Estimating the burden of disease attributable to alcohol use in South Africa in 2000

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Objectives. To make quantitative estimates of the burden of disease attributable to alcohol use by sex and age group in South Africa in 2000.

Design. The analysis follows the World Health Organization comparative risk assessment (CRA) methodology. Population-attributable fractions (PAFs) calculated from modelled prevalence estimates and relative risks based on the global review were applied to the burden of disease estimates from the revised South African National Burden of Disease study for 2000. The alcohol-attributable fractions for injuries were directly determined from blood alcohol concentrations (BAC > 0.05 g/100 ml) at the time of injury. Monte Carlo simulation-modelling techniques were used to quantify uncertainty in the estimates.

Setting. South Africa.

Subjects. Adults ≥ 15 years.

Outcome measures. Deaths and disability-adjusted life years (DALYs) from ischaemic heart disease, stroke, hypertensive disease, diabetes, certain cancers, liver cirrhosis, epilepsy, alcohol use disorder, depression and intentional and unintentional injuries as well as burden from fetal alcohol syndrome (FAS) and low birth weight.

Results. Alcohol harm accounted for an estimated 7.1% (95% uncertainty interval 6.6 - 7.5%) of all deaths and 7.0% (95% uncertainty interval 6.6 - 7.4%) of total DALYs in 2000. Injuries and cardiovascular incidents ranked first and second in terms of attributable deaths. Top rankings for overall attributable burden were interpersonal violence (39.0%), neuropsychiatric conditions (18.4%) and road traffic injuries (14.3%). Interpersonal violence accounted for 42.8% of the injury DALYs attributed to alcohol in males and 25.9% in females. In terms of alcohol-attributable disability, alcohol use disorders ranked first (44.6%), interpersonal violence second (23.2%), and FAS third (18.1%).

Conclusions. Particular attention needs to be given to preventing and reducing the burden of alcohol-related homicide and violence, alcohol-related road traffic accidents, alcohol use disorders, and FAS. Multilevel interventions are required to target high-risk drinkers, in addition to creating awareness in the general population of the problems associated with alcohol abuse.

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Alcohol consumption has a long social history in South Africa. Indigenous people consumed fermented, intoxicating drinks as an important component of social and ritual gatherings. In colonial times alcohol was exchanged for labour and goods.[1] The Western and Northern Cape still experience the legacy of the 'dop system', which was used to control farm workers through a regular supply of crude wine as part of their wages. Alcohol has also been used to exert control over labour on the mines.[2] Until recently, government legislation controlled where black people could buy and consume liquor, how much they could buy, who they could drink with, who produced and procured it, and the quality of alcohol available to them.[3] Not surprisingly, brewing and drinking of alcohol in illegal 'shebeens' (liquor outlets) became a form of resistance against oppressive laws.[3]

Household surveys indicate that currently approximately 50% of men and 20% of women drink alcohol in South Africa, although this is probably an underestimate.[4,5] Alcohol is now an integral part of the South African economy, and the wine and brewing industries have made South Africa an important player in the global alcohol market.[1] Currently, the formal part of the South African liquor industry comprises 23 000 licensed outlets, with about 180 000 informal liquor outlets, mostly shebeens.[3] The alcohol industry generates income through job creation and taxes, but also costs the country: in 2002/3 alcohol taxes raised R4.2 billion, whereas economic costs of alcohol abuse were estimated at R9 billion, about 1% of the GNP.[3]

Alcohol has both beneficial and harmful effects on health. The literature suggests that, on the whole, the health impact of alcohol consumption is negative.[6] A prime target for the toxic effects of alcohol is the liver. Chronic alcohol abuse can

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result in alcoholic cirrhosis, predisposing people to infections.[7] Misuse of alcohol during pregnancy can result in brain damage to the fetus, causing long-term developmental and social consequences. An example of a harmful effect of alcohol consumption on chronic diseases is the increased risk of high blood pressure. However, there are beneficial effects of alcohol on ischaemic heart disease (IHD) and cerebrovascular disease, depending on the pattern of drinking. For example, light to moderate drinking in a regular pattern for older persons reduces blood clotting and the depositing of plaque in arteries, thereby reducing the risk of heart attacks.[6]

Intoxication mediates mainly for acute outcomes such as intentional and unintentional injuries. Even small amounts of alcohol impact on the central nervous system, slowing down reaction time and impairing co-ordination and alertness. Alcohol is also likely to increase aggressive behaviour[8] and can promote crime.[9] Extremely difficult to quantify is the fact that heavy drinking often leads to a disrupted family life, domestic violence and child neglect.[3] Alcohol use is also associated with unsafe sexual practices, increasing the risk of spreading HIV.[10]

The drinking pattern, as well as the volume of alcohol consumed, is relevant to the health effects.[6] The global comparative risk assessment (CRA) study[6] on alcohol identified four patterns with different health risks (scored 1 - 4). Practices that were particularly harmful included drinking to intoxication, high quantities of alcohol per occasion, and not drinking with meals. The more detrimental patterns are found in four World Health Organization (WHO) sub-regions, including AFR-E, which includes South Africa, with a pattern value of 3.[6] Beneficial effects of alcohol consumption are expected for countries with a consumption pattern designated 1, such as drinking with meals and few heavy drinking occasions.

Adult per capita alcohol consumption in South Africa in 2000 is estimated to be 10.2 litres of pure alcohol per year, or 12.4 litres if adjusted for unrecorded consumption (largely home brews). These figures are relatively low compared with those of most developed countries.[11] However, the pattern of drinking is worrying. Given that a large part of the population does not consume alcohol, the amount consumed per drinker is nearer to about 20 litres of absolute alcohol consumed per year – among the highest in the world.[12] One-third of current drinkers in the South African Demographic and Health Survey (SADHS) of 1998[4] reported risky drinking over weekends (5 or more drinks per day for men and 3 or more per day for women). Youth binge drinking is also a problem. According to the Youth Risk Behaviour Survey conducted in 2002,[13] almost 1 in 4 high school students report binge drinking in the past month, drinking 5 or more drinks on 1 or more days. Studies conducted in poorer communities in the Western Cape have observed rates of fetal alcohol syndrome (FAS) 18 - 141 times greater than in the USA.[14]

The aim of this study was to make quantitative estimates of alcohol-attributable disease burden by sex and age group in South Africa in 2000, as has been recently undertaken on a global and regional scale.[6]

Methods

The WHO CRA methodology[6,15,16] was used to determine the amount of disease and injury burden attributable to exposure to alcohol. Although intake of alcohol has been related to more than 60 health outcomes,[17-19] the South African study is restricted to health outcomes identified from meta-analyses in the global review[6] as well as FAS and low birth weight (LBW). Pancreatitis, cholelithiasis, spontaneous abortion and psoriasis are not listed separately in the South African National Burden of Disease (SANBD) study,[20] and have been left out of the analysis. The health outcomes related to alcohol with *International Classification of Diseases* (ICD-10) codes[21] are listed in Table I.

The selected health outcomes include four groups of conditions attributable to alcohol.

1. Chronic conditions and LBW, where alcohol may be a detrimental (e.g. cancer) or beneficial (e.g. type 2 diabetes) contributing cause. The burden attributable to alcohol consumption in the population was estimated by comparing the current observed level of alcohol consumption with a counterfactual of no consumption and the relative risk (RR) of disease occurrence. In the case of ischaemic heart disease (IHD), two dimensions of alcohol consumption were defined as exposure variables; viz. average volume of alcohol consumption, and pattern of drinking.

2. Acute conditions, such as intentional and unintentional injuries where alcohol is a contributing cause, were assessed through categorical attribution.

3. Unipolar depression, where a review of global data revealed an association with alcohol dependence[6] that was used to predict the alcohol-attributable fraction (AAF) from the prevalence of alcohol dependence by sub-region.

4. Those that are 100% alcohol-attributable, such as alcohol use disorders and FAS.

The 1998 SADHS[4] reported that 45% of men and 17% of women aged 15 years and older currently consumed alcohol. These figures are considered an underestimate as people often do not respond truthfully to the sensitive issue of alcohol consumption. The AFR-E sub-region consumption prevalence data from the global CRA study[6] were used to estimate the exposure as they matched the production figures[22] for South Africa in 2000, far better than either the World Health Survey 2001[23] or the SADHS 1998.[4] (AFR-E estimates were based on country survey data on abstainers (including SA) and distributional data on drinkers derived from the SADHS 1998.) Production figures based on the excise collected for the

Southern African Customs Union were converted into litres of alcohol by type and then into the number of drinks per year. The prevalence figures on drinking from each population-based survey were converted into the number of drinks per day and compared with the estimate based on production.[22] Both surveys indicate a trend towards risky drinking among the drinkers, but the very high prevalence of abstention made it impossible to reconcile the implied consumption among the drinkers with the national production figures. Table II lists the assumed prevalence of alcohol exposure levels by age and sex.

There are limited data on the prevalence of alcohol consumption during pregnancy. Only 13 of 191 pregnant women (7%) interviewed in the SADHS 1998[4] acknowledged current drinking. This figure was considered unreliable because of the small number of pregnant women in the sample, and also probably an underestimate because of the particularly sensitive nature of the question. Data from three underprivileged areas in the Western Cape[24] suggest little awareness of the health risks of alcohol as 23.7% of the sample of 636 pregnant women attending 17 antenatal clinics reported alcohol intake sufficient to place unborn children at risk. Hence, we assumed the same prevalence of drinking as in non-pregnant women, (i.e. 16.8%)[4] weighted by the estimated number of births in women of child-bearing age obtained from

Table I. Alcohol-related health outcomes

Health outcomes	ICD-10 codes[21]
Cancers (neoplasms)	
Mouth/oropharynx	C06, C10
Oesophagus	C15
Liver	C22
Larynx	C32
Breast	D05
Cardiovascular diseases	
Hypertensive disease	I10-I13
Ischaemic heart disease	I20-I25
Ischaemic stroke (cerebral infarction)	I63
Haemorrhagic stroke (intracerebral haemorrhage)	I61
Other chronic diseases	
Diabetes (non-insulin dependent)	E11
Cirrhosis of liver	K70, K71, K74, K76
Effects of prenatal alcohol exposure	
Fetal alcohol syndrome	Q86.0
Low birth weight	P07
Neuropsychiatric conditions	
Depression (unipolar major depression)	F32
Epilepsy	G40
Alcohol dependence	Z72
Acute adverse effects	
Intentional injuries	X60-X84, Y87
Unintentional injuries	V01-V99

Table II. Estimated prevalence of alcohol exposure levels by age and sex, South Africa, 2000

Sex	Average volume of consumption category*	Age groups (yrs) 15 - 29	30 - 44	45 - 59	60 - 69	70 - 79	≥ 80
Males	Abstinence	0.43	0.38	0.43	0.48	0.54	0.54
	DI	0.43	0.43	0.40	0.37	0.35	0.35
	DII	0.13	0.16	0.14	0.12	0.08	0.08
	DIII	0.01	0.03	0.03	0.03	0.03	0.03
Females	Abstinence	0.72	0.66	0.66	0.72	0.78	0.78
	DI	0.24	0.28	0.27	0.24	0.20	0.20
	DII	0.04	0.05	0.05	0.24	0.03	0.03
	DIII	0.01	0.01	0.02	0.01	0.01	0.01

Source: Rehm *et al.* (2004) prevalence for AFR-E region.[6]
*Definitions of categories of risk factor levels:[17]
Abstinence: Males 0 - < 0.25 g/d, females, 0 - < 0.25 g/d
Drinking category DI: Males > 0.25 - < 40 g/d, females > 0.25 - < 20 g/d
Drinking category DII: Males 40 - < 60 g/d, females 20 - < 40 g/d
Drinking category DIII: Males ≥ 60 g/d, females ≥ 40 g/d.

the ASSA2002 model.[25] The respective weights were 0.75 and 0.25 for the childbearing age groups 15 - 29 and 30 - 49 years.

Population-attributable fractions (PAFs) by age, sex and cause were calculated in MS Excel using the formula:

$$PAF = \frac{\sum_{i=1}^{k} p_i (RR_i - 1)}{\sum_{i=0}^{k} p_i (RR_i - 1) + 1}$$

where p_i is the prevalence of exposure level i, RR_i is the RR of disease in exposure level i and k is the total number of exposure levels.[17,26] RRs were obtained from the meta-analyses reported in the global review[6] and other studies, and are presented in Table III. In the case of IHD, AFR-E estimates of the attributable fraction incorporating the effect of the alcohol consumption from the global review[6] were used and only harmful effects of alcohol were considered on the basis of the overall drinking pattern in South Africa.

The estimated PAFs were applied to the number of deaths, years of life lost (YLLs) due to premature mortality, years of life lived with disability (YLDs) and disability-adjusted life years (DALYs) for each selected outcome from the revised South African National Burden of Disease Study for 2000.[27] Haemorrhagic and ischaemic stroke are affected differently by alcohol – haemorrhagic stroke is closely related to blood pressure levels, which are adversely affected by alcohol, while moderate to low alcohol consumption affords some protection from ischaemic stroke. However, the South African burden of disease endpoint is 'total stroke' and not stroke subtypes. Total stroke deaths and DALYs were therefore adjusted by the age-specific proportions of ischaemic and haemorrhagic fatal and non-fatal strokes for the AFR-E region, using the method of Lawes and colleagues.[28,29] A study conducted in Pretoria[30] found the case fatality rate (CFR) to be 22% at 1 month for ischaemic stroke and 58% for haemorrhagic stroke, similar to estimated CFRs for stroke subtypes for the AFR-E region, confirming the appropriateness of using AFR-E estimates for stroke subtypes.

For intentional and unintentional injuries we used data from the National Injury Mortality Surveillance System (NIMSS 2001).[31] National AAFs for injury mortality were based on the percentage of fatal injuries positive for blood alcohol concentration (BAC) ≥ 0.05 g/100 ml using NIMSS data by age, sex and injury cause obtained from those mortuaries with academic forensic support (H Donson Crime, Violence

Table III. Relative risks (RRs)* and 95% confidence intervals (CIs) for alcohol-related disease for different drinking categories DI to DIII† relative to abstainers

Health outcome	Abstainer	RR category DI	RR category DII	RR category DIII
Cancer mouth/pharynx‡	1	1.45 (1.32 - 1.60)	1.85 (1.49 - 2.30)	5.39 (4.67 - 6.22)
Cancer oesophagus‡	1	1.80 (1.63 - 1.99)	2.37 (2.03 - 2.76)	4.26 (3.70 - 4.90)
Cancer liver‡	1	1.45 (1.09 - 1.94)	3.03 (1.33 - 6.92)	3.6 (2.05 - 6.32)
Cancer larynx‡	1	1.83 (1.51 - 2.22)	3.90 (2.13 - 7.13)	4.93 (3.41 - 7.15)
Cancer breast§ (females)				
< 45 years	1	1.15 (1.04 - 1.28)	1.41 (1.20 - 1.67)	1.46 (0.99 - 2.14)
45+ years	1	1.14 (1.05 - 1.24)	1.38 (1.24 - 1.53)	1.62 (1.24 - 2.13)
Type 2 diabetes mellitus¶ (males)	1	1.00 (0.98 - 1.01)	0.57 (0.28 - 1.01)	0.73 (0.55 - 1.06)
Type 2 diabetes mellitus¶ (females)	1	0.92 (0.80 - 1.08)	0.87 (0.78 - 1.03)	1.13 (0.97 - 1.22)
Epilepsy¶ (males)	1	1.23 (0.99 - 1.54)	7.52 (5.93 - 9.55)	6.83 (5.41 - 8.65)
Epilepsy¶ (females)	1	1.34 (0.99 - 1.79)	7.22 (5.70 - 9.16)	7.52 (5.93 - 9.55)
Hypertension‖	1	1.4 (1.3 - 1.5)	2.0 (1.8 - 2.3)	4.1 (3.1 - 5.9)
Ischaemic heart disease*	1	0.82 (0.80 - 0.83)	0.84 (0.80 - 0.88)	0.88 (0.84 - 0.92)
Ischaemic stroke‡ (males)	1	0.94 (0.78 - 1.13)	1.33 (1.07 - 1.66)	1.65 (0.95 - 2.86)
Ischaemic stroke‡ (females)	1	0.52 (0.42 - 0.65)	0.64 (0.44 - 0.95)	1.06 (0.36 - 3.12)
Haemorrhagic stroke‡ (males)	1	1.27 (0.83 - 1.94)	2.19 (1.47 - 3.28)	2.38 (1.18 - 4.77)
Haemorrhagic stroke‡ (females)	1	0.59 (0.38 - 0.92)	0.65 (0.36 - 1.19)	7.98 (3.25 - 19.6)
Cirrhosis¶	1	1.26 (1.25 - 1.26)	9.54 (9.31 - 9.77)	13.0 (12.68 - 13.32)
Low birth weight**	1	1	1.40 (1.19 - 1.67)	1.40 (1.19 - 1.67)

Beneficial effects related to alcohol consumption for type 2 diabetes mellitus (males and females), haemorrhagic stroke (females) and ischaemic stroke (females).
Source: Unless otherwise stated Gutjahr *et al.* (2001)[18] and Ridolfo and Stevenson (2001)[19] as reported by Rehm *et al.* (2004).[6]
*RRs from Corrao *et al.* (2000)[51] were not used in analysis; instead the AAFs for IHD for AFR-E predicted from multilevel analysis were used.[6]
†Definitions of categories of risk factor levels:[17]
Abstinence: Males 0 - < 0.25 g/d, females, 0 - < 0.25 g/d
Drinking category DI: Males > 0.25 - < 40 g/d, females > 0.25 - < 20 g/d
Drinking category DII: Males 40 - < 60 g/d, females 20 - < 40 g/d
Drinking category DIII: Males ≥ 60 g/d, females ≥ 40 g/d.
‡English *et al.* (1995).[17]
§Ridolfo and Stevenson (2001).[19]
¶Gutjahr *et al.* (2001)[18] CIs derived from English *et al.* (1995).[17]
‖ Corrao *et al.* (1999).[52]
**Rehm *et al.* (2004).[6]

and Injury Lead Programme, Medical Research Council, 2006 – personal communication).* Injury morbidity AAFs were calculated as the percentage of non-fatal injuries positive for BAC ≥ 0.05 g/100 ml using 1999 - 2001 data from the three-city study of Plüddemann *et al.*[32] The morbidity to mortality relationship observed in each of the three cities (Cape Town, Port Elizabeth and Durban) were averaged to obtain a morbidity to mortality ratio of 0.61 for interpersonal violence and 0.42 for road traffic injuries (RTIs), and applied to the national AAF for injury mortality to derive national injury morbidity AAFs. For all other injury categories we used a ratio of 0.44 (two-thirds of the RTI ratio or the product of 0.67 and 0.42).[6]

The AAF for major depression in AFR-E modelled from AFR-E prevalence of alcohol dependence in the global CRA study[6] was used due to the lack of reliable local estimates of alcohol dependence. Even when a stringent cut-off (an affirmative response to 3 questions instead of the usual of 2) on the CAGE† questions was used with the 1998 SADHS data, the prevalence of problematic alcohol use was too high to be plausible. However, the prevalence of risky weekday drinking in the 1998 SADHS was similar to the prevalence of alcohol dependence in AFR-E, supporting the decision to use the modelled estimates for AFR-E.

For FAS, YLDs were calculated using an incidence of 14 per 1 000 at birth, with age of onset at birth (0 years) and duration based on the life expectancy for South Africa in 1990 (pre-AIDS), with no adjustment for increased mortality from this condition. (This figure is based on an incidence of 11.8 per 1 000 births occurring in 92% of births in 2000 in South Africa and an incidence of 40 per 1 000 in the 8% of births in the coloured population.)[27] The mean IQ of children with FAS is 77.5 (standard deviation (SD) 13.4, from a study in a community in the Western Cape).[14] By assuming that IQ is normally distributed, proportions of children with FAS in each of the categories of mental disability and corresponding Dutch disability weights[33] were used to derive a weighted disability weight of 0.125 for FAS, used in the YLD calculations.[27] FAS YLDs were 100% attributable to alcohol consumption. Additional information on the methodology can be found elsewhere.[34]

Monte Carlo simulation-modelling techniques were used to present uncertainty ranges around point estimates reflecting all the main sources of variability in the calculations. The @RISK software version 4.5 for Excel[35] was used, which allows multiple recalculations of a spreadsheet, each time choosing a value from distributions defined for input variables. For prevalence of average volume of consumption categories, the estimated uncertainty ranges around AFR-E point estimates from the global CRA study[6] were used. For the RR input variables a normal distribution was specified around the logged point estimate and its standard error derived from the 95% CIs (shown in Table III). For each of the output variables (namely attributable burden as a percentage of total burden in South Africa 2000), 95% uncertainty intervals were calculated bounded by the 2.5th and 97.5th percentiles of the 2000 iteration values generated.

Results

Just under 37 000 deaths were attributable to alcohol in 2000, with considerable variation across sex and age groups (Fig. 1). For each female death attributable to alcohol there were just over 4 male deaths, mostly as a result of the large number of fatal injuries in young adult men. Fig. 1 also indicates the beneficial effects of alcohol consumption in terms of prevention of deaths from stroke and diabetes among older men and women (shown below the axis). These are particularly noticeable for stroke in older women. When the deaths that are prevented are taken into account, the total mortality loss attributed to alcohol is 33 699 deaths.

Including the disability related to alcohol abuse, and excluding the beneficial effects, more than 1.1 million DALYs were attributable to alcohol in 2000. Fig. 2 depicts the alcohol-attributable DALYs by cause, and injuries accounted for 63.1% of the burden. Interpersonal violence accounted for the largest proportion of the injury burden, i.e. 39.0%, with 42.8% and 25.9% of the alcohol-attributable DALYs in males and females respectively.

Alcohol accounted for 7.1% of all deaths (95% uncertainty interval 6.6 - 7.5%) and 7.0% of all DALYs (95% uncertainty interval 6.6 - 7.4%) for South Africa in 2000 (Table IV). The alcohol-attributable burden is particularly marked for men, accounting

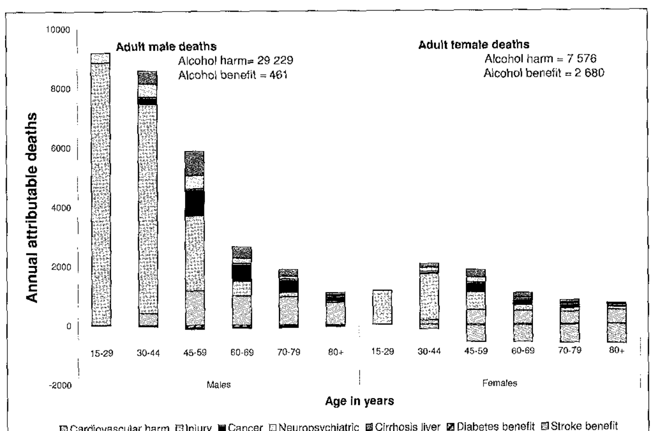

Fig. 1. Annual alcohol-attributable adult deaths by age and sex (including beneficial effects), South Africa, 2000.

* BACs obtained for 41.8% (4 706) of homicide victims (47.1% were ≥ 0.05 g/100 ml);
BACs obtained for 34.6% (2 372) of transport-related deaths (47.2% were ≥ 0.05 g/100 ml);
BACs obtained for 23.9% (595) of burn, fall or other unintentional injury deaths (38.7% were ≥ 0.05 g/100 ml).[31]

† The CAGE questionnaire can serve as a screening instrument for possible alcohol dependence. The questions focus on Cutting down, Annoyance by criticism, Guilty feeling, and Eye-openers. The acronym 'CAGE' helps the physician to recall the questions.

Table IV. Burden attributable to alcohol use in males, females and persons, South Africa, 2000

	Males					Females					Persons				
	PAFs (%)	Deaths	YLLs	YLDs	DALYs	PAFs (%)	Deaths	YLLs	YLDs	DALYs	PAFs (%)	Deaths	YLLs	YLDs	DALYs
Cancer mouth/pharynx	28.5	283	3 353	166	3 519	16.4	63	755	30	785	25.2	345	4 108	197	4 304
Cancer oesophagus	37.2	1 289	14 743	228	14 971	23.0	437	5 194	70	5 264	32.1	1 726	19 937	298	20 235
Cancer liver	30.3	519	6 474	72	6 546	17.0	161	1 829	24	1 852	25.8	680	8 303	95	8 398
Cancer larynx	42.9	271	2 888	0	2 888	28.0	30	375	0	375	40.4	301	3 263	0	3 263
Female breast cancer	0.0	0	0	0	0	5.6	165	2 160	165	2 326	5.6	165	2 160	165	2 326
Type II diabetes mellitus beneficial	-6.4	-301	-3 518	-954	-4 471	-2.3	-189	-1 949	-521	-2 470	-3.9	-491	-5 467	-1 475	-6 942
Epilepsy	53.7	968	21 591	7 688	29 279	22.2	208	3 446	4 492	7 938	41.2	1 176	25 037	12 180	37 217
Hypertensive disease	26.0	1 340	13 219	377	13 596	12.4	1 302	11 231	255	11 486	17.3	2 642	24 450	631	25 081
Ischaemic heart disease	7.6	1 292	11 958	768	12 726	0.0	0	0	0	0	4.4	1 292	11 958	768	12 726
Stroke harmful	12.3	1 635	17 422	1 331	18 753	3.8	631	7 234	343	7 577	7.5	2 266	24 656	1 674	26 330
Stroke beneficial	-1.1	-160	-1 409	-284	-1 694	-13.0	-2 491	-22 487	-3 308	-25 795	-7.9	-2 650	-23 896	-3 593	-27 489
Cirrhosis liver	54.6	1 932	28 209	4 836	33 046	31.3	651	9 358	1 433	10 791	46.1	2 582	37 567	6 269	43 836
Alcohol use disorders/ dependence	100.0	550	9 489	106 973	116 462	100.0	210	3 563	46 536	50 099	100.0	760	13 052	153 509	166 561
Depression	3.6	0	0	3 591	3 591	0.4	0	0	678	678	1.5	0	0	4 269	4 269
Low birth weight	0.3	19	637	47	685	0.3	16	543	41	584	0.3	36	1 181	88	1 269
Fetal alcohol syndrome	100.0	0	0	31 181	31 181	100.0	0	0	31 285	31 285	100.0	0	0	62 466	62 466
Road traffic injuries	49.9	4 935	123 834	6 779	130 613	29.2	1 231	30 485	1 252	31 737	43.9	6 166	154 319	8 031	162 350
Poisonings	31.3	67	1 814	0	1 814	24.4	47	1 034	0	1 034	28.4	114	2 848	0	2 848
Falls	21.3	185	3 576	1 287	4 863	7.7	19	282	1 375	1 657	14.7	204	3 858	2 662	6 520
Fires	51.0	980	24 391	4 076	28 468	46.9	668	14 534	2 073	16 606	49.4	1 648	38 925	6 149	45 074
Drownings	56.8	231	6 149	0	6 149	21.3	21	467	0	467	50.8	252	6 615	0	6 615
Other unintentional injuries	5.9	70	1 857	4 895	6 752	0.0	0	0	0	0	4.8	70	1 857	4 895	6 752
Suicides	36.3	1 430	36 790	7	36 797	18.5	244	5 429	9	5 438	32.3	1 674	42 218	16	42 235
Homicide and violence	47.3	11 253	322 492	53 113	375 604	31.1	1 488	38 946	26 855	65 800	43.9	12 741	361 437	79 967	441 405
Total incl. beneficial effects		**28 787**	**645 958**	**226 178**	**872 136**		**4 912**	**112 428**	**113 085**	**225 513**		**33 699**	**758 386**	**339 263**	**1 097 649**
95% uncertainty interval															
lower		26 370	586 296	217 514	804 513		3 983	100 564	106 925	209 003		31 090	696 654	328 635	1 026 986
upper		30 706	701 650	234 189	935 290		6 287	128 303	116 811	242 672		36 212	817 558	347 786	1 164 342
% of total burden (incl. beneficial effects)		**10.5%**	**11.2%**	**8.4%**	**10.3%**		**2.0%**	**2.3%**	**4.0%**	**2.9%**		**6.5%**	**7.1%**	**6.2%**	**6.8%**
95% uncertainty interval															
lower		9.6%	10.2%	8.0%	9.5%		1.6%	2.0%	3.8%	2.7%		6.0%	6.5%	6.0%	6.3%
upper		11.2%	12.2%	8.7%	11.0%		2.5%	2.6%	4.2%	3.1%		6.9%	7.7%	6.3%	7.2%
Total excl. beneficial effects		**29 248**	**650 885**	**227 416**	**878 301**		**7 592**	**136 864**	**116 914**	**253 778**		**36 840**	**787 749**	**344 331**	**1 132 079**
95% uncertainty interval															
lower		26 923	591 943	219 142	811 511		6 968	127 107	111 027	239 277		34 499	728 402	333 509	1 062 852
upper		31 134	707 043	235 376	942 384		8 516	149 041	120 236	268 131		38 925	846 395	352 766	1 197 765
% of total burden (excl. beneficial effects)		**10.7%**	**11.3%**	**8.4%**	**10.4%**		**3.1%**	**2.8%**	**4.2%**	**3.3%**		**7.1%**	**7.4%**	**6.2%**	**7.0%**
95% uncertainty interval															
lower		9.8%	10.3%	8.1%	9.6%		2.8%	2.6%	4.0%	3.1%		6.6%	6.8%	6.0%	6.6%
upper		11.4%	12.3%	8.7%	11.1%		3.4%	3.0%	4.3%	3.5%		7.5%	7.9%	6.4%	7.4%

PAFs = population-attributable fractions; YLLs = years of life lost; YLDs = years lived with disability; DALYs = disability-adjusted life years.

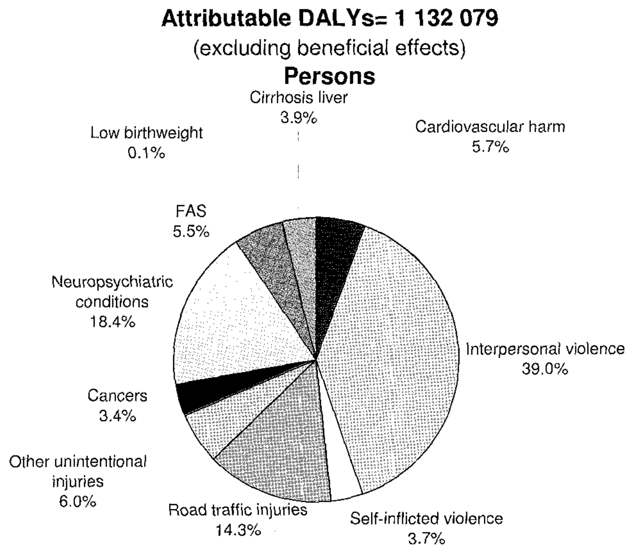

Fig. 2. Alcohol-attributable DALYs for persons (excluding beneficial effects), South Africa, 2000.

for 10.4% of DALYs (95% uncertainty interval 9.6 - 11.1%). In the case of women, alcohol accounted for 3.3% of total DALYs (95% uncertainty interval 3.1 - 3.5%). From Table IV it can be seen that homicide and violence (39.0%), alcohol dependence or use disorders (14.7%) and RTIs (14.3%) are the top 3 rankings in terms of alcohol-attributable DALYs for persons. FAS is ranked fourth and accounts for 5.5% (62 466) of alcohol-attributable DALYs (this despite no deaths attributed to FAS for this study). For YLLs the top rankings are homicide and violence (45.9%), RTIs (19.6%) and suicides (5.4%). However, in terms of alcohol-attributable disability (YLD), alcohol use disorders rank first (44.6%), homicide and violence second (23.2%) and FAS third (18.1%). These are followed by epilepsy and RTIs, accounting for 3.5% and 2.3% of alcohol-attributable YLDs respectively.

Discussion

Alcohol abuse results in a considerable health burden in South Africa. Despite assuming that about 50% of men and 70% of women do not drink any alcohol, alcohol accounts for 7.0% of all DALYs in South Africa. Alcohol harm ranked third in terms of percentages of total DALYs for the 17 risk factors included in the South Africa CRA study. If the beneficial effects of alcohol are included, then alcohol accounts for 6.5% of total deaths and 6.8% of total DALYs. While the ranking against other risk factors remains the same for the percentage total DALYs, alcohol ranks sixth when the beneficial effects are included and not fourth in terms of percentage total deaths.

In 2000, 3.2% (1.8 million) of global deaths and 4.0% (58.3 million) of global DALYs were attributed to alcohol exposure.[6,15] The DALY burden for high-mortality developing sub-regions (including AFR-E) was estimated to be 1.6% of total DALYs – compared with 9.2% for developed regions.[6] The extent of the South Africa burden is more similar to the experience in developed countries than to that in high-mortality developing regions. This is largely accounted for by the high alcohol-related injury burden in South Africa. The WHO global CRA study[6] estimated that 28% of the unintentional and 12% of the intentional injury burden was attributable to alcohol. In South Africa the figures are 20.2% for unintentional and 40.9% for intentional injuries.

There is a need for local epidemiological data on the contribution of alcohol to poor health outcomes. In particular, data are needed on the association between alcohol consumption and increased risk of HIV/AIDS, which was not quantified in this study due to a lack of data. A critical assumption in this analysis has been the use of AFR-E subregion consumption prevalence data from the global CRA study[6] rather than available prevalence data for South Africa. This was done because the prevalence data did not

Table V. Relevance to South Africa of strategies indicated by Barbor *et al.*[42] as having proven effectiveness

Specific strategy	Effectiveness	Cost to implement	Target group	Application in South Africa
Regulating physical activity				
Changes in minimum purchasing age	+++	Low	B	Not feasible at present; rather enforce existing limits
Government monopoly on retail sales	+++	Low	A	Not feasible to reintroduce this
Restrictions on hours/days of sale	++	Low	A	Only feasible if enforced
Outlet density restrictions	++	Low	A	Need to regulate the market first
Alcohol taxation				
Increase excise taxes on alcohol	+++	Low	A	Government is moving in the right direction
Drinking/driving countermeasures				
Sobriety check-points	++	Moderate	A	Should consider increasing random breath testing
Lowered BAC limits	+++	Low	A	Current efforts should focus on enforcing existing limits
Administrative licence suspension	++	Moderate	C	Useful, but courts are over-burdened
Graduated licensing for novice drivers	++	Low	B	Implementation would be very feasible in South Africa
Brief interventions				
Brief interventions for hazardous drivers	++	Low	B	Good option, but primary practitioners need training

Source: Parry, 2005.[37]
A = general population; B = high-risk drinkers or groups considered to be vulnerable to the effect of alcohol; C = persons already manifesting harmful drinking and alcohol dependence; ++ = moderate; +++ = high; BAC = blood alcohol concentration.

match production figures as a result of the high prevalence of reported abstinence. Given the high estimated burden, it is clear that there is an urgent need to improve the population-based data to reliably monitor the use of alcohol. Furthermore, as a large part of the estimated burden of alcohol abuse results from injury, this indicates the need to ensure good quality alcohol-related data are collected in the mortuary surveillance system. However, the narrow uncertainty band for these estimates does suggest that the results of our study are robust.

Many negative effects related to alcohol, including social and economic consequences, are not captured in this analysis. Costs of these negative consequences have been shown to exceed direct health costs,[36] emphasising the need for a public health response to this risk factor. To date, alcohol interventions have been fragmented across different departments and levels of government,[37] and are poorly distributed. There is no single strategy for reducing the social, economic and health burden associated with alcohol misuse. Multi-level interventions are required to foster the responsible development of the alcohol industry on the one hand and simultaneously reduce the burden imposed by alcohol on the other.[38] Taking the high burden of alcohol-related problems, insufficient revenue to cover social costs associated with alcohol misuse, and the relatively low real price of alcohol into consideration, it is recommended that a moderate real increase in excise taxes on all alcoholic beverages be levied.[39] There is compelling evidence that young drinkers are especially responsive to price,[39] and that taxes contain moderate and heavy drinking and control the level of alcohol-related problems in developing countries.[40]

Parry and Bennetts[41] identified a number of individual and population-based strategies to address alcohol misuse in South Africa. This list incorporates most of the WHO-recommended short-term alcohol intervention strategies found to be effective in a review by Barbor *et al.*[42] and an assessment of the feasibility of their implementation in South Africa (Table V). Strategies with proven effectiveness include regulating physical availability of alcohol, drinking/driving counter-measures, and brief interventions (including a structural motivational interviewing technique aimed at enhancing motivation to change) for hazardous drinkers.[42]

According to Parry,[37] strategies that also need to be considered in the South African context include workplace interventions, broad-based community development initiatives, and specific interventions aimed at drunken pedestrians. There should also be specific programmes directed at pregnant women and drunk drivers.[43] Various product restrictions should also be implemented, such as restricting the size of beer containers and stopping 'papsakke' (wine in plastic bags). There should also be increased restrictions on alcohol marketing and increased alcohol counter-advertising.

The exercise of constraint when consuming alcohol is critically important. Certain groups, such as pregnant women or machine operators, should abstain from alcohol use, and motor vehicle drivers should avoid consuming alcohol. The South African Department of Health's *Food-Based Dietary Guidelines*[44,45] recommends sensible drinking or 'low-risk drinking' as: 'for those who drink – no more than four units of alcohol per day for men and two per day for women, with at least two alcohol-free days per week'.[44] Public health experts question the appropriateness of these so-called weekly 'low-risk' maximums for sensible alcohol consumption.[46] New Canadian guidelines[47] stipulate 14 standard drinks per week for men and 9 for women, with a maximum of 2 drinks per day.

Conclusion and recommendations

Despite the fact that many South Africans do not drink, alcohol abuse results in a considerable burden of disease in South Africa. The National Liquor Act of 2003[48] aims to promote a sustainable liquor industry, and encourages responsible drinking to reduce the social and economic costs of alcohol abuse. Focus should now shift from legislation and regulation to making resources available for implementing intervention strategies.[41] These should include a coherent liquor outlet policy, increasing random breath analysis of drivers, brief interventions,[49,50] and other forms of treatment for high-risk and hazardous drinkers, as well as training and accreditation of treatment and prevention programmes.[1] Changing the pattern of drinking in South Africa is essential if the alcohol-related burden is to be reduced. A co-ordinated national intervention strategy – ideally a National Plan with provincial components that include civil society – is required especially given the linkage between alcohol and other national priorities such as crime and violence, RTIs and HIV/AIDS. An adequate information base should underpin the implementation of a national alcohol strategy.

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References

1. Parry CDH. SA: alcohol today. *Addiction* 2005; 100: 426-429.
2. Mager A. 'White liquor hits black livers': meanings of excessive liquor consumption in South Africa in the second half of the twentieth century. *Soc Sci Med* 2004; 59: 735-751.
3. Brady M, Rendall-Mkosi K. *Tackling Alcohol Problems.* Strengthening Community Action in South Africa. Cape Town: Blue Weaver, 2005.
4. Department of Health, Medical Research Council, Macro International. *South African Demographic and Health Survey 1998.* Full report. Pretoria: DOH, 2001.
5. Demers A, Room R, Bourgault. *Surveys of Drinking Patterns and Problems in Seven Developing Countries.* Geneva: Department of Mental Health and Substance Dependence, World Health Organization, 2001. http://www.unicri.it/min.san.bollettino/dati/AlcBrochur.pdf (last accessed 14 May 2007).
6. Rehm J, Room R, Monteiro M, *et al.* Alcohol use. In: Ezzati M, Lopez AD, Rodgers A, Murray CJL, eds. *Comparative Quantification of Health Risks: Global and Regional Burden of Disease Attributable to Selected Major Risk Factors.* Geneva: World Health Organization, 2004: 959-1109.
7. Walker ARP, Koornhof HJ, Wadee AA. Rising alcohol consumption – any hopes of control? *Southern African Journal of Epidemiology and Infection* 2005; 20(1): 2-3.
8. Room R, Barbor T, Rehm J. Alcohol and public health. *Lancet* 2005; 365: 519-530.
9. Parry CDH, Dewing S. A public health approach to addressing alcohol-related crime in SA. *African Journal of Drug and Alcohol Studies* 2006; 5: 1-56.
10. Morojele NK, Kachieng MA, Mokoko E, *et al.* Alcohol use and sexual behaviour among risky drinkers and bar and shebeen patrons in Gauteng province, South Africa. *Soc Sci Med* 2006; 62(1): 217-227.
11. Room R, Jernigan D, Carlini-Marlatt B, *et al. Alcohol in Developing Societies: A Public Health Approach.* Helsinki: Finnish Foundation for Alcohol Studies, 2002.
12. Rehm J, Rehn N, Room R, *et al.* The global distribution of average volume of alcohol consumption and patterns of drinking. *Eur Addict Res* 2003; 9: 147-156.
13. Reddy SP, Panday S, Swart D, *et al. Umthenthe Uhlaba Usamila – The South African Youth Risk Behaviour Survey 2002.* Cape Town: South African Medical Research Council, 2003.
14. May PA, Brook L, Gossage JP, *et al.* Epidemiology of fetal alcohol syndrome in a South African Community in the Western Cape Province. *Am J Public Health* 2000; 90: 1905-1912.
15. World Health Organization. *The World Health Report 2002. Reducing Risks, Promoting Healthy Life.* Geneva: WHO, 2002.
16. Ezzati M, Lopez A, Rodgers A, Vander Hoorn S, Murray CJL. Selected major risk factors and global and regional burden of disease. *Lancet* 2002; 360: 1347-1360.
17. English D, Holman C, Milne E, *et al. The Quantification of Drug Caused Morbidity and Mortality in Australia.* Canberra: Commonwealth Department of Human Services and Health, 1995.
18. Gutjahr E, Gmel G, Rehm J. Relation between average alcohol consumption and disease: an overview *Eur Addict Res* 2001; 7: 117-127.
19. Ridolfo B, Stevenson C. *The Quantification of Drug-caused Mortality and Morbidity in Australia in 1998.* Canberra: Australian Institute of Health and Welfare, 2001. http://www.aihw.gov.au/publications/phe/qdcmma98/qdcmma98.pdf (last accessed 10 May 2007).
20. Bradshaw D, Groenewald P, Laubscher R, *et al.* Initial burden of disease estimates for South Africa, 2000. *S Afr Med J* 2003; 93: 682-688.
21. World Health Organization. *International Statistical Classification of Diseases and Related Health Problems.* 10th Revision. Geneva: WHO, 1988. http://www3.who.int/icd/vol1htm2003/fr-icd.htm (last accessed 14 May 2007).
22. *Alcoholic Beverage Review Incorporating Beverage Business Yearbook. Hotel and Restaurant.* Pinelands, Cape Town: Ramsay Son & Parker, 2004
23. World Health Organization. *World Health Survey.* Geneva: WHO. 2001. http://www.who.int/healthinfo/survey/en/ (last accessed 10 May 2007).
24. Croxford J, Viljoen D. Alcohol consumption in the Western Cape. *S Afr Med J* 1999: 89: 961-965.
25. Actuarial Society of South Africa. *ASSA2002 AIDS and Demographic Model.* Actuarial Society of SA (ASSA) AIDS Sub-Committee. http://www.assa.org.za/aids/content.asp?id=1000000449 (last accessed 5 June 2006).
26. Walter S. The estimation and interpretation of attributable risk in health research. *Biometrics* 1976; 32: 829-849.
27. Norman R, Bradshaw D, Schneider M, Pieterse D, Groenewald P. *Revised Burden of Disease Estimates for the Comparative Risk Factor Assessment, South Africa 2000.* Methodological Notes. Cape Town: South African Medical Research Council, 2006. http://www.mrc.ac.za/bod/bod.htm (last accessed 6 May 2007).
28. Lawes CMM, Vander Hoorn S, Law MR, Rodgers A. High cholesterol. In: Ezzati M, Lopez AD, Rodgers A, Murray CJL, eds. *Comparative Quantification of Health Risks, Global and Regional Burden of Disease Attributable to Selected Major Risk Factors.* Geneva: World Health Organization, 2004: 391-496.
29. Clinical Trials Research Unit. *Estimating Ischaemic and Haemorrhagic Stroke, by Age, Sex Region, and Fatal and Non-fatal Categories.* Produced for Comparative Risk Analysis (CRA) Project. Auckland: University of Auckland, Australia, 2002.
30. Rosman KD. The epidemiology of stroke in an urban black population. *Stroke* 1986; 17: 667-669.
31. Matzopoulos R, Seedat M, Cassim M. *A Profile of Fatal Injuries in SA: Third Annual Report of the National Injury Mortality Surveillance System 2001.* Cape Town: Medical Research Council, 2002.
32. Plüddemann A, Parry C, Donson H, Sukhai A. Alcohol use and trauma in Cape Town, Durban and Port Elizabeth, SA: 1999-2001. *Injury Control Saf Promot* 2004; 11: 265-267.
33. Stouthard M, Essink-Bot M, Bonsel G, Barendregt J, Kramers P. *Disability Weights for Diseases in the Netherlands.* Rotterdam: Department of Public Health, Erasmus University, 1997.
34. Schneider M, Norman R, Parry C, Bradshaw D, Plüddemann A and the South African Comparative Risk Assessment Collaborating Group. *Technical Report: Estimating the Burden of Disease Attributable to Alcohol Use in South Africa in 2000.* Methodological Notes. Cape Town: South African Medical Research Council, 2007. http://www.mrc.ac.za/bod/bod.htm (last accessed 30 July 2007).
35. Palisade Corporation. @Risk software. Advanced risk analysis for spreadsheets. Version 4.5. New York: Palisade Corporation, 2002.
36. Room R, Graham K, Rehm J, *et al.* Drinking and its burden in a global perspective: policy considerations and options. *Eur Addict Res* 2003; 9: 165-175.
37. Parry CDH. A review of policy-relevant strategies and interventions to address the burden of alcohol on individuals and society in SA. *South African Journal of Psychiatry Rev* 2005; 8: 20-24.
38. Parry CDH, Myers B, Thiede M. The case for an increased tax on alcohol in SA. *South African Journal of Economics* 2003; 71: 265-281.
39. Grossman M, Chaloupka FJ, Saffer H, Laixuthai A. Effects of alcohol price policy on youth: a summary of economic research. In: Boyd GM, Howard J, Zucker RA, eds. *Alcohol Problems Among Adolescents: Current Directions in Prevention Research.* Hillsdale, NJ: Lawrence Erlbaum and Associates, 1995: 225-242.
40. Edwards G, Anderson P, Barbor TF. *Alcohol Policy and Public Good.* Oxford: Oxford University Press, 1994.
41. Parry CDH, Bennetts AL. *Alcohol Policy and Public Health in South Africa.* Oxford: Oxford University Press, 1998.
42. Barbor T, Caetano R, Casswell S, *et al. Alcohol: No Ordinary Commodity. Research and Public Policy.* Oxford: Oxford University Press, 2003.
43. Parry CDH, Plüddemann A, Steyn K, Bradshaw D, Norman R, Laubscher R. Alcohol use in South Africa: Findings from the First Demographic and Health Survey (1998). *J Stud Alcohol* 2005; 66: 91-97.
44. Department of Health. *Food-based Dietary Guidelines for South Africa.* Pretoria: DOH, 2004. ftp://ftp.fao.org/es/esn/nutrition/dietary_guidelines/zaf_eating.pdf (last accessed 14 May 2007).
45. Van Heerden IV, Parry CDH. If you drink alcohol, drink sensibly. *South African Journal of Clinical Nutrition* 2001; 14(3): S71-S77.
46. Parry CDH. Alcohol and your health. *S Afr Med J* 2002; 92: 568.
47. Bondy S, Rehm J, Ashley MJ, Walsh E, Single R. Low risk drinking guidelines: scientific evidence and its implications. *Can J Public Health* 1999; 90: 264-270.
48. Republic of South Africa. *Liquor Act No. 59 of 2003.* Gazette No. 26294. Pretoria: Government Printers, 2004.
49. Babor TF, Higgins-Biddle JC. *Brief Intervention for Hazardous and Harmful Drinking: A Manual for Use in Primary Care.* Geneva: Department of Mental Health and Substance Abuse, World Health Organization, 2001.
50. Kaner E, Beyer F, Dickinson H *et al.* Effectiveness of brief alcohol interventions in primary care populations. *Cochrane Database Syst Rev* 2007; 18(2): CD004148.
51. Corrao G, Rubiatti L, Bagnardi V, Zambon A, Poikolainen K. Alcohol and coronary heart disease: a meta-analysis. *Addiction* 2000; 95: 1505-1523.
52. Corrao G, Bagnardi V, Zambon A, Arico S. Exploring the dose-response relationship between alcohol consumption and the risk of several alcohol-related conditions: a meta-analysis. *Addiction* 1999; 94: 1555-1573.