                | Female | Male                        | Female    | Male           | Female    |
| 1  | Tuberculosis                              | 240.29           | 12.37  | 108.59              | 5.59   | 9370.54                     | 503.40    | 9719.43        | 521.36    |
| 2  | HIV/AIDS                                  | 87.01            | 9.57   | 14.80               | 1.49   | 820.02                      | 60.46     | 921.82         | 71.52     |
| 3  | Lower respiratory infections: Pneumonia   | 1268.74          | 165.68 | 232.95              | 30.32  | 6265.21                     | 478.10    | 7766.89        | 674.10    |
| 4  | Lip and oral cavity cancers               | 85.91            | 8.57   | 20.96               | 2.03   | 2472.92                     | 156.91    | 2579.79        | 167.51    |
| 5  | Other pharyngeal cancers                  | 60.45            | 1.52   | 14.07               | 0.33   | 1087.87                     | 20.17     | 1162.39        | 22.02     |
| 6  | Esophagus cancer                          | 90.81            | 3.78   | 20.55               | 0.84   | 3036.55                     | 94.99     | 3147.91        | 99.61     |
| 7  | Colon and rectum cancers                  | 152.06           | 15.09  | 26.54               | 2.65   | 1334.38                     | 130.06    | 1512.98        | 147.80    |
| 8  | Liver cancer                              | 142.39           | 3.37   | 19.38               | 0.46   | 7748.74                     | 156.02    | 7910.51        | 159.85    |
| 9  | Breast cancer                             | –                | 23.39  | –                   | 5.23   | –                           | 607.95    | –              | 636.57    |
| 10 | Larynx cancer                             | 29.68            | 0.32   | 7.08                | 0.07   | 870.57                      | 6.38      | 907.32         | 6.78      |
| 11 | Diabetes mellitus                         | –                | –      | –                   | –      | –                           | –         | –              | –         |
| 12 | Alcohol use disorders                     | 413.76           | 49.43  | 290.11              | 34.63  | 10,387.47                   | 1148.14   | 11091.34       | 1232.20   |
| 13 | Epilepsy                                  | 128.81           | 7.42   | 38.69               | 2.26   | 835.70                      | 48.77     | 1003.20        | 58.44     |
| 14 | Hypertensive heart disease                | 686.51           | –      | 357.35              | –      | 2303.25                     | –         | 3347.12        | –         |
| 15 | Ischemic heart disease                    | –                | 27.36  | –                   | 3.40   | –                           | 477.04    | –              | 507.80    |
| 16 | Ischemic stroke                           | 152.78           | –      | 54.72               | –      | 2722.73                     | –         | 2930.22        | –         |
| 17 | Hemorrhagic stroke                        | 74.88            | 15.56  | 18.88               | 3.92   | 8380.68                     | 1257.70   | 8474.43        | 1277.18   |
| 18 | Cardiomyopathy, myocarditis, endocarditis | 36.23            | 6.64   | 7.48                | 1.39   | 608.38                      | 139.83    | 6.08           | 147.86    |
| 19 | Cirrhosis of the liver                    | 235.11           | 45.60  | 69.44               | 13.60  | 20544.89                    | 3195.11   | 2849.43        | 3254.31   |
| 20 | Pancreatitis                              | 83.02            | –      | 23.66               | –      | 956.20                      | –         | 1062.88        | –         |
| 21 | Road injury                               | 1.63             | 0.98   | 0.86                | 0.52   | 36,834.11                   | 10987.87  | 36,836.60      | 10,989.37 |
| 22 | Drowning                                  | 0.02             | 0.00   | 0.01                | 0.00   | 2320.67                     | 477.16    | 2320.70        | 477.17    |
| 23 | Exposure to mechanical forces             | 1.85             | 0.85   | 3.32                | 1.52   | 1033.94                     | 188.59    | 1039.1         | 190.96    |
| 24 | Self-harm                                 | 0.03             | 0.03   | 0.02                | 0.02   | 10,453.54                   | 2490.77   | 10,453.58      | 2490.82   |
| 25 | Interpersonal violence                    | 0.26             | 0.38   | 0.17                | 0.24   | 4036.37                     | 868.54    | 4036.80        | 869.16    |
|    | Total                                     | 3972.21          | 397.92 | 1329.62             | 110.50 | 13,4424.70                  | 23,493.95 | 139,726.53     | 24,002.38 |
|    |   | 4370.13          |        | 1440.12             |        | 157,918.66                  |           | 163,728.91     |           |

**Table 4** Sensitivity analyses

| Parameter/method                                 | Economic cost (million baht) | % change |
|--|------------------------------|----------|
| Base case (Gross cost estimation)                | 165,450.45                   | NA       |
| Net cost estimation                              | 150,026.08                   | –9.32    |
| Prevalence increases from base case 10%          | 171,504.43                   | +3.66    |
| Prevalence increases from base case 20%          | 177,327.22                   | +7.18    |
| Prevalence decreases from base case 10%          | 159,143.23                   | –3.81    |
| Prevalence decreases from base case 20%          | 152,557.14                   | –7.79    |
| Discount rate at 0%                              | 299,487.76                   | +81.01   |
| Discount rate at 6%                              | 108,499.55                   | –34.42   |
| No productivity loss beyond age of 65            | 81,148.10                    | –50.95   |
| 50% reduction of the earning after the age of 60 | 113,546.47                   | –31.37   |

NA Not applicable

crimes were expected to be decline due to the COVID-19 related restrictions policy.

This study has some limitations. Firstly, the proportion of road traffic accidents/road injuries attributable to alcohol consumption may be overestimated using statistics during the festival period. Furthermore, the proportion of alcohol-related crimes and offenses was derived from the previous local study conducted in only one province in 2001.

Finally, the implementation of effective policies and interventions that aim to reduce the prevalence of drinking or to mitigate the negative effects of alcohol consumption should be prioritized to decrease the economic burden associated with alcohol consumption in the country. To date, various effective alcohol policies [49] such as taxation, restriction of alcohol marketing, restriction on alcohol availability (i.e. restriction on minimum purchase age of

the buyer, time of sale of alcohol, and alcohol outlet location), and drunk-driving laws have been implemented for many years in Thailand [50, 51]. Nevertheless, a slightly increase in alcohol consumption was yet observed recently [50]. A recent study suggested that the lack of robustness of law and policy enforcement could hamper the effectiveness of such policies [52]. Therefore, well-formulated law enforcement strategies on alcohol control policy are highly warranted.

## Conclusions

Alcohol continues to impose a substantial economic burden on Thai society. Hence, the government and related organizations need to put priority on the policies aims at reducing alcohol consumption, including policies to mitigate the negative consequences of alcohol drinking. Furthermore, law enforcement on alcohol control policy should be emphasized to reduce the economic burden of alcohol consumption in the country.

## Abbreviations

|      |                                    |
|------|------------------------------------|
| AAFs | Alcohol-attributable fractions     |
| DALY | Disability-adjusted life year      |
| GDP  | Gross domestic product             |
| GNI  | Gross national income              |
| IPD  | In-patient department              |
| NHES | National Health Examination Survey |
| NHSO | National Health Security Office    |
| OPD  | Out-patient department             |
| RR   | Relative risk                      |
| UHC  | Universal Health Coverage          |
| WHO  | World Health Organization          |

## Acknowledgements

The authors would also like to thank Mr. Nattakrit Tongpoonsakdi for conducting a comprehensive language review of this manuscript.

## Author contributions

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

## Funding

This study was funded by the Center for Alcohol Studies (CAS), Thailand. This study was a part of PhD study at social, economic, and administrative pharmacy graduate program of Chaisiri Luangsinsiri which scholarship provided by the RGJ-Ph.D Program under the National Research Council of Thailand, Ministry of Higher Education, Science, Research and Innovation (Grant No. PHD/0061/2561). The funder and the grantor of scholarship have no role in the design of the study; in the collection, analysis, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.

## Availability of data and materials

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

## Declarations

### Ethics approval and consent to participate

The Institutional Review Board of Mahidol University, Faculty of Dentistry/ Faculty of Pharmacy has confirmed that no ethical approval is required (COE. No.MU-DT/PY-IRB 2022/019.2503).

### Consent for publication

Not applicable.

### Competing interests

This study received grant from the Center for Alcohol Studies (CAS), Thailand.

Received: 7 February 2023 Accepted: 22 November 2023

Published online: 11 December 2023

## References

1. Alcohol Collaborators. Alcohol use and burden for 195 countries and territories, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016. *Lancet*. 2018;392(10152):1015–35.
2. Manthey J, Hassan SA, Carr S, Kilian C, Kuitunen-Paul S, Rehm J. What are the economic costs to society attributable to alcohol use? A systematic review and modelling study. *Pharmacoeconomics*. 2021;39(7):809–22.
3. Rehm J, Mathers C, Popova S, Thavorncharoensap M, Teerawattananon Y, Patra J. Global burden of disease and injury and economic cost attributable to alcohol use and alcohol-use disorders. *Lancet*. 2009;373(9682):2223–33.
4. Thavorncharoensap M, Teerawattananon Y, Yothasamut J, Lertpitakpong C, Chaikledkaew U. The economic impact of alcohol consumption: a systematic review. *Subst Abuse Treat Prev Policy*. 2009;4(20):1–11.
5. Shield KD, Rehm J. Societal development and the alcohol-attributable burden of disease. *Addiction*. 2021;116(9):2326–38.
6. Yaowarat P, Punyaratabandhu P. National health examination survey III, 2003–2004. Bangkok: Health system research institute; 2006.
7. Aekplakorn W. National health examination survey V, 2014. Nonthaburi: Health System Research Institute; 2014.
8. Aekplakorn W. National health examination survey VI, 2019–2020. Bangkok: Faculty of medicine Ramathibodi hospital; 2021.
9. Yongpisanphob W. Industry Outlook 2022–2024: Beverage industry. 2022. <https://www.krungsri.com/en/research/industry/industry-outlook/food-beverage/beverage/io/io-beverage-2022>. Accessed 19 Mar 2023.
10. International Health Policy Program Foundation. Thailand burden of diseases attributable to risk factors 2014. Nonthaburi: International Health Policy Program Foundation; 2018.
11. Thavorncharoensap M, Teerawattananon Y, Yothasamut J, Lertpitakpong C, Thitiboonsuwan K, Neramitpitagkul P, et al. The economic costs of alcohol consumption in Thailand, 2006. *BMC Public Health*. 2010;10(323):1–12.
12. Komonpaisarn T. The estimation of societal cost of alcohol consumption in Thailand: the development of estimation template. Bangkok: Center for Alcohol Studies, Faculty of Economics, Chulalongkorn University; 2015.
13. Komonpaisarn T. The social cost of alcohol consumption in Thailand in 2017. Bangkok: Center for Alcohol Studies, Faculty of Medicine, Prince of Songkla University; 2019.
14. Rice DP, Hodgson TA, Kopstein AN. The economic costs of illness: a replication and update. *Health Care Financ Rev*. 1985;7(1):61–80.
15. Cost of Illness [online]. (2016). York; York Health Economics Consortium; 2016. <https://yhec.co.uk/glossary/cost-of-illness/>. Accessed 22 May 2022.
16. Tarricone R. Cost-of-illness analysis. What room in health economics? *Health Policy*. 2006;77(1):51–63.
17. Rehm J, Gmel GE Sr, Gmel G, Hasan O, Imtiaz S, Popova S, et al. The relationship between different dimensions of alcohol use and the burden of disease—an update. *Addiction*. 2017;112(6):968–1001.
18. Shield K, Manthey J, Rylett M, Probst C, Wettlaufer A, Parry CDH, et al. National, regional, and global burdens of disease from 2000 to 2016 attributable to alcohol use: a comparative risk assessment study. *Lancet Public Health*. 2020;5:e51–61.

19. Lilienfeld DE, Lilienfeld AM, Stolley PD. Foundations of epidemiology. Oxford University Press; 1994.
20. National Statistical Office. The survey of smoking and drinking behavior 2017. Bangkok: National Statistical Office; 2018.
21. World Health Organization. International guide for monitoring alcohol consumption and related harm. World Health Organization; 2020.
22. Rehm J, Probst C, Shield KD, Shuper PA. Does alcohol use have a causal effect on HIV incidence and disease progression? A review of the literature and a modeling strategy for quantifying the effect. *Popul Health Metr.* 2017;15:1–7.
23. Bagnardi V, Rota M, Botteri E, Tramacere I, Islami F, Fedirko V, et al. Alcohol consumption and site-specific cancer risk: a comprehensive dose-response meta-analysis. *Br J Cancer.* 2015;112(3):580–93.
24. Manthey J, Imtiaz S, Neufeld M, Rylett M, Rehm J. Quantifying the global contribution of alcohol consumption to cardiomyopathy. *Popul Health Metr.* 2017;15(1):20.
25. The Secretariat of the Prime Minister, Government House. Government reveals “Drink Don’t Drive” campaign reducing the number of accidents during the New Year holidays, 2021. 2021. <https://www.thaigov.go.th/news/contents/details/38075>. Accessed 8 May 2022.
26. Bureau B. Annual budget expenditures for fiscal year 2021, issue 3, vol. 12. Bangkok: Budget Bureau; 2020.
27. Bureau B. Annual budget expenditures for fiscal year 2021, Issue 3, vol. 15. Bangkok: Budget Bureau; 2020.
28. Bureau B. Annual budget expenditures for fiscal year 2022, Issue 3, vol. 12. Bangkok: Budget Bureau; 2021.
29. Bureau B. Annual budget expenditures for fiscal year 2022, Issue 3, vol. 15. Bangkok: Budget Bureau; 2021.
30. Department of Corrections, Ministry of Justice. Report of per unit production costs for fiscal year 2020. Nonthaburi: Department of Corrections; 2020.
31. The Royal Thai Police. The number of crimes prosecuted by the Royal Thai Police. 2021. [http://164.115.22.198/nso/phpview.php?folder=uploads/Fairly/File/&partfile=Data\\_09010100\\_1001.xlsx](http://164.115.22.198/nso/phpview.php?folder=uploads/Fairly/File/&partfile=Data_09010100_1001.xlsx). Accessed 12 May 2022.
32. Office of the Judiciary, Court of Justice. Annual juridical statistics Thailand 2020. Bangkok: Office of the Judiciary; 2021.
33. Office of the attorney general. Case file summary. 2021. <https://graph.ago.go.th:82/chart2.php>. Accessed 13 May 2022.
34. Department of Corrections, Ministry of Justice. Statistics of prisoners 2010-2022. 2022. <http://www.correct.go.th/stathomepage/>. Accessed 12 May 2022.
35. Laixuthai A, Sirivongsena Aydhaya A, Poshychinda V. Problem associated with alcohol consumption with the aim to identify and search for prevention strategy: lopburi case study. Bangkok: Chulalongkorn University Press; 2001.
36. The Royal Thai Police. Statistics of road traffic accident casualty and property damaged. 2022. [https://ittdashboard.nso.go.th/preview.php?id\\_project=64](https://ittdashboard.nso.go.th/preview.php?id_project=64). Accessed 16 May 2022.
37. Office of the National Economic and Social Development Council. Social situation and outlook fourth quarter 2020. Bangkok: Office of the National Economic and Social Development Council; 2021.
38. Office of the National Economic and Social Development Council. Social situation and outlook first quarter 2021. Bangkok: Office of the National Economic and Social Development Council; 2021.
39. Office of the Permanent Secretary, Ministry of Public Health. The national vital statistics system. 2022. <https://vitalstat.dcs.moph.go.th>. Accessed 22 May 2022.
40. International Health Policy Program Foundation. Causes of death in Thailand, 2017–2019. Nonthaburi: International Health Policy Program Foundation; 2021.
41. Office of the national economic and social development council. Report on economic conditions in Thailand, 2021. 2022. [https://www.nesdc.go.th/ewt\\_news.php?nid=11555](https://www.nesdc.go.th/ewt_news.php?nid=11555). Accessed May 22 2022.
42. The World Bank. GDP per capita growth (annual %)–Thailand. 2022. <https://data.worldbank.org/indicator/NY.GDPPCAPKD.ZG?locations=TH>. Accessed 22 May 2022.
43. World Health Organization. Life tables: Life tables by country Thailand. 2022. <https://apps.who.int/gho/data/view.searo.61640?lang=en>. Accessed 22 May 2022.
44. Guideline Development Working Group. Guideline for health technology assessment in Thailand updated edition: 2019. Bangkok: Health Systems Research Institute; 2021.
45. Permsuwan U, Guntawongwan K, Buddhawongsa P. Handling time in economic evaluation studies. *J Med Assoc Thai.* 2008;Suppl1 2:S53–8.
46. National Statistical Office. The labor force survey, whole Kingdom, Quarter 4 October–December 2022. Bangkok: Statistical Forecasting Division; 2023.
47. Holmes J, Meier PS, Booth A, Guo Y, Brennan A. The temporal relationship between per capita alcohol consumption and harm: a systematic review of time lag specifications in aggregate time series analyses. *Drug Alcohol Depend.* 2012;123(1):7–14.
48. Moynihan R, Sanders S, Michaleff ZA, Scott AM, Clark J, To EJ, et al. Impact of COVID-19 pandemic on utilisation of healthcare services: a systematic review. *BMJ Open.* 2021;11(3):e045343.
49. Chisholm D, Moro D, Bertram M, Pretorius C, Gmel G, Shield K, et al. Are the “Best Buys” for alcohol control still valid? An update on the comparative cost-effectiveness of alcohol control strategies at the global level. *J Stud Alcohol Drugs.* 2018;79(4):514–22.
50. Sornpaisarn B, Shield K, Manthey J, Limmade Y, Low WY, Van Thang V, et al. Alcohol consumption and attributable harm in middle-income South-East Asian countries: epidemiology and policy options. *Int J Drug Policy.* 2020;83:102856.
51. Pongutta S, Suphanchaimat R, Patcharanarumol W, Tangcharoensathien V. Lessons from the Thai health promotion foundation. *Bull World Health Organ.* 2019;97(3):213–20.
52. Kaewpramkusol R, Senior K, Chenhall R, Nanthamongkolchai S, Chaiyasong S. A qualitative exploration of Thai alcohol policy in regulating availability and access. *Int J Drug Policy.* 2018;58:1–8.

**Ready to submit your research? Choose BMC and benefit from:**

- fast, convenient online submission
- thorough peer review by experienced researchers in your field
- rapid publication on acceptance
- support for research data, including large and complex data types
- gold Open Access which fosters wider collaboration and increased citations
- maximum visibility for your research: over 100M website views per year

**At BMC, research is always in progress.**

Learn more [biomedcentral.com/submissions](https://biomedcentral.com/submissions)

