Te Whatu Ora
Health New Zealand

Interventions to reduce alcohol's harms to health: a modelling study

Report

SEPTEMBER 2023

Dr Tim Chambers, University of Otago Wellington
Dr Anja Mizdrak, University of Otago Wellington
Dr Sarah Herbert, Northern Regional Alliance Limited
Dr Amanda C Jones, University of Otago Wellington

UNIVERSITY of OTAGO
Te Whare Wānanga o Otāgo
NEW ZEALAND

Prepared for Te Whatu Ora – Health New Zealand (Health Promotion) by Dr Tim Chambers (University of Otago Wellington), Dr Anja Mizdrak (University of Otago Wellington), Dr Sarah Herbert (Northern Regional Alliance Limited) and Dr Amanda C Jones (University of Otago Wellington).

Citation: Chambers, T., Mizdrak, A., Herbert, S., & Jones, A. C. (2023). *Interventions to reduce alcohol's harms to health: a modelling study.* Wellington: Te Whatu Ora – Health New Zealand.

Acknowledgements

Te Whatu Ora would like to thank the workshop attendees who took the time to participate in this research.

Copyright

Disclaimer

This research has been carried out by an independent party under contract to Te Whatu Ora. The views, observations and analysis expressed in this report are those of the authors and are not to be attributed to Te Whatu Ora.

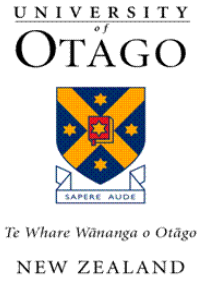
This document has not been externally peer reviewed.

The document is available at: www.hpa.org.nz/our-work/research/publications

Any queries regarding this report should be directed to Te Whatu Ora at the following address:
Te Whatu Ora (Health Promotion)
PO Box 2142
Wellington 6140
New Zealand
www.hpa.org.nz
enquiries@hpa.org.nz

NZBN 9429041905333

September 2023



Interventions to reduce alcohol's harms to health: a modelling study

Prepared for Te Whatu Ora – Health New Zealand
(Health Promotion)

Dr Tim Chambers, University of Otago Wellington
Dr Anja Mizdrak, University of Otago Wellington
Dr Sarah Herbert, Northern Regional Alliance Limited
Dr Amanda C Jones, University of Otago Wellington

Original November 2022
(updated 30 August 2023)

Acknowledgements

This work was funded by Te Hiringa Hauora. Te Hiringa Hauora | Health Promotion Agency was a Crown entity established under the New Zealand Public Health and Disability Amendment Act 2000. As of 1 July 2022, it was disestablished as a separate entity and moved into Te Whatu Ora – Health New Zealand. Additional support was provided through the Health Research Council (grant 16/443) and a University of Otago Wellington Dean's Research Grant. The authors thank Adam Sherk, Anna Davies, Kendra Telfer, Dr Thoa Hoang, Anaru Waa, Dr Leah Grout and Ruby Kent-Royds for analyses, literature searches, and advice that they provided to this project. The authors also thank the workshop participants whose recommendations directed the framing and selection of interventions modelled within this project.

Conflict of interest statement

Dr Jones' involvement in this project predated her employment at Te Hiringa Hauora. The authors have no other conflict of interests to declare. No authors have received funding from the alcohol industry.

Notes on revision

The core results from this report were submitted to the Journal *Addiction* for publication. During the peer-review process, the reviewers highlighted an error with our estimate for tourist consumption. The updated report has incorporated other reviewer comments, including the correction of the tourist consumption estimate. Article DOI 10.1111/add.16331.

Suggested citation

Chambers T., Mizdrak A., Herbert S., Jones A.C. (2022). Interventions to reduce alcohol's harms to health: a modelling study. Report prepared for Te Hiringa Hauora. Wellington, New Zealand.

Contact

Dr Tim Chambers
Department of Public Health
University of Otago, Wellington
PO Box 7343
Wellington South 6242
New Zealand
tim.chambers@otago.ac.nz

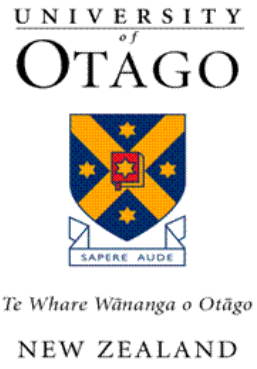


Table of contents

Table of tables

Table of figures

Executive summary

Introduction

Alcohol consumption is a substantial health risk factor and driver of health inequities in Aotearoa. A wealth of international research identifies highly effective interventions for governments to adopt. We aim to model which interventions are most effective and contribute toward health equity in the Aotearoa context.

Methods

We created an alcohol intervention model using Aotearoa alcohol consumption data, dose-response relationships between alcohol and 15 disease and injury categories from the 2016 Global Burden of Disease Study and intervention effect sizes from international literature. The model's population replicates the 2018 New Zealand population by ethnicity, age and sex. We modelled four hypothetical scenarios: 1) business as usual (BAU) which assumed no changes in alcohol consumption or policy settings; 2) an intervention package scenario that included a 50% tax increase, a complete marketing ban, reduced off-licence alcohol outlet trading hours and density; 3) variations of higher tax increases and the extent of marketing restrictions; and 4) a scenario where the Government acted on key 2010 Law Commission recommendations. The model provides conservative estimates of the impacts of these interventions.

Results

Compared to the BAU scenario (Scenario One), the total alcohol intervention package (Scenario Two) would result in 726,000 health-adjusted life years (HALYs) gained or 0.18 HALYs (65.7 days) gained per capita over the lifetime of the modelled population. Māori experienced greater age-adjusted per capita HALYs gains than non-Māori (0.21 compared to 0.16). Men gained over twice as many HALYs than women per capita accounting for differences in ethnicity. The four individual alcohol interventions within the Scenario 2 intervention package produced similar health gains (~200,000 HALYs). However, higher tax increases (Scenario Three) of 107% (393,000 HALYs) and 133% (482,000 HALYs) produced approximately twice the impact of any other intervention (including the 50% increase in tax). In fact, taxation at 133% would have approximately 70% of the effect of the total alcohol intervention package (including the 50% tax increase). We estimated that the failure to act on the Law Commission recommendations has cost an estimated 7,300 HALYs (Scenario Four) between 2011-2020, which would increase by six-fold if action is delayed by an additional decade (e.g., from 2020 to 2030).

Recommendations

1) Ensure future policy work is led by Māori and/or conducted in partnership with Māori with a clear focus on improving Māori health outcomes and upholding Māori rights under Te Tiriti o Waitangi.
2) Include in alcohol legislation: explicit reference to Te Tiriti o Waitangi; mechanisms to enable Māori to effectively participate in decision-making around alcohol in their communities; and mechanisms to ensure legislation addresses health inequities.
3) Introduce national off-licence density measures.
4) Reduce national off-licence trading hours to a maximum of 50 hours, with a closing time of 8pm.
5) Introduce a comprehensive ban on alcohol marketing including alcohol sponsorship.
6) Increase alcohol tax rates to achieve an effective minimum unit price as previously modelled by the Ministry of Justice.
7) Ensure the standardisation of the alcohol outlet trading hours in the Alcohol Regulatory and Licensing Authority (ARLA) database.

Conclusion

Based upon conservative estimates of health benefits, our modelled interventions on tax, availability and marketing showed that there are substantial health gains available if the Government followed advice from previous Government-led inquiries. Further, these interventions could reduce health inequities between Māori and non-Māori and thereby contribute to rectifying ongoing Crown failings to uphold Te Tiriti o Waitangi.

Introduction

Alcohol consumption is a substantial health risk factor and is ranked seventh globally and fifth for the population of Aotearoa as a cause of morbidity and mortality in 2016.[1] The proportion of the population drinking alcohol has remained relatively constant, but the prevalence of hazardous drinking has risen.[2] The health impacts of alcohol include at least 25 diseases and injuries.[1] Individual drinkers suffer harms from alcohol, but so too do others.[3] Indicative of alcohol's wider societal impacts, an estimated 10% of interpersonal violence and property damage offences are attributable to alcohol consumption.[4] Indeed, alcohol harms are widespread and have direct and indirect impacts on health, justice, social and economic outcomes.

Māori are more likely than non-Māori to have hazardous drinking patterns,[5] and therefore suffer a disproportionate burden of the ill-effects of alcohol consumption. Māori have long recognised the negative impact of colonisation and Crown action and inaction which have contributed to alcohol harms among Māori over time. Disproportionate alcohol harms to Māori have been specifically raised in the Waitangi Tribunal claim, Health Services and Kaupapa Inquiry (Wai 2575).[5] A specific tobacco, alcohol and other substance abuse report[6] highlights alcohol harm disparities for Māori including how the Crown has failed to address, and in fact, actively contributed to, the disproportionately high rates of alcohol harm among Māori. Central to Government failings is the lack of provision of health services, policies and legislative controls that either prevent or address alcohol harm inequities experienced among Māori.[6] Further, the lack of acknowledgement of Te Tiriti o Waitangi in legislation, in particular alcohol legislation, perpetuates inequities in alcohol-related harm for Māori.[7]

Moreover, such inequities highlight Crown breaches of Te Tiriti o Waitangi. For example, Article 1 guarantees to Māori fair, just and ethical governance by the Crown. Evidence of a breach of Article 1 is reflected in the disproportionate alcohol-related harms experienced by Māori as well as the differential impact of Crown-led alcohol interventions that have driven these disparities.[8] Article 3 guarantees equal rights to Māori and equity in terms of both access to resources and outcomes. Again, the disproportionate harms from alcohol that Māori experience reflect a breach of Article 3 in Te Tiriti o Waitangi. Additionally, failure to enable Māori leadership and agency in the determination of how alcohol controls may function effectively, as well as failing to enable Māori-led solutions, is further evidence of Crown failings.[6,9]

As identified in the Wai 2575 Hauora report, recognition of the principles of Te Tiriti o Waitangi is important to acknowledge: equity, active protection, options, partnership and Tino Rangatiratanga. Briefly, the principles of equity and protection recognise Māori rights to equitably manage the control of alcohol, as well as the right to experience equitable protection from the numerous health and social harms arising from alcohol use. Similarly, the principle of Tino Rangatiratanga recognises iwi, hapū, whānau and Māori communities' rights to determining the control of alcohol access and use as well as mitigating the harms.[6] Māori rights to options and meaningful partnerships also recognise Māori authority to determine appropriate alcohol control measures, as well as being valued and meaningful partners in determining the access, supply and use of alcohol in Aotearoa. Further, the principle of Tino Rangatiratanga provides for Māori self-determination and mana motuhake, and in the context of alcohol use and harms, this translates to Māori rights to determine access, availability, and use of alcohol in Aotearoa.

In 2010, the New Zealand (NZ) Law Commission proposed 153 recommendations to address harm from alcohol in Aotearoa,[10] but progress has been slow.[11] Failure to implement the Commission's recommendations is one aspect of the aforementioned Waitangi Tribunal claim (Wai 2575).[5] A wealth of international studies identify benefits from different alcohol interventions[12-15] and the World Health Organization's (WHO) SAFER initiative identifies highly effective strategies for governments to adopt.[16] We provide a brief background on the three most cost-effective alcohol interventions, termed "best buys" by the WHO, which are price, availability and marketing.[16]

Tax

Price, which can be modified through taxation, is one of the strongest determinants of alcohol use.[16] Increasing alcohol tax is one of the most cost-effective alcohol interventions.[17] Reviews and meta-analyses report that an increase in alcohol price is consistently associated with a decrease in its consumption, where a 10% price increase is associated with an estimated 5% decrease in consumption.[18] A meta-analysis reported that doubling tax rates decreases alcohol-related mortality by an average of 35%, with additional reductions in violence, crime, road fatalities, and sexually transmitted infections.[12] Existing evidence suggests alcohol taxation is progressive when considering all households, but economically regressive when considering only those who consume alcohol.[19] However, less affluent groups are more likely to suffer the harms associated with alcohol consumption, thus increasing the price of alcohol through tax has the potential to reduce health inequities.[20]

Evidence of the efficacy of alcohol taxation on health outcomes in Aotearoa is largely limited to modelling studies.[21-23] One Aotearoa study modelled a tax increase to bring the Aotearoa tax rate in line with Australia and the United Kingdom (~25-50% tax increases across different products), and found that alcohol sales would be reduced by 4.3%.[22] In 2014, the Ministry of Justice (MoJ) estimated that tax increases between 82% to 133% would reduce total alcohol consumption by 12.2% to 19.5%. The tax increases were selected based on the tax required to achieve a minimum unit price of $1.00, $1.10 and $1.20. A 82% increase in tax was estimated to result in net savings to society of $339 million in the first year and $2.452 million over 10 years.[23] However, to date, no Aotearoa modelling has included comprehensive consumption data with sufficient sample sizes in all age groups, developed an accurate set of relative risks for the full range of alcohol-related conditions, identified the impact of alcohol interventions on health-adjusted life years (HALYs) or investigated differences by ethnicity.

Currently, the overall alcohol tax rate in Aotearoa is lower than in Australia or the UK.[22] The MoJ states that "Taxes on alcohol are justified as externality-correcting taxes" since taxes signal to consumers the true cost of alcohol on society.[23 p.13] In 2005/06, alcohol's varied harms had an estimated societal cost of NZ$5 billion (3% of GDP),[24] more than five times the alcohol tax revenue collected to address externalities.[25] In addition to comparatively low alcohol tax rates, major inconsistences are inherent in Aotearoa's alcohol tax system. For example, alcohol tax is not matched to inflation, leading to the increased affordability of alcohol over time.[26] Further, low alcohol wine is no more affordable than regular strength wine, and high strength spirits and RTDs are taxed at a lower rate than reflects their high alcohol content.[26] The flaws of Aotearoa's alcohol tax system can be addressed through fiscal measures that have international precedents and proven effectiveness.[27] In 2010, the Law Commission recommended raising alcohol tax by at least 50%, a recommendation which has not been implemented.[10]

Availability

Alcohol availability relates to the ease of obtaining alcohol.[28] Alcohol availability encompasses the number of outlets, the distance to outlets, minimum purchase age, willingness of outlets to sell to minors, trading hours and days, and volumes of alcohol sales.[28] Four systematic reviews have explored the association between alcohol availability and alcohol consumption.[13,14,29,30] These reviews included over 100 studies examining many different aspects of alcohol availability (e.g., trading hours and days of sale and density), outlet types (e.g., on-licence and off-licence), samples (e.g., adults and children) and methodologies (e.g., cross-sectional and longitudinal). The reviews reinforce WHO conclusions that alcohol availability restrictions are one of most cost-effective alcohol interventions.

This current report focuses on two aspects of availability—outlet density and trading hours. Outlet density is the "number of physical locations in which alcoholic beverages are available for purchase either per area or population."[31, p.556] Trading hours are simply those hours where alcohol sales are permitted by licenced alcohol outlets.

Alcohol outlets are typically divided into two categories, on-licence and off-licence, defined according to where the purchased alcohol is consumed.[32] On-licence outlets sell alcohol that must be consumed on-site; typical on-licence outlets include bars, sports clubs, and restaurants. In contrast, the alcohol purchased in off-licence outlets must be taken off-site for consumption; typical off-licence outlets include supermarkets and bottle stores. The majority of research investigating on-licence availability has tended to focus on acute outcomes (e.g., injuries) so the specific impacts of reductions in on-licence availability impacts overall alcohol consumption are unclear. In contrast, studies assessing off-licence availability tend to focus on levels of alcohol consumption. Thus, due to limitations in evidence, this current analysis is focused on the regulation of off-licence outlets.

Internationally, people living in areas of the highest deprivation tend to experience the highest levels of alcohol availability.[33-35] One Australian study found that outlets tended to be concentrated in areas of high deprivation despite the largest market potential being in adjacent areas of lower deprivation with older, male and higher income populations.[35] Potential explanations for the mismatch between supply and demand in areas of high deprivation include the lower operation costs for outlets and lower community political capital to resist new licences. Likewise, in Aotearoa, people living in the most deprived areas have the highest levels of alcohol availability.[36-38] Higher availability includes having more outlets per area and having to travel on average 50% less to reach an alcohol outlet than people living in areas of low deprivation. A 2012 study in Manakau City showed that areas of higher deprivation or outlet density had longer trading hours than areas of lower deprivation or outlet density.[39] To our knowledge, there are no studies investigating the relationship between deprivation or outlet density and outlet trading hours at a national level.

International evidence suggests that alcohol outlets appear to concentrate in those areas with greater proportions of ethnic minority or indigenous people.[33,34,40] In general, national-level data internationally shows lower consumption by ethnic minorities,[33] which suggests the higher availability of alcohol in minority neighbourhoods is unlikely attributable to higher demand. In Aotearoa, research has found outlet density was highest in neighbourhoods with high numbers of younger Māori and Pacific peoples.[41] Given the current alcohol consumption patterns in Aotearoa, the disproportionate availability of alcohol in Māori and Pacific communities represents a mismatch between supply and demand. Internationally, researchers have noted that alcohol companies appear to deliberately target ethnic minority and indigenous neighbourhoods to maximise profits, due to the high number of heavy drinkers and never drinkers (who are considered a growth market by the industry).[42]

A recent analysis found the Sale and Supply of Alcohol Act 2012 (SSAA) did not result in any substantial changes to alcohol trading hours or outlet density.[43] Currently, trading hours for off-licence outlets are from 7am to 11pm, a total of 112 hours per week. The SSAA also included a provision to enable Territorial Authorities (TAs) to design and implement a Local Alcohol Policy (LAP) which could have outlet density provisions.[43] However, to date, few LAPs have successfully implemented outlet density measures. [44,45] Many LAPs developed by TAs have met legal resistance from the alcohol industry that has halted their implementation or weakened their alcohol control measures.[44,45] The Sale and Supply of Alcohol (Harm Minimisation) Amendment Bill, a private member's Bill of Chlöe Swarbrick, seeks to remove appeals to LAPs but was only introduced to Parliament on 30 June 2022.

Marketing

Alcohol marketing, including sponsorship, is a mix of sophisticated, integrated strategies, grouped around four main elements: the product, its price, its place (distribution) and its promotion.[46] There is growing evidence, including multiple systematic reviews, which demonstrates exposure to alcohol marketing is associated with early onset drinking and hazardous alcohol consumption, particularly for children.[47-49] The weight of evidence suggests that there is a causal relationship between alcohol marketing and subsequent drinking.[50]

To date, the only sign of legislative restrictions on alcohol marketing in Aotearoa is from the Sale and

Supply of Alcohol (Harm Minimisation) Amendment Bill, which provides for an end to alcohol sponsorship of sport.[51] Sport has attracted regulatory attention as it is emotionally captivating, highly popular and permits alcohol marketing at times not permitted by existing marketing codes.[51] Sports sponsorship also enables alcohol companies to reach younger audiences that conflate positive attitudes associated with sports and their personalities with alcohol.[51] In particular, the rapid expansion of Esports has provided a new avenue for alcohol companies to target huge numbers of young people at much lower costs than traditional sports.[52] In Aotearoa, sports sponsorship is the main avenue for children's exposure to alcohol marketing and is the main driver of inequities in exposure between Māori and non-Māori children.[53] Athletes sponsored by alcohol companies also experience greater alcohol-related harms than those athletes with non-alcohol sponsors.[48]

Despite strong evidence between alcohol marketing exposure and consumption,[47-49] there is limited empirical evidence of the impact of alcohol marketing restrictions. For example, one Cochrane Review of intervention studies from 1970-2013 only included four studies that met the strict inclusion criteria.[54] The review concluded that the quality of available evidence was very low. Another barrier to the generation of research evidence is that there are relatively few real-world examples where substantial marketing restrictions have been implemented and rigorously evaluated. Consequently, the existing evidence on the impact of marketing restrictions is largely based on modelling studies, which suggest complete bans on alcohol marketing could reduce population-level alcohol consumption by between 5-9%.[15,54-58] The existing epidemiological evidence and modelling studies provide a compelling case for additional marketing restrictions, which is why the WHO classifies alcohol marketing restrictions as one of three best buys to reduce alcohol-related harm and has included this intervention as part of the SAFER initiative.[16]

Numerous countries, including Aotearoa, have self-regulatory codes for alcohol marketing, which involve the advertising industry developing and enforcing its own codes of marketing practice.[56] A recent systematic review of the effectiveness of alcohol marketing self-regulation concluded that "self-regulatory systems that govern alcohol marketing practices are not meeting their intended goal of protecting vulnerable populations." [59, p.45] In Aotearoa, the Advertising Standards Authority (ASA) is an advertising industry organisation responsible for the development, monitoring and enforcement of marketing practice in Aotearoa.[60] Three government-initiated reviews completed since 2006 have recommended implementing a legislative framework to regulate all forms of alcohol marketing due to the major limitations of self-regulation. [10,61,62] Recommendations have included introducing a legislative framework for alcohol marketing,[63] a total phasing out of alcohol marketing[10] and a ban on alcohol sponsorship of sport.[62]

Purpose

Researchers in the UK,[64] Australia,[65] and Denmark[66] have developed simulation models to identify alcohol interventions that are best value-for-money. This current research builds on these simulation models and is one of the first to determine the impact of alcohol interventions on ethnic health inequities. Our work replicates key risk factor and disease pathways and scales the model to predict the impacts across the population. We aim to identify which interventions are most effective and inequities-reducing. Altogether, our approach provides a strong foundation for undertaking a comprehensive examination of potential alcohol interventions for Māori and non-Māori populations in Aotearoa. Specifically, this project aims to understand:

1. What are the health impacts of key modelled alcohol interventions for Māori and non-Māori?

Methods

A detailed description of the methods used in this report is available in an accompanying protocol document. The model's population replicates the 2018 Aotearoa population by ethnicity (Māori/non-

Māori), and by age and sex by using the adjusted 2018 Aotearoa Census population estimates. The model uses a proportional multi-state life-table design[67] that divides the 2018 Aotearoa population into 5-year age, sex, and ethnicity (Māori/non-Māori) cohorts.

We modelled four hypothetical scenarios: 1) business as usual (BAU) which assumed no changes in alcohol consumption or policy settings; 2) an intervention package scenario that included a 50% tax increase, a complete marketing ban and reduced off-licence outlet trading hours and density; 3) variations of higher tax increases and the extent of marketing restrictions; and 4) a scenario where the Government acted on the key 2010 Law Commission recommendations.

Alcohol consumption

Alcohol consumption data were used to simulate current drinking patterns in Aotearoa, specifically: measures of alcohol consumption drawn from data in the nationally-representative New Zealand Health Survey 2017/18,[2] Statistics New Zealand Alcohol Available for Consumption[68] and the WHO Global Information System on Alcohol and Health (GISAH).[69]

Disease and injury data

Diseases and injuries attributable to alcohol in Aotearoa were simulated.[1] Ministry of Health National Collections data from 2015/16 to 2017/18 were used to estimate disease incidence, prevalence, and mortality for diseases and injuries. We used dose-response relationships between alcohol and illness from the 2016 Global Burden of Disease (GBD) Study,[1] which are conservative estimates of the overall negative impact of alcohol on health (i.e., they likely underestimate the total adverse effects of alcohol on health).[70] The GBD dose-response relationships also exclude some conditions associated with alcohol-related harm, particularly those for which evidence is still emerging, such as mental health conditions. It also does not include illness due to others' alcohol consumption, such as Fetal Alcohol Spectrum Disorder (FASD). We included 15 alcohol-related disease and injuries: alcohol use disorders, cancers (breast, colorectal, mouth and neck, liver), cardiovascular diseases (stroke, coronary disease, hypertensive heart disease), other diseases (diabetes mellitus type 1 and type 2, cirrhosis and other chronic liver diseases, lower respiratory tract infections), and injuries (transport, self-harm, interpersonal violence, other unintentional injuries). Disability rates account for time spent in ill health[71] and were calculated from Aotearoa-specific GBD results by dividing years lived with disability by the population count of each illness in each age and sex strata.[1] The disability rates were applied to each illness.

Intervention selection

Our approach considered which interventions would bring the greatest health gain for Māori, the potential for impact (with strong consideration for the WHO SAFER strategies), and relevance to current policy. We conducted two stakeholder engagement workshops to discuss possible intervention options. The first workshop with various Māori stakeholders focused on interventions important to Māori. The second workshop involved other alcohol and health experts (see protocol document for full list of workshop stakeholders).

Both workshops strongly recommended interventions focused on tax, availability and marketing. They also recommended that the project emphasise health inequities and the potential of interventions to reduce or exacerbate them. The Māori stakeholder group recommended that the project focus on the cost of Government inaction in relation to the key 2010 Law Commission recommendations.

Intervention effect size

Tax

There are a number of alcohol price elasticity reviews,[12,20,55,58] each with their own limitations and specificities which may not be immediately applicable to the Aotearoa context. After reviewing these

options, we adopted the Ministry of Justice (MoJ)[23] advice that future modelling studies incorporate the updated UK price elasticities which were published later in 2014.[20] To determine which tax scenarios to model, we considered the MoJ modelled tax increases of 82%, 107% and 133% which met minimum unit prices of $1.00, $1.10 and $1.20, respectively. The Law Commission's recommendation was a 50% increase in tax. Altogether, we used the MoJ and Law Commission tax increases in our scenarios. We used linear interpolation using the effect sizes from the MoJ report to estimate the effect size of any given alcohol tax increase on alcohol consumption.[23] Thus, 50%, 82%, 107% and 133% increases in alcohol tax resulted in estimated reduction in alcohol consumption of 7.6% (95%CI 5.64%, 9.56%), 12.2% (95%CI 10.22%, 14.14%), 15.8% (95%CI 13.83%, 17.75%) and 19.5% (95%CI 17.57, 21.48%), respectively.

Availability

To assess the potential health equity implications of the proposed availability interventions, we generated neighbourhood classifications using 2018 census data[72,73] and the New Zealand Index of Socioeconomic Deprivation (NZDep2018).[74] We linked 2018 census data to each Statistical Area 1 (SA1), which includes information on the resident population, as well as the age and ethnicity of residents. Communities with a high proportion of Māori or Pacific were defined as a Māori population >=15% and Pacific population >= 8%, respectively. Communities of high deprivation were defined by an NZDep 2018 measure, an area-based classification system for deprivation, between eight and 10.[74]

Outlet density

To measure outlet density in Aotearoa, we retrieved a validated geocoded dataset of alcohol outlets in the Alcohol Regulatory and Licensing Authority (ARLA) licence registry (2015-2018 version) from the University of Canterbury (UC) GeoHealth Laboratory.[75] We spatially matched off-licence outlets to SA1s to extract the total number of outlets in each community. Table 1 shows the off-licence outlet density as the number of outlets per 100,000 population by community type. We modelled changes in consumption by reductions in outlets per 100,000 population as done in two previous studies.[57,76] We modelled a decrease from 63.1 to 5 outlets per 100,000 people. The outlet reduction is estimated to reduce alcohol consumption by 8.64% (95%CI 7.02%, 10.26%), or equivalent to ~2% per 10 outlets per 100,000 people after applying a decay effect. The decay effect adjusts for the likelihood that each additional outlet will have less impact than the one that preceded it (e.g., the 20th outlet will likely have a greater relative impact than the 21st outlet or 60th outlet etc).[57,76]

Table 1. Population-weighted off-licence outlet densities for different communities in Aotearoa

Community		**SA1,[a] n**	**Total population [b]**	**Off-licence outlets**	**Outlets per 100,000 people**
Total		29,386	3,776,355	2,383	63.1
Ethnicity	European	10,754	1,435,287	989	68.9
	Māori	11,188	1,391,058	1,037	74.5
	Pacific	7,146	925,533	548	59.2
Ethnicity	Non-Māori	18,198	2,385,297	1,346	56.4
	Māori	11,188	1,391,058	1,037	74.5
Deprivation [c]	Low	8,503	1,099,215	341	31.0
	Moderate	11,902	1,523,613	951	62.4
	High	8,981	1,153,527	1,091	94.6
Rurality	Urban	24,351	3,166,386	376	63.4
	Rural	5,035	609,969	2,007	61.6

[a] Number of communities defined by Statistical Area 1 (SA1) 2018.

[b] Total number of people aged 15+ within these communities.

[c] Neighbourhood deprivation measured using the New Zealand Index of Socioeconomic Deprivation (NZDep2018). High deprivation 8-10; moderate 4-7; low 1-3.

Trading hours

Currently, the national trading hours for Aotearoa off-licence outlets are from 7am to 11pm, a total of 112 hours per week. A 2018 systematic review of natural experiments assessing the impact of changes in trading hours and days of operation included six studies.[14] Consistent with previous modelling studies,[57,76] we applied the effect size for a reduction in one day of sale from the Sherk et al 2018 meta-analysis.[14] We applied the same decay function used in previous studies.[57,76] We estimated that reducing trading hours from 112 to 50 per week, with a maximum closing time of 8pm, would decrease alcohol consumption by 9.24% (95%CI 7.34%, 11.14%).

Marketing

Despite strong evidence linking alcohol marketing exposure and consumption,[47,48,77] there have been relatively few studies assessing the impact of alcohol marketing restrictions or bans.[54] One modelling study estimated bans could reduce alcohol consumption by ~9% for complete bans, and ~5% for partial bans (bans on one beverage or media),[15] which has been used to inform recent Organization for Economic Co-operation and Development (OECD) modelling[56] and other peer-reviewed modelling studies.[57,58] We determined that applying the Saffer 2002[15] effect sizes of 8.89% (95%CI 5.06%, 12.90%) for a complete ban and 4.86% (95%CI 0.94%, 8.78%) for a partial ban was appropriate given the limited evidence base and the major developments in the effectiveness of alcohol marketing since its publication.

Simulation analysis

Our simulation analysis used an incidence approach which links changes in alcohol consumption to disease incidence (i.e., the first onset of disease) at each year of simulation. Changes in disease incidence resulted in changes in disease prevalence and mortality. In turn, this influenced overall mortality and morbidity in the cohort.

A full list of interventions modelled is listed in Table 2. We evaluated and compared modelled interventions using two main model outputs. We measured health gain using health-adjusted life years (HALYs), which is a population health measure permitting morbidity and mortality to be simultaneously described within a single number.[78] Health gain was also represented as life expectancy (LE), which is the median age at death for a particular population group (five-year age, sex and ethnicity groups) for the youngest cohort members (aged 2 in 2018). Uncertainty intervals (UI) around results were estimated using a Monte Carlo analysis; the model was run 2000 times with input parameters sampled independently from their probability distributions. Uncertainty intervals capture uncertainty around disease rate inputs, alcohol consumption, relative risks, and intervention effect sizes.

Our first scenario, BAU, assumed no changes in the level of alcohol consumption or to alcohol policy over time. The second scenario was an intervention package scenario that included a 50% tax increase, a complete marketing ban and reduced off-licence outlet trading hours and density. The third scenario examined variations of the extent of marketing restrictions and higher tax increases. The final scenario was where the Government acted on the key 2010 Law Commission recommendations. The differences in alcohol consumption between an intervention and the BAU determined the impacts of the intervention on health outcomes. These impacts were specific to ethnicity (Māori/non-Māori), age, and sex. We also quantified impacts over time in 10-year increments over the full lifetime of the population.

To further examine the interventions' impacts on Māori-specific health inequities, we quantified relative per capita health gains and age-standardised health gains (to eliminate confounding by age).[67] Among the mix of modelled interventions, we identified which interventions gave the least and greatest absolute health gain for Māori, and which interventions reduce inequities (or not) for Māori.

Table 2. Interventions modelled with current policy, proposed intervention and expected effect size

Intervention area	Current policy	Modelled intervention	Modelled effect size (95% CI)	Source and original effect sizes
Taxation	~15% of price	50% increase	-7.6% (-5.64% to -9.56%)	Ministry of Justice modelling of 82%, 107% and 133% alcohol tax increases. [23] Estimated decreases of 12.2%, 15.8% and 19.5%, respectively. Linear interpolation of Ministry of Justice modelling was used to estimate impact for the 50% increase.
		82% increase	-12.2% (-10.22% to -14.14%)	
		107% increase	-15.8% (-13.83% to -17.75%)	
		133% increase	-19.5% (-17.57% to -21.48%)	
Availability, outlet density	63 outlets per 100,000	5 outlets per 100,000	-8.64% (-7.02% to -10.26%) Equivalent to ~2% per 10 outlets per 100,000 people after applying decay effect	Stockwell (2017) estimated that an increase from 5 to 75 outlets per 100,000 population results in an estimated 16.4% (95%CI 14.7%, 18.2%) increase in consumption.[79] Formula and coefficients for applying decay effect available in Stockwell (2017).
Availability, outlet trading hours	112 hours	8pm closing time and reducing weekly trading hours to 50	-9.24% (-7.34% to -11.14%) Equivalent to ~1.5% per 9 hours reduction after applying the decay effect [14]	Original estimate of 3.4% (95%CI 2.7%, 4.1%) decrease in consumption for each day reduction in sales (9 hours). [14] Decay effect results in each 9-hour increment has 0.65 the effect of the previous 9-hour increment.
Marketing	Self-regulation	Total ban	-8.98% (-5.06% to -12.9%)	Estimate from regression model using data from 20 OECD countries [15]. Modelled effect size was the same as the original effect size reported.
		Partial ban	-4.86% (-0.94% to -8.78%)	
Total intervention package	The total intervention package modelled in the main scenario includes a 50% tax increase; outlet density reduction to five outlets per 100,000 people; outlet trading hours' reduction to 50 hours per week with a maximum closing time of 8pm; a complete ban on all forms of alcohol marketing. The effect sizes of all four alcohol interventions were applied to alcohol consumption sequentially. In total, alcohol consumption was reduced by 30.3% (95%CI 26.5% to 34.1%)).			

Results

Business as usual (BAU): Scenario One

The BAU scenario represented our current policy settings. Our cohort represented all those people in the 2018 census (~4.9 million) with a total of 181 million health-adjusted life years (HALYs) (see Supplementary material for a full breakdown by age, sex and ethnicity). The cohort had an average life expectancy of 78.9, with higher life expectancy among non-Māori (80.9) compared to Māori (73.6) and for women (75.4 and 82.7 for Māori and non-Māori, respectively) compared to men (71.9 and 79.3) (Supplementary material).

Table 3 displays alcohol consumption in ethanol grams per day (per capita) by sex, age and ethnicity in the BAU scenario and the total intervention package scenario. In Aotearoa, one standard drink is equivalent to 10 grams of ethanol. In all scenarios, men consistently drank more than women at any given age or ethnicity. For both ethnicity and sex, higher per day consumption was observed in age groups 35-64 compared to other age groups. Younger Māori tended to have higher consumption than younger non-Māori, while Māori women aged over 65 and Māori men aged over 55 drank less than their non-Māori counterparts.

In the BAU scenario, all male age and ethnic strata have a daily alcohol consumption that was higher than the Ministry of Health (MoH) alcohol guidelines to reduce long-term health risks (Table 3).[80] Most non-Māori women (except ages 45-64) and Māori women over 65 consumed less alcohol than the MoH guidelines in the BAU scenario. Despite the reduction in alcohol consumption in the total intervention package scenario, the only additional population groups to consume less than the MoH guidelines were Māori women younger than 34 and non-Māori men aged 75+. Consequently, 9 of the 28 population groups (32%) were still consuming alcohol over the MoH guidelines post-intervention. This highlights the high baseline alcohol consumption in Aotearoa and the extent of reductions required to bring the population under low-risk guidelines.

Table 3. Alcohol consumption in grams of ethanol (10g ethanol = 1 standard drink) by sex, age and ethnicity in business as usual (BAU) (Scenario One) and full intervention scenarios (Scenario Two)

		Business as usual (Scenario One)		Intervention package [a] (Scenario Two)			
Sex	Age	Māori	Non-Māori	Māori	Reduction (g)	Non-Māori	Reduction (g)
Female	15-24	**14.9**	10.8	10.4	4.5	7.5	3.3
	25-34	**15.4**	10.3	10.8	4.7	7.2	3.1
	35-44	**24.0**	13.9	**16.7**	7.3	9.7	4.2
	45-54	**21.6**	**18.6**	**15.0**	6.5	13.0	5.6
	55-64	**19.4**	**17.3**	13.5	5.9	12.0	5.2
	65-74	9.6	13.9	6.7	2.9	9.7	4.2
	75-99	6.1	13.0	4.3	1.9	9.1	3.9
Male	15-24	**26.5**	**26.2**	18.4	8.0	18.3	8.0
	25-34	**27.7**	**26.2**	19.3	8.4	18.3	8.0
	35-44	**34.8**	**28.9**	**24.2**	10.6	20.2	8.8
	45-54	**39.2**	**35.2**	**27.3**	11.9	**24.5**	10.7
	55-64	**37.2**	**40.1**	**25.9**	11.3	**28.0**	12.2
	65-74	**33.6**	**37.0**	**23.4**	10.2	**25.8**	11.2
	75-99	**27.0**	**22.4**	18.8	8.2	15.6	6.8

[a] Total Intervention package consists of the combined effectiveness of a 50% increase in 2018 alcohol tax rates, reduction in outlet density to five outlets per 100,000 people, reduction in outlet trading hours to 50 per week with a maximum closing time of 8pm, and a complete marketing ban including sponsorship.

[b] **Bolded** values represent a weekly consumption greater than the Ministry of Health recommendations to reduce long-term health risks[80] (women = two standard drinks per day with maximum of 10 per week, or 100g per week divided by seven days = 14.3g per day; men = three standard drinks per day with a maximum of 15 per week, 150g per week divided by seven days = 21.4g per day).

Total alcohol intervention package effectiveness: Scenario Two

Table 4 and Table 5 outline the health-adjusted life years (HALYs) gained compared to the BAU scenario from the total alcohol intervention package over the lifetime of the cohort. The intervention package would result in 726,000 (95% uncertainty intervals [UI] 492,000, 913,000) HALYs gained, with an average of 0.18 (95%UI 0.12, 0.23) HALYs gained per capita (note 0.01 HALY = 3.65 days). Māori experienced 32% (rate ratio 1.32) greater age-adjusted per capita HALYs gains of 0.21 (95%UI 0.14, 0.26) than non-Māori with 0.16 (95%UI 0.11, 0.20). Men gained twice the HALYs per capita compared to women in both Māori (0.30 95%UI 0.20, 0.37 compared to 0.12 95%CI 0.07, 0.16) and non-Māori (0.22 95%UI 0.15, 0.27 compared to 0.10 95%UI 0.06, 0.13) groups.

The trends by ethnicity and sex that were observed in the intervention package were also reflected within individual alcohol interventions. Each intervention was relatively similar in total HALY gains (~200,000) and per capita HALY gains (0.05 HALYs). Reducing alcohol outlet trading hours produced the highest gains in HALYs (232,000 and 0.05 HALYS total and per capita, respectively) and the 50%

tax increase produced the lowest gains in HALYs (193,000 and 0.05 HALYs total and per capita, respectively), but uncertainty intervals for these interventions overlapped.

Māori and men experienced greater increases in overall life expectancy from alcohol interventions compared to non-Māori and women, respectively (Table 6). However, the modelled alcohol interventions did not achieve a substantial improvement in the existing large life expectancy inequities between populations in Aotearoa. For example, the intervention package addressed only 1.5% of the baseline inequity in life expectancy between Māori and non-Māori. Years of life expectancy gained were slightly higher than HALYs gained across the suite of alcohol interventions suggesting that most life years gained will be lived in good health. For example, the intervention package resulted in 0.18 (95%UI 0.12, 0.23) HALYs and 0.24 (95%UI 0.16, 0.31) LE gained per capita, or 75% of life years gained will be lived in good health.

HALYs gained over time from intervention package: Scenario Two

Figure 1 provides an overview on when the modelled health gains from Scenario Two's alcohol interventions were realised. After the interventions were implemented in 2018, most of the modelled health gains were realised between the period from 2048 to 2088. As a result, health gains from alcohol interventions took a substantial period of time before they occurred (>20 years). Figure 1 highlights the disproportionate health gains likely to be experienced by men and Māori compared to women and non-Māori, respectively.

Table 4. Total health-adjusted life years (HALYs) [a] gained from alcohol interventions (Scenario Two) compared to Business as usual (BAU) (Scenario One)

Population	Intervention package [b]		Taxation [b]		Off-licence outlet density [b]		Off-licence outlet hours [b]		Marketing ban [b]	
	Total (000)	95%UI (000)	Total (000)	95%UI (000)	Total (000)	95%UI (000)	Total (000)	95%UI (000)	Total (000)	95%UI (000)
All	726	(492, 913)	193	(115, 254)	218	(138, 283)	232	(145, 306)	227	(102, 333)
Non-Māori	555	(378, 696)	148	(89, 195)	168	(107, 218)	178	(112, 235)	174	(79, 256)
Māori	171	(112, 215)	45	(26, 58)	51	(31, 66)	54	(33, 71)	53	(23, 77)
Non-Māori females	167	(106, 221)	49	(29, 67)	55	(34, 75)	59	(37, 80)	57	(26, 86)
Non-Māori males	388	(269, 477)	99	(59, 128)	112	(73, 143)	120	(75, 154)	117	(53, 168)
Māori females	49	(28, 67)	14	(7, 20)	16	(9, 21)	17	(10, 24)	16	(7, 25)
Māori males	122	(83, 151)	31	(18, 39)	35	(22, 45)	37	(23, 48)	36	(16, 52)

[a] Health-adjusted life years (HALYs) is a population health measure permitting morbidity and mortality to be simultaneously described within a single number.
[b] **Intervention package** includes the effect sizes of all four alcohol interventions applied to alcohol consumption sequentially: **Taxation** is a 50% increase in 2018 alcohol tax rates; **off-licence outlet density** is a reduction to 5 outlets per 100,000 people from 63.1; **off-licence outlet hours** is a reduction to 50 hours per week from 112 with a maximum closing time of 8pm; **marketing ban** includes a complete ban on all forms of alcohol marketing, including sponsorship.

Table 5. Per capita health-adjusted life years (HALYs) [a] gained from alcohol interventions (Scenario Two) compared to Business as usual (BAU) (Scenario One)

Population	Intervention package			Taxation [b]			Off-licence outlet density [b]			Off-licence outlet hours [b]			Marketing ban [b]		
	p/c [c]	95%UI	RR[d]	p/c [c]	95%UI	RR[d]	p/c [c]	95%UI	RR[d]	p/c [c]	95%UI	RR[d]	p/c [c]	95%UI	RR[d]
All	0.18	(0.12, 0.23)	.	0.05	(0.03, 0.06)	.	0.05	(0.03, 0.07)	.	0.06	(0.04, 0.08)	.	0.06	(0.03, 0.08)	.
Non-Māori	0.16	(0.11, 0.20)	.	0.04	(0.03, 0.06)	.	0.05	(0.03, 0.06)	.	0.05	(0.03, 0.07)	.	0.05	(0.02, 0.07)	.
Māori	0.21	(0.14, 0.26)	1.32	0.05	(0.03, 0.07)	1.29	0.06	(0.04, 0.08)	1.29	0.07	(0.04, 0.09)	1.29	0.06	(0.03, 0.09)	1.29
Non-Māori females	0.10	(0.06, 0.13)	.	0.03	(0.02, 0.04)	.	0.03	(0.02, 0.04)	.	0.03	(0.02, 0.05)	.	0.03	(0.01, 0.05)	.
Non-Māori males	0.22	(0.15, 0.27)	2.33	0.06	(0.03, 0.07)	2.03	0.06	(0.04, 0.08)	2.04	0.07	(0.04, 0.09)	2.05	0.07	(0.03, 0.10)	2.04
Māori females	0.12	(0.07, 0.16)	.	0.03	(0.02, 0.05)	.	0.04	(0.02, 0.05)	.	0.04	(0.02, 0.06)	.	0.04	(0.02, 0.06)	.
Māori males	0.30	(0.20, 0.37)	2.53	0.08	(0.04, 0.10)	2.23	0.09	(0.05, 0.11)	2.24	0.09	(0.06, 0.12)	2.25	0.09	(0.04, 0.13)	2.25

[a] Health-adjusted life years (HALYs) is a population health measure permitting morbidity and mortality to be simultaneously described within a single number.
[b] **Intervention package** includes the effect sizes of all four alcohol interventions applied to alcohol consumption sequentially: **Taxation** is a 50% increase in 2018 alcohol tax rates; **off-licence outlet density** is a reduction to 5 outlets per 100,000 people from 63.1; **off-licence outlet hours** is a reduction to 50 hours per week from 112 with a maximum closing time of 8pm; **marketing ban** includes a complete ban on all forms of alcohol marketing, including sponsorship.
[c] The number of age-adjusted HALYs gained per capita (p/c). 0.01 p/c HALYs = 3.65 days
[d] The rate ratio (RR) of the age-adjusted HALYs gained per capita between population groups.

Table 6. Total and per capita life expectancy (LE)[a] gained by the cohort aged 2 in 2018 from alcohol interventions (Scenario Two) compared to Business as usual (BAU) (Scenario One)

Population	Intervention package [b]			Taxation [b]			Off-licence outlet density [b]			Off-licence outlet hours [b]			Marketing ban [b]		
	LE[a]	p/c (95%UI)[c]	RR[d]	LE[a]	p/c (95%UI)[c]	RR[d]	LE[a]	p/c (95%UI)[c]	RR[d]	LE[a]	p/c (95%UI)[c]	RR[d]	LE[a]	p/c (95%UI)[c]	RR[d]
All	79.2	0.24 (0.16, 0.31)		79.0	0.06 (0.04, 0.08)		79.0	0.07 (0.04, 0.1)		79.0	0.08 (0.05, 0.1)		79.0	0.08 (0.03, 0.11)	
Non-Māori	81.1	0.21 (0.21, 0.41)		81.0	0.06 (0.05, 0.11)		81.0	0.06 (0.06, 0.13)		81.0	0.07 (0.06, 0.14)		81.0	0.07 (0.04, 0.15)	
Māori	73.9	0.32 (0.21, 0.41)	1.52	73.7	0.08 (0.05, 0.11)	1.33	73.7	0.1 (0.06, 0.13)	1.67	73.7	0.1 (0.06, 0.14)	1.43	73.7	0.1 (0.04, 0.15)	1.43
Non-Māori females	82.8	0.13 (0.29, 0.56)		82.7	0.04 (0.06, 0.15)		82.7	0.04 (0.08, 0.17)		82.7	0.05 (0.08, 0.18)		82.7	0.04 (0.06, 0.2)	
Non-Māori males	79.6	0.28 (0.19, 0.36)	2.15	79.3	0.07 (0.04, 0.1)	1.75	79.4	0.08 (0.05, 0.11)	2.00	79.4	0.09 (0.05, 0.12)	1.80	79.4	0.09 (0.04, 0.12)	2.25
Māori females	75.6	0.18 (0.11, 0.25)		75.5	0.05 (0.03, 0.07)		75.5	0.06 (0.03, 0.08)		75.5	0.06 (0.04, 0.09)		75.5	0.06 (0.03, 0.09)	
Māori males	72.4	0.45 (0.09, 0.18)	2.50	72.0	0.11 (0.02, 0.05)	2.20	72.0	0.13 (0.03, 0.06)	2.17	72.1	0.14 (0.03, 0.06)	2.33	72.0	0.13 (0.02, 0.07)	2.17

[a] Life expectancy (LE) is the median age at death for a particular population group. This table represents the life expectancy of the age group aged 2 in 2018.

[b] **Intervention package** includes the effect sizes of all four alcohol interventions applied to alcohol consumption sequentially: **Taxation** is a 50% increase in 2018 alcohol tax rates; **off-licence outlet density** is a reduction to 5 outlets per 100,000 people from 63.1; **off-licence outlet hours** is a reduction to 50 hours per week from 112 with a maximum closing time of 8pm; **marketing ban** includes a complete ban on all forms of alcohol marketing, including sponsorship.

[c] The number of age-adjusted LEs gained per capita (p/c) – 0.01 p/c LE = 3.65 days

[d] The rate ratio (RR) of the age-adjusted LEs gained per capita between groups.

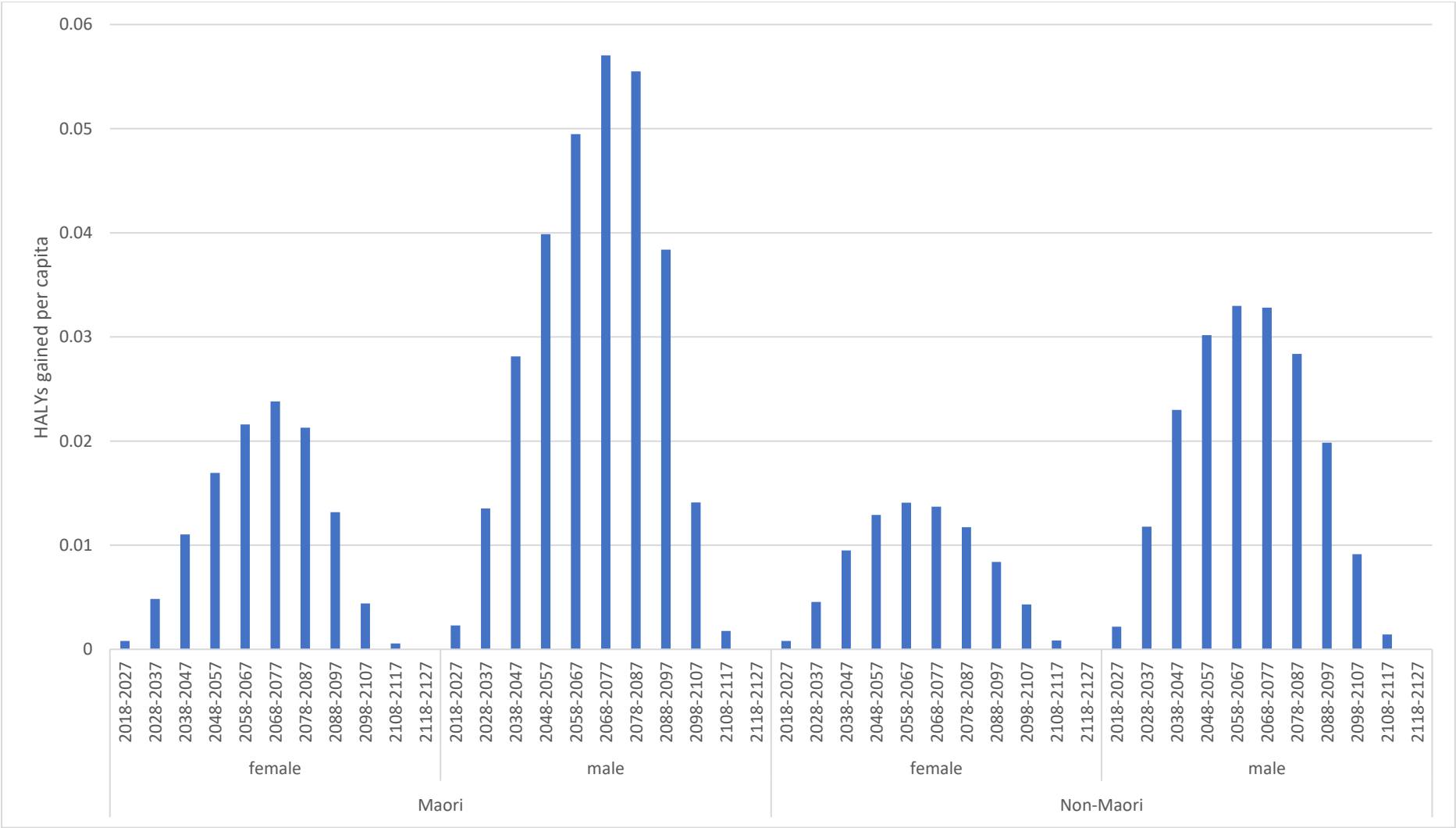


Figure 1. Health-adjusted life years (HALYs) gained per capita from the complete alcohol intervention package (Scenario Two) compared to Business as usual (BAU) (Scenario One) by decade, stratified by sex and ethnicity

Health impact of different marketing interventions: Scenario Three

Table 7 shows the impact of partial and complete alcohol marketing bans on HALYs and LE gains compared to the BAU scenario (Scenario One). The marketing ban in the intervention package was a complete ban. A partial ban on alcohol marketing resulted in 123,000 (95%UI 21,000, 220,000) HALYs gained compared to 226,000 (95%CI 102,000, 333,000) HALYs for a complete ban. A partial ban would be based on full legislative restrictions on one form of marketing, for example, alcohol sponsorship of sport. Consistent with other alcohol interventions, greater gains were experienced for Māori compared to non-Māori in both HALYs and LE.

Table 7. Health-adjusted life years (HALYs) and life expectancy (LE) gains from alcohol marketing interventions (Scenario Three) compared to Business as usual (BAU) (Scenario One)

Health outcome	Population	Partial marketing ban		Complete marketing ban	
		Total, 000 (95%UI)	per capita (95%UI)	Total, 000 (95%UI)	per capita (95%UI)
HALYs [a]	All	123 (21, 220)	0.03 (0.01, 0.06)	226 (102, 333)	0.06 (0.03, 0.08)
	Non-Māori	95 (16, 169)	0.03 (0.02, 0.07)	174 (79, 256)	0.05 (0.02, 0.07)
	Māori	29 (5, 51)	0.03 (0.03, 0.09)	52 (23, 77)	0.06 (0.03, 0.09)
Health outcome	**Population**	**Expected value**	**per capita (95% UI)**	**Expected value**	**per capita (95%UI)**
Life expectancy (LE) [b]	All	79.0	0.04 (0.01, 0.07)	79.0	0.08 (0.03, 0.11)
	Non-Māori	81.0	0.04 (0.01, 0.10)	81.0	0.07 (0.04, 0.15)
	Māori	73.7	0.05 (0.01, 0.10)	73.7	0.1 (0.04, 0.15)

[a] Health-adjusted life years (HALYs) is a population health measure permitting morbidity and mortality to be simultaneously described within a single number.

[b] Life expectancy (LE) is the median age at death for a particular population group. This table represents the life expectancy of the age group aged 2 in 2018.

Health impact of different taxation rates: Scenario Three

Table 8 demonstrates the effectiveness of alcohol taxation at different levels of tax increases recommended by either the Law Commission or the MoJ. A tax increase of 107% (393,000 HALYs, 95%UI 147,000, 480,000) and 133% (482,000 HALYs, 95%UI 123,000, 577,000) would have approximately twice the impact of any intervention used in the intervention package (Scenario Two), as displayed in Table 4. Thus, increase in taxation was the most effective intervention if implemented at levels modelled by the MoJ. In fact, taxation at 133%, would have ~70% of the effect of the entire alcohol intervention package presented in Table 4 (including a 50% tax increase). Greater HALY and LE gains were experienced by Māori than non-Māori at each level of taxation.

Table 8. Health-adjusted life years (HALYs) and life expectancy (LE) gains from different taxation rates (Scenario Three) compared to Business as Usual (BAU) (Scenario One)

Health outcome	Population	Taxation 50% [c]		Taxation 82% [c]		Taxation 107% [c]		Taxation 133% [c]	
		Total, 000 (95% UI)	p/c (95% UI)	Total, 000 (95% UI)	p/c (95% UI)	Total, 000 (95% UI)	p/c (95% UI)	Total, 000 (95% UI)	p/c (95% UI)
HALYs[a]	All	192 (115, 254)	0.05 (0.03, 0.06)	305 (37, 370)	0.08 (0.01, 0.09)	393 (147, 480)	0.10 (0.04, 0.12)	482 (123, 577)	0.12 (0.03, 0.15)
	Non-Māori	147 (89, 195)	0.04 (0.03, 0.06)	234 (29, 284)	0.07 (0.01, 0.08)	301 (114, 368)	0.09 (0.03, 0.11)	369 (95, 441)	0.11 (0.03, 0.13)
	Māori	44 (26, 58)	0.05 (0.03, 0.07)	71 (8, 86)	0.09 (0.01, 0.11)	91 (33, 112)	0.11 (0.04, 0.14)	112 (28, 136)	0.14 (0.03, 0.17)
Health outcome	**Population**	**Expected value (95% UI)**	**per capita (95% UI)**	**Expected value (95% UI)**	**per capita (95% UI)**	**Expected value (95% UI)**	**per capita (95% UI)**	**Expected value (95% UI)**	**per capita (95% UI)**
LE[b]	All	79.0	0.06 (0.04, 0.08)	79.0	0.10 (0.01, 0.12)	79.0	0.13 (0.05, 0.16)	79.1	0.16 (0.04, 0.19)
	Non-Māori	81.0	0.06 (0.05, 0.11)	81.0	0.09 (0.02, 0.16)	81.0	0.11 (0.06, 0.21)	81.1	0.14 (0.05, 0.26)
	Māori	73.7	0.08 (0.05, 0.11)	73.8	0.13 (0.02, 0.16)	73.8	0.17 (0.06, 0.21)	73.8	0.21 (0.05, 0.26)

[a] Health-adjusted life years (HALYs) is a population health measure permitting morbidity and mortality to be simultaneously described within a single number.

[b] Life expectancy (LE) is the median age at death for a particular population group. This table represents the life expectancy of the age group aged 2 in 2018.

[c] Taxation scenarios in line with the Law Commission (50%)[10], Ministry of Justice modelling (82% = minimum unit price (MUP) of $1; 107% increase = MUP of $1.10; 133% increase = MUP price of $1.20).[23]

Health loss attributable to Government inaction on the Law Commission recommendations: Scenario Four

To determine the health loss attributable to Government inaction on the 2010 Law Commission recommendations, we took the estimated HALYs from the first decade of the main model (2018 to 2027) as representative of the time period from 2011 to 2020 (Table 9). Under these assumptions, this model estimates that the failure to implement a comprehensive package of alcohol interventions has cost an estimated 7,300 HALYs. Importantly, these health costs will accelerate as most health gains are not observed until at least 20 years after intervention implementation (refer to Figure 1). By the year 2030, the health cost of inaction will have increased to an estimated total of 48,000 HALYs, a six-fold increase on the health cost from the first decade. The health cost of this inaction disproportionately impacts Māori compared to non-Māori across the suite of alcohol interventions and overall.

Table 9. Health loss attributable to Government inaction on 2010 Law Commission recommendations over the first decade (for example, 2011-2020) in health adjusted life years (HALYs)

Intervention	Population	Total HALYs
Taxation	All	2,000
	Non-Māori	1,600
	Māori	300
Off-licence outlet density	All	2,200
	Non-Māori	1,900
	Māori	400
Off-licence outlet hours	All	2,400
	Non-Māori	2,000
	Māori	400
Marketing ban	All	2,300
	Non-Māori	1,900
	Māori	400
Intervention package	All	7,300
	Non-Māori	6,100
	Māori	1,300

Discussion

Main results

Our modelling estimated a package of alcohol interventions could gain 726,000 (95%UI 492,000, 913,000) health-adjusted life years (HALYs), with an average of 0.18 (95%UI 0.12, 0.23) HALYs gained per capita. This intervention package was estimated to improve median life expectancy by 0.24 (95%UI 0.16, 0.31) years or 87.6 days. Across the intervention package and individual interventions, life expectancy improved only slightly more than HALYs gained, suggesting that gained years of life would be lived in good health.

Overall, all individual alcohol interventions and the combined package benefited Māori more compared to non-Māori across all health outcomes. Men also benefited disproportionately from alcohol interventions compared to women. These disproportionate effects are attributable to baseline alcohol consumption and disease incidence across population groups.

In the package of modelled interventions, a substantial reduction in off-licence alcohol outlet trading hours was marginally more effective than a 50% tax increase, reduction in off-licence alcohol outlet density and a complete alcohol marketing ban. However, when higher tax rates were modelled at rates consistent with the Ministry of Justice recommendations, taxation was more effective than restrictions on alcohol outlet trading hours.

The majority of health gains from any alcohol intervention were not realised until 20 years or more after intervention implementation. The temporal trend was consistent by sex and ethnicity, and reflects the lag between changes in alcohol consumption and changes in health. For example, a person's risk of alcohol-related cancer would not drop to a "never drinker's" risk overnight if the person stopped consuming alcohol today. Taking just the first decade of health gains, the model provides the potential impact of Government inaction on the 2010 Law Commission recommendations. We estimated Government inaction in the first decade from 2011-2020 to have cost 7,300 HALYs, which would increase by six-fold with an additional decade of inaction.

Strengths and limitations

One of the core limitations of this analysis is the uncertainty in our effect size estimates for different interventions. While there is strong evidence for the impact of price, marketing and availability on alcohol consumption,[16] substantial variability on the precise effect sizes persist. Further complicating effect size estimates is that most alcohol interventions are implemented concurrently with other policies, which makes isolating the effect of any particular intervention difficult. Fortunately, the modelling approach used in this current report is flexible to the incorporation of new effect sizes for key policies as our understanding of the effectiveness of different interventions becomes more complete.

Our analysis grouped non-Māori into a single homogenous category due to data availability, which could mask major inequities in the current burden of alcohol-related harm and intervention effectiveness within the non-Māori group.

Another limitation was that we did not include the full suite of alcohol-attributable disease and injury conditions identified in the Global Burden of Disease Study.[1] We included all the conditions identified in the Global Burden of Disease Study for which it was possible to obtain stable estimates of disease rates. Consequently, we excluded tuberculosis, epilepsy, oesophageal cancer, pancreatitis, and alcoholic cardiomyopathy. Further, our modelled results do not include FASD, sexually transmitted diseases, violence or other social harms (e.g., relationship and workplace problems) that would have an impact on both HALYs and life expectancy estimates. As a result, we have underestimated the total negative health impact of alcohol use.

We applied the intervention effect sizes uniformly across population groups, which likely underestimated the health equity potential of the modelled interventions. We anticipate that interventions would have differential effectiveness in certain population groups due to drinker type, age structure and variations in baseline exposures. First, while we raise health equity concerns around taxation, evidence suggests heavy drinkers are the most price sensitive.[20] In Aotearoa, Māori are more likely to have hazardous drinking patterns,[2] which means any resulting tax increase may result in disproportionate effectiveness due to drinker type. Second, younger people are more sensitive to price increases[81] and to the persuasive effects of alcohol marketing (and thus more responsive to an alcohol marketing ban).[49] Given Māori have a younger age structure than non-Māori, and the earlier the intervention, the greater health gain over the cohort, these interventions would likely have a disproportionate benefit for Māori. Third, Māori are also disproportionately exposed to the drivers of alcohol consumption including higher rates of alcohol marketing exposure[53] and alcohol outlet density and trading hours.[39] Thus, future research should examine the differential effectiveness of interventions accounting for drinker type, age structures and baseline exposure to the determinants of alcohol consumption.

Moreover, while this research offers policy solutions to minimising the harms from alcohol, we recognise that a suite of actions or more comprehensive work is needed with Māori leadership at the fore in order to uphold Māori rights to equity, Tino Rangatiratanga, partnership, active protection and ultimately control over how alcohol is managed in society as well as how alcohol harms are mitigated among Māori. More broadly, the underlying (or overarching) drivers of harmful alcohol use among Māori, such as colonisation and ongoing impacts from this, must be addressed via a clear commitment by the Crown to adequately resource and support Māori-led solutions to decrease harms from alcohol across Aotearoa.

This modelling study also had a number of strengths. First, it incorporated 15 disability and injury rates from a global study on alcohol-related harm. Second, it uses Aotearoa alcohol consumption data that were stratified by age and ethnicity so we were able to examine some of the health equity implications of different interventions. Third, the study also benefited from a refined methodological approach that has been effectively applied and validated on modelling studies on tobacco, transport and diet.[67,82,83] Thus, the modelling approach, including some core components within this model, have received extensive peer-review through publication in top international journals.

Overall impact of intervention package

Few studies have estimated the impact of a suite of alcohol interventions.[17] We estimated our alcohol interventions could gain 726,000 health-adjusted life years (HALYs) in Aotearoa. A common practice in cost-effective analyses is to multiply the HALYs gained by the Gross Domestic Product (GDP) per capita to establish cost effectiveness.[84] Interventions costing less than GDP per capita for each HALY have been defined as very cost effective, while interventions costing between one and three times GDP per capita per HALY are cost-effective. Using the 2018 World Bank estimate of GDP per capita in Aotearoa (~NZ$64,000), interventions costing up to ~NZ$46billion over the next 100 years would be likely to be cost-effective based on this threshold. Whilst this report does not present a formal cost-effectiveness analysis, the figures help contextualises the potential magnitude of the potential health benefits.

The full intervention package was estimated to increase median life expectancy by 0.24 years per capita or 87.6 days. The improvements in life expectancy are consistent with results from another study demonstrating the impact of completely eradicating tobacco use and obesity in Aotearoa.[83] The authors estimated that eradicating tobacco use would improve median life expectancy by 0.50 years or twice the effect of our alcohol intervention package, while eradicating overweight and obesity would result in an increase of 1.21 years of life.[83] In comparison, in our alcohol intervention scenario, nine (32%) population groups were still consuming alcohol above the Ministry of Health guidelines

post-intervention so we were not modelling the complete eradication of alcohol-related disease and injury conditions. [80]

The results highlight that alcohol interventions may only reduce a small amount of the substantial existing inequities in HALYs and life expectancy between Māori and non-Māori (~1.5%). Health inequities between Māori and non-Māori have arisen from generational and systemic inequities in the social determinants of health,[83] which are not likely to be resolved through modification of one contributing factor to inequities. However, in contrast to more structural and systemic determinants driving health inequities in Aotearoa, the Government has readily available policy levers to control alcohol-related harm.

Our results also show that health gains are predominantly realised around 20 years after the policies are implemented. This is consistent with previous studies estimating health gains over the life course of other alcohol interventions.[85] However, we note that many of the non-health negative impacts of alcohol would likely be reduced much more rapidly from our modelled interventions, such as alcohol-related crime.

Across all policies, Māori would experience greater benefits compared to non-Māori largely due to differences in baseline consumption, age structure and disease incidence. However, as mentioned in the limitations, we did not account for the differential impact of our policies due to differences in drinking patterns or in underlying exposure or responsiveness to policies. Māori are more likely than non-Māori to have hazardous drinking patterns and it is known that interventions such as taxation have a greater impact on hazardous drinkers compared to moderate drinkers.[23] Our preliminary analysis also showed that Māori communities are more likely to have higher alcohol outlet density than non-Māori (Table 1). Evidence also showed that Māori children are exposed to five times more alcohol marketing than non-Māori.[53]

Crown failings to address the disproportionate harms and determinants of alcohol consumption experienced by Māori are currently being heard in Waitangi Tribunal (Wai 2575)[5] and were addressed in a specific report on tobacco, alcohol and other substance abuse.[6] Our results highlight specifically the impact of the Government's inaction on key Law Commission recommendations. We estimated the cost of inaction in the first decade to have resulted in a total of 7,400 HALYs lost, with 1,300 lost by Māori. The magnitude of this health loss will increase substantially as more time passes.

Further work must be undertaken to ensure that policy changes are made in partnership with Māori, in order to affect the greatest level of benefit to Māori. Specifically, Maynard (2022)[7] outlines four key features of future alcohol policy to ensure it is Te Tiriti o Waitangi-compliant: 1) Te Tiriti o Waitangi is specifically referred to and references are precisely worded; 2) Māori can meaningfully and effectively participate in decisions around alcohol in their communities; 3) inequities between Māori and non-Māori are actively addressed; and 4) monitoring systems ensure progress on eliminating health inequities.

Tax

Our results showed that taxation at sufficiently high enough rates was the most effective alcohol intervention, which is consistent with previous studies.[16-18] We estimated that our tax intervention could reduce alcohol consumption by between 7.6-19.5% compared to BAU (Scenario One).[23] Increasing tax rates by 50-133% in Aotearoa was estimated to generate between 192,000 and 482,000 HALYs gained. One 2008 modelling study in the Netherlands estimated a five-fold increase in tax would result in ~624,000 HALYs gained compared to BAU over a 100 year period, with a cost saving of €3.3billion.[85] In 2014, the MoJ estimated a 82% increase in alcohol taxes would result in net savings to society of $339million in the first year and $2.5billion over 10 years.[23]

In addition to clear health gains, there are numerous supporting arguments for increased taxation. First, the alcohol tax rates in Aotearoa are low compared to some other OECD countries, which places

us out-of-step with our closest international comparators.[22] Second, alcohol taxes are often justified as externality-correcting taxes that account for the full cost of alcohol-related harm.[23] There is currently a $4billion deficit per year attributable to the societal harms associated with alcohol,[24,25] which is borne by taxpayers. Third, the largest review of Aotearoa's alcohol laws, the 2010 Law Commission review, recommended raising alcohol tax by at least 50%, which has not been implemented.[10] Fourth, common alcohol industry arguments against tax increases are not supported by evidence. For example, MoJ estimated the direct impact of different tax increases on the alcohol industry to be between $1-10million per year, or less than 1% of total sales.[23] This is largely because alcohol tax increases are often almost entirely passed through to consumers. A 2010 UK analysis found that alcohol tax passthrough rates were between 86%-133% for different products,[86] suggesting the alcohol industry in some cases used alcohol tax increases to extend their profit margins or at least recover the cost of implementation. Lastly, alcohol taxation is one of the cheapest interventions to implement.[16] In Aotearoa, there are already alcohol tax systems in place and simply raising the tax rates is unlikely to place additional regulatory costs on the Government after the initial implementation of the tax increase.

Existing evidence suggests alcohol taxation is progressive when considering all households, but economically regressive when considering only those who consume alcohol.[19] Unfortunately, we were not able to conduct an analysis stratified by socioeconomic status (SES). Less affluent groups are more likely to suffer the harms associated with alcohol consumption; thus, increasing the price of alcohol through tax has the potential to reduce health inequities.[20] For example, tobacco taxation has seen the greatest gains for those with low SES.[67] However, while these absolute health gains are largest for low SES and Māori populations, these groups often experience a relatively smaller percentage decrease from baseline consumption compared to their high SES and non-Māori counterparts. For example, Māori and non-Māori smoking rates have decreased from 40.3% and 18.4% in 2011 to 25.7% and 10.9% in 2020, respectively.[2] For Māori this is an absolute decrease of 14.6% and relative decrease of 36.2% while for non-Māori it is an absolute decrease of 7.5% and relative decrease of 40.7%. Therefore, it is strongly recommended that tax increases are introduced with other controls on the drivers of alcohol consumption to decrease the potential for tax to maintain or exacerbate existing inequities.

Availability

Reducing alcohol outlet trading hours was nominally the most effective intervention in the package intervention, with an estimated 232,000 HALYs gained over 100 years. However, this estimate should be interpreted with consideration. Currently, there is very limited empirical evidence of the impact of reducing alcohol outlet trading hours, so our effect size relied on the result of a meta-analysis[14] of reduced days of operation consistent with two previous modelling studies.[57,76] This assumed that there is no difference between weekend and weekday trading hours of operation as the empirical studies focused on reducing a weekend day of sale. Additionally, we have a poor understanding of the baseline total trading hours of alcohol outlets in Aotearoa. The Alcohol Regulatory and Licensing Authority (ARLA) maintains the registry of alcohol licences in Aotearoa. The registry has data on licenced trading hours but the information is not entered in a standardised format and would require manual data cleansing and approaches to address substantial data missingness. Further, even if these issues were resolved, the trading hours only relate to the total permissible hours and not the actual trading hours. These limitations in Aotearoa are likely similar to those experienced internationally. Accurate information on alcohol outlet trading hours is central to better understanding the impact of alcohol availability on alcohol consumption.

A substantial reduction in alcohol outlet density from 63 to five outlets per 100,000 population was estimated to result in 218,000 HALYs gained. Again, these results should be interpreted with care as the effect size was reliant on results from one study, which has been used in two subsequent modelling studies.[57,76] This effect size was our best available estimate, and is supported by a large body

of evidence demonstrating a consistent link between increased physical availability of alcohol and alcohol consumption.[13,14,29,30]

It is uncertain how online alcohol sales would impact the observed effect sizes used in this modelling study. The rapid expansion of online alcohol sales presents a number of new challenges around increased accessibility on a number of fronts: 1) fewer barriers to under-aged purchasing; 2) expansion of times where alcohol can be purchased and delivered; and 3) reduced opportunity costs associated with travel.[87] If online purchases and deliveries were restricted to the same trading hours as physical stores then the effect size may remain unchanged for hours. It is unknown what impact online sales will have on the physical number of off-licence outlets. Consolidation into centralised distribution hubs may reduce the number of physical locations that are financially viable in any given area. This has the potential to reduce the associated amenity effects and marketing opportunities provided by physical bricks-and-mortar stores.[31] However, there is currently no evidence of declining physical off-licence locations so it is possible online alcohol sales are having an additive rather than a substitution effect.

It is likely we underestimated the potential health equity implications of reducing alcohol availability. People living in neighbourhoods of higher deprivation are more likely to have higher alcohol outlet density.[33-38] Alcohol outlets are also concentrated in areas with greater proportions of indigenous people.[33,34,40] In Aotearoa, our analysis suggested people living in high deprived neighbourhoods have almost three times more alcohol outlets than areas of low deprivation, 94.6 compared to 31.0 outlets per 100,000 people, respectively (Table 1). Māori communities also have 74.5 alcohol outlets per 100,000 people compared to 56.4 for non-Māori communities (Table 1). The density of outlets also means people in these neighbourhoods are exposed to a greater number of available trading hours. It is possible that areas of higher alcohol outlet density may also have longer trading hours due to increased competition between outlets;[88] however, national evidence in Aotearoa is limited.

The Sale and Supply of Alcohol Act 2012 (SSAA) has contributed to no substantial changes in alcohol outlet trading hours or density.[43] Aotearoa has long permissible trading hours (7am-11pm or 112 hours per week) and high outlet density (63 outlets per 100,000), especially when compared to countries like Finland and Sweden (~50 hours per week, five outlets per 100,000). The Sale and Supply of Alcohol (Harm Minimisation) Amendment Bill would support reductions in outlet trading hours and density by removing the appeals process which has prevented Territorial Authorities from realising community calls for increased restrictions on alcohol availability through Local Alcohol Policies. However, this approach still relies on effective community advocacy and political will from Territorial Authorities, which could lead to inequitable outcomes across the country.

An amendment to the SSAA to set new default national maximum trading hours and days of operation for off-licence outlets would be an equitable and regulatory simple approach to reduce alcohol availability. Ideally, this would restrict alcohol sales after 8pm[89] and remove sales on one weekend day.[14]

Marketing

Partial and complete bans on alcohol marketing were estimated to result in 123,000 and 226,000 HALYs gained, respectively. Despite strong evidence on the relationship between alcohol marketing exposure and consumption,[47-49] there is limited empirical evidence of the impact of alcohol marketing restrictions.[54] However, the existing epidemiological evidence and modelling studies provide a compelling case for strong marketing restrictions.[16]

Our results do not account for differential exposure or effectiveness of marketing based on sociodemographic characteristics. Young people and children are more susceptible to the persuasive effects of alcohol marketing. [47-49] Our effect sizes were based on the average population-level effect; however, it is likely a marketing ban would disproportionately benefit younger people. The majority of health gains over the cohort are experienced by those in the youngest cohorts, suggesting that we may be underestimating the potential effectiveness of marketing restrictions in this context. Next, our

effect size assumes all people are exposed equally to alcohol marketing. However, Aotearoa evidence shows Māori children experience five times greater rates of exposure to alcohol marketing than other children.[53] Thus, restrictions on alcohol marketing may produce greater reductions in health inequity than we have estimated.

Three government-initiated reviews completed since 2006 have recommended implementing a legislative framework to regulate all forms of alcohol marketing due to the major limitations of self-regulation. [10,61,62] Additionally, there have been three previous attempts to bring alcohol marketing under a legislative regime but none have made it past a third reading in Parliament.[63,90,91] To date, the only remaining sign of legislative restrictions on alcohol marketing is from the Sale and Supply of Alcohol (Harm Minimisation) Bill that provides for an end to alcohol sponsorship of sport.[51]

Recommendations

Our recommendations are based on the results presented in this report, best practice and those interventions that have the greatest impact to reduce health inequities, particularly between Māori and non-Māori. We recommend Aotearoa should:

1) Ensure future policy work is led by Māori and/or conducted in partnership with Māori with a clear focus on improving Māori health outcomes and upholding Māori rights under Te Tiriti o Waitangi.
2) Include in alcohol legislation: explicit reference to Te Tiriti o Waitangi; mechanisms to enable Māori to effectively participate in decision-making around alcohol in their communities; and mechanisms to ensure legislation addresses health inequities.
3) Introduce national off-licence density measures.
4) Reduce national off-licence trading hours to a maximum of 50 hours, with a closing time of 8pm.
5) Introduce a comprehensive ban on alcohol marketing including alcohol sponsorship.
6) Increase alcohol tax rates to achieve an effective minimum unit price as previously modelled by the Ministry of Justice.
7) Ensure the standardisation of the alcohol outlet trading hours in the Alcohol Regulatory and Licensing Authority (ARLA) database.

Conclusion

Alcohol consumption is a substantial health risk factor and driver of health inequities in Aotearoa. Our modelled interventions on tax, availability and marketing showed that there are substantial health gains available if the Government followed advice from previous Government-led inquiries, WHO advice and scientific evidence. Further, these interventions could reduce health inequities between Māori and non-Māori and thereby begin to rectify Crown failings to uphold Te Tiriti o Waitangi.

References

1. Griswold MG, Fullman N, Hawley C, Arian N, Zimsen SR, Tymeson HD *et al.* Alcohol use and burden for 195 countries and territories, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016. *The Lancet.* 2018;392(10152):1015-1035. https://doi.org/10.1016/S0140-6736(18)31310-2

2. Ministry of Health. *Annual update of key results 2019/20: New Zealand Health Survey.* Online: Ministry of Health;2020. Accessed 19 May 2022. https://www.health.govt.nz/publication/annual-update-key-results-2019-20-new-zealand-health-survey.

3. Connor J, Casswell S. Alcohol-related harm to others in New Zealand: evidence of the burden and gaps in knowledge. *New Zealand Medical Journal.* 2012;125(1360).

4. Boden JM, Fergusson DM, Horwood LJ. Alcohol misuse and criminal offending: Findings from a 30-year longitudinal study. *Drug and Alcohol Dependence.* 2013;128(1-2):30-36. https://doi.org/10.1016/j.drugalcdep.2012.07.014

5. Ministry of Justice. *Wai 2575—the health services and outcomes inquiry.* Wellington (NZL): Ministry of Justice;2019. Accessed 18 May 2021. https://waitangitribunal.govt.nz/inquiries/kaupapa-inquiries/health-services-and-outcomes-inquiry/.

6. Walker K. *Issues of tobacco, alcohol and other substance abuse for Māori.* Wellington (NZL): Waitangi Tribunal;2019. Accessed 13 Dec 2021. https://forms.justice.govt.nz/search/Documents/WT/wt_DOC_155808738/Wai%202575%2C%20B030.pdf.

7. Maynard K. *Te TiritI o Waitangi and alcohol law.* Wellington (NZL): Te Hiringa Hauora | Health Promotion Agency;2022. Accessed 26 Aug 2022. https://www.hpa.org.nz/sites/default/files/Te%20Tiriti%20o%20Waitangi%20and%20alcohol%20law.pdf.

8. McDowell T. Taua Nākahi nui: Māori, liquor and land loss in the 19th century. *AlterNative: An International Journal of Indigenous Peoples.* 2015;11(2):103-117. https://doi.org/10.1177/117718011501100202

9. Fleras A. Māori Wardens and the control of liquor among the Maori of New Zealand. *The Journal of the Polynesian Society.* 1981;90(4):495-513. https://www.jstor.org/stable/20705600.

10. New Zealand Law Commission. *Alcohol in our lives curbing the harm: a report on the review of the regulatory framework for the sale and supply of liquor.* Wellington (NZL): New Zealand Law Commission;2010. Accessed 14 May 2021. http://www.lawcom.govt.nz/sites/default/files/projectAvailableFormats/NZLC%20R114.pdf.

11. Kypri K, Connor J, Maclennan B, Sellman D. What became of New Zealand's golden opportunity for liquor law reform? *Drug and Alcohol Review.* 2013;32(6):557-560. https://doi.org/10.1111/dar.12075

12. Wagenaar AC, Tobler AL, Komro KA. Effects of alcohol tax and price policies on morbidity and mortality: a systematic review. *American Journal of Public Health.* 2010;100(11):2270-2278. https://doi.org/10.2105/AJPH.2009.186007

13. Popova S, Giesbrecht N, Bekmuradov D, Patra J. Hours and days of sale and density of alcohol outlets: impacts on alcohol consumption and damage: a systematic review. *Alcohol and Alcoholism.* 2009;44(5):500-516. https://doi.org/10.1093/alcalc/agp054

14. Sherk A, Stockwell T, Chikritzhs T, Andréasson S, Angus C, Gripenberg J *et al.* Alcohol consumption and the physical availability of take-away alcohol: systematic reviews and meta-analyses of the days and hours of sale and outlet density. *Journal of Studies on Alcohol and Drugs.* 2018;79(1):58-67. https://core.ac.uk/download/145317360.pdf.

15. Saffer H, Dave D. Alcohol consumption and alcohol advertising bans. *Applied Economics.* 2002;34(11):1325-1334. https://doi.org/10.1080/00036840110102743

16. World Health Organization. *SAFER: A world free from alcohol related harms.* Geneva (CHE): World Health Organization;2018. Accessed 14 May 2021. https://www.who.int/initiatives/SAFER.

17. 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. *Journal of Studies on Alcohol and Drugs.* 2018;79(4):514-522. https://doi.org/10.15288/jsad.2018.79.514

18. Burton R, Henn C, Lavoie D, O'Connor R, Perkins C, Sweeney K *et al.* A rapid evidence review of the effectiveness and cost-effectiveness of alcohol control policies: an English perspective. *The Lancet.* 2017;389(10078):1558-1580. https://doi.org/10.1016/S0140-6736(16)32420-5

19. Smith K, Foster J. *Alcohol, health inequalities and the harm paradox: why some groups face greater problems despite consuming less alcohol*. London: Institute of Alcohol Studies;2014. https://www.ias.org.uk/uploads/pdf/IAS%20reports/IAS%20report%20Alcohol%20and%20health%20inequalities%20FULL.pdf. Accessed 31 Aug 2022.

20. Meier PS, Holmes J, Angus C, Ally AK, Meng Y, Brennan A. Estimated effects of different alcohol taxation and price policies on health inequalities: a mathematical modelling study. *PLoS Medicine.* 2016;13(2):e1001963. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4764336/pdf/pmed.1001963.pdf.

21. NZ Institute of Economic Research. *Estimating demand for competition analysis: A statistical exploration, and some possible applications.* Wellington (NZL): NZ Institute of Economic Research;2020. Accessed 18 Nov 2021. https://www.nzier.org.nz/hubfs/Public%20Publications/Client%20reports/estimating-demand-for-competition-analysis.pdf.

22. Cobiac LJ, Mizdrak A, Wilson N. Cost-effectiveness of raising alcohol excise taxes to reduce the injury burden of road traffic crashes. *Injury Prevention.* 2018;25(5):421-427. https://doi.org/10.1136/injuryprev-2018-042914

23. White J, Lynn R, Ong S-W, Whittington P, Condon C, Joy S. *The effectiveness of alcohol pricing policies: Reducing harmful alcohol consumption and alcohol-related harm.* Wellington (NZL) Ministry of Justice;2014. Accessed 26 Aug 2021. https://www.justice.govt.nz/assets/effectiveness-of-alcohol-pricing-policies.pdf.

24. Slack A, Nana G, Webster M, Stokes F, Wu J. *Costs of harmful and alcohol and other drug use.* Wellington (NZL): BERL Economics;2009. Accessed 14 May 2021. https://www.scribd.com/document/169802341/BERL-July-2009-Costs-of-Harmful-Alcohol-and-Other-Drug-Use-1

25. New Zealand Government. *Excise and excise-equivalent duties table.* Online: Treasury;2017. Accessed 18 Nov 2021. https://www.customs.govt.nz/globalassets/documents/tariff-documents/the-working-tariff-document-excise-and-excise-equivalent-duties-table.pdf.

26. Jackson N, Esther U, J. A. *A road map for alcohol pricing policies: creating a fairer and healthier Aotearoa New Zealand.* Auckland (NZL): Alcohol Healthwatch;2020. Accessed 18 Nov 2021. https://www.ahw.org.nz/Portals/5/Resources/Documents-other/2020/Road_map_for_alcohol_pricing_policies-Final_version_Aug_6_2020.pdf.

27. Sornpaisarn B, Shield KD, Österberg E, Rehm J. *Resource tool on alcohol taxation and pricing policies.* Geneva (CHE): World Health Organization;2017. 9241512709. Accessed 19 Nov 2021. https://www.who.int/publications/i/item/resource-tool-on-alcohol-taxation-and-pricing-policies.

28. Babor T, Caetano R, Casswell S, Edwards G, Giesbrecht N, Graham K *et al. Alcohol: no ordinary commodity research and public policy.* Oxford (UK): Oxford University Press; 2010.

29. Bryden A, Roberts B, McKee M, Petticrew M. A systematic review of the influence on alcohol use of community level availability and marketing of alcohol. *Health & Place.* 2012;18(2):349-357. https://doi.org/10.1016/j.healthplace.2011.11.003

30. Gmel G, Holmes J, Studer J. Are alcohol outlet densities strongly associated with alcohol-related outcomes? A critical review of recent evidence. *Drug and Alcohol Review.* 2016;35(1):40-54. https://doi.org/10.1111/dar.12304

31. Campbell CA, Hahn RA, Elder R, Brewer R, Chattopadhyay S, Fielding J *et al.* The effectiveness of limiting alcohol outlet density as a means of reducing excessive alcohol consumption and alcohol-related harms. *American Journal of Preventive Medicine.* 2009;37(6):556-569. https://doi.org/10.1016/j.amepre.2009.09.028

32. Cameron M, Cochrane W, Gordon C, Livingston M. *The locally-specific impacts of alcohol outlet density in the North Island of New Zealand.* Wellington (NZL): Health Promotion Agency;2013. Accessed 31 Oct 2017. https://www.hpa.org.nz/sites/default/files/Alcohol%20Outlet%20Density.pdf.

33. Romley JA, Cohen D, Ringel J, Sturm R. Alcohol and environmental justice: the density of liquor stores and bars in urban neighborhoods in the United States. *Journal of Studies on Alcohol and Drugs.* 2007;68(1):48-55. https://doi.org/10.15288/jsad.2007.68.48

34. Truong KD, Sturm R. Alcohol environments and disparities in exposure associated with adolescent drinking in California. *American Journal of Public Health.* 2009;99(2):264-270. https://doi.org/10.2105/AJPH.2007.122077

35. Morrison C, Gruenewald PJ, Ponicki WR. Socioeconomic determinants of exposure to alcohol outlets. *Journal of Studies on Alcohol and Drugs.* 2015;76(3):439-446. https://doi.org/10.15288/jsad.2015.76.439

36. Pearce J, Day P, Witten K. Neighbourhood provision of food and alcohol retailing and social deprivation in urban New Zealand. *Urban Policy and Research.* 2008;26(2):213-227. https://doi.org/10.1080/08111140701697610

37. Connor JL, Kypri K, Bell ML, Cousins K. Alcohol outlet density, levels of drinking and alcohol-related harm in New Zealand: a national study. *Journal of Epidemiology and Community Health.* 2011;65:841-846. https://doi.org/10.1136/jech.2009.104935

38. Hay GC, Whigham PA, Kypri K, Langley JD. Neighbourhood deprivation and access to alcohol outlets: a national study. *Health & Place.* 2009;15(4):1086-1093. https://doi.org/10.1016/j.healthplace.2009.05.008

39. Cameron M, Cochrane W, McNeil K, Melbourne P, Morrison S, Robertson N. *The impacts of liquor outlets in Manukau City: Summary report—revised.* Wellington (NZL): Alcohol Advisory Council of New Zealand;2012. Accessed 26 Aug 2022.

https://www.hpa.org.nz/sites/default/files/imported/field_research_publication_file/ManukauReportSummaryREVISED.PDF.

40. Sturm R. Disparities in the food environment surrounding US middle and high schools. *Public Health.* 2008;122(7):681-690. https://doi.org/10.1016/j.puhe.2007.09.004

41. Ayuka F, Barnett R, Pearce J. Neighbourhood availability of alcohol outlets and hazardous alcohol consumption in New Zealand. *Health & Place.* 2014;29:186-199. https://doi.org/10.1016/j.healthplace.2014.07.002

42. Berke EM, Tanski SE, Demidenko E, Alford-Teaster J, Shi X, Sargent JD. Alcohol retail density and demographic predictors of health disparities: a geographic analysis. *American Journal of Public Health.* 2010;100(10):1967-1971. https://doi.org/10.2105/AJPH.2009.170464

43. Randerson S, Casswell S, Huckle T. Changes in New Zealand's alcohol environment following implementation of the Sale and Supply of Alcohol Act (2012). *New Zealand Medical Journal.* 2018;131(1476):14-23. https://www.nzma.org.nz/journal/read-the-journal/all-issues/2010-2019/2018/vol-131-no-1476-8-june-2018/7581.

44. Alcohol Healthwatch. *A review of Territorial Authority progress towards local alcohol policy development.* Auckland (NZL): Alcohol Healthwatch;2016. Accessed 27 Oct 2017. http://www.ahw.org.nz/Portals/5/Resources/Documents-other/2016/LAPReport_FinalWEB%202016.pdf.

45. Auckland City Council. *Provisional Auckland Council Local Alcohol Policy.* Auckland (NZL): Auckland City Council;2015. Accessed 2 Nov 2017. https://www.aucklandcouncil.govt.nz/plans-projects-policies-reports-bylaws/our-policies/provisionallocalalcoholpolicy/provisionallap.pdf.

46. Tricas-Sauras S, Garnes N. *Alcohol marketing and social media - Eurocare reflections 2014.* Brussels: (BEL): European Alcohol Policy Alliance;2014. Accessed 25 Oct 2017. http://www.eurocare.org/content/download/18236/99528/version/2/file/Alcohol+marketing+and+social+media.pdf.

47. Anderson P, De Bruijn A, Angus K, Gordon R, Hastings G. Impact of alcohol advertising and media exposure on adolescent alcohol use: A systematic review of longitudinal studies. *Alcohol and Alcoholism.* 2009;44(3):229-243. https://doi.org/10.1093/alcalc/agn115

48. Brown K. Association between alcohol sports sponsorship and consumption: A systematic review. *Alcohol and Alcoholism.* 2016;51(6):747-755. https://doi.org/10.1093/alcalc/agw006

49. Jernigan D, Noel J, Landon J, Thornton N, Lobstein T. Alcohol marketing and youth alcohol consumption: a systematic review of longitudinal studies published since 2008. *Addiction.* 2017;112:7-20. https://doi.org/10.1111/add.13591

50. Sargent JD, Babor TF. The relationship between exposure to alcohol marketing and underage drinking is causal. *Journal of Studies on Alcohol and Drugs, Supplement.* 2020(s19):113-124. https://doi.org/10.15288/jsads.2020.s19.113

51. Chambers T, Jackson N, Hoek J. New Zealand's proposed ban on alcohol sponsorship of sport: a cost-effective, pro-equity and feasible move towards reducing alcohol-related harm. *The Lancet Regional Health - Western Pacific.* 2021;13:100218. https://doi.org/10.1016/j.lanwpc.2021.100218

52. Chambers T. Alcohol sponsorship and esports: reinforcing the need for legislative restrictions on alcohol sponsorship. *Alcohol and Alcoholism.* 2020;55(2):144-146. https://doi.org/10.1093/alcalc/agz104

53. Chambers T, Stanley J, Signal L, Pearson AL, Smith M, Barr M *et al.* Quantifying the nature and extent of children's real-time exposure to alcohol marketing in their everyday lives using wearable cameras: Children's exposure via a range of media in a range of key places. *Alcohol and Alcoholism.* 2018;53(5):626-633. https://doi.org/10.1093/alcalc/agy053

54. Siegfried N, Pienaar DC, Ataguba JE, Volmink J, Kredo T, Jere M *et al.* Restricting or banning alcohol advertising to reduce alcohol consumption in adults and adolescents. *Cochrane Database of Systematic Reviews.* 2014(11). https://doi.org/10.1002/14651858.CD010704.pub2

55. Gallet CA. The demand for alcohol: a meta-analysis of elasticities. *Australian Journal of Agricultural and Resource Economics.* 2007;51(2):121-135. https://doi.org/10.1111/j.1467-8489.2007.00365.x

56. OECD. *Preventing Harmful Alcohol Use.* OECD Publishing; 2021.

57. Stockwell T, Sherk A, Norström T, Angus C, Ramstedt M, Andréasson S *et al.* Estimating the public health impact of disbanding a government alcohol monopoly: application of new methods to the case of Sweden. *BMC Public Health.* 2018;18(1):1-16. https://doi.org/10.1186/s12889-018-6312-x

58. Purshouse R, Brennan A, Latimer N, Meng Y, Rafia R. *Modelling to assess the effectiveness and cost-effectiveness of public health related strategies and interventions to reduce alcohol attributable harm in England using the Sheffield Alcohol Policy Model version 2.0* Sheffield (UK): The University of Sheffield;2009. Accessed 13 Oct 2021. https://www.nice.org.uk/guidance/ph24/evidence/economic-modelling-report-371533357.

59. Noel JK, Babor TF, Robaina K. Industry self-regulation of alcohol marketing: a systematic review of content and exposure research. *Addiction.* 2017;112(S1):28-50. https://doi.org/10.1111/add.13410

60. Advertising Standards Authority. *Advertising codes of practice.* Advertising Standards Authority;2017. Accessed 20 Mar 2018. http://www.asa.co.nz/.

61. New Zealand Government Steering Group on Alcohol Advertising. *Report of the steering group for the review of the regulation of alcohol advertising.* Wellington (NZL): New Zealand Government;2007. Accessed 9 Feb 2018. https://www.health.govt.nz/system/files/documents/publications/reportsteeringgroupalcoholadvertising.pdf.

62. Ministry of Health. *Ministerial forum on alcohol advertising and sponsorship: recommendations on alcohol advertising and sponsorship.* Wellington (NZL): Ministry of Health;2014. Accessed 14 May 2021. http://www.health.govt.nz/system/files/documents/publications/ministerial-forum-on-alcohol-advertising-and-sponsorship-recommendations-on-alcohol-advertising-and-sponsorship-dec14.pdf.

63. New Zealand Government. *Liquor Advertising (Television and Radio) Bill.* New Zealand Government;2006. https://www.parliament.nz/en/pb/bills-and-laws/bills-proposed-laws/document/00DBHOH_BILL7629_1/liquor-advertising-television-and-radio-bill.

64. Brennan A, Meier P, Purshouse R, Rafia R, Meng Y, Hill-Macmanus D. Developing policy analytics for public health strategy and decisions—the Sheffield alcohol policy model framework. *Annals of Operations Research.* 2016;236(1):149-176. https://doi.org/10.1007/s10479-013-1451-z

65. Cobiac L, Vos T, Doran C, Wallace A. Cost-effectiveness of interventions to prevent alcohol-related disease and injury in Australia. *Addiction.* 2009;104(10):1646-1655. https://doi.org/10.1111/j.1360-0443.2009.02708.x

66. Holm AL, Veerman L, Cobiac L, Ekholm O, Diderichsen F. Cost-effectiveness of preventive interventions to reduce alcohol consumption in Denmark. *PloS One.* 2014;9(2):e88041. https://doi.org/10.1371/journal.pone.0088041

67. Blakely T, Cobiac LJ, Cleghorn CL, Pearson AL, van der Deen FS, Kvizhinadze G *et al.* Health, health inequality, and cost impacts of annual increases in tobacco tax: multistate life table modeling in New Zealand. *PLoS Medicine.* 2015;12(7):e1001856. https://doi.org/10.1371/journal.pmed.1002211

68. Statistics New Zealand. *Alcohol available for consumption: Year ended December 2019.* Online: Statistics New Zealand;2019. Accessed 5 Sep 2022. https://www.stats.govt.nz/information-releases/alcohol-available-for-consumption-year-ended-december-2019.

69. World Health Organization. *Global Information System on Alcohol and Health.* Online: World Health Organization;2022. Accessed 5 Sep 2022. https://www.who.int/data/gho/data/themes/global-information-system-on-alcohol-and-health.

70. Rehm J, Rovira P, Llamosas-Falcón L, Shield KD. Dose–response relationships between levels of alcohol use and risks of mortality or disease, for all people, by age, sex, and specific risk factors. *Nutrients.* 2021;13(8):2652. https://doi.org/10.3390/nu13082652

71. Vos T, Abajobir AA, Abate KH, Abbafati C, Abbas KM, Abd-Allah F *et al.* Global, regional, and national incidence, prevalence, and years lived with disability for 328 diseases and injuries for 195 countries, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016. *The Lancet.* 2017;390(10100):1211-1259. https://doi.org/10.1016/S0140-6736(17)32154-2

72. Statistics New Zealand. *Statistical Area 1 2018 (Centroid Inside).* Online: Statistics New Zealand;2018. Accessed 30 September 2021. https://datafinder.stats.govt.nz/layer/93613-statistical-area-1-2018-centroid-inside/.

73. Statistics New Zealand. *Urban Rural 2018 (generalised).* Online: Statistics New Zealand;2018. Accessed 15 Nov 2021. https://datafinder.stats.govt.nz/layer/92218-urban-rural-2018-generalised/.

74. Atkinson J, Salmond C, Crampton P. *NZDep2018 index of deprivation: Interim research report.* Wellington (NZL): University of Otago;2019. Accessed 15 Nov 2021. https://www.otago.ac.nz/wellington/departments/publichealth/research/hirp/otago020194.html.

75. Deng BY, Wiki J, Hobbs M, Marek L, Campbell M, Kingham S. *GeoHealth laboratory dataset: cleaned nationwide alcohol outlets 2015–2018. (Version 1) [Data set].* Online: GeoHealth Lab;2020. Accessed 22 Nov 2021. https://www.canterbury.ac.nz/science/research/geohealth/.

76. Stockwell T, Sherk A, Sorge J, Norström T, Angus C, Chikritzhs T *et al. Finnish alcohol policy at the crossroads: the health, safety and economic consequences of alternative systems to manage the retail sale of alcohol.* Centre for Addictions Research of BC, University of Victoria;2019. Accessed 8 Sep 2021. https://www.uvic.ca/research/centres/cisur/assets/docs/report-alko.pdf.

77. Jernigan D, Noel J, Landon J, Thornton N, Lobstein T. Alcohol marketing and youth alcohol consumption: a systematic review of longitudinal studies published since 2008. *Addiction.* 2017;112(S1):7-20. https://doi.org/10.1111/add.13591

78. van Baal PHM, Hoogenveen RT, de Wit AG, Boshuizen HC. Estimating health-adjusted life expectancy conditional on risk factors: results for smoking and obesity. *Population Health Metrics.* 2006;4(1):14. https://doi.org/10.1186/1478-7954-4-14

79. Stockwell T, Norström T, Angus C, Sherk A, Ramstedt M, Andréasson S *et al. What would be the public health impact of privatising the Swedish government alcohol monopoly?* 2017. Accessed 11 Jul 2023. https://www.uvic.ca/research/centres/cisur/assets/docs/Systembolaget-public-health-safety-benefits-April_2017.pdf.

80. Ministry of Health. *Alcohol.* Online: Ministry of Health;2022. Accessed 3 Aug 2022. https://www.health.govt.nz/your-health/healthy-living/addictions/alcohol-and-drug-abuse/alcohol.

81. Meier PS, Purshouse R, Brennan A. Policy options for alcohol price regulation: the importance of modelling population heterogeneity. *Addiction.* 2010;105(3):383-393. https://doi.org/10.1111/j.1360-0443.2009.02721.x

82. Mizdrak A, Blakely T, Cleghorn CL, Cobiac LJ. Potential of active transport to improve health, reduce healthcare costs, and reduce greenhouse gas emissions: A modelling study. *PLoS One.* 2019;14(7):e0219316. https://doi.org/10.1371/journal.pone.0219316

83. Blakely T, Cleghorn C, Petrović-van der Deen F, Cobiac LJ, Mizdrak A, Mackenbach JP *et al.* Prospective impact of tobacco eradication and overweight and obesity eradication on future morbidity and health-adjusted life expectancy: simulation study. *Journal of Epidemiology & Community Health.* 2020;74(4):354-361. https://doi.org/10.1136/jech-2019-213091

84. Robinson LA, Hammitt JK, Chang AY, Resch S. Understanding and improving the one and three times GDP per capita cost-effectiveness thresholds. *Health Policy and Planning.* 2017;32(1):141-145. https://doi.org/10.1093/heapol/czw09

85. van den Berg M, van Baal PHM, Tariq L, Schuit AJ, de Wit GA, Hoogenveen RT. The cost-effectiveness of increasing alcohol taxes: a modelling study. *BMC Medicine.* 2008;6(1):36. https://doi.org/10.1186/1741-7015-6-36

86. Hunt P, Rabinovich L, Baumberg Geiger B. *Preliminary assessment of the economic impacts of alcohol pricing policy options in the UK.* Rand Europe;2011. Accessed 31 Aug 2022. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/98137/economic-impacts-alcohol-pricing.pdf.

87. Colbert S, Wilkinson C, Thornton L, Feng X, Richmond R. Online alcohol sales and home delivery: An international policy review and systematic literature review. *Health Policy.* 2021;125(9):1222-1237. https://doi.org/10.1016/j.healthpol.2021.07.005

88. Livingston M, Chikritzhs T, Room R. Changing the density of alcohol outlets to reduce alcohol-related problems. *Drug and Alcohol Review.* 2007;26(5):557-566. https://doi.org/10.1080/09595230701499191

89. Kolosnitsyna M, Sitdikov M, Khorkina N. Availability restrictions and alcohol consumption: A case of restricted hours of alcohol sales in Russian regions. *The International Journal of Alcohol and Drug Research.* 2014;3(3):193–201-193–201. https://doi.org/10.7895/ijadr.v3i3.154

90. New Zealand Government. *Sale of Liquor (Youth Alcohol Harm Reduction) Amendment Bill.* New Zealand Government;2005. Accessed. https://www.parliament.nz/en/pb/bills-and-

laws/bills-proposed-laws/document/00DBHOH_BILL6696_1/sale-of-liquor-youth-alcohol-harm-reduction-amendment.

91. New Zealand Government. *Sale and Supply of Liquor Enforcement Bill.* New Zealand Government;2010. https://www.parliament.nz/en/pb/bills-and-laws/bills-proposed-laws/document/00DBHOH_BILL8682_1/sale-and-supply-of-liquor-and-liquor-enforcement-bill.

Supplementary material

Table 10. Population size and total HALYs in the 2018 cohort under business as usual scenario stratified by ethnicity, sex and age

Ethnicity	Sex	Age group	Population	HALYs
All	All	All	4,900,610	181,526,538
	Female	All	2,470,450	91,628,465
	Male	All	2,430,160	89,898,073
Māori	All	All	816,490	31,356,714
	Female	All	410,290	15,879,893
	Male	All	406,200	15,476,821
Non-Māori	All	All	4,084,120	150,169,824
	Female	All	2,060,160	75,748,572
	Male	All	2,023,960	74,421,252
Māori	Female	0-14	124,060	7,167,645
		15-34	129,620	5,513,988
		35-54	93,370	2,424,434
		55-74	54,260	730,728
		75+	8,980	43,098
	Male	0-14	131,620	7,363,098
		15-34	130,880	5,363,647
		35-54	87,980	2,129,754
		55-74	49,000	591,806
		75+	6,720	28,517
Non-Māori	Female	0-14	336,460	22,184,613
		15-34	540,790	26,683,188
		35-54	552,430	17,864,522
		55-74	466,390	8,042,533
		75+	164,090	973,716
	Male	0-14	354,310	22,973,367
		15-34	565,560	27,353,342
		35-54	531,230	16,388,404
		55-74	444,470	6,997,827
		75+	128,390	708,312

Table 11. Life expectancy of cohort under business as usual scenario

Population	Life Expectancy (years)
All	78.9
Māori	73.6
Non-Māori	80.9
Māori females	75.4
Non-Māori females	82.7
Māori males	71.9
Non-Māori males	79.3