The impact of alcohol pricing policies on public health in Hong Kong, China: A modelling study

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Summary

Background Contrary to most developed economies, Hong Kong has reduced and eliminated taxes on beer and wine over the last 15 years and observed increasing alcohol consumption.

Methods We applied econometric epidemiological modelling to assess the impact of reverting ad valorem taxation to pre-2008 levels (20% on wine and 40% on beer) on consumption and health outcomes. We used 15 years of industry sales and pricing data (2004-2018) to derive 25 own-price and cross-price elasticity estimates. We applied risk functions from the World Health Organization 2018 Global Status Report to assess the impact on 25 alcohol-attributable conditions.

Findings An estimated 616 deaths (91.3% in men) were attributable to alcohol in 2018. Raising taxes to pre-2008 levels is estimated to reduce consumption of pure alcohol consumption by 8.0%, 15.9%, and 31.1%; and reduce alcohol-attributable deaths by 11.6%, 21.8%, and 40.2% assuming 25%, 50% and 100% pass through rates of taxes to consumers. The largest projected decreases in alcohol-attributable mortality in absolute numbers are alcohol abuse, alcohol dependence, and alcoholic psychoses (wholly alcohol-attributable disorders). The largest absolute number of new alcohol-attributable cases in 2018 were hypertension, alcohol dependence and alcohol abuse; which are estimated to be reduced by 31.3%, 34.2%, and 34.3% respectively by raising taxes to pre-2008 levels. The alcohol-attributable health burden and absolute reductions in health harms are far greater in men.

Interpretation Reversing the 2008 alcohol tax reductions is potentially effective in averting the alcohol-attributable health burden and thus mitigate against the avoidable harms of alcohol-related disease.

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Introduction

The harmful effects of alcohol are well-established; alcohol consumption is the third leading contributor to the global burden of disease, responsible for 3.3 million deaths worldwide (5.9% of all deaths).[1] Alcohol is classed as a Group 1 carcinogen and has broad adverse effects on health and society. Globally, alcohol use was the seventh leading risk factor for both deaths and disability-adjusted life-years (DALYs) in 2016, accounting for 2.2% of deaths among females and 6.8% of deaths among males.[2] Alcohol use is among the top 15 risk factors of global burden of disease, and per capita consumption is climbing annually.[3]

Although East Asia has the highest alcohol-attributable fraction for cancers worldwide, Hong Kong abolished taxes for most types of alcoholic beverages to promote itself as Asia's global wine hub.[4] In 2007, the Hong Kong government halved the existing 80% duty on wine and 40% duty on beer, and in 2008, waived all duties for alcohol beverages with a strength ≤30% alcohol by volume (abv) leading to rising sales. The excise duty on high strength spirits (>30% abv) remained at 100%. Alcohol consumption in Hong Kong has risen following the taxes reductions; annual per capita alcohol consumption increased from 2.57 litres in 2004 to 2.85 litres in 2018.[5] The Health Behaviour Survey 2018/19 reported 20.1% of persons aged 15 and up drank occasionally (three days or less a month) and 8.8% drank

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Research in context

Evidence before this study

The negative impacts of alcohol consumption in social and health contexts are widely established. Prior research has established higher alcohol taxes as an effective intervention for alcohol-attributable harms in Western populations with higher levels of alcohol consumption. The World Health Organization (WHO) recommends increasing alcohol taxes as an effective intervention tool for alcohol-related harms. Local studies and public health data have shown the 2008 alcohol tax elimination in Hong Kong led to increasing sales, binge drinking and alcohol-attributable mortality. The Hong Kong population has lower per capita alcohol consumption relative to other high-income economies, and thus lower burdens of alcohol-attributable disease.

Added value of this study

Using econometric epidemiological modelling, we estimated that reintroducing the taxation policies revoked in Hong Kong would reduce alcohol consumption and, in turn, alcohol-attributable health burdens. We estimate introducing ad valorem taxes of 20% on beer and 40% on wine (pre-2008 levels) would reduce consumption of pure ethanol by one-third. We estimate significant reductions in deaths attributable to alcohol of 11.6%, 21.8%, and 40.2% assuming 25%, 50% and 100% of tax increases are passed through to consumer prices. Reversing the alcohol taxation reductions is effective at reducing the alcohol-attributable portion, however, the absolute population impact is moderate as levels of alcohol consumption are relatively low in Hong Kong compared to other high-income places. Our modelling study provide contemporaneous evidence on the impact of reintroducing alcohol excise duties on consumption and health burdens in Hong Kong, China.

Implications of all the available evidence

Our findings indicate that reverting alcohol taxes to pre-2008 levels would decrease nearly all alcohol-attributable health burdens. The high prevalence of aldehyde dehydrogenase-2 (ALDH2*2) allele deficiency among individuals of East Asian descent which increases susceptibility to alcohol toxicity was not accounted for in WHO's alcohol-dose risk estimates, which may have led to an underestimation of the impact. Due to the broad harms from alcohol use, reintroducing taxation on alcohol is likely to have wider health and societal benefits than those modelled in this study.

regularly (at least once a week); with higher prevalence among males.[6]

There is extensive evidence that taxes and higher prices reduces both alcohol consumption and related harms.[7] The World Health Organization (WHO) recommends increasing taxation as a 'best buy' to reduce the harmful use of alcohol. Taxation is among one of the most effective interventions to reduce alcohol use in high-income economies.[8] Previous studies have shown associations between the 2007-2008 tax reductions in Hong Kong and higher cardiovascular and all-cause mortality.[9,10]

Despite the increasing consumption of alcohol in Hong Kong, the potential impact of reintroducing alcohol excise taxes on alcohol-related health burden has not been studied. To guide evidence-based health policy, we examined the potential impact of reversing the alcohol taxation reduction policy in Hong Kong on alcohol consumption by beverage type and alcohol-attributable health burden.

Methods

Study design

We applied econometric epidemiological modelling to estimate the impact of taxation policies on alcohol consumption and related health outcomes. This analytical approach involves a set of models linking alcohol taxation policy to consumption and health outcomes (analytical framework illustrated in Figure 1).

We studied the potential effects of reverting ad valorem taxation to pre-2008 levels on public health in Hong Kong, (20% on beer and 40% on wine prior to elimination of duty in February 2008) at 25%, 50%, and 100% tax pass through rates. For each scenario, we estimate the changes in health burden associated with policy implementation compared to baseline levels in 2018. Analyses were also performed for the six age-gender groups (15-34 years, 35-64 years and 65 years and over).

Data sources

This study synthesised several data sources (model inputs summarised in Supplementary Table 1). Hong Kong alcohol price and sales data were available for the 15 years (2004-2018) from Euromonitor International, which provided aggregate level statistics on annual recorded sales and unit prices by beverage type. Per capita consumption utilised in our study was provided by the Department of Health.[5] Proportions of lifetime abstainers, current drinkers, and per capita consumption were obtained from the Health Behaviour Survey 2018/2019, and because baseline patterns of alcohol consumption were not available in this survey, this data was extracted from the Population Health Survey 2014/2015.[6,11] Respectively, the Population Health Survey 2014/2015 and Health Behaviour Survey 2018/2019 consists of responses from 12,022 and 5,903 persons aged 15 or above, from 5,435 and 2,717 households, excluding foreign domestic helpers and two-way permit holders from Mainland China or other visitors of Hong

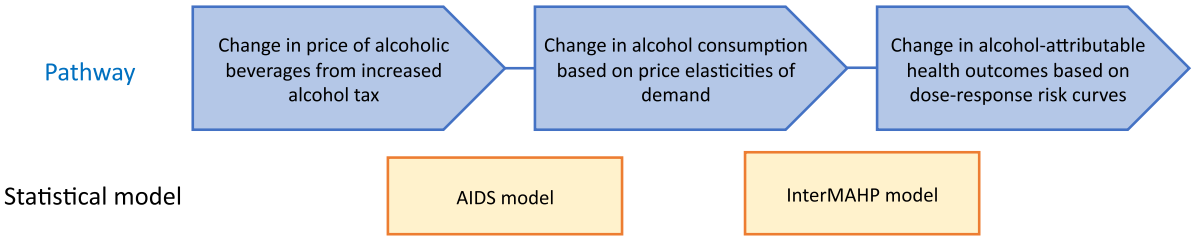

Figure 1. Logic pathway for modelling the health impact of increasing alcohol tax.
AIDS, almost ideal demand system; InterMAHP, International Model of Alcohol Harms and Policies.

Kong. Both surveys were adjusted for differential response rates by District Council district and grossed-up to control for age and gender profiles by housing type. After these adjustments, the survey estimates are representative of the Hong Kong resident population, aged 15 or above.

Baseline morbidity and mortality data in 2018 were obtained from the cancer registry and death records in Hong Kong. Non-cancer incidence data was obtained from the Hospital Authority Clinical Management System (CMS), the health informatics system for the public healthcare provider in Hong Kong, that account for the majority of inpatient care (90% of total bed days and 80% of admissions), 50% of specialist outpatient care, and 30% of first-contact outpatient services.[12]

Alcohol pricing and consumption

Socioeconomic differences such as cultural norms around alcohol consumption, beverage preferences (e.g., preference for spirits) and lower overall alcohol consumption may result in variations in price sensitivity. We estimated the alcohol price sensitivity for the Hong Kong population by calculating the population-level own- and cross-price elasticities of demand for five alcohol beverage categories: beer, wine, spirits, ciders and perry; ready-to-drinks (RTDs, also known as alcopops). Price elasticities model the relationship between price and consumption, i.e., how price changes in one product relate to purchasing changes of the same and related products. To derive the elasticity matrix, we fitted the AIDS (Almost Ideal Demand System) econometric model to 15 years of industry price and sales data (2004-2018).[13,14] The AIDS model developed by Deaton and Muellbauer is widely used in microeconomics for empirical demand analysis; it satisfies the axioms of consumer choice theory (completeness, transitivity, and reflexivity) and has a functional form which is consistent with known household-budget data.[13] The AIDS mathematical equation can be found in Supplementary Text 1; further details on the implementation of the AIDS model in R are available elsewhere.[14] We used uncompensated demands where consumer utility is not held constant to account for both income and substitution effects when price rises. Uncompensated demand maximizes utility given prices and income, i.e., indicating the quantities the consumer can afford to derive the highest level of utility.[14]

To model taxation policy effects on consumption for each alcoholic beverage category, we assumed three scenarios of 25%, 50%, and 100% pass-through of tax to retail prices (equivalent to tax rates of 5%, 10% and 20% on beer, and 10%, 20% and 40% on wine). We then applied the price elasticities to derive a percentage change in consumption for each alcoholic beverage category and then converted to the quantity of pure ethanol using the average alcoholic strength of the beverage categories in the dataset. Consumption was defined in grams of ethanol to align with the exposure level used in the epidemiological literature. We adopted a conservative approach by estimating relative changes in consumption and did not model any transition between current drinkers and abstainers. This likely underestimates the effects of the modelled policies as some may not drink or give up drinking alcohol completely in response to price increases. Analyses were conducted on R version 4.0 (*micEconAids* package).

Consumption and alcohol-attributable harms

Having calculated changes in alcohol consumption, we then applied separate risk functions for 25 alcohol-attributable diseases (Supplementary Table 2) to model the impact of consumption changes on alcohol-related harm.[15] Measures of morbidity and mortality from alcohol were defined as population attributable fractions (PAFs), which are widely used to evaluate impacts on population health. PAFs can be interpreted as the fraction of all cases for a given condition that would been avoided if there had been no exposure to alcohol. The relationship between alcohol consumption and the risk of illness and death for each alcohol-related condition was modelled using relative risks derived from the WHO 2018 Global Status Report on Alcohol and Health.[16] We simulated the health impact of changes in alcohol consumption using the International Model of Alcohol Harms and Policies (InterMAHP) model,[17] rescaling the per capita alcohol consumption and computing the new outcome counts for each scenario. The InterMAHP model is an international standardized set of core methodologies to estimate attributable fractions for all alcohol-related conditions from different policy scenarios that we

calibrated to local patterns of alcohol use. Alcohol consumption was modelled using a gamma distribution. Further details on the mathematical formulas used in the analyses can be found in Supplementary Text 2-4. We applied a correction factor of 0.8 for under-reporting, and an upper limit of consumption of 150 grams-ethanol per day using a capped relative risk extrapolation method based on guidance from the WHO 2018 Global Status Report on Alcohol and Health.[16] Inputs for the population metrics for InterMAHP model are shown in Supplementary Table 3.

Sensitivity analysis

We also calculated changes in health outcomes using alternate risk functions from Institute for Health Metrics and Evaluation (IHME) Global Burden of Disease Study (GBD) 2016 and meta-analyses by Zhao et al. and Roerecke and Rehm that do not assume any protective effects for ischaemic heart disease and ischaemic stroke at low levels of alcohol consumption.[2,18,19]

Ethical approval

Ethics approval was obtained from the HKU/Hospital Authority Hong Kong West Institutional Review Board.

Role of funding source

The study was funded by the Health and Medical Research Fund, Food and Health Bureau of the Hong Kong SAR, China [03170067]. The funders had no influence on the study design; on the collection, analysis, and interpretation of data; on the writing of the report; or on the decision to submit the article for publication.

Results

Baseline alcohol consumption, pricing, and health burden

Reported total per capita consumption of pure ethanol in 2018 was 2.85 litres per year,[5] relatively low compared to other high-income economies and surrounding East Asian populations. The price-to-consumption model input consisted of 5 × 5 matrix containing both own-price elasticities and cross-price elasticities (Table 1). The own-price elasticities, shown diagonally in the table, indicate how demand responds to price increases; positive values indicate increased consumption, and negative values indicate decreased consumption. For example, the own-price elasticity of beer is -0.427 indicating that a 10% increase in the price of beer would reduce consumption of this beverage by 4.27%. Wine showed a positive own-price elasticity, (increased demand with increasing price) indicative of a luxury good. The impact of the tax increase on pure ethanol volume with different pass-through rates are illustrated in Table 2. Sales of cider, perry, and RTDs in 2018 accounted for less than 0.5% of total volume of pure alcohol. We estimate introducing ad valorem taxes of 20% on beer and 40% on wine (pre-2008 policy) would reduce consumption of pure ethanol by 31.1% at 100% pass-through rate. A 5% tax on beer and 10% on wine (equivalent to 25% pass-through rate of pre-2008 taxes) is estimated to reduce total consumption of pure ethanol by 8.0%, while a 10% tax on beer and 20% on wine (i.e., 50% pass-through rate) is estimated to reduce consumption by 15.9%. The health burden attributable to alcohol is far greater in males than females; baseline

		Price				
		Beer	Wine	Spirits	Cider	RTDs
Consumption	Beer	-0.427	-1.653	2.212	-0.746	-0.035
	Wine	-0.464	1.169	-3.401	0.831	0.218
	Spirits	-0.639	0.137	-0.176	0.347	-0.331
	Cider	0.484	-1.477	3.775	-0.575	-2.176
	RTDs	0.607	-1.918	2.393	-0.107	-0.612

***Table 1*: Estimated own- and cross-price elasticities of beer, wine, spirits, cider, and RTDs in Hong Kong.**
RTDs, ready-to-drink.

	Volume of pure alcohol, million L (%)	Change in volume of pure alcohol, million L (percentage change)		
	Baseline (2018 market size)	25% pass-through of tax (5% beer and 10% wine tax)	50% pass-through of tax (10% beer and 20% wine tax)	20% beer and 40% wine tax (pre-2008 levels)
Beer	9.15 (57.8%)	-1.71 (-18.7%)	-3.42 (-37.3%)	-6.84 (-74.7%)
Wine	4.58 (28.9%)	0.43 (9.4%)	0.86 (18.7%)	1.72 (37.5%)
Spirits	2.06 (13.0%)	-0.04 (-1.8%)	-0.07 (-3.6%)	-0.15 (-7.3%)
Cider/Perry	0.03 (0.2%)	-0.003 (-12.4%)	-0.007 (-24.7%)	-0.01 (-49.4%)
RTDs	0.02 (0.1%)	-0.002 (-16.1%)	-0.005 (-32.3%)	-0.01 (-64.6%)
Total	15.83 (100%)	-1.27 (-8.0%)	-2.51 (-15.9%)	-4.93 (-31.1%)

***Table 2*: Estimated impact of tax policy on alcohol consumption.**
RTDs, ready-to-drink.

Condition	Deaths per year at baseline[a]	Percentage change in the number of deaths per year			Absolute change in the number of deaths per year		
		25% pass-through of tax	50% pass-through of tax	20% beer and 40% wine tax (pre-2008 levels	25% pass-through of tax	50% pass-through of tax	20% beer and 40% wine tax (pre-2008 levels
Cancer	63	-8.2%	-16.2%	-31.5%	-5	-10	-20
Cardiovascular	-64	17.5%	24.5%	24.5%	11	16	16
Communicable	39	-8.2%	-16.2%	-31.6%	-3	-6	-12
Digestive	27	-8.7%	-17.0%	-32.8%	-2	-4	-9
Neuropsychiatric	552	-8.9%	-17.7%	-34.7%	-49	-98	-191
Total	616	-11.6%	-21.8%	-40.2%	-71	-134	-248

***Table 3*: Estimated impact of tax policy on alcohol-attributable mortality.**

[a] Alcohol-attributable deaths at baseline year (2018). 25% pass-through of tax increase (5% beer and 10% wine tax), 50% pass-through of tax increase (10% beer and 20% wine tax), and 100% pass-through of tax increase (20% beer and 40% wine tax, pre-2008 levels).

population attributable fractions, and the numbers of alcohol-attributable cases and deaths in 2018 are shown in Supplementary Tables 4–5. The highest baseline PAFs for males were oesophageal varices (9.7%), oesophageal cancer (7.8%), liver cirrhosis (6.2%) and oropharyngeal cancer (5.4%), and for women were oesophageal varices (5.7%), liver cirrhosis (5.5%) and oesophageal cancer (1.4%), and oropharyngeal cancer (1.0%).

Policy impact on alcohol-attributable health harms

Projected changes in alcohol-attributable mortality with the reintroduction of pre-2008 taxes are shown in Table 3 and Figure 2. A total of 616 deaths in 2018 were attributable to alcohol (562 men and 54 women). Raising taxes to pre-2008 levels (20% on beer and 40% on wine) was estimated to reduce alcohol-attributable deaths by 11.6%, 21.8%, and 40.2% assuming 25%, 50% and 100% pass through rates of taxes to consumers. The WHO risk curves assume cardioprotective effects at low doses of alcohol consumption. Increases in mortality from cardiovascular conditions due to lower alcohol consumption are substantially outweighed by the reductions from other alcohol-attributable causes. The estimated absolute and relative reductions in mortality by health condition at different pass-through rates for each age and sex group are shown in Supplementary Tables 6-8. The largest projected decreases in alcohol-attributable mortality in terms of absolute numbers are alcohol abuse, alcohol dependence, and alcoholic psychoses (wholly alcohol-attributable neuropsychiatric disorders).

The impact of reimplementing alcohol taxes to pre-2008 levels at 25%, 50% and 100% pass-through rates on the incidence of 25 alcohol-attributable health conditions is shown by age- and sex groups in Supplementary Tables 6-8, and for overall in Supplementary Table 9. The largest absolute number of new alcohol-attributable cases in 2018 were hypertension (1,274 men and 11 women), alcohol dependence (934 men and 251 women) and alcohol abuse (513 men and 103 women). Raising taxes to pre-2008 levels is estimated to reduce the number of alcohol-attributable cases of hypertension by 31.3%, alcohol dependence by 34.2%, and alcohol abuse by 34.3% each year, (8.0%, 8.8%, and 8.8% at 25% tax pass through: 15.9%, 17.4% and 17.5% at 50% tax pass-through rate).

Sensitivity analysis

For each tax scenario, we conducted sensitivity analysis for conditions with alternative set of risk curves published by IHME for breast cancer, colorectal cancer, liver cancer, oesophageal cancer, oropharyngeal cancer, atrial fibrillation and cardiac arrhythmia, haemorrhagic stroke, hypertension, lower respiratory tract infections, tuberculosis, liver cirrhosis, and epilepsy, and risk curves that do not assume any cardioprotective effects from alcohol for ischaemic heart disease published Zhao et al. and ischaemic stroke published by Roerecke and Rehm (Supplementary Table 4, 10-11). These risk curves yield slightly more conservative estimates of changes than WHO risk estimates for alcohol-attributable mortality and incidence (Table 4 and Supplementary Table 12).

Discussion

Our study examined the impact of reintroducing alcohol taxes to pre-2008 levels on consumption and population health. We estimated reintroducing ad valorem alcohol taxes to pre-2008 levels (20% beer and 40% wine while keeping taxes on spirits at 100%) would reduce consumption of pure ethanol by approximately one-third. Nevertheless, the baseline risk is small, and the averted health burdens were moderate as population consumption levels are relatively low in Hong Kong compared to other high-income populations. This may stem from conservative cultural attitudes and lower physiological tolerance among a significant portion of Chinese people.

Figure 2. Estimated impact of tax policy on alcohol-attributable mortality.

Bars are percentage change in alcohol-attributable counts relative to baseline levels in 2018. 25% pass-through of tax increase (5% beer and 10% wine tax), 50% pass-through of tax increase (10% beer and 20% wine tax), and 100% pass-through of tax increase (20% beer and 40% wine tax, pre-2008 levels).

	WHO risk function				Zhao et al., Roerecke and Rehm, and IHME			
	Deaths per year at baseline[a]	Absolute change in the number of new cases per year			Deaths per year at baseline[a]	Absolute change in the number of new cases per year		
		25% pass-through of tax	50% pass-through of tax	20% beer and 40% wine tax (pre-2008 levels		25% pass-through of tax	50% pass-through of tax	20% beer and 40% wine tax (pre-2008 levels
Cancer	60	-5	-10	-19	49	-4	-8	-15
Cardiovascular	-104	-8	-9	-2	21	-2	-4	-8
Communicable	39	-3	-6	-12	13	-1	-2	-4
Digestive	21	-2	-4	-7	11	-1	-3	-5
Neuropsychiatric	0	0	0	0	1	0	0	0
Total	**16**	**-18**	**-28**	**-40**	**94**	**-9**	**-17**	**-32**

***Table 4*: Sensitivity analysis of the estimated impact of tax policies on alcohol-attributable mortality by risk function.**

[a] Alcohol-attributable cases at baseline year (2018). 25% pass-through of tax increase (5% beer and 10% wine tax), 50% pass-through of tax increase (10% beer and 20% wine tax), and 100% pass-through of tax increase (20% beer and 40% wine tax, pre-2008 levels).

Table only includes health conditions with risk curves available for both WHO 2018 Global Status Report on Alcohol and Health, and Zhao et al, Roerecke and Rehm and IHME (Institute of Health Metrics) Global Burden of Disease Studies 2016: breast cancer, colorectal cancer, liver cancer, oesophageal cancer, oropharyngeal cancer, atrial fibrillation and cardiac arrhythmia, haemorrhagic stroke, hypertension, ischaemic heart disease, ischaemic stroke, lower respiratory tract infections, tuberculosis, liver cirrhosis, and epilepsy.

The own-price elasticity for beer is comparable to a previous meta-analysis of 112 studies (-0.46) and also to elasticity estimates in China (-0.50).[20,21] Similar to other studies in China, wine showed a positive own-price elasticity (increased demand with increasing price) indicative of a luxury good.[22] Hong Kong drinkers were less sensitive to the price of spirits than elsewhere.[21]

One problem with implementing alcohol taxes is that retailers are not obliged to pass on the full tax increase to consumer prices; retailers may choose to absorb tax rises within their profits, reduce costs, or increase the price of other alcoholic or non-alcoholic beverages. Furthermore, affordability (prices relative to income) should be considered when evaluating taxation. Since heavier drinkers tend to favour cheap alcohol, an industry strategy to minimise the price increase on cheaper drinks could reduce the effectiveness of taxation to combat alcohol-related harms. In Hong Kong, only a small part of the eliminated alcohol duty from 2008 to 2011 was passed on as lower retail prices; as a result, price reductions for consumers was moderate: -1.8% for beer and -14.3% for wine.[23] It is possible that re-introducing alcohol taxes would generate public revenue without much increase in consumer prices. The public revenue raised, particularly if gained from alcohol industry profits, could be deployed to mitigate the adverse effects of alcohol and to improve population health elsewhere.

Our analytical approach is highly conservative with regards to estimates of consumption and health harms. As we only estimated relative changes in alcohol consumption, this likely underestimates the true effects of the tax policies as some consumers may switch to abstinence in response to price rises. We were unable to model changes in alcohol-use disorder in the population due to lack of data, in particular people who began abusing alcohol following the previous tax reductions may now be less susceptible to the new tax increases. We applied the widely used WHO relative risk estimates that assumes protective effects (J- or U-shaped curves) at low-to-moderate levels of alcohol consumption for certain health conditions such as ischaemic heart disease and ischaemic stroke. However, recent evidence from a large Chinese biobank indicate alcohol consumption at any level uniformly increases blood pressure, the risk of ischaemic and haemorrhagic stroke risk, and has little net effect on the risk of myocardial infarction.[24] The high prevalence of the inactive aldehyde dehydrogenase-2 (ALDH2*2) genotype among East Asian populations may confer greater susceptibility to the harmful effects of alcohol that are not reflected in the uniform alcohol-dose risk estimates adopted by the WHO. The results of our sensitivity analyses using an alternative set of risk curves highlights the controversy over the protective effects of alcohol. Another limitation is the partial coding of stroke in the death registry, we estimated the proportion of deaths due to haemorrhagic strokes from the Global Burden of Disease data on China. We also lacked data on partly attributable acute conditions such as accidents, injuries, and motor vehicle collisions that are not well captured by healthcare utilisation data, though Hong Kong did enact specific mitigation measures that were effective at combating drink-driving.[25] Other limitations include diagnosis coding errors and incomplete capture of hospitalization and outpatient data.

A central limitation to our econometric modelling is the absence of a longitudinal dataset on alcohol

purchase and consumption at the individual level. The Euromonitor data provides robust data on population-level alcohol sales by beverage type (beer, wine, spirits, cider/perry and RTDs), subcategories, and relative market shares. The limitation of this macro-level data is the difficulty in modelling changes at the individual level. Since the elasticities obtained represent average estimates for the population, it is impossible to conclude whether population-level changes in alcohol consumption are reflected in some or all demographic groups. Finer approaches than aggregate data could assess for potential variations by demographic factors such as age, sex, education, employment, and income.[26] While the Hong Kong Behavioural Risk Factor Survey (BRFS) includes some demographic information associated with patterns of alcohol intake, it is a serial cross-sectional study with participants limited to 18-64-year-olds;[27] and detailed purchasing data remain unavailable.

By focusing on the ethanol content and its relationship with price, our study did not account for possible confounding factors such as product availability and marketing; for example, government and industry marketing efforts to promote Hong Kong as a global wine hub, however, no policy changes for availability and marketing occurred at the same time. Other possible limitations not captured by the modelling include unrecorded alcohol consumption such as illicit sales, home brewing, and local beverages, and consumption by tourists. We were unable to assess minimum unit pricing due to lack of detailed data on the distribution of prices beyond average (mean) prices. However, unlike taxation, increased revenue from minimum-unit pricing benefits industry rather than the public purse.

Further research is needed on the application of health policy modelling including development and testing of alternative econometric methods and models, as well as validation against future data after actual policy implementation. There remains a lack of data on the risks of alcohol consumption among underage and youth drinkers; the WHO risk estimates of alcohol-attributable conditions are not applicable to people under 15 years. While we did not have data on adolescent drinking, higher alcohol taxation is associated with lower risk of underage binge-drinking in the United States.[28] Taxation and pricing policies also affects the pattern of heavy drinking, but the magnitude of effect is reportedly smaller than effects on overall drinking.[21] The impact of the pattern of drinking (rather than amount of alcohol) on relative risks remain under researched.

Conclusions

Unlike most developed economies, Hong Kong reduced and mostly eliminated taxes on alcohol with lower alcoholic strength over the last 15 years, leading to increasing alcohol consumption. Consistent with WHO's "best buy" recommendations and previous studies done in high-income economies, we found that reversing the alcohol taxation reductions and elimination policies in 2007-08 is likely to be effective at averting alcohol-attributable health burdens. Given the wide social harms of alcohol consumption, the overall benefits to population health are likely more extensive than the estimates presented in this study. Reintroduction of taxes to reduce alcohol-related burden of disease merits consideration to mitigate against avoidable harms.

Contributors

C.S.N. and J.Q. conceptualised and designed the study, conducted the statistical analysis, interpreted the results, drafted the manuscript, and compiled edits from other authors. C.S.N. did the data visualisation. M.A. collected the data, contributed to data analysis and manuscript writing. R.M. and J.Y.Y.L. interpreted the results and contributed to manuscript writing. The dataset was accessed and verified by C.S.N., M.A. and J.Q.J.Q. supervised the study and obtained funding. All authors critically revised the manuscript for important intellectual content and approved the final version.

Data sharing statement

Individual participant data will not be available as we utilised aggregate-level data from several sources. Data sharing, consent forms and other documents are not applicable. Data used for this study indicated in the Supplementary Appendix is available for anyone who wishes to access the data with no end date.

Declaration of interests

J.Y.Y.L. is a member of the Hong Kong Alliance for Advocacy Against Alcohol. All other authors declare no conflict of interests.

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Supplementary materials

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.lanwpc.2022.100510.

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