



## Research Article

### **THE ESTIMATED ECONOMIC COST OF ALCOHOL-RELATED ACCIDENT AND INJURIES IN INDONESIA**

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#### **ABSTRACT**

Alcohol consumption is associated with the risk of health problems including the risk to accident and injuries. This study aimed to estimate the Alcohol Attributable Fractions (AAF), incidence and the economic cost of alcohol-related accidents and injuries in Indonesia. This study using prevalence-based, where proportion of alcohol contribution was calculated using AAF formula. Number of accidents and injuries in Indonesia in 2016 was used to estimate the economic costs. Direct and indirect costs were calculated, including treatment cost, disability cost, transportation cost, material losses due to accident, cost of premature mortality and loss of income due to disability using human capital approach. The total economic cost of alcohol-related accidents and injuries in Indonesia 2016 was estimated as 895 billion IDR, represent 0.01% of Indonesia's Gross Domestic Product (GDP) in 2016. It consisted of total direct cost accounted for 233 billion IDR (26%) and indirect costs at 661 billion IDR (74%). The largest cost component was premature mortality, 660 billion IDR (73.8%), and total cost per victim was also estimated at 315 million IDR. Alcohol-related accidents and injuries impose the high economic cost. Indonesia's government should give more attention to reduce the alcohol consumption and improve the alcohol policy.

**Keywords:** Alcohol, accidents, injuries, economic costs, Indonesia

#### **INTRODUCTION**

Alcoholic beverages are widely consumed throughout the world. The harmful use of alcohol considered as one of the world's leading health risks. Alcohol consumption is associated with the risk of health problems such as mental and behavioral disorders, including alcohol dependence to the accidents and injuries.<sup>1</sup> According to the WHO global survey, deaths due to alcohol reached 3.3 million per year. Accidents also represent a major public health issue around the world and one of the leading causes of death and injuries worldwide.<sup>2</sup> The consumption of alcohol represents an increasing risk in the severity of the injuries, hospitalization periods and healthcare costs.<sup>3, 4</sup> Moreover, productivity loss, cost of property damage, funeral if the victim dies and cost of law are the other impact of the accident that must be considered<sup>5</sup>.

The estimation of accidents due to alcohol consumption was being performed worldwide and become the standard reporting in developed countries. The incidence of alcohol-related accidents has been identified to be an economic burden for almost all countries and requires very high cost of treatment depends on severity, legal fees and the cost of accidental damage.<sup>4</sup> Therefore, studies estimating the economic burden of alcohol-related accident in Indonesia with alcohol attributable approach are considered fundamental for public awareness about harmful effect of alcohol consumption include its cost. This also can be taken into consideration for the government to carry out accident prevention and control strategies. Then, this was the first study provided the economic cost alcohol-related accident and injuries in Indonesia from societal view.

#### **METHODS**

This study design was cost of illness study which using prevalence-based to estimate the economic costs of alcohol-related accident and injuries in Indonesia 2016. This study used the database from Indonesia's Social Security Administrative Body, for incidence of accidents and accident cost data including treatment and indirect costs in 2016. The material loss data were retrieved from national and regional police office data. The prevalence of alcohol consumption in Indonesia was obtained from the WHO Global Status Report on Alcohol. Alcohol consumption prevalence for male was 4.9% and female was 0.3% of the total population. In total, about 2.6% of both sexes drunk the alcohol in 2016.

The estimated of relative risk for injury accidents caused by alcohol was obtained from meta-analysis of epidemiological studies by Shield in 2012.<sup>6</sup> The injury classified into intentional injury, falls, motor vehicle accident and other unintentional. Relative risk (RR) of injury because of fall is about 1.25, substantially higher than relative risk of motor vehicle accident, accounted for 1.24.<sup>7</sup>

Both prevalence and RR were used to calculate Alcohol Attributable Fraction (AAF) and Alcohol Attributable Incidence (AAI). The costs component consisted of into direct and indirect costs. Direct costs include treatment cost, disability cost, transportation cost and material losses or property damage, while indirect costs were examining the cost of premature mortality and loss income from disability. One-way sensitivity analysis was

performed to identify the variables that potentially lead to significant changes in the results of the study.

#### Alcohol Attributable Fraction (AAF) calculation

Alcohol attributable fraction is an approach to measure the proportion of drinking-related harm, e.g. illness, injury, death and crime attributable to alcohol. AAF is also defined as the proportion of accident and injuries caused by alcohol. It was estimated from relative risk (RR) of accidents compared to the prevalence of alcohol consumption (p) with the AAF formula.

$$AAF = \frac{p(RR - 1)}{1 + p(RR - 1)}$$

#### Alcohol Attributable Incident (AAI) calculation

Alcohol attributable incident (AAI) is a number of events of accident or injuries related to alcohol. This was calculated by multiplying AAF with incidences.

#### Direct costs

The direct cost of alcohol-related accidents was calculated by multiplying the number of accidents and injuries due to the AAI with an average treatment cost of accidents or injuries, and material losses of accidents. Treatment cost, disability cost and transportation for the category of accidents per patient was obtained from the data of Universal Health Coverage Employment Data in 2016 and material losses cost was obtained from National Police database.

#### Indirect costs

Indirect costs component were consisted of cost of premature mortality and loss income from disability.

#### Cost of premature mortality

The costs of productivity loss due to premature mortality was calculated as the products of the total number of alcohol attributable mortality by age and the present value of age adjusted earnings lost. This study applied discount rate of 3% based on The Organization for Economic Co-operation and Development (OECD). Alcohol attributable mortality (AAM) was calculated by combining the total number of deaths in age category with the specific AAF. The average wage was also obtained from Universal Health Coverage This calculation of premature mortality considered the age of retirement in Indonesia, 60 years old on average. Since there were also some non-formal worker which has no retirement age, then we compare the cost of premature mortality with and without age of retirement.

#### Loss income from disability

Meanwhile, the estimated loss income from absenteeism due to disability was also using the average wage and the average number of absent day from Universal Health Coverage Data. The average victims absent to work were approximately 98 days or 3.2 month (from serious to minor injuries). Then alcohol attributable disability can be estimated by combining number of disability and each AAF.

## RESULTS

### Alcohol attributable fraction (AAF) of accident and injuries

The largest proportion of AAF in men was injuries (55%), followed by accident (54%). Meanwhile, the AAF value in women on injuries also higher than accident, were 7% and 6.7%, respectively. In both gender, AAF value in aged <25 to 40 was higher than the older, as much as 92%, while the older age was 86%. The incidence of injuries including motor vehicle accidents in 2016 were 101,367 victims (Table 1).

### The incidence of alcohol-related injuries and accidents

The total of alcohol attributable incidence of injuries in both gender was higher than accidents. The alcohol attributable incidence of injuries was estimated at 68% and for accident about 32% from total AAI. The AAI in injury category for men took the highest amount, which is 28,621, followed with AAI of motor vehicle accident (MVA) in men 12,598, injury in women was 804 victims, while the AAI of MVA in women was 977. The incident of alcohol-related accident and injuries was estimated took 42% from common incidents of accident and injuries in Indonesia.

### Deaths from alcohol-related accident and injuries 2016

Patients on age 26-40 had highest number of deaths as much as 887 or 41% of total deaths, followed by aged 41-55 (37%) (Table 2). This findings were in accordance with literature, where the estimated highest number of deaths from alcohol-attributable conditions occurred in the age ranged 45-64 years.<sup>3</sup>

The total economic cost of alcohol-related accident and injuries in Indonesia 2016 was estimated at approximately IDR 895 billion or US\$ 67 million as shown in Table 3. This represents 0.01% of GDP Indonesia. In this finding we highlighted that the indirect cost outweigh the direct cost, representing as amount as IDR 661 million (74%) of the total cost. The largest proportion was cost of premature mortality, IDR 660,090 million (73.8% of the total cost), and the rest of indirect cost was loss income due to disability, accounted for IDR 925 million (0.1%). In term of direct cost, treatment costs were shown to be the largest portion of direct cost with the estimated value was IDR174,309 million (19.5%), followed by estimation of material losses was IDR 19,812 million (2.2%) and transportation cost IDR 1,887 million (0.2%) (Table 4).

As shown in Table 4, about 51% injuries direct cost and 42% of accident direct cost were attributable to alcohol. In all categories, 47% of total costs were related to alcohol. Cost of premature mortality represents 97.5% of total indirect cost and total indirect cost per victim was estimated as much as IDR 313.66 million or US\$23,570.

A number of sensitivity analyses were conducted to examine whether the results were sensitive to the changes of important parameters. Three different quantities were used for each prevalence and RR changed, showing increases in binge drinking quantity. This meant from the original per occasion for men and women, while consumption level was decreased 5%, increased 10%, 20% from the origin data. For more detail, this study also using of alternative discount rates (0% and 6%) and show the effect of excluding and including the retirement age in cost of premature mortality. According to the result of sensitivity analysis, found that increasing prevalence or relative risk (RR) of alcohol consumption in Indonesia led to increasing AAF, alcohol attributable incident included deaths and disability, and the economic cost alcohol-related accident and injuries in Indonesia.

In contrast, if the prevalence of drinkers and RR alcohol-related accident and injuries were decrease even just 5%, then AAF, alcohol attributable incidents and the economic cost were also decrease (Table 5). Then, it is important to make efforts in

reducing the prevalence and RR of alcohol consumption by restricting alcohol availability through government control of alcohol distribution and sales can be done.

**Table 1: Proportion alcohol-related accident and injury in AAF**

No	Category	GBD code	Alcohol Attributable Fraction (AAF) %	
			Male	Female
1	Injuries	III A 1	55	7
2	Accident	III A	54	6.7

**Table 2: Alcohol attributable deaths caused by accident and injuries in Indonesia**

Age category	Deaths of accident and injuries	Alcohol attributable deaths	Alcohol attributable deaths (%)
<25	351	326	0.93
26-40	955	887	0.93
41-55	907	785	0.87
>55	169	147	0.87
Total	2,382	2,145	0.90

**Table 3: The estimated cost of premature mortality**

Age category	Number of deaths	Alcohol attributable mortality (AAM)	Years of life lost (YLL)	Cost of premature mortality (IDR million)
<25	351	326	11,403	149,673
26-40	955	887	23,962	344,925
41-55	907	785	9,421	157,927
>55	169	147	513	7,565
Total	2,382	2,145	45,299	660,090

**Table 4: The estimated economic cost of alcohol-related accident in Indonesia**

Direct costs	Total (IDR million)	Due to injuries (IDR million)	Due to accident (IDR million)
Treatment cost	174,309	116,729	57,579
Transportation cost	1,887	1,264	623
Disability cost	37,293	26,380	10,913
Material loss	19,812	-	19,812
	233,300	144,373	88,927
Indirect costs			
Premature mortality cost	660,090		
Loss income from disability	925	636	290
	661,015	636	290
Total cost	894,315	145,008	89,217
Total (US\$)	67,201,283	10,896,324	6,703,978

**Table 5: Summary of sensitivity analysis for total estimated costs**

Parameter	Method	Total estimated costs (IDR billion)
Prevalence	decrease 5%	886.6
	base case	894.3
	increase 10%	911.2
	increase 20%	925.3
RR	decrease 5%	859.0
	base case	894.3
	increase 10%	946.8
	increase 20%	981.9
Discounting rate	0%	1219.0
	3% (base case)	894.3
	6%	728.7
Premature mortality cost	with retirement age (base case)	894.3
	without retirement age	1123.2

## DISCUSSION

Alcohol consumption imposes substantially high economic impact, estimated as 895 billion IDR or US\$ 67 million, about 0.01% of GDP Indonesia 2016. Previous studies also showed the high cost of alcohol, for example, in Thailand the economic cost reach 156 billion baht or US\$ 9627.2 million.<sup>8</sup> In Scotland, the total cost reach £3.6 billion. Another cost of alcohol study from the Northern Irish calculated the external costs of alcohol misuse to be an annual £679.8 million.<sup>4</sup>

In Sri Lanka, the direct and indirect costs of alcohol was estimated to be Rs. 209.03 billion (US\$ 1,548.37 million) for the year 2015.<sup>9</sup> Same pattern in treatment cost, the injuries or accidents direct cost attributable to alcohol also have been found higher in previous studies. In Thailand, total direct cost of traffic accident reached 6,775 million Baht or US\$ 202.97 million.<sup>8</sup> The average total cost of medical care per patient was 628 USD or IDR 8 million, in Bogota-Colombia.<sup>5</sup>

A systematic review found that alcohol contributes substantial intangible cost. Cost of premature mortality had the largest part in contributing to the total indirect costs in just over half of the studies. Although, some studies found the cost of reduced productivity accounted for the highest proportion of the total indirect cost. Total cost as % GDP ranged from 0.6% to 5.44% with cost per capita ranged from 85.53 US\$ PPP to 1,012.21 US\$ PPP. Meanwhile, total direct cost as percentage of GDP ranged from 0.08% to 0.81%.<sup>10</sup>

One other study of such estimates also found that the weighted average total cost of alcohol to society in high-income countries is 2.5% of GDP.<sup>11</sup> In other analysis pulling together cost studies from four high-income countries and two middle-income countries, the total costs attributable to alcohol ranged from 1.3% to 3.3% of GDP.<sup>3</sup> In India 2007, road traffic injuries resulted in economic losses to the tune of 3% of the GDP India.<sup>12</sup>

Even had lower total alcohol consumption and lower cost than any developed countries, Indonesia must be aware about this, because there were illegal alcohol distribution and the data above merely recorded cases.<sup>13</sup> Indonesia still lack of alcohol policy indeed, can be predicted the cases will increase within several years. Government could control of alcohol distribution and sales.<sup>14</sup> Awareness raising activities are among the most common measures taken by governments. Over 152 countries reporting undertaken the same alcohol awareness campaign in the past three years.<sup>13</sup>

According to the latest data on alcohol excise, the excise tax of alcohol was ranged from 13 thousand IDR to 80 thousand IDR per liter of alcohol. This study points out the fact that economic cost related to alcohol substantially exceeded its revenue generated from Indonesian government.<sup>15</sup>

Our study is further limited by lack of some information. Because of limited data, we were unable to determine specific type of victims. We were also unable to quantify the cost of premature mortality by gender and each category of injuries. This lack of data leads to two different prevalence being used for AAFs, prevalence by gender and both sexes were used. This study is also limited by using the other counties RR because there was no specific study about RR alcohol-related injuries in Indonesia. Then, using RR both gender because there was no study had detail RR for each category vehicle accident and other injuries per gender. We suspect that the risk relationship may change by injury type and actually, in men category different with women. However, the risk estimates for accident and injuries were not

stable. Lastly, this study just identified alcohol-related accident and injuries in the workers aged between 15 and 60 years old, and excluded those who were older or unemployed or in informal sector.

In conclusion, alcohol-related accident and injuries imposed the substantial economic cost. Indonesia's government should give more attention to reduce the alcohol consumption and improve the alcohol policy.

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## REFERENCES

1. Clausen T, Martinez P, Towers A, Greenfield T, Kowal P. Alcohol consumption at any level increases risk of injury caused by others: Data from the study on Global AGEing and Adult Health. *Subst Abuse*. 2015;9((Suppl 2)):125-32.
2. World Health Organization. *World Health Statistics - Monitoring Health For The SDGs*. World Health Organization, Geneva. 2016.
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. Institute for Alcohol Studies. *The Economic Impacts of Alcohol*. London: The Institute of Alcohol Studies, 2016.
5. Gómez-Restrepo C, Naranjo-Lujan S, Rondón M, Acosta A, Maldonado P, Arango Villegas C, et al. Costs of health care and influence of alcohol in traffic accidents in Bogota-Colombia. *J Clin Epidemiology*. 2016;86(1):106-10.
6. Shield KD, Gmel G, Patra J, Rehm J. Global burden of injuries attributable to alcohol consumption in 2004: a novel way of calculating the burden of injuries attributable to alcohol consumption. *Popul Health Metr*. 2012;10(9):1-8.
7. Taylor B, Irving HM, Kanteres F, Room R, Borges G, Cherpitel C, et al. The more you drink, the harder you fall: A systematic review and meta-analysis of how acute alcohol consumption and injury or collision risk increase together. *Drug Alcohol Dependence*. 2010;110(1-2):108-16.
8. Thavorncharoensap M, Teerawattananon Y, Yothasamut J, Lertpitakpong C, Thitiboonsuwan K, Neramitpitagkul P, et al. The economic costs of alcohol consumption in Thailand 2006. *BMC Pub Health*. 2010;10(1):1-7.
9. World Health Organization. *Economic and Social Costs of Tobacco and Alcohol in Sri Lanka 2015*. Geneva: World Health Organization, 2017.
10. Thavorncharoensap M, Teerawattananon Y, Yothasamut J, Lertpitakpong C, Chaikledkaew U. The economic impact of alcohol consumption: A systematic review. *Substance Abuse Treatment, Prev, Policy*. 2009; 4(1):20-8.
11. Connor J, Kydd R, Shield K, Rehm J. The burden of disease and injury attributable to alcohol in New Zealanders under 80 years of age: marked disparities by ethnicity and sex. *New Zealand Med J*. 2015;128(1):108-12.
12. Gururaj G. Road traffic deaths, injuries and disabilities in India: Current scenario. *National Med J India*. 2008;21(1):14-20.
13. World Health Organization. *Global Status Report on Alcohol and Health*. Geneva: World Health Organization, 2014.
14. Gómez-Restrepo C, Gómez-García MJ, Naranjo S, Rondón MA, Acosta-Hernández AL. Alcohol consumption as an incremental factor in health care costs for traffic accident victims: Evidence in a medium sized Colombian city. *Accident Anal Prev*. 2014;73:269-73.

15. Ministry of Finance Republic of Indonesia, Rule number 207/PMK.011/2013 about Alcohol taxation policy, Jakarta: Ministry of Finance, 2013.

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