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Research Paper

Alcohol consumption and attributable harm in middle-income South-East Asian countries: Epidemiology and policy options

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ABSTRACT

Background Factors and policies which potentially explain the changes in alcohol consumption and related harms from 2010 to 2017 in 11 middle-income countries in the South-East Asian region (Cambodia, Lao PDR, Indonesia, the Philippines, Malaysia, Maldives, Myanmar, Sri Lanka, Thailand, Timor-Leste, and Vietnam) were examined.

Methods Using secondary data from UN agencies, we analyzed trends in alcohol consumption, alcohol-attributable deaths and the burden of disease.

Results Starting from a level of consumption significantly below the global average—especially among the Muslim-majority countries (Maldives, Indonesia, and Malaysia)—the majority of the countries in this region had markedly increased their alcohol consumption along with the economic development they experienced between 2010 and 2017. In fact, five middle-income countries in this region (Vietnam, Lao PDR, Cambodia, Myanmar, and Timor-Leste) were in the top 12 countries globally based on absolute increases in adult alcohol *per capita* consumption (APC). The Philippines and Malaysia were the exceptions, as they had reduced their APC over this period. The majority of South-East Asian countries had parallel increasing trends in the age-standardized alcohol-attributable deaths and DALYs since 2010, in contrast to global trends. While all countries put some alcohol control policies in place, there were differences in the number and strength of the policies applied, commensurate with trends in consumption. In particular, three of the countries which were most successful in reducing consumption and harm (Malaysia, Philippines, and Sri Lanka) applied more effective tax methods based on specific taxation alone or in combination with another taxation method, applying higher taxation rates and regularly increasing them over time.

Conclusion To achieve the global target and the Sustainable Development Goal in reducing alcohol consumption worldwide, middle-income countries, especially lower-middle-income countries, should employ stricter alcohol control policies, and apply an appropriate excise tax on alcohol products with regular increases to reflect inflation.

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Introduction

Alcohol continues to be an important risk factor for global burden of disease (Rehm & Imtiaz, 2016; Shield et al., 2020). In 2016, globally, alcohol caused an estimated 3.0 million deaths (5.3% of all deaths) and a loss of 131.4 million disability-adjusted life years (DALYs) (5.0% of all DALYs). However, despite international efforts and treaties aimed at reducing the harmful use of alcohol, alcohol exposure more or less stagnated between 2010 and 2017 with 6.4 (95% CI: 6.2 to 6.6) and 6.5 (95% CI 6.0 to 6.9) litres/year adult *per capita* consumption, respectively (this represented an increase of +1.0% (95% Confidence Interval (CI): −6.1 to 8.1); calculations based on (Manthey et al., 2019)).

This stability masks some general developments for the period from 2010 to 2017: for instance, lower- middle-income countries increased their consumption markedly (+21.2%, 95% CI 8.9 to 34.0%) (Manthey et al., 2019), while upper-middle income and low-income countries decreased their consumption. Moreover, there has been high variability in APC within income groups (Manthey et al., 2019).

In 2017, South-East Asia as a region still consumed less than the global average (69% of global; or 4.5 vs 6.5 litres APC), but with high variations amongst countries (see Fig. 1). At the lower end was Indonesia, with an 87.2% Muslim population, at 0.8 litres APC (95% CI 0.7 to 0.9), and at the higher end was Lao PDR with an APC of 10.6 litres (95% CI 9.7 to 11.5). The other two Muslim-majority countries, also had significantly lower APCs compared to the average: Malaysia (61.3% Muslim population) at 0.9 litres APC ((95% CI 0.6 to 1.2), and Maldives (100% Muslim as per law) at 2.5 litres APC (95% CI 1.6 to 3.5), but in the latter country we cannot be sure if tourist consumption was entirely accounted for.

For the region, the APC for 2017 (4.5, 95% CI 4.0 to 5.0) represented a 0.9 litre per adult (27.0%, 95% CI 11.0 to 43.8%) increase compared to 2010 (3.5, 95% CI: 3.3 to 3.7), and a 139% (95% CI: 112 to 167%) increase compared to 1990 (all numbers are based on Manthey et al., 2019). In addition, the region was home to some of the countries with the highest increase in APC worldwide, both in absolute and relative terms, while other countries in the region showed either no change or even a decrease in APC. These trends and their potential causes have not yet been described.

Accordingly, it is the aim of the present study to (i) examine trends in alcohol consumption and alcohol-attributable harm; (ii) investigate potential explanations for changes in alcohol consumption and alcohol-attributable harm, such as economic, cultural, and religious factors; and (iii) suggest potential policies to reverse or diminish increases in alcohol consumption and alcohol-attributable harm that threaten public health, using case examples from the South-East Asian region.

Methods

We defined the region of middle-income South-East Asia in a similar manner to the Global Burden of Disease Study (GBD) (Institute for Health Metrics and Evaluation (IHME), 2019) by including 11 middle-income countries: Cambodia, Indonesia, Lao People's Democratic Republic (Lao PDR), Malaysia, Maldives, Myanmar, the Philippines, Sri Lanka, Thailand, the Democratic Republic of Timor-Leste (Timor-Leste), and Vietnam. While all of these countries were middle-income countries in 2017, there were some upward changes in ratings for some countries in the World Bank income classification system during the study period (Lao PDR, 2010; Cambodia, 2015 and Myanmar, 2015: change from low-income to lower-middle-income country; Maldives, 2010; Sri Lanka, 2018, and Thailand, 2010: change from lower-middle to upper-middle income country; The World Bank, 2020).

Our study design employed retrospective data analyses to explore trends in alcohol consumption, attributable death and burden of disease among middle-income countries in the South-East Asia region, and potential explanations for changes in alcohol consumption and its related harms, including macroeconomic and socio-cultural indicators. Factors which might explain these changes include economic development; proportion of the Muslim population; share of female graduates from science, technology, engineering, and mathematics programs in tertiary education; as well as alcohol control policies implemented by the countries' governments.

Data on the alcohol-attributable burden of disease were calculated based on Shield and colleagues (Shield et al., 2020). Data on economic development as measured by *per capita* gross-domestic product adjusted for purchase power parity were obtained from the World Bank

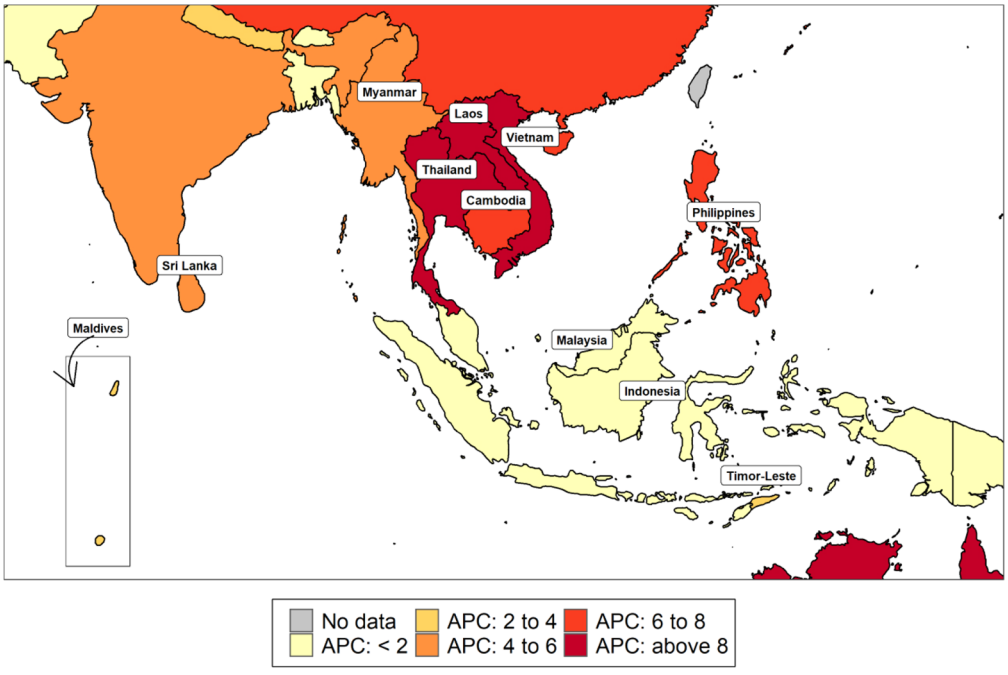

Fig. 1. Map of South-East Asia and adult *per capita* alcohol consumption in 2017.

(World Bank, 2017). In terms of other potential underlying reasons (for influencing factors on alcohol consumption, see Probst, Manthey & Rehm, 2017), the following data sources were used: alcohol control policy data were derived from the WHO Global Status Reports of 2014 and 2018 (World Health Organization, 2014, 2018), which are based on surveys completed by all member states in 2010 and 2016, respectively (for a description of methodology, see Poznyak et al., 2013). Target countries' policy-related gray literature published in English was also reviewed. The proportion of the Muslim population in 2010 and 2017 was taken from Grim and Karim (2011), and the share of female graduates from science, technology, engineering and mathematics programs in tertiary education in 2010 and 2017 (as a measure of emancipation) was taken from the Human Development Report (United Nations Development Programme, 2019).

Results

Trends in the level of alcohol consumption and attributable harm in South-East Asia

Fig. 2 illustrates the absolute (with 95% CI) and relative changes in APC between 2010 and 2017 for 11 middle-income South-East Asian countries, and globally. Analyses of global alcohol consumption trends show that five middle-income South-East Asian countries are among the 12 countries with the highest increasing consumption globally (in order of highest increases: Vietnam, Lao PDR, Cambodia, Myanmar, Timor-Leste; see Supplementary Materials Table S1), but they are also countries with stable or decreasing APC levels (the latter includes Malaysia and the Philippines).

With increasing consumption, in most of these countries, age-standardized alcohol-attributable rates of mortality and burden of disease in disability-adjusted life years lost (DALYs) increased in the past years as well (calculations based on Shield et al., 2020). In 2016, a total of 196,600 deaths and 8,950,000 DALYs in the South-East Asian region were attributable to alcohol consumption, representing 4.4% of all deaths and 4.3% of all DALYs. When compared to 2010, the age-standardized alcohol-attributable burden of deaths and DALYs increased by 6.3% and 5.4%, respectively. This increase in the age-standardized burden of disease between 2010 and 2016 is behind only South Asia (10.7% and 8.0% increase in alcohol-attributable deaths and DALYs, respectively), and the high-income North American regions (9.1% and 7.5% increase in alcohol-attributable deaths and DALYs, respectively).

Stratified by disease, condition, and injury, the age-standardized alcohol-attributable burden of disease decreased by 1.3% and 3.3% for communicable, maternal, perinatal and nutritional deaths and DALYs, respectively; increased by 9.8% and 8.1%, for noncommunicable deaths and DALYs, respectively; and increased by 4.2% and 4.9% for injury deaths and DALYs, respectively. The increase in the burden of alcohol-attributable burden of disease was observed for both men and women, with the age-standardized alcohol-attributable burden of deaths and DALYs increasing by 7.3% and 6.2%, respectively, among men, and 3.8% and 2.8%, respectively, among women. (See Supplementary Materials Table S2 and S3 for alcohol-attributable deaths and DALYs in South-East Asia in 2016 by cause, respectively.)

At the country level, the alcohol-attributable age-standardized burden of deaths ranged from 9.5 per 100,000 for Maldives to 81.3 per 100,000 for Laos PDR, and similarly the alcohol-attributable age-standardized burden of DALYs ranged from 341.1 per 100,000 for Maldives to 3067.8 per 100,000 for Lao PDR. The change in the age-standardized alcohol-attributable deaths rates between 2010 and 2016 ranged from −15.1% for the Philippines, and 85.7% for Timor-Leste, while the change in the age-standardized alcohol-attributable DALYs rates ranged

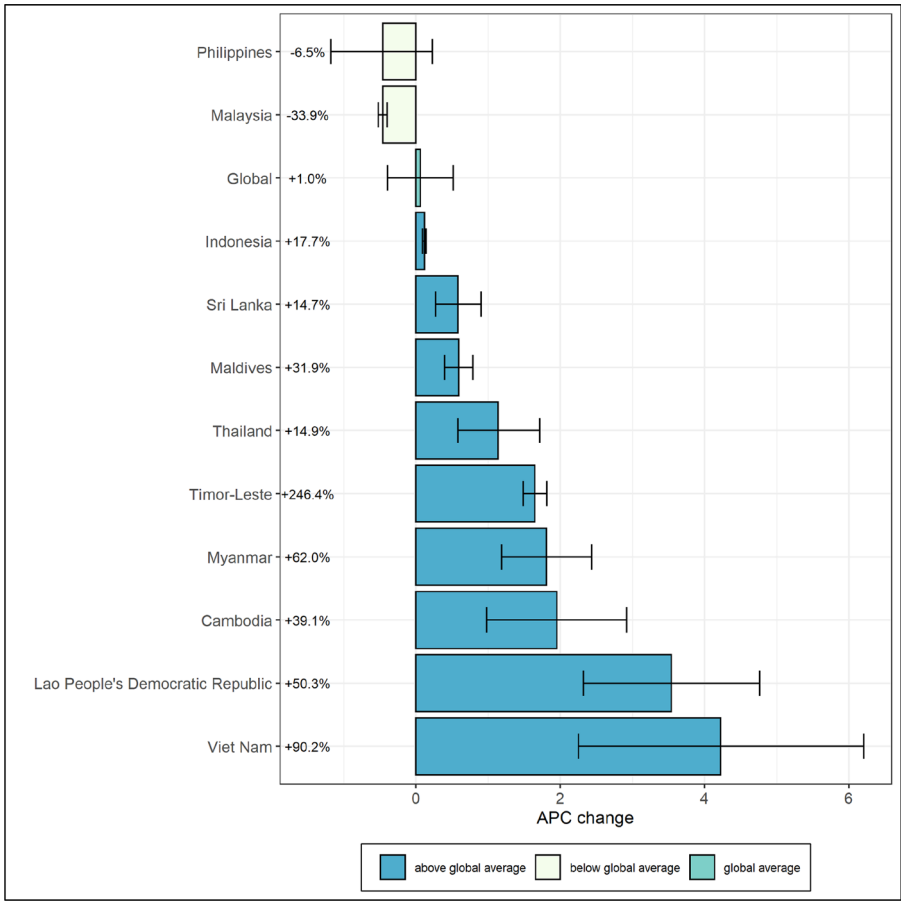

Fig. 2. Absolute and relative change in APC between 2010 and 2017 for South-East Asian countries and globally.

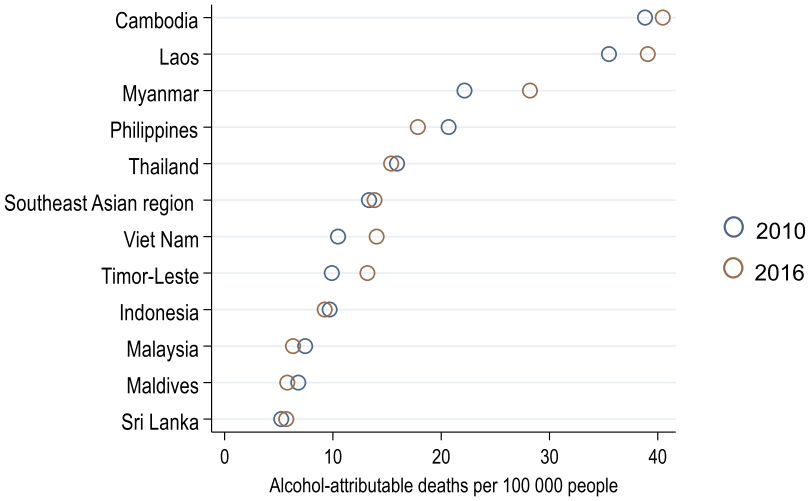

Fig. 3. Age-standardized alcohol-attributable death rates in 2010 and 2016 by country in the South-East Asian region.

from −13.0% for the Philippines, to 53.0%% for Timor-Leste (see Figs. 3 and 4 for further details and see Supplementary Materials Figs. S1 and S2 for 95%CIs).

Reasons for changes in alcohol consumption per capita

In Fig. 5, the proportional changes between 2010 and 2017 in APC and all three indicators are plotted for six groups of countries: globally (N = 189), South-East Asian countries (N = 11), low income (N = 35), lower middle income (N = 53), upper middle income (N = 52) and high income (N = 49), with income classification based on the year 2010. South-East Asian countries fall into lower-middle and upper-middle-income groups. In short, South-East Asia showed very similar trends to all lower-middle-income countries, e.g., for APC and the proportion of female graduates. In addition, economic growth in South-East Asia matched trajectories of other lower-middle and upper-middle income countries in other areas of the world. The only exception to this pattern was seen in the South-East Asian Muslim populations, which proportion increased at a slower pace.

For a clear understanding regarding the link of economic growth and changes in APC, see Fig. 6. This figure shows plots of the absolute changes in APC and the relative changes in GDP-PPP *per capita* between 2010 and 2017 for all 11 middle-income countries in the South-East Asian region included in our study. Only a clear link of economic growth and increases in APC could be observed; however, this was not significant due to the small number of countries included (Pearson correlation: r = 0.443, p = .173). Globally—i.e., for 189 countries—this link was much weaker (Pearson correlation: r = 0.171, p = .019).

Policy options

Tables 1 and 2 show proven-effective alcohol control policies applied in the 11 middle-income South-East Asian countries in 2010 and 2016 according to the WHO Global Reports on Alcohol and Health 2014 and 2018, respectively (World Health Organization, 2014, 2018); for the effectiveness of alcohol policies see (Babor et al., 2010; Chisholm et al., 2018). In particular, we compared the five countries with the highest increases in absolute APC between 2010 and 2017 (Vietnam, Lao PDR, Cambodia, Myanmar, and Timor-Leste) with three better-situation countries (the Philippines, Malaysia, and Sri Lanka). The Philippines and Malaysia had decreased their APC between 2010 and 2017. Sri Lanka had modestly increased its absolute APC while its economic growth was highest in the region during the same period. For a crude analysis, we added all sub-items of policies applied by each country, the sum of which could reach as high as 25. It can be readily observed that in 2010 the number of policies employed in the countries with the highest increase in absolute APC was smaller compared to the other three countries (average of 12 and 19 sub-items, respectively). To give some highlights: only two out of the five worse-situation countries

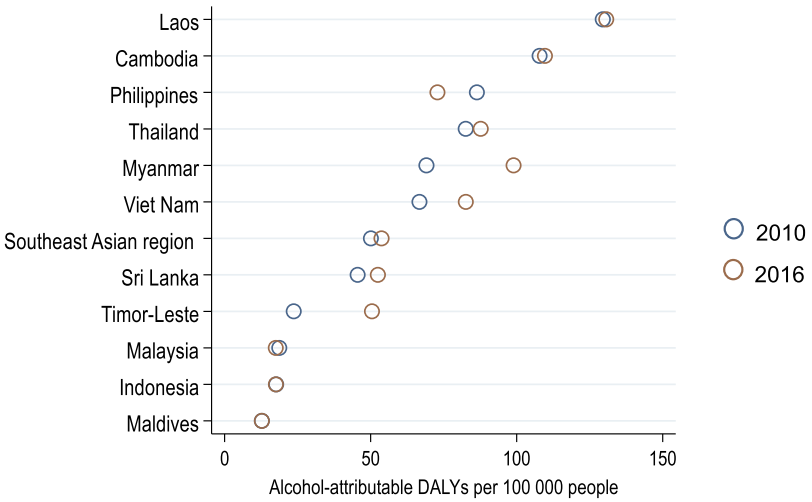

Fig. 4. Age-standardized alcohol-attributable disability-adjusted life years lost rates in 2010 and 2016 by country in the South-East Asian region.

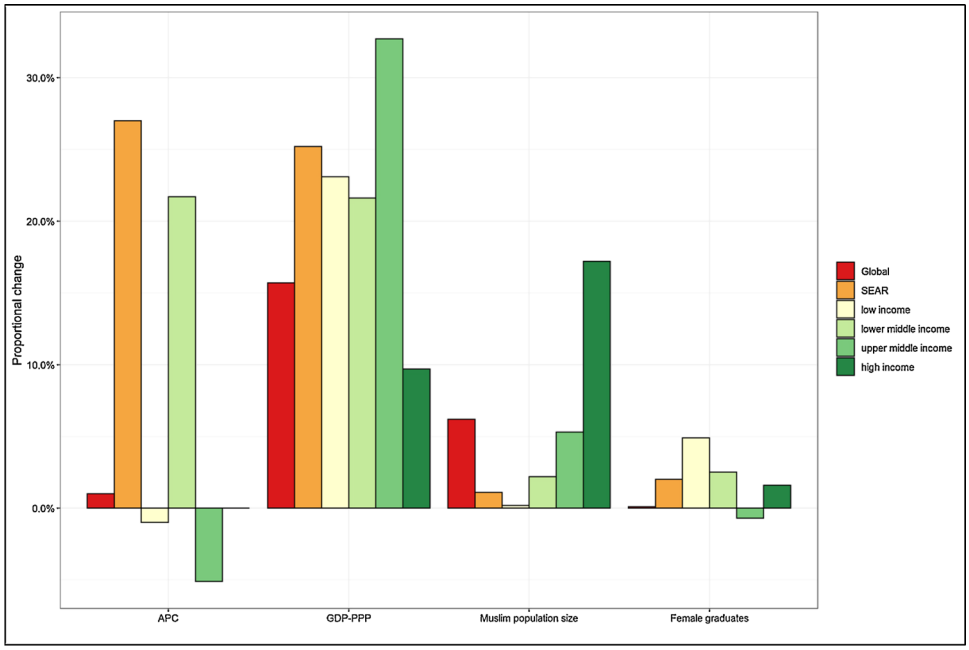

Fig. 5. Proportional change from 2010 to 2017 in adult *per capita* consumption, female graduates, gross domestic product *per capita* (adjusted for purchase power parity) and the percent of the population which identifies as Muslim.

had a minimum legal purchasing age (MLPA), and the highest MLPA of these was set at 18 years old, while all three better-situation countries had a MLPA, with the highest MLPA being set at 21 years old. On the other hand, it should be noted that the five worse-situation former countries had a stricter level for the legal blood concentration (BAC) than the three better-situation countries. However, this policy mainly affects traffic injury, a minor part of all alcohol-attributable deaths and DALYs. Most countries in this region had increased the number and strength of their alcohol control policies between 2010 and 2017, except for Cambodia, Indonesia, and Timor-Leste.

Supplementary Materials Box S1 illustrates the alcohol tax methods and tax rates applied in the five countries with the highest-increasing alcohol consumption in the region compared to three good-practice countries (the Philippines, Malaysia, and Sri Lanka). These five countries did not use the specific taxation method, either alone or in combination with another method. In contrast, both the Philippines and Malaysia combined both ad valorem and specific taxation methods, and Sri Lanka employed the specific taxation method. Furthermore, tax rates have been raised heavily and then regularly increased in these three countries. The specific taxation method involves placement of a tax on the alcohol content of an alcoholic beverage, while the ad valorem taxation method is a tax based solely on the price of an alcoholic beverage.

To see how intensive alcohol control policies can be applied in a middle-income country, Box 1 demonstrates the comprehensive alcohol control measures employed in Sri Lanka. Sri Lanka completely bans alcohol advertising, sponsorship, and alcohol sale promotion. Moreover, alcohol cannot be sold to minors under 21 years of age, and alcohol sales using automatic vending machines are prohibited.

Discussion

Starting from a level of consumption significantly below the global average, especially among Muslim-majority countries, the majority of

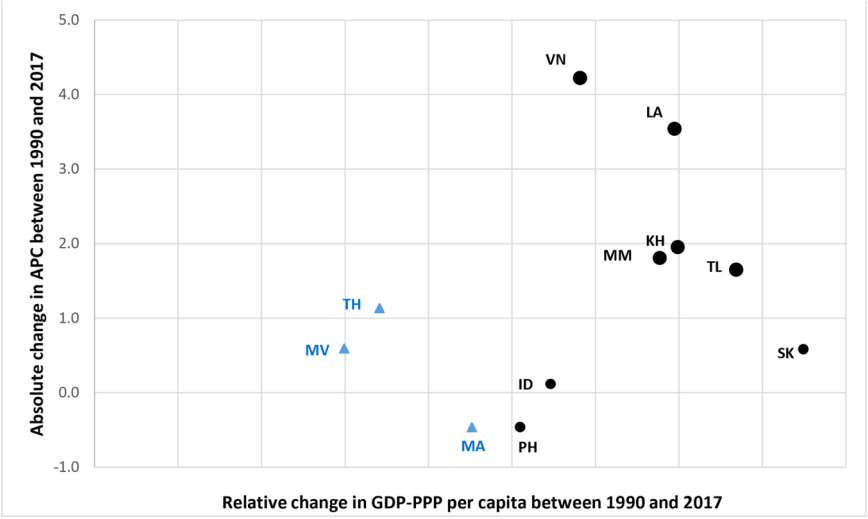

Fig. 6. Scatter plot between the relative change in GDP-PPP *per capita* (x-axis) and the absolute change in APC (y-axis) between 1990 and 2017 for 11 middle-income South-East Asia countries.

Table 1
Alcohol control policies put into effect in 11 middle-income South-East Asian countries in 2010.
Source: World Health Organization (2014, 2018), with the correction from the country experts.

	Policy			Vietnam	Lao PDR	Cambodia	Myanmar	Timor-Leste	Philippines	Malaysia	Sri Lanka	Indonesia	Maldives	Thailand
1	Excise		beer	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Total ban	Yes
2			wine	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Total ban	Yes
3			spirits	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Total ban	Yes
4	MLPA	off-premise	beer	18	No	No	18	No	18	18	21	21	Total ban	20
5			wine	18	No	No	18	No	18	18	21	21	Total ban	20
6			spirits	18	No	No	18	No	18	18	21	21	Total ban	20
7		on-premise	beer	18	18	No	18	No	18	18	21	21	Total ban	20
8			wine	18	18	No	18	No	18	18	21	21	Total ban	20
9			spirits	18	18	No	18	No	18	18	21	21	Total ban	20
10	Restrictions for on-/off-premise sales	hours		No	No	No	Yes	No	Yes	Yes	No	No	Total ban	Yes
11		days		No	No	No	No	No	No	No	Yes	No	Total ban	Yes
12		places		Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Total ban	Yes
13		density		No	No	No	Yes	No	No	Yes	Yes	No	Total ban	No
14		special events		No	Yes	No	Yes	No	No	Yes	Yes	No	Total ban	No
15		intoxicated persons		No	No	No	Yes	No	No	Yes	No	No	Total ban	Yes
16		petrol stations		No	No	No	No	No	No	No	Yes	No	Total ban	Yes
17	BAC	general		0.00	0.08	0.05	0.07	0.05	0.05	0.08	0.08	0.00	Total ban	0.05
18		young		0.00	0.08	0.05	0.00	0.05	0.05	0.08	0.08	00.0	Total ban	0.05
19		professional	(in%)	0.00	0.08	0.05	0.00	0.05	0.05	0.08	0.08	0.00	Total ban	0.05
20	Legally binding regulations	advertising		Yes	No	Yes	Yes	No	No	Yes	Yes	Yes	Total ban	Yes
21		product placement		Yes	No	No	Yes	No	No	Yes	Yes	Yes	Total ban	Yes
22		sponsorship		No	No	No	Yes	No	No	No	Yes	Yes	Total ban	Yes
23		sales promotion		No	No	No	No	No	No	No	Yes	Yes	Total ban	Yes
24	Legally required health warning	advertisements		No	Yes	No	No	No	Yes	No	No	NA	Total ban	Yes
25		containers		No	Yes	No	No	No	Yes	No	No	Yes	Total ban	Yes
		Number of policies applied in total		15	11	7	19	6	16	19	21	18	Total ban	23

Note: countries in the light gray column are the countries that had the greatest increase in absolute APC between 2010 and 2017. Countries in the darker gray columns include those that decreased their absolute APC during the same period (Philippines and Malaysia), as well as the one country that had a low increase in absolute APC relative to its economic growth (Sri Lanka).

the countries in this region had markedly increased their alcohol consumption in tandem with the economic development experienced in these countries between 2010 and 2017. Only the Philippines and Malaysia reduced their APC. The majority of South-East Asian countries had increasing trends in age-standardized alcohol-attributable deaths and DALYs from 2010 to 2016: six and nine countries, respectively. In terms of explaining changes in alcohol consumption and attributable harm, the association with economic factors was relatively pronounced, but a correlation of around 0.44 leaves room for alternative explanations. Alcohol control policies have also been found to possibly make a difference.

Five countries that had the highest increase in absolute APC between 2010 and 2017 had implemented fewer alcohol control policies in terms of number and strength compared to three countries that had better control over their alcohol consumption. The five countries had used either the ad valorem taxation or the unitary taxation method (the unitary taxation method is a taxation that taxes on the volume of an alcoholic beverage.) In comparison, the three countries had used either the combination taxation method, which included specific taxation, or had used specific taxation alone.

The economic wealth of a country is a predictor of the amount of alcohol consumed by the population (World Health Organization , 2018). An increasing trend in alcohol exposure in the South-East Asian region, especially among lower-middle-income countries, is similar to the findings by Manthey et al. (2019). However, our results also showed that an increase in economic wealth does not automatically mean that APC and alcohol-attributable harm also increase. Some countries in the regions kept their consumption low or even decreased their APC, and avoided increases in alcohol-attributable harm, because they applied effective alcohol control policies. In other words, alcohol control policies can mitigate against the unintended negative consequences of economic growth (see Fig. 7).

The achievements of countries applying tighter alcohol consumption controls, such as regular alcohol tax rate increases and comprehensive bans on alcohol advertising and sale promotion, may be similar to the success achieved in Russia with the implementation of comprehensive alcohol control policies (Neufeld & Rehm, 2013; World Health Organization, 2019).

Similar to what has been done in the Philippines, Malaysia, and Sri Lanka, regular increases in taxes on alcohol have been proven to reduce alcohol consumption in other countries (Babor et al., 2010; Sornpaisarn, Kaewmungkun & Rehm, 2015; Sornpaisarn, Shield, Österberg, & Rehm, 2017). The actual tax method employed is also critical to achieving the success of alcohol harmful consumption control (Barzel, 1976; Keen, 1998; Myles, 1996; Smith, 2005; Sornpaisarn, Kaewmungkun, & Rehm, 2015; Sornpaisarn, Shield, Österberg, & Rehm, 2017). When imposed on alcoholic beverages, the ad valorem taxation method (taxing on the beverage price as in the cases of Vietnam, Lao PDR, Cambodia, and Myanmar) and the unitary taxation method (taxing on the beverage volume as in the case of Timor-Leste) may actually cause an increase in the total alcohol consumption. The reason for this is that ethanol is not taxed directly using these two tax methods. In contrast, the specific taxation method (as applied by Sri Lanka) is an excise tax method that taxes alcohol products based on the volume of ethanol contained in the alcoholic beverage, resulting in the total alcohol consumption reduction (for theoretical considerations see

Table 2
Alcohol control policies put into effect in 11 middle-income South-East Asian countries in 2016.
Source: World Health Organization (2014, 2018), with the correction from the country experts.

	Policy			Vietnam	Lao PDR	Cambodia	Myanmar	Timor-Leste	Philippines	Malaysia	Sri Lanka	Indonesia	Maldives	Thailand
1	Excise		beer	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Total ban	Yes
2			wine	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Total ban	Yes
3			spirits	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Total ban	Yes
4	MLPA	off-premise	beer	18	18	No	18	No	18	21	21	21	Total ban	20
5			wine	18	18	No	18	No	18	21	21	21	Total ban	20
6			spirits	18	18	No	18	No	18	21	21	21	Total ban	20
7		on-premise	beer	18	18	No	18	No	18	21	21	21	Total ban	20
8			wine	18	18	No	18	No	18	21	21	21	Total ban	20
9			spirits	18	18	No	18	No	18	21	21	21	Total ban	20
10	Restrictions for on-/off-premise sales	hours		No	Yes	No	Yes	No	Yes	Yes	Yes	No	Total ban	Yes
11		days		No	No	No	No	No	No	No	Yes	No	Total ban	Yes
12		places		Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Total ban	Yes
13		density		Yes	Yes	No	Yes	No	Yes	Yes	Yes	No	Total ban	No
14		special events		No	No	No	Yes	No	Yes	Yes	Yes	No	Total ban	No
15		intoxicated persons		Yes	No	No	Yes	Yes	No	Yes	Yes	No	Total ban	Yes
16		petrol stations		No	No	No	No	No	No	Yes	Yes	No	Total ban	Yes
17	BAC	general		0.00	0.05	0.05	0.08	0.05	0.05	0.08	0.08	0.00	Total ban	0.05
18		young		0.00	0.05	0.05	0.08	0.05	0.05	0.08	0.08	00.0	Total ban	0.05
19		professional	(in%)	0.00	0.05	0.05	0.08	0.05	0.05	0.08	0.08	0.00	Total ban	0.05
20	Legally binding regulations	advertising		Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Total ban	Yes
21		product placement		Yes	Yes	No	Yes	No	No	Yes	Yes	Yes	Total ban	Yes
22		sponsorship		Yes	Yes	No	Yes	No	No	Yes	Yes	Yes	Total ban	Yes
23		sales promotion		Yes	Yes	No	No	No	No	Yes	Yes	Yes	Total ban	Yes
24	Legally required health warning	advertisements		No	Yes	No	No	No	Yes	No	No	NA	Total ban	Yes
25		containers		No	Yes	No	Yes	No	Yes	No	No	No	Total ban	Yes
		Number of policies applied in total		19	21	7	21	7	18	22	23	18	Total ban	23

Note: countries in the light gray column are the countries that had the greatest increase in absolute APC between 2010 and 2017. Countries in the darker gray columns include those that decreased their absolute APC during the same period (Philippines and Malaysia), as well as the one country that had a low increase in absolute APC relative to its economic growth (Sri Lanka).

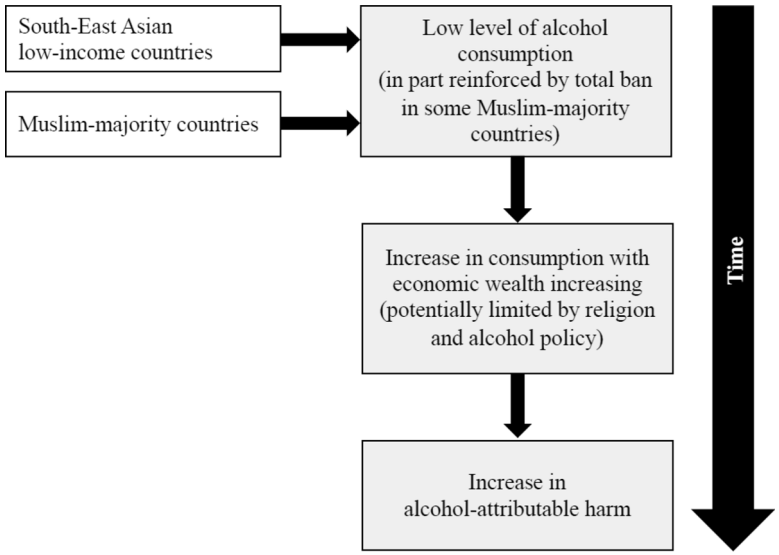

Fig. 7. Development of increasing alcohol use and alcohol-attributable harm in low-income countries over time.

(Rehm et al., 2019)). Empirical evidence studies (Keen, 1998; World Health Organization, 2010) and modeling studies (Doran, Byrnes, Cobiac, Vandenberg & Vos, 2013; Meier et al., 2016) have supported this claim.

The combination taxation method which combines the specific taxation and the ad valorem taxation methods (i.e., the alcohol taxation employed by the Philippines and Malaysia) can simultaneously reduce total alcohol consumption and prevent drinking initiation (Sornpaisarn, Kaewmungkun, & Rehm, 2015; Sornpaisarn, Shield, Cohen, Schwartz & Rehm, 2015; Sornpaisarn, Shield, Österberg, & Rehm, 2017). The combination tax method can affect the higher variability in alcohol prices, resulting in an opportunity for alcohol producers to avoid paying

tax (Chaloupka, Powell & Warner, 2019); this pitfall can be reduced by introducing a combination tax being largely determined by the specific taxation (Barzel, 1976; Keen, 1998; Myles, 1996; Smith, 2005; Sornpaisarn, Kaewmungkun, & Rehm, 2015; Sornpaisarn,Shield, Österberg, & Rehm, 2017).

Our study has some limitations. First, and foremost, it is ecological in nature, and while we point out potential causality, one of the above results is based on a comparison of trends and correlations, and thus we cannot definitively exclude the possibility that other factors were the true causal factors. Secondly, our results are based on a WHO questionnaire filled out, with varying quality, by ministry officials within different countries. While we did our best to involve local experts to check these answers and our conclusions, some errors may still have been introduced. Finally, we relied on standard sources for exposure, mortality, and burden of disease, which may contain errors as well.

In conclusion, to achieve the global target and the Sustainable Development Goal in reducing alcohol consumption worldwide, middle-income countries—especially lower-middle-income countries—should employ stricter alcohol control policies, apply an appropriate excise tax method on alcohol products, and regularly update them for inflation.

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Box 1 Comprehensive list of alcohol control measures put in place in Sri Lanka

Sri Lanka has had a comprehensive set of alcohol control policies in place since 2006 (Parliament of the Democratic Socialist Republic of Sri Lanka, 2006). These policies include:

- A minimum legal purchasing age for alcohol of 21 years old.
- The sale of alcohol from automatic vending machines is prohibited.
- A total ban on alcohol advertisements. Alcohol advertisement is defined as any distinctive writing, still or moving picture, sign, symbol, color or other visual image, or any audible message, or any combination of the aforesaid that promotes or is intended to promote (a) the drinking of liquor, (b) the purchase or use of an alcohol product, (c) a trademark registered with respect to any alcohol product or article that includes alcohol products, (d) a brand name associated with an alcohol product, (e) the name of the manufacturer of an alcohol product. Alcohol advertising is prohibited in the following channels: (a) broadcast media (i.e., TV, radio, internet), (b) printed media (i.e., newspaper, magazine, leaflet), (c) the screening or display of it in any place or vehicle which the public has access to, and (d) the sale, hire or supply of the advertisement or anything containing the advertisement to the public or a section of the public.
- A ban on alcohol sponsorship (i.e., sponsorship for educational, cultural, social, or sport activity or event), alcohol sale promotion (i.e., offering a prize, gift, or discount), or placement of an alcohol product's trademark, symbol, logo, or brand name on non-alcoholic products.

Authors' contribution

BS: Conceptualization, formal analysis, funding acquisition, project administration, writing-original draft, writing: review and editing

KDS: Data curation, formal analysis, investigation, software, visualization, writing-original draft, writing: review and editing

JM: Data curation, formal analysis, investigation, software, visualization, writing-original draft, writing: review and editing

YL: Data curation, review and editing

WYL: Data curation, review and editing

VVT: Data curation, review and editing

JR: Conceptualization, formal analysis, funding acquisition, methodology, supervision, visualization, writing-original draft, writing: review and editing

Declaration of Competing Interest

None.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.drugpo.2020.102856.

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