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## The burden of death, disease, and disability due to alcohol in New Zealand

Jennie Connor, Joanna Broad, Jürgen Rehm, Stephen Vander Hoorn, Rod Jackson

### Abstract

**Aim** To estimate the burden of death, disease, and disability attributable to alcohol consumption in New Zealand

**Methods** We applied the World Health Organization's comparative risk assessment methodology at country level; separately for Maori and non-Maori where possible. We combined the best estimates of alcohol consumption in the populations, with best estimates of alcohol-disease relationships from the international and, where available, national epidemiological literature, to calculate the proportions of alcohol-related conditions attributable to alcohol.

**Results** We estimated that 3.9% of deaths in New Zealand in 2000 were attributable to alcohol consumption (approximately 1037 deaths), and approximately 981 deaths were prevented by alcohol, resulting in a net loss of about 56 lives. As a consequence, 17,200 years of life were lost, but only 5,300 years of life gained; a net loss of almost 12,000 years of life. The burden was substantially higher for younger age groups, for men compared with women, and for Maori compared with non-Maori. Injury was the biggest contributing cause of death and years of life lost, while positive effects were largely due to reduced coronary disease mortality in elderly people. The impact of alcohol on these conditions depended on the pattern as well as volume of drinking.

In a separate analysis that included estimates of morbidity, we calculated a net loss of 26,000 disability-adjusted life years (DALYs) due to alcohol in 2002, with 76% lost by men. Alcohol use disorders accounted for about half of all DALYs lost.

**Conclusions** Five main messages emerged from the analysis that can inform policy to reduce the health burden of alcohol: there are no health benefits of drinking alcohol before middle age; pattern of drinking is an important determinant of health effects; injuries are a major component of the alcohol burden; alcohol use disorders underlie many adverse effects; and the health impact of alcohol falls inequitably on Maori.

The relationship between alcohol consumption and health is complex, and a better understanding of the determinants of this relationship is essential for effective strategies to reduce harm from alcohol.

Biological and social effects of alcohol-use result from three main intermediaries or pathways: intoxication, dependence, and direct biochemical effects.<sup>1</sup> These effects relate to both the average volume of alcohol consumed and the pattern of drinking. Direct biochemical effects include both harmful and beneficial effects; for example, chronic pancreatic and liver damage on one hand, and improvements in blood lipid and coagulation profiles on the other.

Intoxication is a powerful mediator of acute adverse outcomes, and risk of injury is increased at even moderate levels of consumption when there may be little subjective

experience of intoxication. Alcohol dependence, a disorder in itself, mediates the impact of alcohol on all classes of health outcome.

Average volume of drinking, or total alcohol consumption in a population, has been used to measure relationships between alcohol and disease.<sup>2</sup> However, average consumption is not a good predictor of intoxication and consequent injury—or of health benefits derived from small frequent doses of alcohol, such as reduction in coronary heart disease. Such effects are better predicted by including measures of pattern of drinking. ‘Pattern of drinking’ refers to the way in which most alcohol is consumed (such as in irregular heavy drinking occasions, or binge drinking) compared with light-to-moderate drinking on a daily basis,<sup>3</sup> and also ‘where and with whom’ drinking occurs.

Previous quantitative studies of the overall health impact of alcohol drinking on the New Zealand population<sup>4,5</sup> have attempted the complicated task of estimating the net effect of the impact of alcohol on many aspects of health. The comparative risk assessment (CRA) methodology developed for the World Health Report 2002<sup>6,7</sup> has provided an opportunity to update and refine these estimates.

## Methods

Details of the methodology used in this study are published elsewhere,<sup>8</sup> and will only be briefly outlined here.

**Comparative risk assessment (CRA)**—The CRA methodology was developed by the World Health Organization (WHO) as a systematic approach to measuring the burden of disease attributable to a range of important global risk factors, and ranking them.<sup>6,7,9,10</sup> CRA aims to combine best estimates of the risk factor distribution in the population, with best estimates of risk factor-disease relationships from the international epidemiological literature to measure the impact of each major risk factor. In the World Health Report 2002, global and regional burden of disease due to a range of risk factors was estimated. This included alcohol, but no country level estimates were calculated.

The WHO CRA for alcohol drew heavily on existing reports on the quantification of drug-caused mortality and morbidity in Australia<sup>11–13</sup> and Canada,<sup>14,15</sup> as well as reviewing new epidemiological evidence about the association of alcohol with health outcomes.<sup>16</sup> (See Rehm et al<sup>17</sup> for an overview.) New methods were developed for incorporating the effect of pattern of drinking for some conditions, and for modelling estimates where reliable data on the individual level were lacking.<sup>17</sup>

This report employs the CRA approach at a country level, and for Maori and non-Maori separately where this has been possible.

**Prevalence and patterns of exposure to alcohol**—We calculated average daily consumption and pattern of drinking from the 2000 National Alcohol and Te Ao Waipiro surveys<sup>18,19</sup> for New Zealanders aged between 15 and 65 years, weighted to represent consumption for the whole adult NZ population. Data from five other New Zealand (NZ) studies<sup>20–24</sup> were used to estimate the alcohol consumption patterns for those older than 65 years,<sup>8</sup> and consumption during pregnancy was estimated from survey data<sup>25</sup> in order to include the health effects of drinking in pregnancy.

We used four levels of average daily consumption, with different cut points for men and women, corresponding to those used by the WHO Global Burden of Disease Study (based originally on English et al<sup>11</sup>).

To capture the effect of heavy drinking episodes, we used the pattern of drinking classification developed by WHO, based on evidence about average harmful and beneficial effects of different alcohol consumption patterns in populations worldwide.<sup>17</sup> The WHO pattern of drinking category for a country is determined by scoring men and women according to the proportion that drinks daily, the frequency of getting drunk, usual drinking quantity per session, fiesta binge drinking, drinking with meals, and drinking in public places.

Alcohol consumption in New Zealand had been classified by WHO as Pattern 2 of four possible patterns, where Pattern 1 is the most beneficial and Pattern 4 is the most detrimental. Based on the best available NZ survey data,<sup>18,19</sup> we allocated non-Maori to Pattern 2 and Maori to a Pattern 3. Although

non-Maori were more likely to be alcohol drinkers and drink more often, they drank less on a typical drinking occasion, when compared with Maori. The differences were such that average alcohol consumption per day amongst Maori and non-Maori was similar, but the health implications were different.<sup>26</sup>

**Alcohol-related conditions included in the study**—The selection of the conditions attributable to alcohol was based on evidence of established epidemiological relationships, assessed by the CRA group, using meta-analyses,<sup>11, 14–16</sup> new research, and biological evidence (for details see Rehm et al<sup>1</sup>). Three groups of conditions were considered: wholly alcohol-attributable conditions, with an alcohol-attributable fraction (AAF) of 100%; chronic conditions where alcohol is a contributing cause (detrimental or beneficial); and acute conditions where alcohol is a contributing cause.

Although some conditions were omitted or combined into broader groups where detailed epidemiological evidence was lacking, most of the alcohol-related burden is in fact due to a only few major disease categories.<sup>27</sup> The conditions included in this study are listed in Table 1. Social outcomes of alcohol consumption (such as family problems, public disorder, or workplace problems) have not been included unless they are coded in ICD-10 (International Classification of Diseases Version 10), although it is recognised that they also contribute to population health.

**Estimating alcohol-disease relationships and alcohol-attributable fractions**—A few conditions are, by definition, wholly attributable to alcohol. For all others, the proportion of the burden that was attributable to alcohol (AAF) was established from the available epidemiological evidence—by sex, age group, and Maori/non-Maori status.

For most chronic conditions where pattern of drinking had not been demonstrated to be important, the AAF was derived from combining prevalence data and relative risk estimates from meta-analyses,<sup>17</sup> using standard methods for estimating attributable risk.<sup>28</sup> This group included cancers, hypertensive disease, epilepsy, cardiac arrhythmias, oesophageal varices, pancreatitis, and low birth weight. The beneficial effects of alcohol on diabetes incidence,<sup>16</sup> stroke,<sup>29</sup> and cholelithiasis were calculated in the same way, yielding negative AAFs. The AAFs for unipolar depression were estimated indirectly from the prevalence of alcohol abuse and dependence in the NZ population, in the absence of better data.<sup>1,8</sup>

Although the effect of pattern of drinking may be underestimated in some conditions (such as stroke) because pattern information has not been routinely collected in epidemiological studies, the risks of coronary heart disease, unintentional injuries, and intentional injuries are known to be associated with pattern independently of average volume. Multilevel-modelling was used by the WHO CRA group to assess the effect of pattern on coronary heart disease (CHD) outcomes,<sup>1</sup> and we have applied the relative risk estimates for Pattern 2 drinkers in our analysis. As Maori have a different drinking pattern on average, a sensitivity analysis investigated the scenario where there was no CHD benefit for Maori.

Injuries make up most of the acute adverse effects of alcohol, and as the risk is associated with episodes of intoxication, it is highly pattern dependent. Car crash injuries are the single biggest cause group and are the best studied. We used a population-based case-control study from Auckland<sup>30</sup> to estimate the AAFs for car crash injury by age, sex, and Maori/non-Maori status. We then used the ratio of Maori AAF: non-Maori AAF (1.5) to scale the AAFs for other injuries for Maori.<sup>8</sup>

**Calculation of alcohol attributable burden of disease and injury: mortality, YLLs, and DALYs**—The health burden of each of the alcohol-related conditions was measured using routinely collected mortality data from the New Zealand Health Information Service (NZHIS) mortality database for 2000—and the estimated burden for each condition in disability-adjusted life years (DALYs) lost in 2002 was obtained from the Global Burden of Disease (GBD) 2000 Study.<sup>31</sup>

The DALY is a summary health gap measure that integrates fatal and nonfatal outcomes (measured by years of life lost and years of life lived with disability). Mortality data were available for Maori and non-Maori separately, as well as by sex and age group, but DALY data were not. The analysis was restricted to people over 15 years of age, apart from the secondary effects of drinking by an adult.

Alcohol-attributable mortality was calculated by multiplying the mortality from each alcohol-related condition in 2000 by the alcohol attributable fraction for that condition, for each age, sex, and ethnicity subgroup. Years of life lost (YLL), a measure of the burden of premature mortality, were derived from mortality data by the ‘remaining life expectancy method.’<sup>32</sup> This method measures the difference between age at death and life expectancy remaining at that age.

As life expectancies for Maori and non-Maori differ, a model life table (Coale and Demeny model life table West level26) was used for both populations, to estimate ‘standard expected years of life lost’ (SEYLL) as in the GBD Study,<sup>33</sup> and discounted at 3% per annum.

Alcohol attributable DALYs have been calculated by multiplying the DALY count for each alcohol-related condition in New Zealand in 2002 (provided by WHO) by the alcohol attributable fraction for that condition, for each age and sex subgroup. DALY counts are age-weighted and also discounted at 3% per annum. Mortality, YLL, and DALY rates have been derived from the counts (using 2000 and 2002 mid-year population estimates provided by Statistics New Zealand). Rates were age standardised by the direct method using the WHO World population as the standard population.<sup>34</sup>

**Table 1. Alcohol-related conditions included in the study**

<p><b>Cancers</b></p> <ul style="list-style-type: none"> <li>-Mouth and oropharyngeal cancers</li> <li>-Oesophagus cancer</li> <li>-Liver cancer</li> <li>-Laryngeal cancer</li> <li>-Breast cancer</li> </ul> <p><b>Diabetes</b></p> <ul style="list-style-type: none"> <li>-Diabetes mellitus</li> </ul> <p><b>Neuro-psychiatric disorders</b></p> <ul style="list-style-type: none"> <li>-Alcohol use disorders</li> <li>-Unipolar depressive disorders</li> <li>-Epilepsy</li> </ul> <p><b>Cardiovascular disorders</b></p> <ul style="list-style-type: none"> <li>-Hypertensive heart disease</li> <li>-Ischaemic heart disease</li> <li>-Cardiac arrhythmias</li> <li>-Oesophageal varices</li> <li>-Stroke, ischaemic, or haemorrhagic</li> </ul>	<p><b>Digestive disorders</b></p> <ul style="list-style-type: none"> <li>-Cholelithiasis</li> <li>-Pancreatitis</li> <li>-Alcoholic liver cirrhosis</li> </ul> <p><b>Conditions arising during pregnancy</b></p> <ul style="list-style-type: none"> <li>-Spontaneous abortion</li> <li>-Low birth weight</li> <li>-Fetal alcohol syndrome</li> </ul> <p><b>Injuries</b></p> <ul style="list-style-type: none"> <li>-Road traffic injuries</li> <li>-Alcohol poisoning</li> <li>-Other poisonings</li> <li>-Falls</li> <li>-Drownings</li> <li>-Other unintentional injuries</li> <li>-Self-inflicted injuries</li> <li>-Violence</li> <li>-Other intentional injuries</li> </ul>
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## Results

**Mortality**—We estimated that 1037 deaths in New Zealand in 2000 were attributable to alcohol consumption; representing 3.9% of all deaths. Alcohol consumption was also estimated to prevent 981 deaths in the same year, resulting in a net loss of 56 lives.

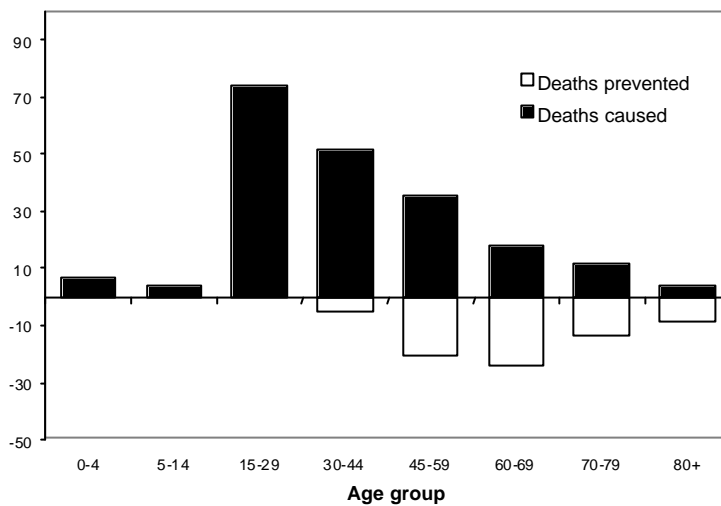
The mortality burden was not evenly distributed by sex or ethnicity (Table 2). In non-Maori women, deaths prevented by alcohol consumption outweighed deaths caused, but in all men, and in Maori women, more deaths were caused than prevented. The standardised alcohol-related death rate for men was considerably higher than for women in both Maori and non-Maori. The alcohol-related death rate for Maori overall was 4.2 times the rate for non-Maori, after standardisation to the WHO world population to eliminate the effect of differences in the age structure of the two populations. More lives were lost due to alcohol as well as fewer deaths prevented by alcohol in Maori compared with non-Maori, relative to the size of their populations.

More than half (51%) of alcohol-related deaths were due to injuries, 24% were due to cancer, and 25% to other chronic diseases. Most of the deaths prevented were from reduction in coronary heart disease (78%) and stroke (18%).

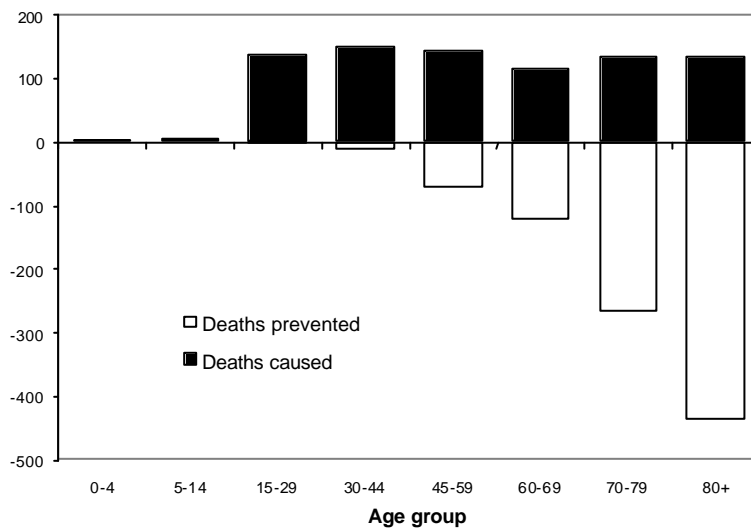
The predominance of injury as a cause of death in children and young adults, and of ischaemic heart disease and stroke in older adults, means that the balance of risks and benefits of alcohol consumption varied with age. Figures 1 and 2 show the balance

between detrimental and preventive effects of alcohol for Maori and non-Maori, at different ages. The effects of different average drinking patterns in Maori and non-Maori, and the small proportion of Maori in the oldest age groups, are reflected in these Figures.

**Figure 1. Number of deaths caused and prevented by alcohol consumption in 2000 among Maori (by age group)**



**Figure 2. Number of deaths caused and prevented by alcohol consumption in 2000 among non-Maori (by age group)**



**Table 2. Mortality and years of life lost (YLL) attributable to alcohol (by ethnicity and sex) in 2000**

	Ethnicity	Deaths	% of all	Deaths	Net deaths	Net deaths	Net YLL	Net YLL
		caused	deaths	prevented	(count)	(rate)*	(count)	(rate) *
<b>Males</b>	Maori	161	11.3	47	114	37.8	3143	1100
	Non-Maori	557	4.5	476	81	9.7	6533	442
	Total	718	5.2	523	195	13.6	9676	548
<b>Females</b>	Maori	45	3.9	26	19	1.9	769	240
	Non-Maori	273	2.3	431	-158	-0.8	1468	112
	Total	319	2.5	457	-139	-0.1	2237	136
<b>Total</b>	Maori	206	8.0	73	133	19.0	3912	656
	Non-Maori	831	3.4	907	-77	4.5	8001	276
	Total	1037	3.9	981	56	6.7	11913	339

\*Rate per 100,000 age-standardised to WHO world population.

**Years of life lost**—Years of life lost (YLL) incorporate the impact of deaths at different ages. The net effects of alcohol on YLL for the 2000 year are also summarised in Table 2. As with mortality, the burden is not evenly spread in the population—it is higher in men than women, and higher in Maori than non-Maori.

Table 3 shows the numbers and proportions of alcohol-attributable YLLs by condition. Injury is the leading cause of alcohol-related YLLs and as many injury deaths occur in younger age groups, injury is responsible for an even larger proportion of alcohol-attributable YLLs (72%) than deaths (51%).

Years of life gained by alcohol consumption are summarised by condition in Table 4. Over 80% of the life years gained were from reduction in IHD in the elderly. The balance of gains and losses due to alcohol for Maori and non-Maori in different age groups is shown in Figure 3.

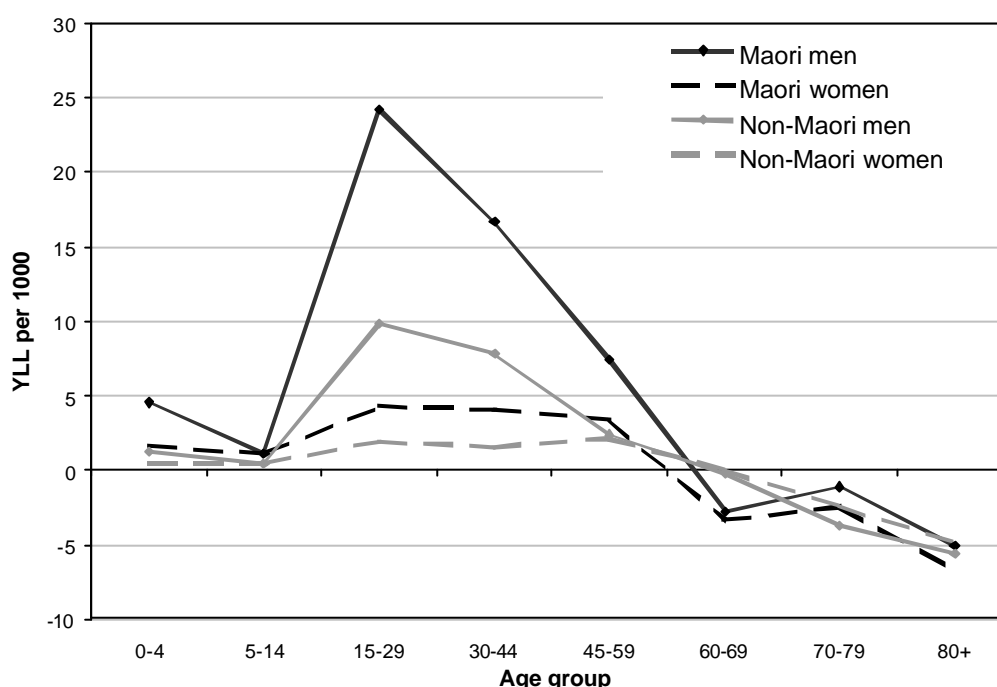
**Table 3. Proportions of alcohol-attributable years of life lost (by condition) in 2000**

Condition	Men	Women	Percent of all alcohol attributable YLLs (n=17,207)
Cancers	1189	1186	13.8%
Other chronic diseases	1509	827	13.6%
Injuries	10234	2200	72.3%

**Table 4. Years of life gained by alcohol consumption (by condition) in 2000**

Condition	Men	Women	Percentage of all years of life gained due to alcohol (n=5291)
Ischaemic heart disease	3033	1298	81.8%
Stroke	142	538	12.8%
Diabetes	123	129	4.8%
Cholelithiasis	11	17	<1%

**Figure 3. Age-specific rates of net years of life lost (YLL) due to alcohol in 2000 (by ethnicity and gender)**



**Coronary heart disease mortality in Maori**—The effect of alcohol consumption on CHD in Maori in New Zealand is less well understood than in populations where it has been directly studied. In the calculations above, we have assumed Maori accrue the same benefit in the prevention of CHD from drinking the same average volumes of alcohol as non-Maori, even though the pattern of drinking is different.

Recalculating the impact of alcohol on Maori assuming no preventive effect on CHD results in the total net deaths due to alcohol in Maori rising from 133 to 195, and for the whole population from 56 to 118. Due to small numbers of Maori in the affected age groups, this increases the age-standardised mortality rate from 38 to 72 per 100,000 in Maori men, and from less than 2 to almost 16 per 100,000 in Maori women. Therefore, under this assumption, there are virtually no health benefits for Maori from drinking at any age.



**Disability-adjusted life years (DALYs)**—Alcohol-attributable DALYs were calculated using our estimates of AAFs combined with WHO estimates of DALY burden in New Zealand for alcohol-related conditions. Due to combined outcome data, it was not possible to analyse Maori and non-Maori separately.

Table 5 summarises DALYs lost due to alcohol in 2002. The burden in men was three times that in women, accounting for 76% of all alcohol-attributable DALYs lost. Alcohol use disorders comprised the largest cause group, accounting for 49% of DALYs lost, and this proportion was the same for men and women. Approximately 11% of alcohol-attributable DALYs lost in women was due to the increased risk of breast cancer.

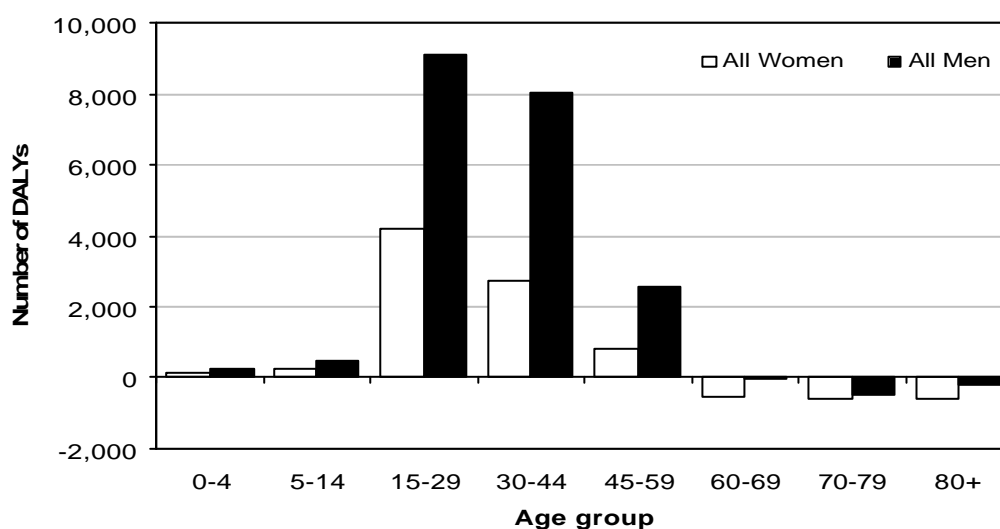
**Table 5. Alcohol attributable DALYs; total NZ population 2002**

Sex	DALYs lost	Percentage of all DALYs lost	DALYs gained	Net DALYs lost	DALY rate*
Males	23,540	10.4%	3,910	19,630	1,075
Females	10,003	4.4%	3,662	6,341	386
Total	33,543	7.4%	7,572	25,971	726

\*Rate per 100,000 age-standardised to WHO world population

The balance of DALYs lost and gained varied with age, and the net DALY burden of alcohol at different ages is summarised in Figure 4.

**Figure 4. Net number of disability-adjusted life years (DALYs) caused or prevented by alcohol consumption in 2002**



## Discussion

In 2000, about 1037 deaths were caused (and 981 deaths prevented) by alcohol, resulting in a net loss of about 56 lives. Since lives lost were younger on average than lives saved, this resulted in a net loss of almost 12,000 years of life. The burden was substantially higher for men compared with women, and for Maori compared with non-Maori. Injury was the biggest contributing cause, while positive effects were largely due to reduced coronary disease mortality in elderly people. The impact of alcohol on these two conditions depended on pattern of drinking as well as volume.

A net loss of 26,000 disability-adjusted life years (DALYs) due to alcohol was calculated for 2002, with 76% lost by men. Alcohol-use disorders accounted for about half of all DALYs lost.

There are several important limitations that should be considered when interpreting the results of this study. The scope of the analysis is limited to conditions captured by the ICD-10 coding system and therefore excludes social outcomes, and many mental health conditions. Estimates from other countries have indicated that the costs of social consequences of alcohol exceed the cost of direct health consequences.<sup>35</sup> There is uncertainty in the estimates arising from measurements of exposure, determination of risk relationships, and from outcome assessment, especially for non-fatal outcomes.

The methodology does not account for the lag time between exposure to alcohol and development of each condition, with current exposure used as a proxy for the relevant exposure period. Knowledge of risk-relationships is still evolving and some have been better characterised than others. Reliable prevalence and risk information is particularly lacking amongst the elderly, who are seldom participants in epidemiological research or health surveys.

This study has endeavoured to take an approach consistent with the Treaty of Waitangi. That is, analyses of the alcohol attributable burden of disease for Maori and non-Maori have been conducted separately where possible. However, the evidence base for estimating the burden of alcohol for Maori is very small, with little specific information on risk relationships and non-fatal outcomes for Maori. The extrapolation from available data sources to Maori may be less appropriate than for non-Maori, and further research needs to be undertaken to address these issues.

The mortality rates calculated from data collected in 2000 are unlikely to be affected by numerator-denominator bias, since the classification of ethnicity for mortality and census data was similar by then.

Alcohol is responsible for a considerable burden of ill-health, and further public health intervention is warranted. Moreover, most of the benefits of alcohol are based on specific patterns of drinking, which are associated with small risk for other disease endpoints, so the burden of alcohol use could be substantially reduced while retaining the benefits.

Five main messages emerged from the analysis that should inform the public health response: there are no health benefits of drinking alcohol before middle age; pattern of drinking is an important determinant of the health effects of alcohol; injury is a major component of the alcohol burden; alcohol use disorders underlie many of the adverse effects of alcohol; and the health burden of alcohol falls inequitably on Maori.

Evidence-based policy measures exist<sup>2,35,36</sup> that could be used to reduce alcohol-related harm. Based on our findings, the focus of these interventions in New Zealand should be reduction of alcohol-related injury, and reduction of the disproportionate burden of alcohol for Maori. However, both of these objectives involve modifying drinking patterns, which are largely socially and culturally determined. Therefore, as well as targeted strategies, policy measures aimed at the modification of the wider drinking culture of New Zealand will be required.

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