

Alcohol consumption and non-communicable diseases: epidemiology and policy implications

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Abstract

Aims This paper summarises the relationships between different patterns of alcohol consumption and various non-communicable disease (NCD) outcomes and estimates the overall impact of alcohol consumption on global mortality and burden of disease. **Methods** A narrative review, based on published meta-analyses of alcohol consumption-disease relations, together with an examination of the Comparative Risk Assessment estimates applied to the latest available revision of Global Burden of Disease study.

Results Alcohol is causally linked (to varying degrees) to eight different cancers, with the risk increasing with the volume consumed. Similarly alcohol use is detrimentally related to many cardiovascular outcomes, including hypertension, haemorrhagic stroke and atrial fibrillation. For other cardiovascular outcomes the relationship is more complex. Alcohol is furthermore linked to various forms of liver disease (particularly with fatty liver, alcoholic hepatitis and cirrhosis) and pancreatitis. For diabetes the relationship is also complex. Conservatively of the global NCD-related burden of deaths, net years of life lost (YLL) and net disability adjusted life years (DALYs), 3.4%, 5.0% and 2.4% respectively can be attributed to alcohol consumption, with the burden being particularly high for cancer and liver cirrhosis. This burden is especially pronounced in countries of the former Soviet Union. **Conclusions** There is a strong link between alcohol and NCDs, particularly cancer, cardiovascular disease, liver disease, pancreatitis and diabetes and these findings support calls by WHO to implement evidence-based strategies to reduce harmful use of alcohol.

Introduction and Aims

In May 2010 the UN General Assembly (GA) passed Resolution 64/265 which called for the convening of a high-level meeting of the GA in September 2011 in New York on the prevention and control of non-communicable diseases (NCDs) [1]. This resolution and related documents have stressed the need to recognise the primary role and responsibility of governments to respond to the challenges of NCDs, but also the responsibility of the international community in assisting member states, particularly in low and mid-income countries, to generate effective responses [2]. It comes with the hope of garnering multi-sectoral commitment and facilitating action on an unprecedented scale to address NCDs. Among the various NCDs, cardiovascular diseases, cancers, chronic respiratory diseases and diabetes have been singled out for attention[2].

This resolution reflects the growing recognition of NCDs as a major threat to development in low and mid income countries. Furthermore, the resolution is seen as having reframed the global discussion about NCDs into emphasising broader social and environmental drivers of NCDs rather than concentrating solely on unhealthy choices made by individuals [3]. Consumption of alcohol has been identified as one of the main determinants of NCDs, and while it is an individual-level risk factor [4;5]), its consequences can be prevented via broader public health interventions such as those impacting on availability, affordability and marketing of alcohol [6].

The aims of this contribution can be summarised as follows:

- To summarise the relationships between different patterns of alcohol consumption and various NCD outcomes.
- To estimate the overall impact of alcohol consumption on global mortality and burden of disease.

- To draw conclusions for prevention of NCDs with special emphasis on low to mid-income countries.

Methods

For the first aim, we will use the techniques of a narrative review, based on published meta-analyses of alcohol consumption – disease relations (for an overview see [7]). For the second aim, we will examine the Comparative Risk Assessment (CRA) estimates [5;8], applied to the latest available revision of Global Burden of Disease (GBD) study [9]. As these estimates were conducted by our group [5;8], we can go back to the original data for further analyses and present outcomes by level of economic development and drinking pattern (for an overview on economic development and alcohol consumption see [10;11]; for an earlier use the classification see [12]). The 2000 CRA for NCD except for ischemic heart disease was based on combining alcohol exposure with risk relations derived from meta-analyses [8]. For ischemic heart disease, for high-income countries, the meta-analysis of Corrao et al. [13] was used, whereas for the rest of the world multi-level modelling of aggregate data was used to incorporate both the effects of average volume of alcohol consumption and patterns of drinking [8;14].

Results

Alcohol has been identified as a leading risk factor for death and disability globally, accounting for 3.8% of death and 4.6% of disability adjusted life years (DALYs) lost in 2004 ([15]; see also [5]) Alcohol was found to be the 8th highest risk factor for death in 2004 (5th in middle-income countries and 9th in high-income countries). In terms of DALYs lost in 2004, alcohol ranked 3rd highest (1st in middle-income countries, 8th highest in low-income countries and 2nd highest in high-income countries). In terms of NCDs, alcohol has been particularly linked to cancer, cardiovascular diseases (CVDs) and liver disease.

Cancer

Nine leading environmental and behavioural risks (higher body mass index, low fruit and vegetable intake, physical inactivity, tobacco use, alcohol use, and unsafe sex, urban and indoor air pollution, and unsafe health-care injections) have been estimated to be jointly responsible for 35% of cancer deaths. [15]

In 2007 the International Agency for Research on Cancer asserted that there was sufficient evidence for a causal link between alcohol and cancer of the oral cavity, pharynx, larynx, oesophagus, liver, colon, rectum, and female breast. [16;17] All these cancers showed evidence of a dose-response relationship, that is, the risk of cancer increased steadily with greater volumes of drinking [7;17].

The strength of the relationship to levels of average alcohol consumption varies for different cancers. For example, with regard to female breast cancer, each additional 10 g of pure alcohol per day (roughly one standard drink; in the UK 1 standard drink is 8 g of ethanol, in Australia it is 10 g, in South Africa 12 g and in the USA 14g. 12 g is probably the most common mass for 1 standard drink – [18]) is associated with an increase of 7% in the relative risk (RR) of breast cancer whereas regular consumption of approximately 50 g of pure alcohol increases the relative risk of colorectal cancer by between 10% and 20%, indicating that the association is stronger for female breast cancer [7]. The relationship of average consumption to larynx, pharynx and oesophagus cancer on the other hand is markedly higher than the relationship to both breast and colorectal cancer (more than 100% increase for an average consumption of 50 g pure alcohol per day; [16]).

Among the causal mechanisms that have been indicated for some cancers is the toxic effect of acetaldehyde which is a metabolite of alcohol [17;19].

Cardiovascular diseases (CVDs)

Eight risk factors (alcohol use, tobacco use, high blood pressure, high body mass index, high cholesterol, high blood glucose, low fruit and vegetable intake, and physical inactivity) jointly account for

61% of loss of healthy life years from CVDs and 61% of cardiovascular deaths. These same risk factors together account for over three quarters of deaths from ischaemic and hypertensive heart disease [15]. Alcohol use is overwhelmingly detrimentally related to many cardiovascular outcomes, including hypertensive disease [20], haemorrhagic stroke [21], and atrial fibrillation [22].

For ischaemic heart disease and ischaemic stroke the relationship is more complex. Chronic heavy alcohol use has been uniformly associated with adverse cardiovascular outcomes [7;23;24]. For on average light to moderate drinking there is a protective effect on ischaemic diseases, which disappears when this drinking style contains irregular heavy drinking occasions [25;26]. For instance, Roerecke and Rehm found in a meta-analysis of studies, that consumption of 60 g pure alcohol on one occasion among otherwise light to moderate drinkers was associated with no cardioprotective effect at all [25].

The detrimental effects of heavy drinking occasions on ischemic diseases are consistent with the physiological mechanisms of increased clotting and a reduced threshold for ventricular fibrillation which occur following heavy drinking.[7].

Liver disease

Alcohol is associated with various kinds of liver disease, with fatty liver, alcoholic hepatitis and cirrhosis being the most common. The relationship is that strong that in ICD several subcategories of liver disease were given the prefix of alcoholic, e.g. alcoholic liver cirrhosis. The likelihood of developing liver disease is a function of both the duration and the amount of heavy drinking [27].

For men drinking 30 g of absolute alcohol per day is associated with a RR of 2.8 of dying from liver cirrhosis (7.7 for females). Regarding morbidity, the RRs for males and females for drinking the same amount of alcohol per day were 0.7 and 2.4. For men drinking 54 g of alcohol per day was associated with a relative risk of 2.3 for acquiring liver cirrhosis. For both morbidity and mortality, the RR increases with the volume consumed per day [28].

Various mechanisms have been put forward for how alcohol is associated with liver disease, such as the view that the breakdown of alcohol in the liver leads to the generation of free radicals and acetaldehyde which individually damage liver cells [29;30].

Other diseases

For pancreatitis a threshold of about 48 g/day has been found, again with increased volume of alcohol consumed per day being associated with increased risk [31]. With regards to diabetes the situation is more complicated. A recent meta-analysis confirmed that there is a U-shaped relationship between the average amount of alcohol consumed per day and the risk of type 2 diabetes [32]. There appears to be a protective effect of moderate consumption of alcohol, particularly among women. Further research appears to be needed to make stronger claims about the negative effects of higher levels of consumption of alcohol and the incidence of diabetes and to allow for greater generalisability of the findings to broader populations globally.

Historically, the term NCD has excluded mental disorders, even though they are clearly non-communicable as well. If we look into this category of disease, alcohol use disorders are obviously related to alcohol and associated with high levels of disability [9;33]. In addition, there are associations of alcohol use and alcohol use disorders with almost every mental disorder.

Quantification of impact

Overall, in the year 2004, alcohol consumption caused 1.4 million net NCD deaths, and 17.8 million net years of life lost (YLLs) and 21.1 million net disability adjusted life years (DALYs) among NCDs. For all categories, men contribute the lion's share of the burden (see Table 1), by a factor of about 6-7 times greater burden in men. Overall, these numbers constitute 3.4%, 5.0% and 2.4% of all deaths, YLLs and DALYs respectively (see Table 1). These numbers were based on the alcohol-attributable fractions from the

CRA of 2000 [8;34] applied to the estimation of the GBD for 2004 [9]: this means that they did not take into consideration the effect of alcohol on atrial fibrillation [33] or pancreatitis, as there had not been any GBD categories for either disease [35]. As alcohol consumption has only detrimental effects on both categories, this means that Table 1 clearly underestimates the alcohol-attributable portion of NCD.

- Insert Table 1 about here –

With regard to the disease categories, for deaths the detrimental burden from alcohol is greatest for cancer followed by liver cirrhosis. For DALYS, the alcohol-related detrimental burden was highest for liver cirrhosis followed by cancer. With respect to different regions of the world: the impact of alcohol clearly is most pronounced in countries of the former Soviet Union, which is no surprise given the volume and patterns of drinking in this part of the world (see Table 2; [36;37]). Otherwise there is a gradient among low and mid income countries: the higher the gross-domestic product of a region, i.e., the wealthier the countries, the more pronounced the effect of alcohol (see Table 2). However, for high income countries, the effect of alcohol on NCD is detrimental for men, and slightly beneficial for women, because of the beneficial effect of light to moderate consumption on ischaemic disease and diabetes (see above).

Discussion

The role of alcohol (and particularly heavy alcohol use and having an alcohol use disorder) in NCDs has been given increasing recognition. For example, alcohol was mentioned along with tobacco, diet and lack of exercise, as one of four major common risk factors for NCD in the recent status report of the World Health Organization [38] and by the Lancet NCD action group [39]. It has also been discussed at the recent NGO conference in Melbourne on health and the Millenium Development Goals (MDGs) during a session on NCDs, along with tobacco, diet and lack of exercise, alcohol was recognised as one of four major common risk factors [3]. In terms of NCDs, alcohol has been particularly linked to cancer, cardiovascular diseases and

liver disease. Preliminary estimates on the impact of alcohol on these diseases support the inclusion of alcohol consumption as one of four major risk factors globally.

Before discussing further implications we would like to lay open limitations of our approach. The CRA as well as the GBD are estimates based on best available data and modelling techniques. With respect to alcohol, even though the underlying data overall has relatively good reliability and validity, the estimates of alcohol exposure in countries with high level of unrecorded consumption confer a higher level of uncertainty [40]. However, as the impact of unrecorded alcohol consumption was modelled the same as the impact of recorded consumption, overall its impact was probably underestimated (for health effects of unrecorded consumptions see [41]). The second potential bias results from basing risk relationships on meta-analyses mainly stemming from cohort studies in high income countries. While the so derived risks may contain bias, especially for disease categories which are highly related to social determinants, the direction of this bias is also towards underestimations, as many research studies have shown that conditions like undernutrition or lack of sanitation which are more prevalent in low and mid income countries, increase the effect of alcohol [10]. Also, the modelling of ischemic heart disease used in the 2000 CRA is based on a meta-analysis for high income regions (see above), overestimating the beneficial effect, as several of the underlying studies did not differentiate between lifetime abstainers and former drinkers (e.g., [42]). For other regions, the modelling of the effects of alcohol on ischemic heart disease is based on multi-level analyses of aggregate data, and there is no overestimation of the protective effect because of misclassification of abstention in this type of analysis. Together with the lack of inclusion of NCD categories in the underlying GBD where alcohol has a detrimental effect (see above), overall the presented figures should be considered as conservative estimates; i.e. the net detrimental impact of alcohol consumption is underestimated.

As part of national efforts to address NCDs countries need to give priority to implementing the *Global Strategy to Reduce the Harmful Use of Alcohol* approved by the WHA in Geneva in May 2010 [43]. Particular attention should be given to implementing evidence-based strategies that have the potential to

reduce the occurrence of heavy drinking episodes and the prevalence of alcohol use disorders that impact on NCDs. Such strategies are likely to include regulating the availability, price and marketing of alcohol, and improving the capacity of health services to support initiatives to screen for risk and conduct brief interventions for hazardous and harmful drinking at primary health care and other settings [6;44;45]. While there is less evidence to support the efficacy of health education on its own, it nonetheless does seem appropriate that alcohol consumers should be made aware of the risk associated with different levels of drinking and NCDs. Consumers should, for example, be informed that stopping or reducing alcohol consumption will reduce cancer risks, albeit slowly over time [46].

At a global level, support should be given to the WHO to enable it to carry out its mandate in terms of the *Global Strategy to Reduce Harmful Use of Alcohol* and allied WHO resolutions, in particular with regard to providing technical assistance to low- and middle-income countries to develop and implement policies to reduce the burden of alcohol-related problems; seeing that public health interests regarding alcohol issues are taken into account in global trade agreements, the settlement of trade disputes, and decisions by international development agencies; and ensuring that transnational marketing or major international event marketing does not act against national policies with regard to alcohol advertising and promotion. For further information on evidenced based strategies that are likely to directly or indirectly impact on NCDs readers are referred to resources supported by WHO/PAHO [6;45].

Conclusion

Addressing NCDs in countries at all levels of development is now seen as important in ensuring the achievement of MDGs [47]. The way forward is to take concerted and inclusive actions to address the common causes of the most prevalent NCDs. Given the overwhelming evidence that alcohol is a major risk factor for NCDs, attention must now be directed towards addressing the drivers of alcohol use, especially of

heavy use, and particularly those drivers operating at the social and environmental level using strategies that have been shown to have a high probability of having an impact.

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Table 1 Deaths, YLLs and DALYs in NCD attributable to alcohol (in 1,000s) 2004

	Deaths			Years of Life Lost			DALYs		
	M [†]	W [†]	T [†]	M	W	T	M	W	T
Cancer	377	111	487	4,646	1,441	6,088	4,732	1,536	6,268
Diabetes mellitus	0	0	0	0	10	10	0	28	28
Hypertensive diseases	101	30	131	1,056	313	1,369	1,142	336	1,478
Ischemic Heart Disease	208	24	232	2,477	212	2,689	2,827	232	3,058
Cerebrovascular disease	157	25	182	1,690	316	2,006	2,016	371	2,387
Liver cirrhosis	297	76	373	4,483	1,107	5,590	5,502	1,443	6,945
Total 'detrimental effects' attributable to alcohol	1,139	266	1,406	14,352	3,399	17,751	16,219	3,946	21,065
Diabetes mellitus	-8	-4	-12	-89	-37	-126	-238	-101	-340
Hypertensive diseases	0	0	0	0	0	0	0	0	0
Ischemic Heart Disease	-88	-59	-147	-754	-481	-1236	-837	-522	-1,359
Cerebrovascular disease	0	-68	-68	0	-539	-539	0	-622	-622
Total 'beneficial effects' attributable to alcohol	-96	-132	-227	-843	-1,058	-1,901	-1,075	-1,246	-2,321
All alcohol-attributable net NCD outcomes	1,044	135	1,178	13,509	2,342	15,850	15,144	2,700	17,844
Global burden total	31,063	27,674	58,738	508,165	424,000	932,165	799,536	730,631	1,530,168
Percentage of global burden due to alcohol-attributable NCD	3.4%	0.5%	2.0%	2.7%	0.6%	1.7%	1.9%	0.4%	1.2%
All global NCD burden	17,974	17,007	34,981	173,667	144,244	317,911	378,472	352,499	730,971
Percentage of NCD burden which is attributable to alcohol	5.8%	0.8%	3.4%	7.8%	1.6%	5.0%	4.0%	0.8%	2.4%

†: W: women, M: men, T: total; A number of 0 indicates less than 500.

Source: Own calculations based on [5;15]

Table 2 NCD deaths by economic development 2004 in 1,000s

Disease Category*	Very high or high mortality: lowest consumption; Islamic middle East and Indian subcontinent			Very high or high mortality: low consumption; poorest countries in Africa and America			Low mortality: better-off developing countries in America, Asia, Pacific			Very low mortality: North America, Western Europe, Japan, Australasia			Former Socialist: low mortality; Eastern Europe and Central Asia		
	M [†]	W [†]	T [†]	M	W	T	M	W	T	M	W	T	M	W	T
All alcohol-attributable net NCD deaths	157	6	162	75	28	103	531	73	604	53	-63	-11	230	91	321
Global deaths	8,657	7,482	16,139	6,073	5,716	11,790	9,477	7,868	17,345	3,972	3,967	7,939	2,883	2,641	5,525
Percentage of global deaths due to alcohol-attributable NCD	1.8%	0.1%	1.0%	1.2%	0.5%	0.9%	5.6%	0.9%	3.5%	1.3%	-1.6%	-0.1%	8.0%	3.4%	5.8%
All NCD deaths	4,231	3,668	7,899	1,531	1,551	3,083	6,605	5,869	12,474	3,417	3,541	6,957	2,190	2,378	4,568
Percentage of NCD burden which is attributable to alcohol	3.7%	0.2%	2.1%	4.9%	1.8%	3.3%	8.0%	1.3%	4.8%	1.5%	-1.8%	-0.2%	10.5%	3.8%	7.0%

†: W: women, M: men, T: Total.

Source: Own calculations based on [5;15]