

REDUCING ALCOHOL-RELATED INJURIES

A report for the Building Capacity Project

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1. INTRODUCTION

After consuming alcohol, its most obvious and immediate effects of alcohol are on the brain, beginning with feelings of relaxation, well-being and loss of inhibitions (see NHMRC 2009). However, as the intake of alcohol increases, these effects are counterbalanced by less pleasant effects, such as drowsiness, loss of balance, nausea and vomiting. The range of normal pathophysiological reactions to alcohol begin with dampening of the brain's arousal, motor and sensory centres, which reduces reactions to stimuli and affects coordination, speech, cognition and the senses. There is evidence that drinking decreases cognitive performance, even at low levels of consumption. The first potentially adverse effect of alcohol consumption is loss of fine motor skills and inhibitions. As more alcohol is consumed and the blood alcohol concentration rises, performance and behaviour deteriorate progressively. If the blood alcohol concentration reaches a high enough level, it can lead to life-threatening events such as unconsciousness and, eventually, inhibition of normal breathing. This may be fatal, particularly as the person may vomit and can suffocate if the vomit is inhaled. As well as effects on the body, the amount of alcohol consumed on a single occasion increases the risk of accidents and injury during and immediately after drinking. Every additional drink significantly increases the risk of injury and death for the drinker and may place others at risk of harm as well. Alcohol consumption also increases the likelihood and extent of aggressive behaviours and reduces the cognitive or verbal capacity to resolve conflicts, thereby increasing the likelihood of physical violence.

There is evidence indicating that drinking decreases cognitive performance, even at low levels of consumption. The acute effects of alcohol increase with the amount consumed, along with the risk of adverse outcomes. Studies into the effect of alcohol on cognitive performance have found that as the blood alcohol level increases, cognitive function and psychomotor performance decrease rapidly (Easdon et al 2005); consumption of less than two standard drinks potentially results in effects that increase risk of injury (Tagawa et al 2000; Howland et al 2001; Marinkovic et al 2001; Marinkovic et al 2004; Moulton et al 2005; Breitmeier et al 2007). Substantial impairment can exist well after alcohol has been metabolised and passed from the body (Schweizer et al 2004; Schweizer et al 2006); such temporary impairment, and its attendant risk, is the result of a 'hangover' effect (Verster et al 2003).

This report describes the risk of alcohol-related injuries and what can be done to reduce them. It excludes alcohol-related driving injuries, since these have been reviewed elsewhere (Anderson 2007).

2. METHODS

Formal literature searches of the scientific literature were undertaken in Pub med, MEDLINE, the Cochrane Library and Google scholar using the search terms adapted from Table 1. Searches were restricted to the English language and since the year 1990. Key reviews of the impact of alcohol policies in reducing the harm done by alcohol were screened for information on older people (Anderson et al 2009; World Health Organization 2009; Anderson & Baumberg 2006). 744 titles and abstracts were identified in the search, from which 190 papers were retrieved, of which 156 were relevant to the review.

Table 1 Search terms used for formal literature searches.

#	Search History
1.	(injury OR death OR mortality OR fatality OR trauma OR fall\$ OR violence OR fracture OR drowning OR fire OR accident OR suicide OR assault OR murder OR homicide).ti,ab.
2.	(educat\$ or train\$ or promot\$ or interven\$ or program\$ or administer\$ or campaign\$ or evaluat\$ or assess\$ or control\$ or compar\$ or prevent\$ or safe\$ or strateg\$ or scheme\$ or incentive\$ or trial\$ or policy or policies or reduc\$ or approach\$ or enforce\$ or guideline). Ti,ab.
3.	(drink\$ or consum\$ or heavy or binge or episodic or risk\$ or safe or pattern).ti,ab
4.	alcohol\$.ti,ab.
5.	or/1-3
6.	and/4-5

3. SINGLE OCCASION CONSUMPTION AND RISK

Chapter summary The risk of a non motor vehicle accident injury increases by 30% for every 10g of alcohol consumed during the previous three hours. When 140g alcohol is consumed during the previous three hours, the chance of having an injury is increased 24 fold compared with not drinking. There is no level of consumption risk free.

One way to describe the relationship between the use of alcohol and the risk of an injury is to develop single occasion dose specific relative risks. One meta-analysis has just done that. Taylor et al (2010) identified 28 papers assessing the relationship between acute alcohol use and injury. The relative risks associated with a 10g/occasion increase in alcohol consumption are shown in Figure 1. The risks of a non motor vehicle accident injury increase by 30% for every 10g of alcohol consumed on an occasion.

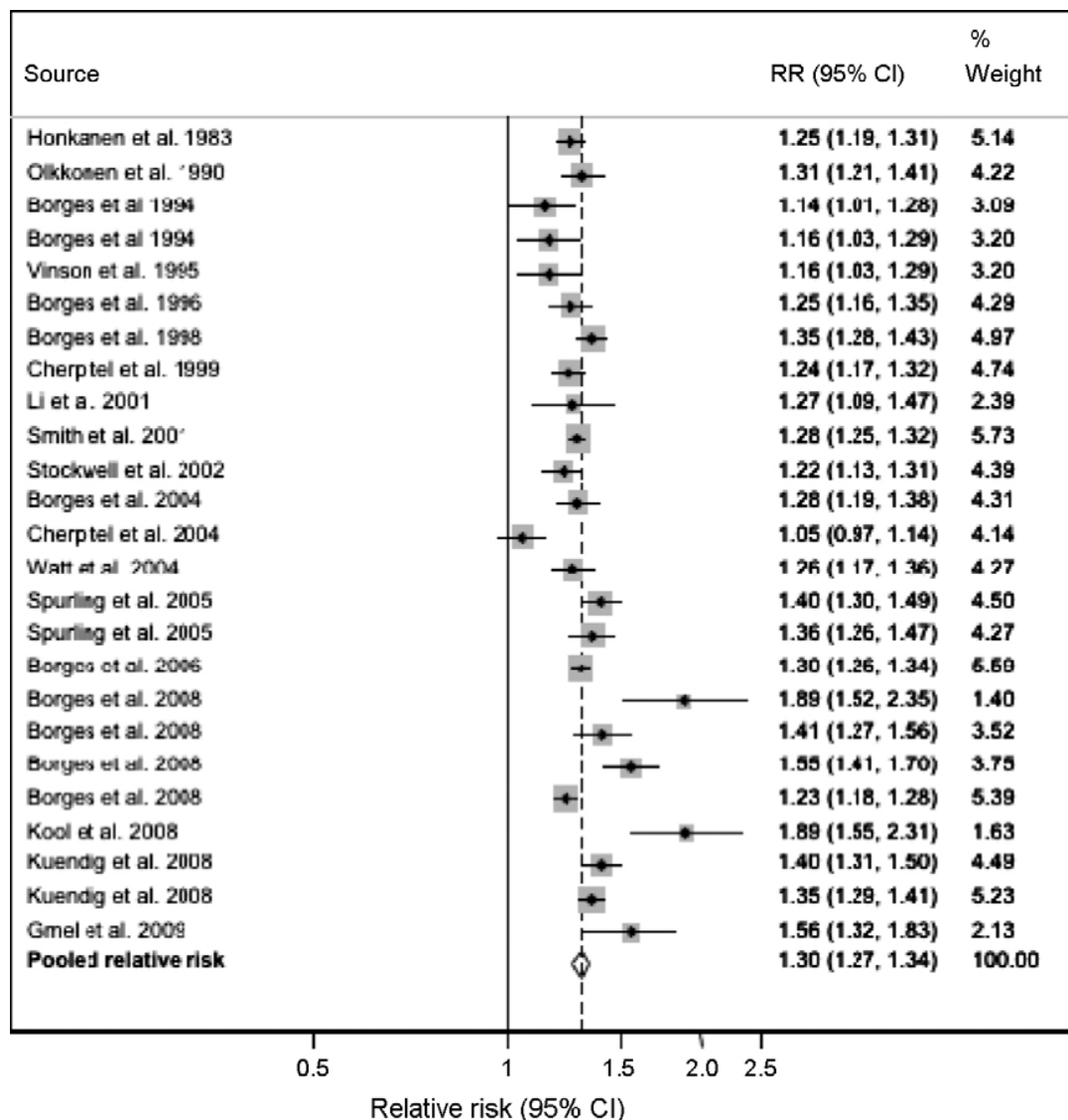


Figure 1 Forest plot for studies of non-motor vehicle accidents only and estimated relative risks associated with a 10 g/occasion increase in alcohol consumption: estimates were derived from a random effects linear model. Source: Taylor et al (2010).

The analysis showed a strong dose-response relationship between the amount of alcohol consumed and non-motor vehicle injuries, Figure 2. At 140g alcohol prior to injury, the odds ratio was 24.2 (95%CI: 16.2-36.2).

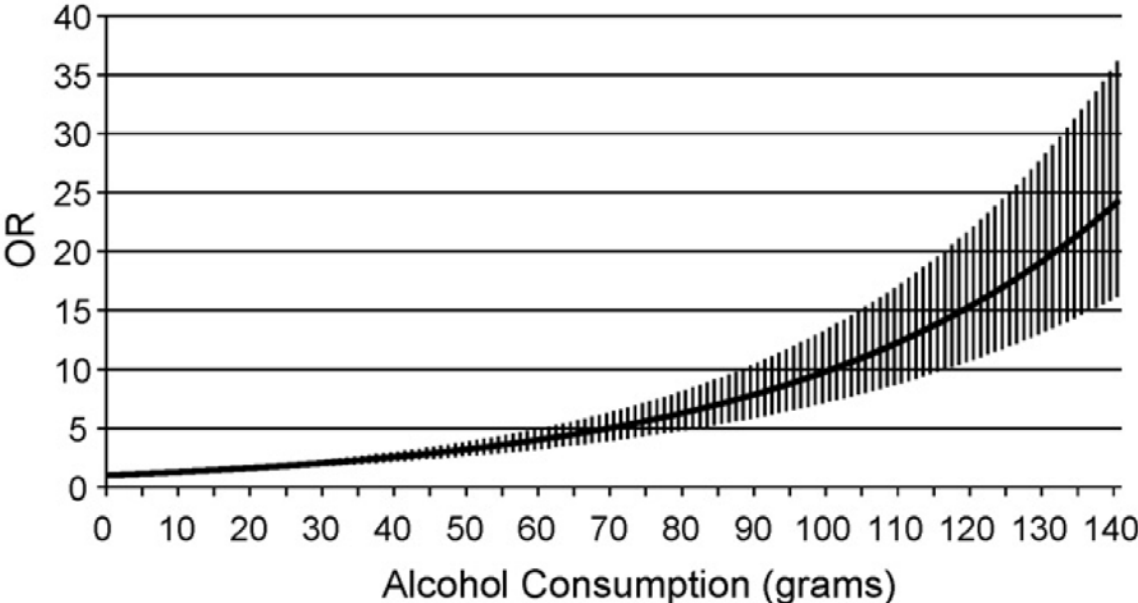


Figure 2 Dose-response curve for the amount of alcohol consumed 3 h prior and the odds of non-motor vehicle accident injury. Source: Taylor et al (2010).

Thus, the risk of injury simply increases with increasing alcohol consumption on a drinking occasion with no safe level of consumption.

4. LIFETIME CONSUMPTION AND RISK

Chapter summary The lifetime risk of dying from an alcohol-related injury increases with both the frequency of drinking and the number of drinks per occasion. At any given alcohol intake, men are more likely to die than women. There is no level of consumption risk free.

Another way to describe the relationship between alcohol and injury risk is to estimate the lifetime risk of death or hospitalization from an injury related to alcohol use. Here, both the frequency of drinking and the amount drunk per occasion are important. Such estimates have been made for the Australian population (NHMRC 2009). Estimates for other countries will vary depending on the country-specific consumption and disease burden patterns.

The estimates for lifetime risk of death for men and women are shown in Figures 3 and 4. For both men and women the risk of death increases with both the frequency of drinking and the number of drinks per occasion. The risks of death for men are higher than those for women at all levels of drinking. A man who drinks 80g alcohol every day has a 1 in 10 lifetime risk of dying from an alcohol-related injury and a woman a 1 in 20 risk. The risk of death from injury remains below 1 in 100 for both men and women if they always drink two drinks (20g alcohol) or less on an occasion, even if the occasions are every day.

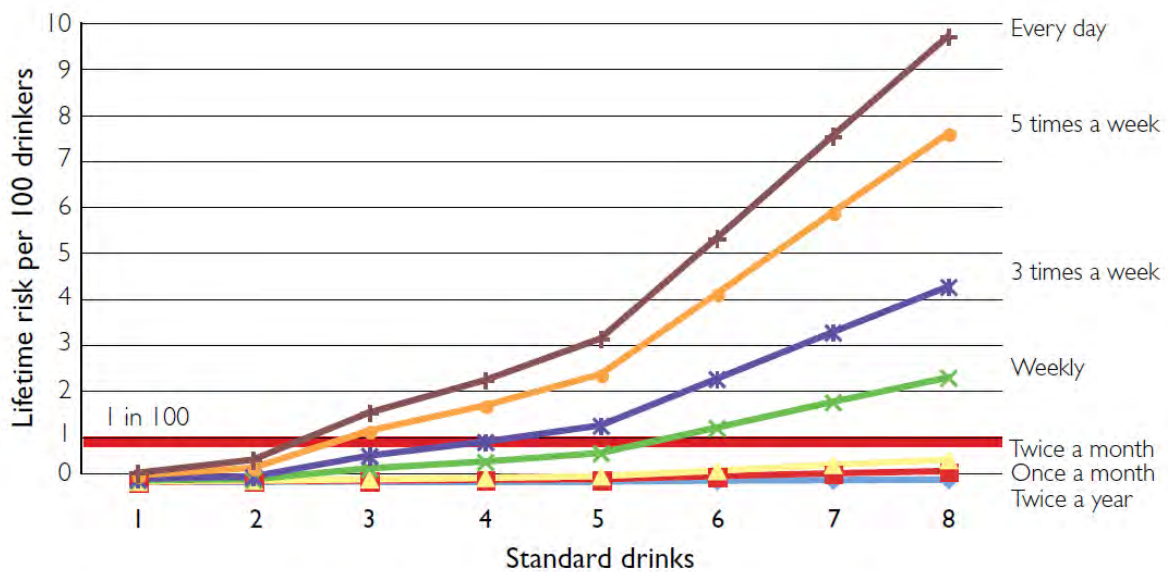


Figure 3 Lifetime risk from alcohol-related injury per 100 male Australian drinkers, by number of standard drinks per occasion (one drink contains 10g alcohol) and frequency of occasions. Source: NHMRC (2009).

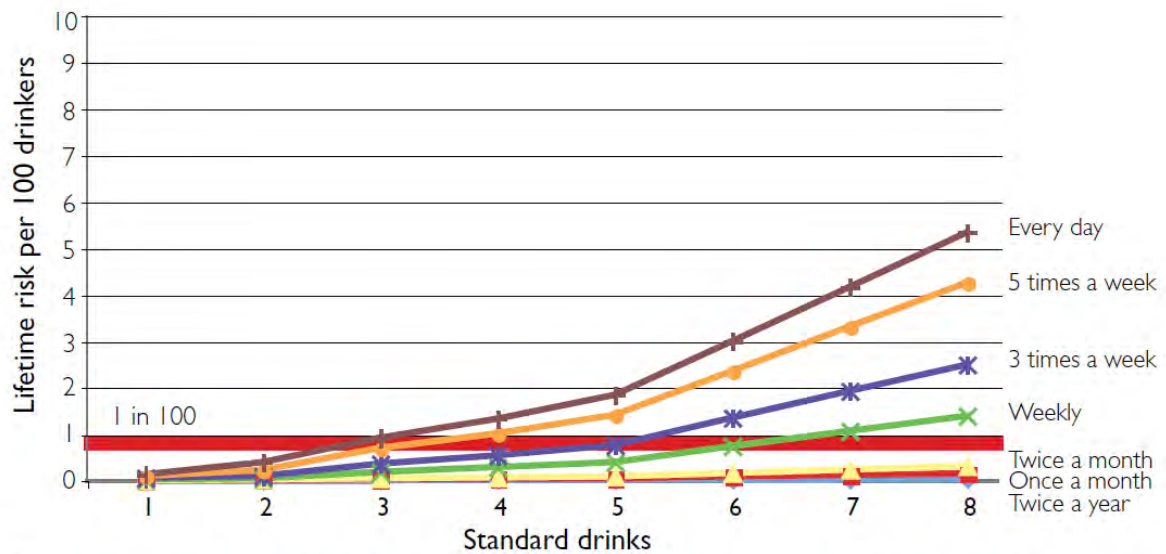


Figure 4 Lifetime risk of death from alcohol-related injury per 100 female Australian drinkers, by number of standard drinks per occasion (one drink contains 10g alcohol) and frequency of occasions. Source: NHMRC (2009).

The lifetime risks of hospitalization for an alcohol related injury are shown in Figures 5 and 6. The curves are somewhat more linear than the curves for deaths from injury. The lifetime chance of hospitalization is an order of magnitude higher than the lifetime chance of death from injury except at the most harmful drinking levels. The ratio of the odds of hospitalisation to the odds of death from injury was much higher at lower amounts of drinking (eg two standard drinks or less on a day) than at higher amounts of drinking. This reflects that the chances of dying from an alcohol-related injury that is serious enough to require hospitalisation increases for higher levels of drinking. The differences between men and women are much less than for death.

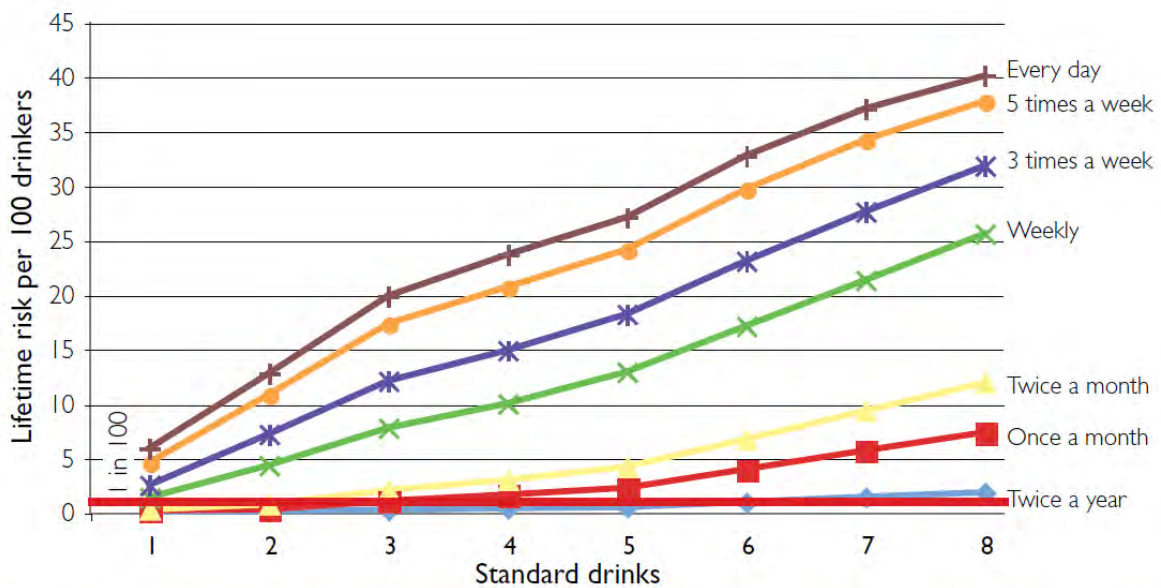


Figure 5 Lifetime risk of hospitalization for alcohol-related injury per 100 male Australian drinkers, by number of standard drinks per occasion (one drink contains 10g alcohol) and frequency of occasions. Source: NHMRC (2009).

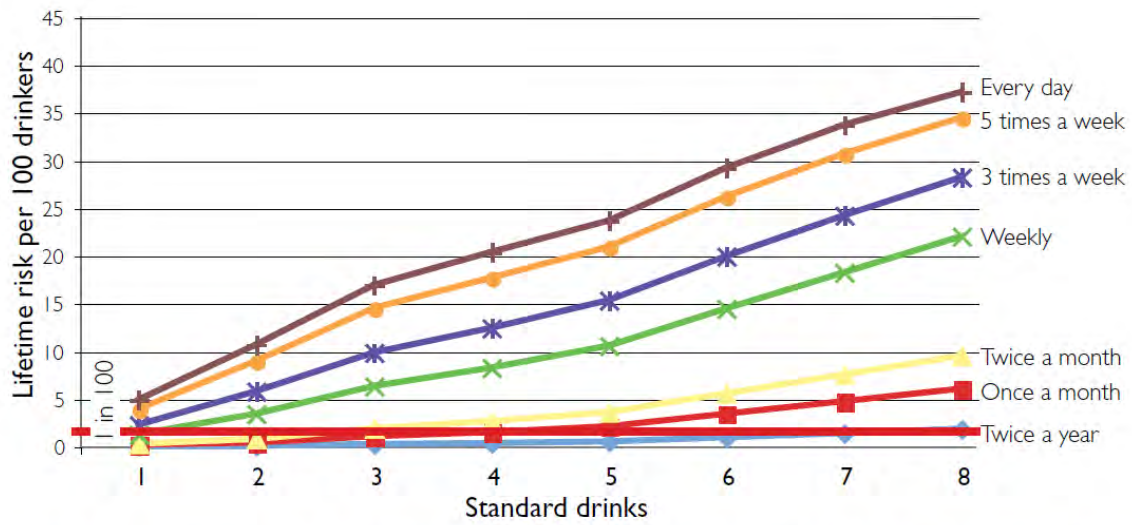


Figure 6 Lifetime risk of hospitalization for alcohol-related injury per 100 male Australian drinkers, by number of standard drinks per occasion (one drink contains 10g alcohol) and frequency of occasions. Source: NHMRC (2009).

Thus, the lifetime risk of dying or being hospitalized from an alcohol-related injury simple increases with both the frequency of drinking and the amount drunk per occasion, with no safe level of consumption.

5. ATTRIBUTABLE RISK

Chapter summary Depending on the injury type, and age of death, and using the example of the Australian population, between one and two fifths of all injury deaths are due to alcohol. This includes over two-fifths of deaths from fires, one third of drowning deaths, one third of deaths from suicide, and over one quarter of all homicides.

From the risk relationships, it is also possible to estimate the alcohol-related attributable fractions for a range of injury outcomes. This has been done in a number of countries with similar results. The data for Australia are summarized in the table below (NHMRC 2009). Taking homicide as the example, it means that 27% of all homicides in Australia are due to alcohol. Essentially, between one and two fifths of all deaths from injuries are due to alcohol.

Table 2 Attributable alcohol fractions of acute alcohol-related health effects in the Australian adult population. Source: NHMRC (2009).

15-29 years		30-44 years		45-59 years		60-69 years		70-79 years		80+ years	
M	F	M	F	M	F	M	F	M	F	M	F
Poisoning											
29	23	16	15	16	15	16	15	8	7	8	7
Falls											
22	14	22	14	22	14	12	4	12	4	12	4
Fire											
44	44	44	44	44	44	44	44	44	44	44	44
Drowning											
34	34	34	34	34	34	34	34	34	34	34	34
Other unintentional injuries											
29	23	29	23	24	19	24	19	24	19	24	19
Suicide											
32	29	32	29	32	29	32	29	32	29	32	29
Homicide											
27	27	27	27	27	27	27	27	27	27	27	27
Other intentional injuries											
20	20	20	20	20	20	20	20	20	20	20	20

6. THE BURDEN OF ALCOHOL RELATED INJURIES

Chapter summary Over one fifth of the adult population of the European Union reported drinking 50g alcohol on one or more occasion at least once a week in 2009. The European Union is one of the regions of the world with the highest alcohol-attributable harm. Some two-fifths of all ill-health and premature death due to alcohol results from alcohol-related injuries, including 1 in 4 homicides and about 1 in 5 suicides. There is a direct relationship between changes in per capita alcohol consumption and changes in death rates from all accidents, homicides and suicides.

The EU is the heaviest drinking region of the world with, on average, each adult drinking 11 litres of pure alcohol each year – a level over two and a half times the average of the rest of the world (Anderson & Baumberg 2006). The Eurobarometer survey conducted at the end of 2009 found that some 80 million Europeans aged 15 years and over (22% of the adult EU population) reported heavy episodic drinking (defined in the Eurobarometer survey as five or more drinks on one occasion or 50g alcohol) at least once a week in 2009. Of those who drank during the previous 12 months, a much higher proportion of all men (36%) than women (19%) reported heavy episodic drinking at least once a week. According to the Eurobarometer survey, heavy episodic drinking was not a prerogative of the young or of northern Europeans. Of those who drank during the previous 12 months, whereas 33% of those aged 15–24 years reported heavy episodic drinking at least once a week in 2009, such drinking was also common among those aged 55 years and over, with 25% reporting heavy episodic drinking at least once a week. The proportion of the total population reporting that they were heavy episodic drinkers was 44% in Ireland and 34% in Spain, much higher than in Finland (22%) and Sweden (13%).

Not surprisingly, this high level of consumption and pattern of drinking brings with it a high level of harm: the WHO European Region has the highest proportion of total ill health and premature deaths due to alcohol in the world (Figure 7) (Rehm et al 2009).

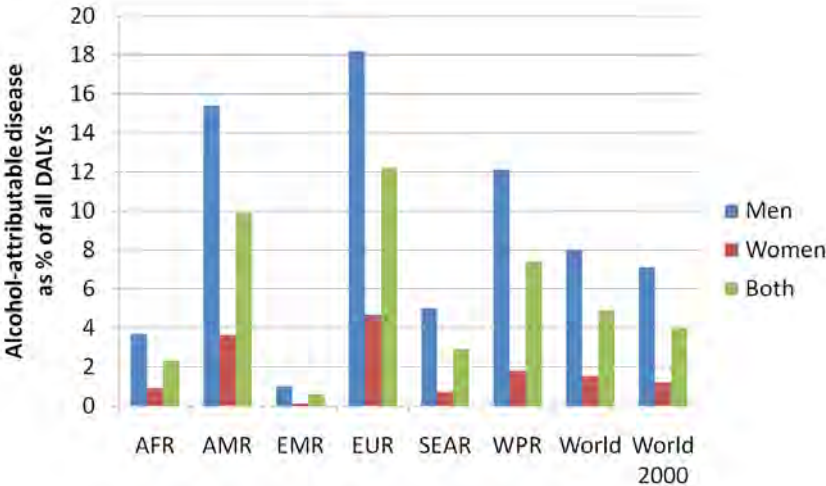


Figure 7 Alcohol-attributable burden of disease in DALYs^a as a proportion of all DALYs, by sex and WHO region, 2004 (%)

AFR: African region; AMR: American region; EMR: Eastern-Mediterranean region; EUR: European region; SEAR: South-east Asian region; WPR: Western Pacific region.

^aWHO uses a measure called disability-adjusted life years (DALYs) to estimate the number of healthy years of life lost due to each risk factor. For example, while a year of perfect health will count as 1 and a year of death

will be 0, a year of damaged health that significantly affects quality of life will be somewhere in between. DALYs measure a gap in health between the current position and what could be achieved.
 Source: Rehm et al (2009).

Alcohol is responsible for the loss of over 4.5 million DALYs every year in the European Union (7.4% of all DALYs), Figure 8. This is principally for men, accounting for 12% of all male ill-health and premature death and a smaller but still sizeable 2% of all female ill-health and premature death. The larger proportion of the burden arises from alcohol-related neuropsychiatric conditions and accidents.

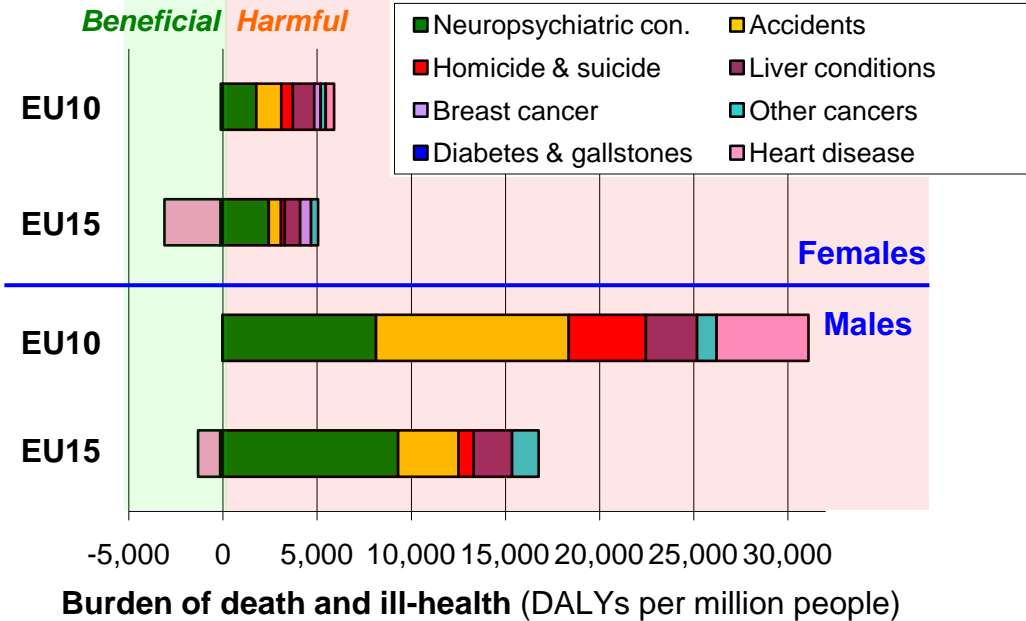


Figure 8 Alcohol-attributable burden of death and ill-health in the European Union
 Adapted from WHO’s Global Burden of Disease study (Rehm et al. 2004)

Over 2,000 homicide deaths per year are attributable to alcohol use – a small proportion of the total harm done by alcohol, but 4 of every 10 homicides that occur in the European Union. In the EU15 this reflects the burden of homicide more generally, but in the EU10 alcohol disproportionately affects homicide in men (accounting for half of all male murders). The results of time-series analyses in 13 EU15 countries and Norway as part of the ECAS project (Rossow 2001) find that, although the effect per litre was greater in northern Europe, the higher consumption levels in southern Europe mean that the overall estimated number of alcohol-attributable homicides is estimated to be similar in northern and southern Europe, Figure 9. In actual fact, the estimated share of all homicides that are due to alcohol is slightly higher in southern (61% of all homicides) than northern Europe (50% of a higher homicide rate).

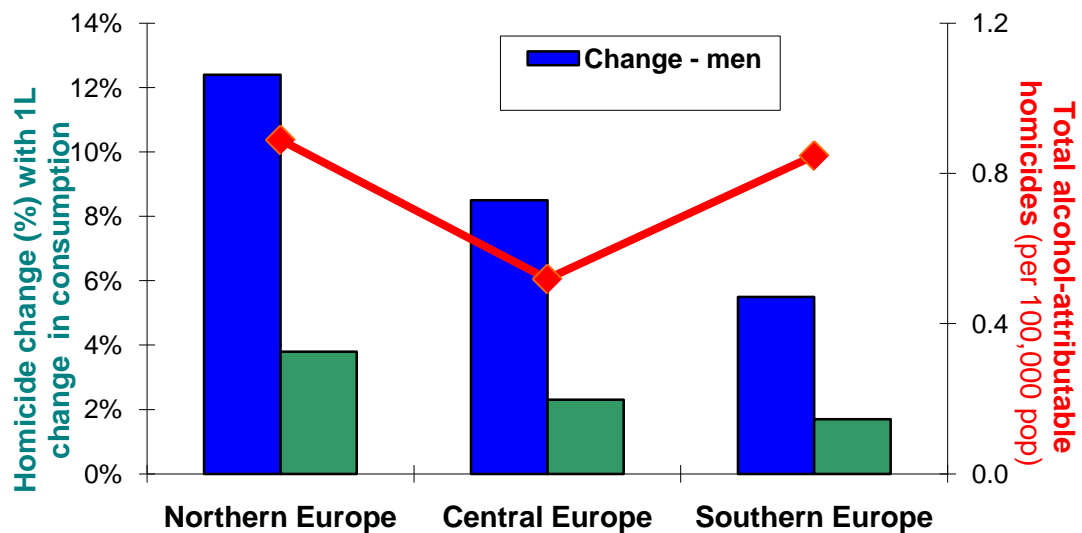


Figure 9 Homicides and alcohol in northern, central and southern Europe. Source: Rossow 2001

Deaths by suicide account for 7%-8% of the total deaths due to alcohol, a toll that is greater for men. The 10,000 deaths represent more than 1 in every 6 suicides and nearly 1 in 4 of those in the EU10. Male suicide is also much more common in the EU10 in parallel fashion to most alcohol-related conditions. Southern Europe contains some of the lowest suicide levels in Europe, although the lowest, Greece, where suicide is one-fifteenth as common a cause of death as in Lithuania, has many more deaths of undetermined intent, suggesting that differing recording practices on death certificates may also be at work.

Based on the results of 21 European studies, the total tangible cost of alcohol to the EU was estimated to be €125 billion (range of estimates: €79–220 billion) in 2003, equivalent to 1.3% of gross domestic product (0.9–2.4%), Figure 10. Actual spending on alcohol-related problems accounted for €66 billion of this, while potential production not realized due to absenteeism, unemployment and premature mortality accounted for a further €59 billion.

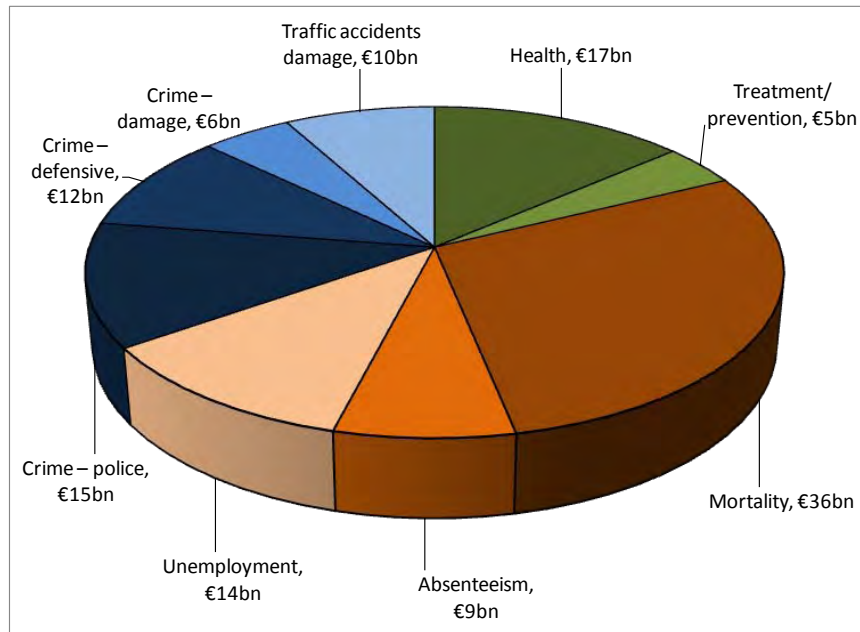


Figure 10 The tangible cost of alcohol in the EU by cost component, 2003. *Source:* Anderson & Baumberg (2006).

The connection between changes in population drinking and mortality has been comprehensively investigated within the European Comparative Alcohol Study (ECAS), using time-series analysis in 14 European countries for the years 1950 to 1995. This technique analyses the relationship between yearly changes in consumption and harm, and estimates the relative change in mortality for a change in per capita consumption of one litre of pure alcohol. Changes in death rates of accidents, suicide and homicide are strongly related to changes in overall alcohol consumption, Figure 11.

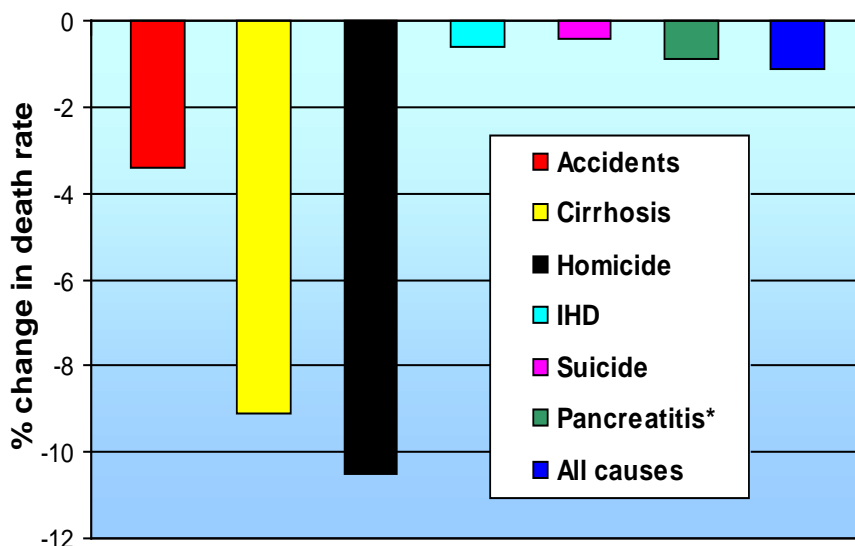


Figure 11 Percentage reduction in male death rate when per capita alcohol consumption is reduced by 1L per year. Medium consuming European countries. *Source:* (Norström et al. 2001)¹¹. Key: *Both men and women.

7. THE INEQUITY OF ALCOHOL-RELATED INJURIES

Chapter summary About 25% of the difference in life expectancy between western and eastern Europe for men aged 20–64 years in 2002 is due to alcohol, largely from differences in alcohol-related injury rates. For Russian men dying between 15 and 54 years during the 1990s, 46% of all deaths were due to accidents and violence, of which 70% were alcohol-related. For women dying between 15 and 54 years, 21% of all deaths were due to accidents and violence, of which 58% were alcohol-related.

There are enormous differences in life expectancy between different parts of the European Union. For example, in 2002, the difference in male life expectancy at the age of 20 years between the EU15¹ and EU5 was 5.8 years, the EU2 6.8 years, and the EU3 9.8 years. About 25% of the difference in life expectancy between the EU10 and the EU15 for men aged 20–64 years in 2002 is attributed to alcohol, largely as a result of differences in heavy episodic drinking patterns (Zatonski et al 2008).

The alcohol-related health gap is reflected largely in differences from cardiovascular and injury mortality. In Europe, there are three clear strata of fatal injury mortality: compared with the EU15 countries, the rates are double in the seven central and eastern European countries and at least five times as high in the three Baltic States. The leading cause of fatal injury mortality is alcohol, causing one third of all mortality from accidents and injuries among Europeans aged 20–64 years. In the Baltic States, one third of all premature mortality is due to injuries, with nearly one half of all deaths from injury due to alcohol, Table 3.

Table 3 Alcohol-attributable mortality from injuries in people aged 20–64 years, 2002

Alcohol-attributable injury mortality		EU15	EU7	EU3
<i>Men:</i>	Mortality rate of alcohol injuries	16.9	44.1	160.0
	% of alcohol injuries in all injuries	29%	38%	48%
<i>Women:</i>	Mortality rate of alcohol injuries	3.1	7.0	27.9
	% of alcohol injuries in all injuries	19%	29%	42%

Source: Zatonski et al (2008).

Russia provides a very interesting, if not dramatic, case study of the impact of alcohol-related injuries and reactions to socio-economic crises. For example, Figure 12 compares the all-cause mortality rates (averaging male and female) at ages 15–54 years in Russia and western Europe since 1980, with Figure 13 showing that alcohol was responsible for about three-quarters of all male Russian deaths at ages 15–54 years and about half of all female Russian deaths at these ages during the 1990s (Zaridze et al 2009). For men dying between 15 and 54 years, 46% of all deaths were due to accidents and violence, of which 70% were alcohol-related, Table 4. For women dying between 15 and 54 years, 21% of all deaths were due to accidents and violence, of which 58% were alcohol-related, Table 5.

¹ EU15: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom

EU10: Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia

EU7: Bulgaria, Czech Republic, Hungary, Poland, Romania, Slovakia, Slovenia

EU5: Czech Republic, Hungary, Poland, Slovakia, Slovenia

EU3: Estonia, Latvia, Lithuania

EU2: Bulgaria, Romania.

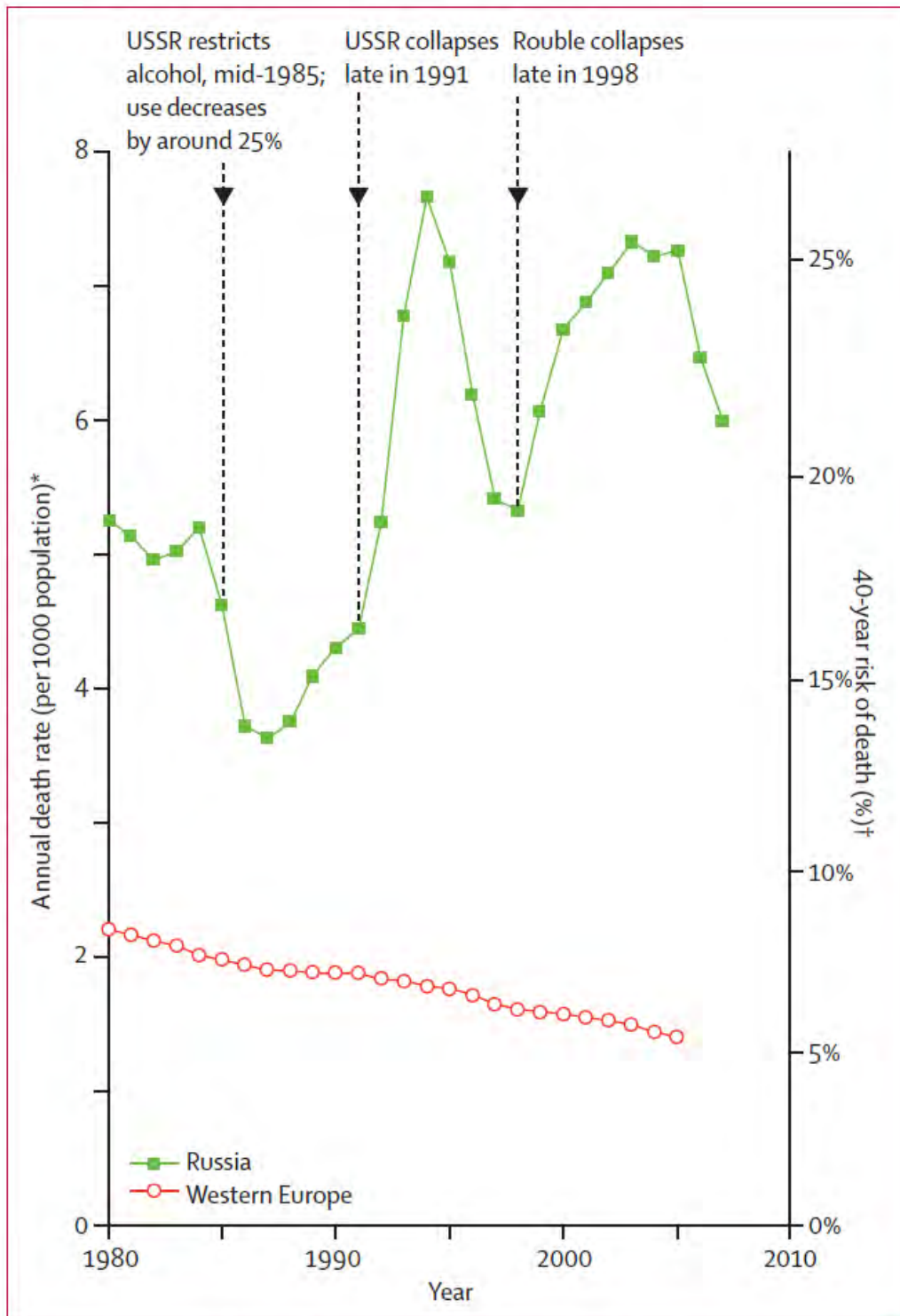


Figure 12 Mortality from all causes and 40-year risks of death in men and women aged 15–54 years in Russia (1980–2007) and western Europe (to 2005) USSR=Union of Soviet Socialist Republics. Source: Zaridze et al (2009).

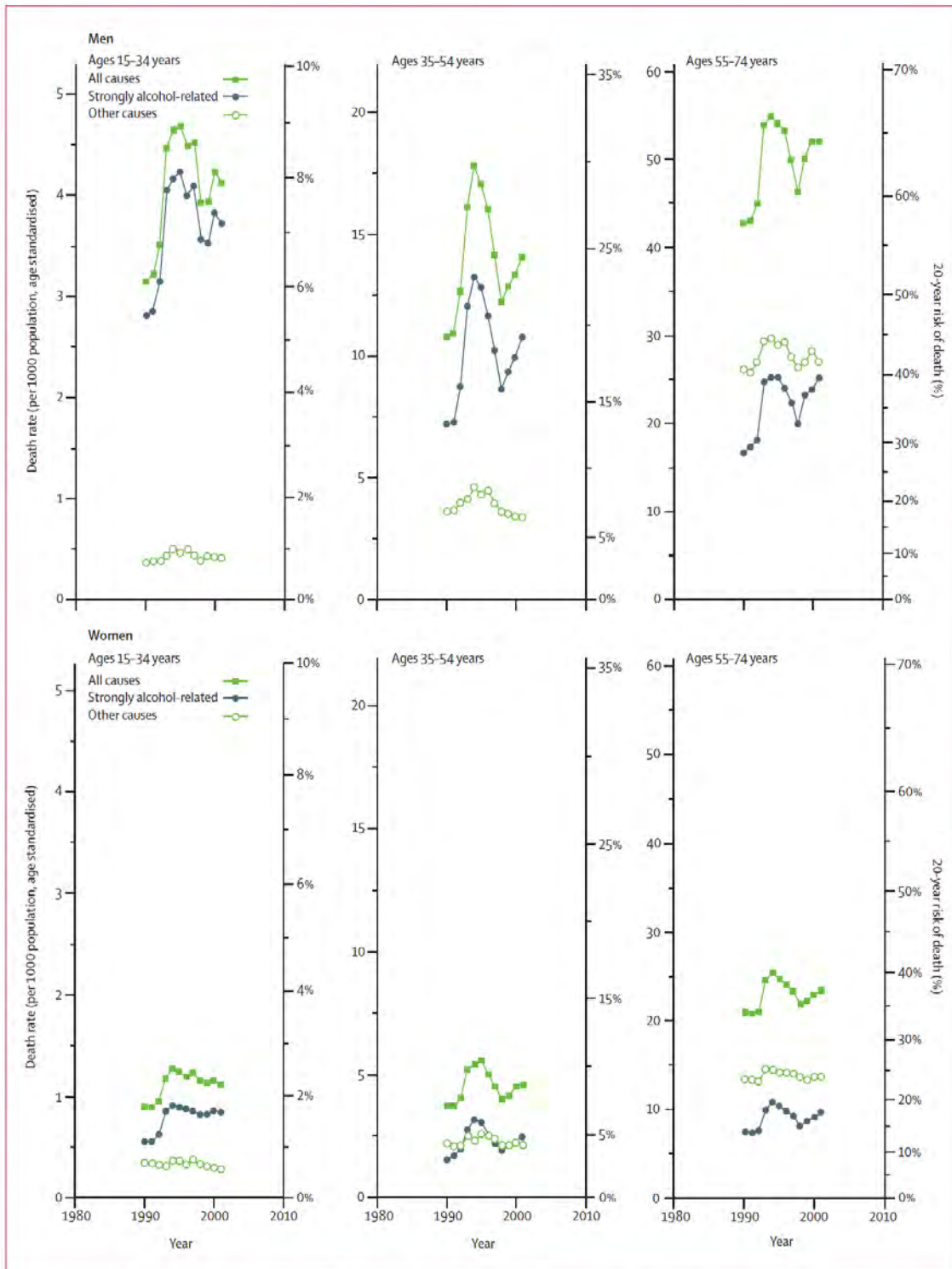


Figure 13 Mortality from all causes, from causes strongly related to alcohol, and from other causes in the Altay and Tomsk regions of Russia, 1990–2001. Source: Zaridze et al (2009).

Table 4 Russian male dose related excess mortality in ever drinkers as a proportion of all mortality in male ever drinkers and never drinkers by age and underlying cause of death. Source: Zaridze et al (2009).

	Never-drinkers		Reference drinkers*	Other drinkers, by usual weekly intake (bottles of vodka, or equivalent)						Total deaths	Dose-related excess number of deaths (%)	
	Number of men	RR (95% CI)	Number of men	Less than one bottle per week		One to less than three bottles per week		Three or more bottles per week			Uncorrected†	Corrected‡
				n	RR (95% CI)	n	RR (95% CI)	n	RR (95% CI)			
Men aged 15-54 years												
Alcohol poisoning	8	0.3 (0.2-0.5)	32	131	1.9 (1.5-2.4)	230	3.8 (3.1-4.8)	762	19.7 (15.6-24.7)	1163	954 (82%)	1163 (100%)
Accidents and violence	428	1.40 (1.19-1.66)	383	1123	1.70 (1.49-1.94)	1538	3.08 (2.70-3.51)	1881	6.25 (5.43-7.19)	5353	3081 (58%)	3756 (70%)
Diseases strongly associated with alcohol§	295	1.77 (1.49-2.10)	226	655	1.32 (1.15-1.51)	1180	2.60 (2.27-2.97)	1431	4.46 (3.87-5.14)	3787	1995 (53%)	2432 (64%)
Other non-control diseases	190	1.25 (1.03-1.50)	242	804	1.29 (1.12-1.48)	864	1.48 (1.29-1.70)	616	1.56 (1.34-1.80)	2716	682 (19%¶)	831 (23%¶)
Control diseases (selected conditions)	114	1.0	140	290	1.0	244	1.0	161	1.0	949	0 (¶)	0 (¶)
Total (by addition)	1035	..	1023	3003	..	4056	..	4851	..	13968	6712 (48%)	8182 (59%)
Men aged 55-74 years												
Alcohol poisoning	3	0.8 (0.4-1.5)	9	57	2.2 (1.5-3.2)	101	4.7 (3.3-6.8)	288	26.6 (18.6-38.0)	458	388 (85%)	458 (100%)
Accidents and violence	88	2.19 (1.78-2.68)	87	287	1.17 (1.01-1.36)	418	2.03 (1.75-2.36)	557	5.49 (4.71-6.41)	1437	710 (49%)	838 (58%)
Diseases strongly associated with alcohol§	371	2.27 (1.95-2.63)	317	873	1.01 (0.91-1.12)	1174	1.59 (1.43-1.77)	1301	3.43 (3.06-3.86)	4036	1367 (34%)	1614 (40%)
Other non-control diseases	560	1.15 (1.01-1.32)	1266	3458	1.03 (0.94-1.12)	3070	1.12 (1.03-1.23)	1686	1.36 (1.22-1.50)	10040	876 (8%¶)	1034 (9%¶)
Control diseases (selected conditions)	98	1.0	223	571	1.0	458	1.0	215	1.0	1565	0 (¶)	0 (¶)
Total (by addition)	1120	..	1902	5246	..	5221	..	4047	..	17536	3341 (19%)	3944 (22%)

RR=relative risk, adjusted for age, city, and smoking. *Ever-drinkers with usual weekly consumption always less than 0.5 bottles of vodka or equivalent, and maximum consumption of spirits in 1 day always less than 0.5 bottles; excludes never-drinkers. †Sum of (n-n/RR) for the three highest alcohol categories, expressed as a percentage of all deaths from the given certified cause in both ever-drinkers and never-drinkers. This is uncorrected for any misclassification of drinking habits (and ignores any excess risks in those reported to have been never-drinkers). ‡Uncorrected excesses multiplied by a common factor (1163/954 at ages 15-54 years, 458/388 at ages 55-74 years) chosen so that the dose-related excess is 100% for the alcohol poisoning deaths. §Liver disease, liver cancer, upper aerodigestive cancer, and other disease groups with RR more than 3.00 for men with usual consumption three or more bottles of vodka per week (tuberculosis, pneumonia, non-myocardial infarction acute ischaemic heart disease, non-neoplastic pancreatic disease, and ill-specified disease). Note that the strongly alcohol-related causes include not only these disease groups but also alcohol poisoning, accidents, and violence. ¶Percentages for other non-control diseases and control diseases (selected conditions) are combined.

Table 5 Russian female dose related excess mortality in ever drinkers as a proportion of all mortality in male ever drinkers and never drinkers by age and underlying cause of death. Source: Zaridze et al (2009).

	Never-drinkers		Reference drinkers*	Other drinkers, by usual weekly intake (bottles of vodka, or equivalent)						Total deaths	Dose-related excess number of deaths (%)	
	Number of women	RR (95% CI)	Number of women	Less than one bottle per week		One to less than three bottles per week		Three or more bottles per week			Uncorrected†	Corrected‡
				n	RR (95% CI)	n	RR (95% CI)	n	RR (95% CI)			
Women aged 15-54 years												
Alcohol poisoning	3	0.1 (0.0-0.2)	24	20	3.5 (2.4-4.9)	69	22.9 (16.9-31.1)	137	72.1 (52.4-99.2)	253	215 (85%)	253 (100%)
Accidents and violence	256	0.90 (0.79-1.03)	331	199	2.15 (1.85-2.50)	226	5.50 (4.59-6.59)	264	8.67 (7.12-10.55)	1276	525 (41%)	618 (48%)
Diseases strongly associated with alcohol§	167	1.12 (0.98-1.29)	215	161	2.60 (2.23-3.03)	204	5.80 (4.84-6.96)	247	8.88 (7.29-10.82)	994	487 (49%)	573 (58%)
Other non-control diseases	319	1.00 (0.89-1.12)	555	204	1.35 (1.18-1.55)	109	1.37 (1.13-1.67)	82	1.34 (1.08-1.67)	1269	103 (5%¶)	121 (5%¶)
Control diseases (selected conditions)	300	1.0	444	119	1.0	55	1.0	41	1.0	959	0 (¶)	0 (¶)
Total (by addition)	1045	..	1569	703	..	663	..	771	..	4751	1330 (28%)	1565 (33%)
Women aged 55-74 years												
Alcohol poisoning	0	0.0 (0.0-0.2)	27	21	2.8 (2.0-3.9)	36	14.0 (10.4-18.8)	90	78.9 (58.4-106.6)	174	136 (78%)	174 (100%)
Accidents and violence	198	1.60 (1.42-1.80)	217	76	1.64 (1.41-1.92)	108	5.71 (4.83-6.76)	87	9.96 (8.06-12.30)	686	197 (29%)	252 (37%)
Diseases strongly associated with alcohol§	544	1.24 (1.14-1.35)	615	224	1.50 (1.34-1.67)	267	3.94 (3.44-4.51)	256	8.01 (6.70-9.57)	1906	498 (26%)	637 (33%)
Other non-control diseases	2020	0.93 (0.87-0.99)	3833	1000	1.22 (1.12-1.33)	446	1.21 (1.07-1.37)	235	1.51 (1.27-1.80)	7534	336 (4%¶)	430 (5%¶)
Control diseases (selected conditions)	603	1.0	1035	227	1.0	94	1.0	43	1.0	2002	0 (¶)	0 (¶)
Total (by addition)	3365	..	5727	1548	..	951	..	711	..	12302	1167 (9%)	1493 (12%)

RR=relative risk, adjusted for age, city, and smoking. *Ever-drinkers with usual weekly consumption always less than 0.5 bottles of vodka or equivalent, and maximum consumption of spirits in 1 day always less than 0.5 bottles; excludes never-drinkers. †Sum of (n-n/RR) for the three highest alcohol categories, expressed as a percentage of all deaths from the given certified cause in both ever-drinkers and never-drinkers. This is uncorrected for any misclassification of drinking habits (and ignores any excess risks in those reported to have been never-drinkers). ‡Uncorrected excesses multiplied by a common factor (253/215 at ages 15-54 years, 174/136 at ages 55-74 years) chosen so that the dose-related excess is 100% for the alcohol poisoning deaths. §Liver disease, liver cancer, upper aerodigestive cancer, and other disease groups with RR more than 3.00 for men with usual consumption three or more bottles of vodka per week (tuberculosis, pneumonia, non-myocardial infarction acute ischaemic heart disease, non-neoplastic pancreatic disease, and ill-specified disease). Note that the strongly alcohol-related causes include not only these disease groups but also alcohol poisoning, accidents, and violence. ¶Percentages for other non-control diseases and control diseases (selected conditions) are combined.

8. ALCOHOL POLICY

Chapter summary Increasing the price of alcohol, and restricting the availability of alcohol reduce alcohol consumption, riskier patterns of drinking and alcohol-related injuries. Lower exposure to alcohol marketing is associated with less risky drinking among young people.

Table 6 summarizes the overall effectiveness of alcohol policies, according to a recent World Health Organization review (World Health Organization 2009). This chapter considers the impact of price, availability, and marketing on patterns of heavy episodic drinking and on injuries. Subsequent chapters will consider the impact of actions in drinking environments, community based programmes, workplace programmes, and brief advice programmes in emergency room settings. Education and persuasion strategies are not discussed as an overwhelming evidence base finds them ineffective in reducing alcohol-related problems (Babor et al 2010).

Table 6 Summary of the evidence of the effectiveness of alcohol policies

Degree of evidence	Evidence of action that reduces alcohol-related harm	Evidence of action that does not reduce alcohol-related harm
Convincing	Alcohol taxes Government monopolies for retail sale Restrictions on outlet density Restrictions on days and hours of sale Minimum purchase age Lower legal BAC levels for driving Random breath-testing Brief advice programmes Treatment for alcohol use disorders	School-based education and information
Probable	A minimum price per gram of alcohol Restrictions on the volume of commercial communications Enforcement of restrictions of sales to intoxicated and under-age people	Lower taxes to manage cross-border trade Training of alcohol servers Designated driver campaigns Consumer labelling and warning messages Public education campaigns
Limited-suggestive	Suspension of driving licences Alcohol locks Workplace programmes Community-based programmes	Campaigns funded by the alcohol industry

Pricing policies

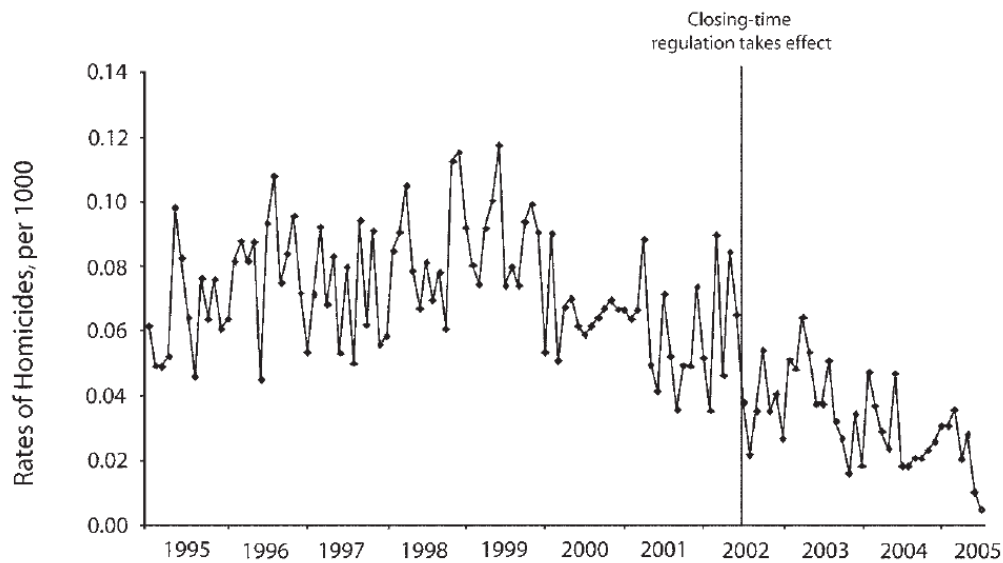
Drinkers respond to changes in the price of alcohol as they do to changes in the price of other consumer products. When other factors are held constant, such as income and the price of other goods, a rise in alcohol prices leads to less alcohol consumption and less alcohol-related harm and vice versa (Gallet 2007; Wagenaar et al 2009; Wagenaar et al 2010). Demand for alcohol is relatively inelastic to price, such that an increase in price results in a drop in consumption that is relatively

smaller than the price increase; thus, increasing alcohol taxes not only reduces alcohol consumption and related harm, but increases government revenue at the same time, noting that, in general, alcohol taxes are well below their maximum revenue producing potential and that collected revenue is usually well below the social costs of alcohol. The existence of a substantial illicit market for alcohol complicates policy considerations on alcohol taxes; in such circumstances, tax changes require efforts to bring the illicit market under effective government control. Beverage elasticities are generally lower for the preferred beverage (beer, spirits or wine) in a particular market than for the less-preferred beverages, and tend to decrease with higher levels of consumption. Controlling for overall consumption, beverage preferences and time period, consumer responses to changes in the price of alcoholic beverages are found not to vary by country. If prices are raised, consumers reduce overall consumption and tend to shift to cheaper beverages, with heavier drinkers tending to buy the cheaper products within their preferred beverage category. Policies that increase alcohol prices delay initiation of drinking, slow young people's progression towards drinking larger amounts, and reduce young people's heavy drinking and the volume of per occasion drinking. Price increases reduce the harms caused by alcohol, including intentional and unintentional injuries. Setting a minimum price per unit gram of alcohol is modelled to reduce consumption and alcohol-related harm (Purshouse et al 2010). Both price increases and setting a minimum price are estimated to have a much greater impact on heavier rather than lighter drinkers, with modest or only minimal extra financial cost to lighter drinkers. Natural experiments in Europe consequent to economic treaties have shown that as alcohol taxes and prices were lowered, so sales, alcohol consumption and alcohol-related harm have usually increased. After Finland lowered its taxes in 2004 by some 33%, there was an immediate 17% increase in alcohol-positive deaths, with the largest number of deaths occurring amongst the underprivileged (Koski et al 2007; Herttua et al 2008).

The availability of alcohol

Government monopolies for the sale of alcohol reduce alcohol-related harm; such systems tend to have fewer stores, which are open for shorter hours than systems of private sellers. In the absence of government monopolies, having a licensing system for the sale of alcohol allows for the opportunity for control, since infringement of laws can be met by license revocation. Implementation of laws which set a minimum age for the purchase of alcohol show clear reductions in alcohol-related harms (Wagenaar & Toomey 2002); the most effective means of enforcement is on sellers, who have a vested interest in retaining the right to sell alcohol.

Urban settings can also be risk factors for harmful alcohol use and harmful patterns of drinking, particularly in areas of low social capital (WHO 2008). An increased density of alcohol outlets is associated with increased levels of alcohol consumption amongst young people (Huckle et al 2008), with increased levels of assault, and with other harms such as homicide, child abuse and neglect and self-inflicted injury (Livingstone et al 2007). While extending times of sale can redistribute the times when many alcohol-related incidents occur, such extensions generally do not reduce rates of violent incidents and often lead to an overall increase in consumption and problems (Babor et al 2010). Reducing the hours or days of sale of alcoholic beverages leads to fewer alcohol-related problems, including homicides and assaults. For example, homicide is one of the leading causes of death in the Brazilian city of Diadema. To respond to this situation, local policy measures were introduced which included a new licensing law in 2002 prohibiting on-premises alcohol sales after 11pm. Introducing a limit on opening hours significantly dropped homicide rates in Diadema and led to a 44% decline of murders (Duailibi et al 2007), Figure 14.



Note. Homicide rate for July 2005 is on the basis of a half-month of data.

Figure 14 Homicide rates in Diadema, Brazil, following introduction of 23.00 hour closing time. Source: Duailibi et al (2007).

The marketing of alcohol beverages

Alcohol is marketed through increasingly sophisticated advertising in mainstream media, as well as through linking alcohol brands to sports and cultural activities, through sponsorships and product placements, and through direct marketing such as the Internet, podcasting and mobile telephones. Econometric studies of the link between alcohol advertising and consumption have only found weak relationships (Gallet 2007), largely due to methodological difficulties. The strongest evidence, however, comes from longitudinal studies that have shown an impact of various forms of alcohol marketing, including exposure to alcohol advertising in traditional media as well as promotion in the form of movie content and of alcohol-branded merchandise, on initiation of youth drinking, and on riskier patterns of youth drinking (Anderson et al 2009). The effects of exposure seem cumulative and, in markets with greater availability of alcohol advertising, young people are more likely to continue to increase their drinking as they move into their mid-twenties, while drinking declines at an earlier age in those who are less exposed.

9. DRINKING ENVIRONMENTS

Chapter summary A systematic review of 52 studies found a wide range of physical, social and staffing factors in drinking environments that were associated with increased alcohol use and alcohol-related harm. There have been very few studies that have looked at the impact of changing these factors on subsequent alcohol use and related harm. A systematic review of 24 studies found consistent evidence that server training, reducing alcohol service to underage drinkers and police intervention were largely ineffective in reducing alcohol use and alcohol-related harm.

Public drinking establishments are high-risk locations for alcohol-related aggression. However, drinking contexts by themselves do not explain the relationship between alcohol and aggression, since the impact of alcohol also acts independently of the context or setting in which drinking is taking place. The environment for alcohol-related aggression is also not independent of drinking. Although a few incidents that occur in bars involve interpersonal conflict between friends or couples that might have occurred in another setting, almost all incidents of aggression that occur in bars are unplanned, emerge from the social interaction in the bar and often involve strangers. The Comparative Risk Assessment study of the World Health Organization concluded that it seems reasonable to assume that almost all incidents of violence occurring in bars and other environments where drinking is the main activity should be considered attributable to alcohol, either directly through the pharmacological effects of alcohol or indirectly through the social norms related to drinking (Rehm et al 2004).

A systematic review of 52 publications grouped environmental factors associated with increased or reduced alcohol use and related harm into three categories: physical factors; social factors; and staffing factors (Hughes et al 2010). Table 7 shows environmental factors in bars and nightclubs that have been associated with increased or reduced measures of alcohol use and access (higher consumption, intoxication, service to drunk or underage customers), and Table 8 shows environmental factors in bars and nightclubs that have been associated with alcohol-related harm (e.g. aggression, crime, injury and drink driving).

A range of physical factors, including poor ventilation, poor cleanliness, crowding, noise, low lighting, high temperature, shabby decor and low maintenance, have been associated with increased aggression in bars and nightclubs in various countries. A permissive environment, the availability of cheap alcoholic drinks, and a focus on music and dancing in bars have been associated with higher levels of alcohol use, intoxication and aggression across a range of studies and countries. Venues with friendly or all female staff have been associated with lower levels of patron intoxication, while younger staff have been found to be more likely to serve pseudo-drunk customers. Poor staff control and practice (e.g. ability to handle problems, continuing to serve drunk customers, drinking whilst working) has been associated with increased alcohol consumption, aggression, crime and other harms.

Table 7 Environmental factors associated with alcohol use and service practices

Environmental Factor	Country in which links identified						
	USA	Australia	Canada	Netherlands	France	Sweden	Bulgaria
Physical Factors	Poor ventilation		↑●				
	Poor cleanliness		↑●				
	Crowded venues	↓◆		↑●		◆ ^a	
	Crowded dance floors	↑■ ^b				↓◆	
	Noisy, loud music	↑■ ^b		↑●	↑▲	↑■	↓◆ ^c
Social Factors	Lighting	↑■ ^b		↑● ^e			
	Venue style	↓◆ ^d					
	Cheap drinks, drinks promotions	↑●■					↑+ ^b
	Permissive environment ^f	↑●■					
	Live bands, juke boxes, discos, dancing	↑■ ^b	↑■	↑●	↑▲		↓◆
Staff Factors	Food availability		↓●				
	Younger staff	↑◆					
	Friendly staff		↓●				
	All female staff		↓●				
	Warning signs, staff policies ^g	↓◆					
Continuing to serve drunk customers		↑■					
References	4,3,48,49,67,68,74	50,51	20	44-46	52,53	39-41	54

Key to symbols
● Intoxication
■ Alcohol use, binge drinking, high risk drinking, abusive drinking
◆ Over-serving (to pseudo-drunk customers)
+ Underage drinking
▲ Drinking speed
↑ Indicates an increase associated with the environmental factor
↓ Indicates a decrease associated with the environmental factor

^a 'Average' hygiene in restrooms was associated with reduced service refusal to pseudo-drunk customers, compared with 'good + bad' hygiene; ^b Linked through qualitative/ethnographic research without statistical analysis [48] - moderate lighting observed to be associated with increased risk of alcohol abuse, compared with bright or low lighting; Tranquil artwork observed to be associated with controlled social drinking; ^c probability of over-serving was higher at a communicable noise level, than at high level, low level or no music; ^d Upscale establishment; ^e Shabby decor, no theme, low expenditure on furnishings, low maintenance; ^f Canada: 'Anything goes' atmosphere, swearing and overt sexual contact. Sweden: overall order at the premises; ^g against the service of alcohol to drunk customers
Only findings that have been associated with increases or reductions in alcohol measures are shown. Thus findings where associations were absent, mixed or unclear are not included in the table.

Table 8 Environmental factors associated with alcohol-related problems

Environmental Factors	Countries in which a link has been identified					
	USA	Australia	Canada	UK	Spain	Bulgaria
Physical Factors						
Poor ventilation/smokiness	↑●	↑●	↑●			
Poor cleanliness	↑●	↑●	↑●	↑●■		
Crowded venues/dance floors/bars	↑●	↑●	↑●		↑●	
Noisy, loud music	↑●	↑● ^a	↑●			
Low lighting	↑●	↑●				
High temperature	↑●					
Combined variable including the above	↑●	↑● ^b	↑● ^c	↑●↑↓■		
Seating				↑+		
Low impact-resistance glassware			↑●			
Unattractive bars (e.g. shabby)	↑●		↑●			
Line up			↑●			
Social Factors						
Cheap drinks and drinks promotions	↑●	↑●			↑●	
Permissive environment ^d	↑● ^a	↑●	↑●	↑●■	↑●	
Games (e.g. pool, billiards)	↑●	↓● ^e	↑●	↑●■	↑●	
Dancing, juke boxes, discos, bands etc.	↑●	↑●▲	↑●			
Illegal activity (e.g. drugs, prostitution)	↑●	↑●	↑●	↓● ^f		
Beer, spirits, high volume alcohol sales		↑●◆				
Non-alcoholic drinks on sale	↓■					
Drunk customers		↑●	↑●	↑●■	↑●	
Availability of food	↓■	↓●	↓●			
Staff factors						
Staff characteristics	↑●(Most ♂)	↓● ^g	↓●(All ♀)			
Poor staff control/practice	↑● ^h	↑●▲ ⁱ	↑● ^{jk}	↑■ ^l		
Staff intervention	↑● ^m ↓■ ^m	↑● ⁿ ↓● ^m	↑●	○ ^o		
Ineffective door supervisors	↑●	↑●	↑●			
Presence of door supervisors	↑↓●	↑●	↑●	↑● ^p		↑● ^a
Low staff:patron ratio		↑●				
References	55,57,59,63,69-72	27-37,50,51,56,58	19-26	60-62,65,66	64	54

Key to symbols

- Aggression, violence, assaults
- Crime, police complaints/ call-outs
- ◆ Drink driving
- + Staff injury
- ▲ Alcohol-related harm (injury, drink driving, crime, violent argument or fight, accident, time off work)
- ↑ Indicates an increase associated with the environmental factor
- ↓ Indicates a decrease associated with the environmental factor

^a Linked through qualitative/ethnographic research without statistical analysis; ^b lack of seating; low comfort; ^c seating in rows; ^d e.g. decorum expectations, rowdiness, swearing, sexual contact, underage patrons; ^e Boredom associated with aggression; entertainment (e.g. game machines, quizzes, stage shows) reduced boredom; ^f Higher drug use; ^g friendlier door supervisors; ^h staff drinking; ⁱ continuing to serve drunk people; ^j ability to identify and handle problems; ^k Customers having 2+ drinks/hanging around at closing time; ^l presence of underage customers; ^m ID checks; ⁿ staff intervention with drunk customers; ^o physical staff intervention (cf non-physical) with disorderly customers increased perceptions of violence in a venue; ^p based on perceptions of violence in venues with or without door supervisors. Only findings that have been associated with increases or reductions in alcohol-related harm are shown. Thus findings where associations were absent, mixed or unclear are not included in the table.

Another systematic review identified 24 four studies which examined interventions designed to reduce harm in drinking environments (Jones et al 2010). There was no clear evidence from the seven server training studies to suggest that server training had an impact on responsible serving practices. Of the five studies that examined the effectiveness of interventions aimed at reducing alcohol related harm (consumption levels, injuries and drink driving) in drinking environments, one low quality study that examined a brief intervention utilising personalised risk assessment for patrons suggested that the intervention was of most benefit to heavy drinkers. Three programmes, two of which targeted drink driving through a designated driver and a ride programme respectively, and a third which promoted responsible drinking, had limited impact on patron behaviours. A study that examined the replacement of pint glasses with toughened glassware found that the glassware had lower impact resistance and resulted in more injuries to bar staff.

The three studies which evaluated interventions aimed at reducing alcohol service to underage patrons found no evidence that programmes specifically targeting underage sales of alcohol were effective. Two studies that examined the placement of age verification devices in communities found either no change in ID checking or a decrease. A third study that examined a programme of combined training and police enforcement checks found that the intervention only had a short term impact on underage sales.

The nine enforcement studies found no clear evidence to suggest that police intervention or increased enforcement of licensing laws were effective in reducing alcohol-related incidents. Two studies reported an increase in assaults following police intervention, though this may be due to better detection by police during the intervention phase of these studies. Police campaigns and other approaches to the enforcement of underage sale laws appeared to be largely ineffective.

10 COMMUNITY BASED PROGRAMMES

Chapter summary A systematic review of 30 studies examined multi-component community-based programmes and found evidence for some impact in some contexts in reducing sales to intoxicated and under-age clients and some reductions in alcohol-related violence and aggression. However, results are not consistent or always statistically significant. Community based programmes may be able to expand the role of guardianship, implement situational deterrents and eliminate some precipitators of risky drinking. However, they require extensive resources and long term commitment and enforcement to ensure any chance of success.

A systematic review of 30 studies which examined multi-component community-based programmes to reduce alcohol-related harm found only eight studies of sufficient scientific validity (Jones et al 2010). Overall, the clearest indication of effectiveness resulted from multi-component programmes combining community mobilisation, responsible beverage server training, house policies and stricter enforcement of licensing laws, as in, for example, the Communities Mobilising for Change on Alcohol, the Community Trials project and the STAD programme).

The Community Trials project was developed to address alcohol-involved accidental injury and death between 1992 and 1996 across three intervention sites in California and South Carolina. The programme had five key intervention components: (1) a community mobilising component to develop community organisation and support; (2) a responsible beverage service (RBS) component to establish standards for servers and owners/managers of on-sales alcohol outlets; (3) a drinking and driving component; (4) an underage drinking component to reduce retail availability to young people; and (5) an alcohol access component designed to control outlet density and to reduce the availability of alcohol. The STAD programme was based on a multicomponent programme combining community mobilisation, RBS training of servers and stricter enforcement of existing alcohol laws delivered in central Stockholm. The *Communities Mobilising for Change on Alcohol* (CMCA) community trial specifically targeted alcohol use among young people in the US. Organisers worked with local public health officials, enforcement agencies, alcohol merchants and merchant associations, the media, schools and other community institutions to change alcohol policies to reduce youth access to alcohol.

Alcohol consumption The Community Trials project resulted in a very small reduction of alcohol consumed from 1.37 to 1.29 drinks per occasion (6% reduction; 95% CI -12% to -1%). In the CMCA community trial, there were no significant differences in drinking behaviour among young people between the intervention and control communities.

Violence and aggression The Community Trials programme reduced the number of assault injuries by 43% (95% CI -71% to 11%). The STAD programme reported a significant 29% reduction in crimes in the intervention area when controlling for the development in the control area. The CMCA found no statistically significant difference between intervention and control communities in arrests for disorderly conduct.

Responsible alcohol service The STAD programme on alcohol service to intoxicated patrons found that the refusal rate was statistically significantly higher for RBS-trained licensed premises in the intervention area compared with licensed premises in the intervention area with no RBS-training (72% vs. 40%; net difference = 26%; 95% CI 6% to 58%).

Sales to underage drinkers Although the CMCA programme indicated that the intervention might have affected access to alcohol via on- and off-sale alcohol outlets, no results achieved statistical significance.

Cost-effectiveness Based on a cost-effectiveness analysis, net savings of the STAD programme (discounted estimates; 3%), were estimated at €30million in the base case scenario and at €13million based on the assumption that the only violence-related consequence among non-respondents was the cost of police handling. When the responses from a survey of the victims of violence were ignored, the cost-savings decreased to €4million.

11. WORKPLACE INTERVENTIONS

Chapter summary There are very few studies that evaluate the impact of work place based policies to reduce alcohol-related harm. Nevertheless, from the limited literature, brief interventions, interventions contained within health and life-style checks, psychosocial skills training and peer referral may all have the potential to produce beneficial, although rather small results.

A recent systematic review of work-place interventions for alcohol-related problems (Webb et al 2009) identified only ten intervention studies comprising three broad types of strategies: psychosocial skills training; brief intervention, including feedback of results of self-reported drinking, life-style factors and general health checks; and alcohol education delivered via an internet website. The psychosocial interventions included peer referral, team building and stress management and skills derived from the social learning model. For health checks, topics covered in addition to alcohol were smoking, exercise, diet, weight, stress, depression, blood pressure, cholesterol, diabetes, cancer, safety and preventive health-care risks. Only one study reported no statistically significant results. Seven studies reported significant reductions in various self-report-measures of alcohol consumption or alcohol-related problems.

The counselling-based interventions either reported no effect, or the effect was small, self-reported only, or measured desire to change rather than actual behaviour. The four mail-out/feedback/brief intervention studies were practical and possibly sustainable interventions that achieved outcomes somewhat comparable to the more intensive counselling interventions. However, the outcomes were self report.

One study which used objective outcome measures described the impact of a workplace peer-focused substance abuse programme in the transportation industry implemented in phases from 1988 to 1990 (Spicer & Miller 2005; Miller & Spicer 2007). The program focused on changing workplace attitudes toward on-the-job substance use in addition to training workers to recognize and intervene with co-workers who had a problem. The program was strengthened by federally mandated random drug and alcohol testing (implemented, respectively, in 1990 and 1994). With time-series analysis, the association of monthly injury rates and costs were analyzed with phased program implementation, controlling for industry injury trend. The combination of the peer-based program and testing was associated with an approximate one-third reduction in injury rate, avoiding an estimated \$48 million in employer costs in 1999. That year, the peer-based program cost the company \$35 and testing cost another \$35 per employee. The program avoided an estimated \$1850 in employer injury costs per employee in 1999, corresponding to a benefit-cost ratio of 26:1.

12. BRIEF INTERVENTIONS IN EMERGENCY DEPARTMENTS

Chapter summary Taken together, two systematic reviews of a relatively small number of studies suggest that brief interventions in emergency departments can be effective in reducing risky drinking and alcohol-related injuries.

A systematic review of 13 studies investigated the use of brief motivational counselling in emergency departments and concluded that existing evidence pointed towards brief interventions being effective in reducing alcohol-related injuries, but not alcohol consumption (Havard *et al.*, 2008). Interventions consisted of brief motivational counselling, with some studies including written materials or personalised feedback. Ten studies included 1 session of counselling. Eight of the interventions assessed included principles of motivational interviewing. The majority of studies provided written materials with a combination of general advice and/or personalised feedback. Reported lengths of sessions ranged from 5 to 60 min. Six studies stated that the majority of counselling occurred during the emergency department visit, with a minority of studies including intervention on an outpatient basis. Interveners included emergency department staff, research staff, health promotion workers, nursing and social work staff and therapists. Control group conditions included standard care, standard care plus generic written advice or generic written advice alone. A non-statistically significant pooled effect size for alcohol consumption at 12 months follow-up of -0.14 was observed. A non-significant small pooled effect size for frequency of heavy drinking of 0.03 at both 3 months and 12 months follow-up was also reported. Thus, it can be seen that brief intervention did not have a significant effect on the quantity or frequency of alcohol consumption. A non-significant pooled effect size for drinking consequences at 6-12 months follow-up of -0.14 was also reported. A clear reduction in the incidence of alcohol-related injuries at 6-12 months follow-up was observed following intervention (pooled OR=0.59 ($P<0.005$)). Therefore, this review shows that whilst brief interventions delivered in emergency departments did not produce a significant effect on alcohol consumption, a clear reduction in the likelihood of an individual sustaining an alcohol-related injury following intervention could be observed.

Another systematic review of 12 studies found that eleven of the 12 studies presented a significant effect of brief intervention on at least one of the following outcomes: alcohol intake, risky drinking practices, alcohol-related negative consequences, or injury frequency (Nilsen *et al.*, 2008). Although brief intervention group patients showed greater reductions in negative outcomes than control group subjects, control group patients also tended to show improvements. A number of study authors suggested that alcohol-related injury alone may result in a degree of self-initiated behaviour change, explaining why control group subjects also showed some improvements in alcohol-related measures. One study focused on facial injury patients treated in outpatient clinic following emergency department care (Smith *et al.*, 2003), in which male patients aged 16-35 yrs, with an alcohol intake of 8+ units prior to injury were included. Brief intervention constituted one session delivered by a nurse during follow-up care at an outpatient clinic (duration not reported), consisting of manual-guided counselling based on motivational interviewing principles. At 12 months follow-up, a decrease from 60% of subjects drinking above recommended levels at baseline to 27% for brief intervention group subjects was observed vs. 54% to 51% for control. Furthermore, 70% of brief intervention subjects reported no alcohol problems at 12 months vs 58% of control. The proportion of hazardous drinkers (according to unstated AUDIT cut-off) reduced from 95% at baseline to 58% at 12 months for brief intervention group patients vs 96% to 81% for control group subjects.

13. COST-EFFECTIVENESS OF POLICIES

Chapter summary The most cost-effective policy options to reduce alcohol-related harm are policies that increase alcohol taxes, followed by policies that limit the availability and marketing of alcohol. Compared with these policies, delivering brief interventions are less cost-effective; however, when compared with other health sector based interventions, brief interventions for hazardous and harmful alcohol consumption are highly cost effective.

This chapter reports the results of the World Health Organization's CHOICE (CHOosing Interventions that are Cost-Effective) model, which provides estimates of the impact and cost of implementing policies in reducing Disability Adjusted Life Years (DALYs) due to harmful alcohol use, re-calculated for the European Union (see World Health Organization 2009). The CHOICE model determines intervention effectiveness via a state transition population model, taking into account births, deaths and the impact of alcohol. Two scenarios are modelled over a lifetime (100 years): 1) no interventions available to reduce hazardous and harmful alcohol use (defined in the CHOICE model as more than 20g alcohol a day for women and more than 40g alcohol a day for men); and 2) the population-level impact of each specified intervention, implemented for a period of 10 years. The difference represents the population-level health gain due to the implementation of the intervention, discounted at 3% and age-weighted.

A summary of the estimated cost and impact of different interventions, compared to a Europe with none of these policies is shown in Table 9, with an estimate of the cost per DALY saved². For information and education, and community action, the costs of school-based education and mass-media awareness campaigns have been estimated respectively. Although these interventions are not expensive, they do not notably alter consumption levels or health outcomes. Such interventions are therefore not effective or cost-effective strategies to pursue in terms of reducing health-related harm due to alcohol use (particularly since there exist other actionable strategies that are very cost-effective).

For the health sector response, brief interventions have been studied extensively. The cost-effectiveness of such interventions is not as favourable as the population-level policy instruments summarized below because they require direct contact with health care professionals and services. Although brief interventions are the most expensive to implement, it should be noted that within health service expenditure, brief interventions for hazardous and harmful alcohol consumption are one of the most cost effective of all health service interventions in leading to health gain. Concerning drink-driving policies and countermeasures, there is good evidence for the effectiveness of drink-driving laws and their enforcement via roadside breath-testing and checkpoints. The estimated cost-effectiveness of such countermeasures ranged from I\$781 (EurC) to I\$4,625 (EurB).

² Eur-A: very low adult/very low child mortality

Andorra, Austria, Belgium, Croatia, Cyprus, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Luxembourg, Malta, Monaco, Netherlands, Norway, Portugal, San Marino, Slovenia, Spain, Sweden, Switzerland, United Kingdom.

Eur-B: low adult/low child mortality

Albania, Armenia, Azerbaijan, Bosnia and Herzegovina, Bulgaria, Georgia, Kyrgyzstan, Montenegro, Poland, Romania, Serbia, Slovakia, Tajikistan, The former Yugoslav Republic of Macedonia, Turkey, Turkmenistan, Uzbekistan.

Eur-C: high adult/low child mortality

Belarus, Estonia, Hungary, Kazakhstan, Latvia, Lithuania, Republic of Moldova, Russian Federation, Ukraine.

Table 9 Costs, impact and cost-effectiveness of different policy options in Europe. Source: WHO (2009)

Target area Specific intervention(s)	Coverage	WHO sub-region (exemplar countries)								
		Europe: EurA (e.g. Spain, Sweden)		Europe: EurB (e.g. Bulgaria, Poland)		Europe: EurC (e.g. Russia, Ukraine)				
		Annual cost per one million persons (US, millions)	Annual effect per one million persons (DALYs saved)	Annual cost per one million persons (US, millions)	Effect per one million persons per year (DALYs saved)	Annual cost per one million persons (US, millions)	Effect per one million persons per year (DALYs saved)			
Health sector response										
Brief interventions for heavy drinkers	30%	4.20	672	6,256	0.77	365	2,100	1.78	667	2,671
Drink-driving policies & countermeasures										
Drink-driving legislation & enforcement (via random breath-testing campaigns)	80%	0.77	204	3,762	0.74	160	4,625	0.72	917	781
Addressing the availability of alcohol										
Reduced access to retail outlets	80%	0.78	316	2,475	0.56	414	1,360	0.47	828	567
Addressing marketing of alcohol beverages										
Comprehensive advertising ban	95%	0.78	351	2,226	0.56	224	2,509	0.47	488	961
Pricing policies										
Increased excise taxation (by 20%)	95%	1.09	2,301	472	0.92	726	1,272	0.67	1,759	380
Increased excise taxation (by 50%)	95%	1.09	2,692	404	0.92	852	1,083	0.67	1,995	335
Tax enforcement (20% less unrecorded)	95%	1.94	2,069	939	1.26	706	1,780	0.87	1,741	498
Tax enforcement (50% less unrecorded)	95%	2.21	2,137	1,034	1.34	790	1,692	0.93	1,934	480

The impact of reducing access to retail outlets for specified periods of the week and implementing a comprehensive advertising ban have the potential to be cost-effective countermeasures, but only if they are fully enforced (each healthy year of life restored costs between I\$567-2,509).

Within the category of pricing policies, there is consistent evidence showing that the consumption of alcohol is responsive to an increase in final price, and this can be effectuated via higher excise taxes on alcoholic beverages. Tax increases (of 20% or even 50%) represent a highly cost-effective throughout Europe. Even accounting for longer life, and thus potentially increased social welfare costs, taxation remains a highly cost effective alcohol policy option. As discussed previously, the effect of alcohol tax increases could be mitigated by illegal production, tax evasion and illegal trading, which accounts for approximately 12% of all consumption in EurA and 40% in EurB and EurC. Reducing this unrecorded consumption (by 20-50%) via concerted tax enforcement efforts is estimated to cost 50-100% more than a tax increase but produces similar levels of effect. In settings with higher levels of unrecorded production and consumption, increasing the proportion of consumption that is taxed (and therefore more costly to the price-sensitive consumer) may represent a more effective pricing policy than a simple increase in excise tax (which may only encourage further illegal production, smuggling and cross-border purchases).

Figures 15 to 17 plot the total costs and effects of each single and combined intervention on an expansion curve. The lower right boundary of this plot represents the increasing incremental cost of saving one additional DALY and indicates the most efficient way of combining different strategies. Interventions to the north-west of this cost-effectiveness frontier or expansion path are 'dominated', i.e. they are less effective and/or more costly than (a combination of) other interventions. The most cost-effective options are those that occur on the inflections of the expansion path. In all three sub-regions of Europe, the most cost-effective option is increased taxation (current + 50%), followed by increased tax and scaled up tax enforcement in EurA and EurC and increased tax and reduced access in EurB, followed by increased tax, scaled up tax enforcement, and reduced access in all three sub-regions, followed by increased tax, scaled up tax enforcement, reduced access, an advertising ban and brief advice in all three sub-regions.

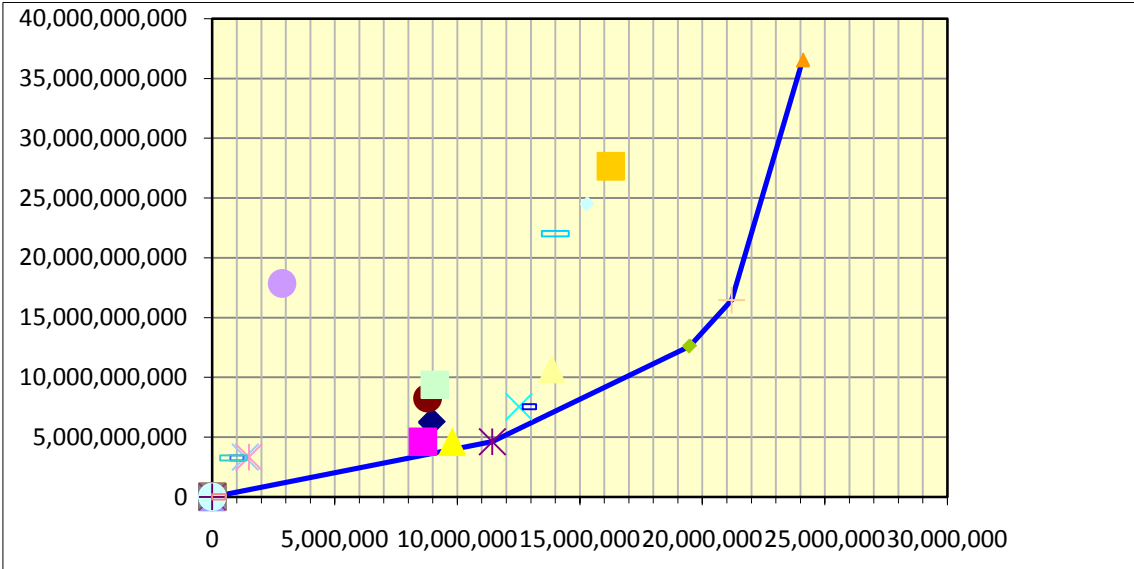


Figure 15 Expansion path of cost effectiveness in European Region A. Source: WHO (2009).

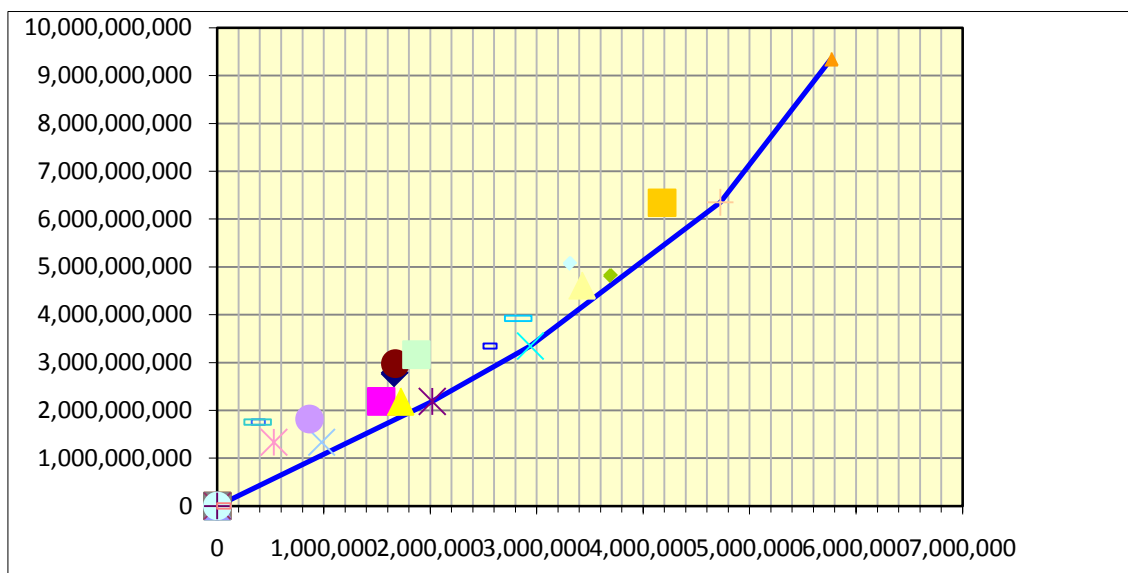
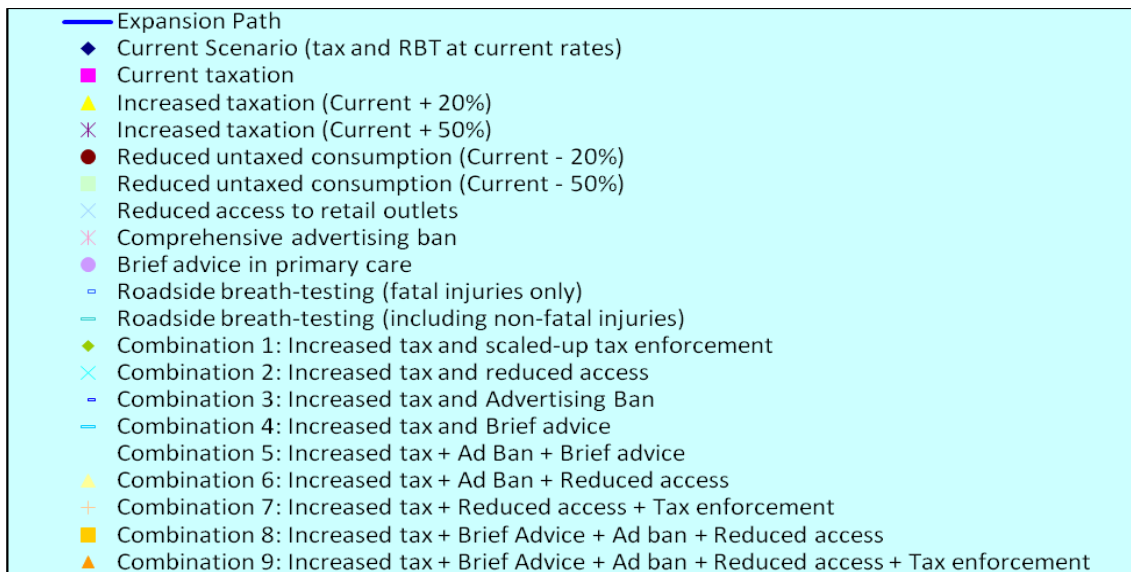


Figure 16 Expansion path of cost effectiveness in European Region B. Source: WHO (2009).

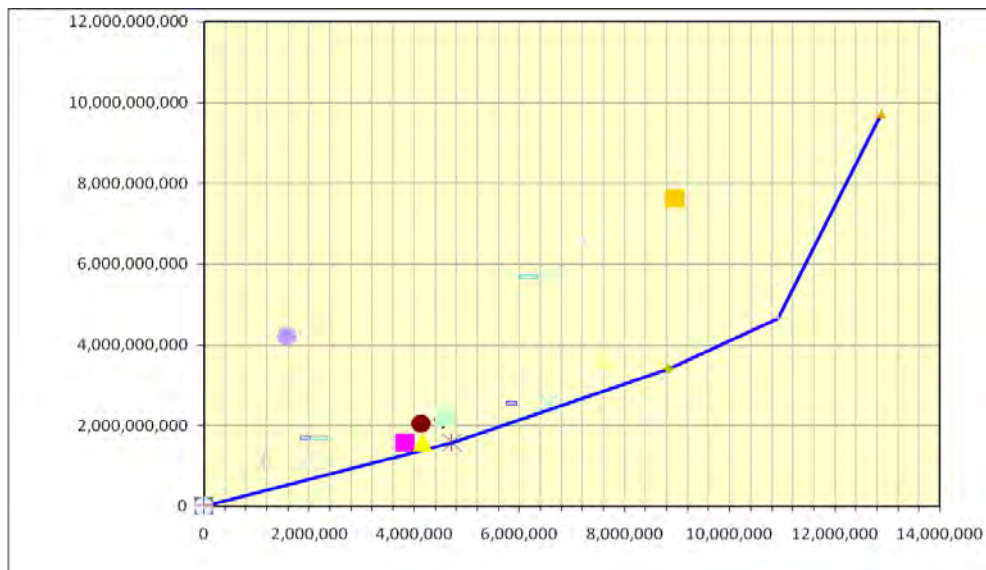


Figure 17 Expansion path of cost effectiveness in European Region C. Source: WHO (2009).

Importantly for policy discussions, it should be noted that the current intervention mix (■), does not appear on any of the expansion paths, indicating room for improvement from a cost-effectiveness point of view and that therefore more DALYs could be saved by increasing the taxation level, improving coverage of interventions and better enforcement, possibly even in the current budgetary range using resource re-allocation.

It is also important to note that country contextualization can change the cost-effectiveness ratios. For example, compared with EurC, costs per DALY averted in Estonia were cheaper for taxation, an advertising ban, and roadside breath testing, and more expensive for reduced access and brief advice in primary care (295). Thus, in Estonia, in contrast to EurC, an advertising ban became more cost effective than reduced access, and roadside breath testing became more cost effective than brief advice in primary care.

Finally, it should be noted that a comprehensive policy that combines individual elements can be far more cost effective than the individual policy elements alone. For example, current taxation plus 50% increase which lies at the first inflexion of the expansions path in EurA has an incremental and average cost effectiveness of I\$404/DALY averted. The next inflection (increased tax and scaled up enforcement) has an incremental cost effectiveness of I\$991 and an average cost effectiveness of I\$647. The third inflection (increased tax, scaled up enforcement, and reduced access) has an incremental cost effectiveness of I\$2,252 and an average cost effectiveness of I\$776. The final point (increased tax, scaled up enforcement, reduced access, advertising ban, and brief advice) has an incremental cost effectiveness of I\$6,923 and an average cost effectiveness of I\$1,517.

14. CONCLUSIONS

This short review has shown that the risk of an injury increases linearly with the amount of alcohol consumed during the previous three hours, such that at 60g alcohol consumed during the previous three hours, a drinker is almost five times as likely to have an injury as a non-drinker. The lifetime risk of dying from an alcohol-related injury increases with both the frequency of drinking and the amount drunk per occasion, such that a man who drinks 60g alcohol per day has between a 5% and 6% lifetime chance of dying from an alcohol-related injury.

The review has also shown that, depending on the injury type and the age of death, somewhere between one and two fifths of all injury deaths are due to alcohol, with alcohol-related injuries being responsible for about two fifths of all alcohol related ill-health and premature death facing the European Union. Alcohol-related injuries are also one of the most important explanatory determinants of health inequalities between different parts of the European Union.

Reducing alcohol-related injuries is, in principle, very straightforward: one simply needs to provide incentives for individuals to drink less frequently and less per occasion. Fortunately, the evidence base is also rather clear as to what can and cannot provide such incentives.

Education and persuasion to drink less does not provide such an incentive: they simply do not work in changing alcohol-related harm. On the other hand, providing identification and brief advice programmes in accident and emergency departments and, to some extent at the workplace seem to have some impact, at least in reducing subsequent alcohol-related injuries. Although much is known about factors in drinking establishments that increase the risk of alcohol-related harm, there is no convincing evidence that interventions designed to reduce harm in drinking environments actually reduce alcohol-related harm. On the other hand, there is some limited evidence that when such measures are implemented as part of multi-component community programmes, alcohol-related harm can be reduced; however, community programmes require extensive resources and long-term commitment and enforcement to ensure any chance of success.

The incentives that really work are those that increase the price of alcohol and make it harder to get through less density of outlets and shorter days and hours of sale, combined with enforced minimum purchase ages. These are also the policy options with the best value for money - they are the most cost-effective in reducing alcohol-related harm.

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