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DOI: https://doi.org/10.1111/j.1360-0443.2006.01491.x

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ZORA URL: https://doi.org/10.5167/uzh-95520
Journal Article
Published Version

Originally published at:
Rehm, Jürgen; Taylor, B; Patra, J (2006). Volume of alcohol consumption, patterns of drinking and burden of disease in the European region 2002. Open Addiction Journal, 101(8):1086-1095.
DOI: https://doi.org/10.1111/j.1360-0443.2006.01491.x

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Volume of alcohol consumption, patterns of drinking and burden of disease in the European region 2002

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ABSTRACT

Aims To describe the volume of alcohol consumption and patterns of drinking in the World Health Organization (WHO) European regions in 2002 and to estimate quantitatively the burden of disease attributable to alcohol in that year. **Methods** Secondary data analysis. Exposure data were taken from the WHO Comparative Risk Assessment, outcome data from the WHO Measurement and Health Information department, and used to derive three outcome measures: deaths, years of life lost (YLL) and disability adjusted life years (DALY) for 2002. All calculations were conducted according to age, sex and region. **Results** Alcohol consumption in the WHO regions for Europe was high, with 12.1 litres pure alcohol per capita, on average more than 100% above the global consumption. Alcohol consumption caused a considerable disease burden: 6.1% of all the deaths, 12.3% of all YLL and 10.7% of all DALY in all European regions in 2002 could be attributed to this exposure. Intentional and unintentional injuries accounted for almost 50% of all alcohol-attributable deaths and almost 44% of alcohol-attributable disease burden. Young people and men were affected the most. Geographically, the most eastern region around Russia had the highest alcohol-attributable disease burden. **Conclusions** Interventions should be implemented to reduce the high burden of alcohol-attributable disease in the European regions. Given the epidemiological structure of the burden, injury prevention, including but not restricted to the prevention of traffic injuries, and specific prevention for young people should play the most important role in a comprehensive plan to reduce alcohol-attributable burden.

Keywords Alcohol, average volume, burden of disease, patterns of drinking, risk factor.

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Submitted 6 September 2005; initial review completed 21 November 2005; final version accepted 21 February 2006

INTRODUCTION

Alcohol is one of the major risk factors for burden of disease and social harm for both developed and developing countries [1–4]. The objective of this paper is to describe the volume of alcohol consumption and pattern of drinking specifically for Europe, to estimate quantitatively the disease burden attributable to alcohol for the different World Health Organization (WHO) European regions, and to derive general implications of the epidemiological situation for public health and alcohol policy. Findings will be based on new WHO burden of disease estimates for 2002 and the results of the Comparative Risk Assessment (CRA) of WHO, which was part of the Global Burden of Disease (GBD) 2000 study (for results for the CRA see [2,4,5]; for a more general description of GBD see [6,7]). The CRA was a landmark study that focused on causal attribution of disease to selected risk factors in order to evaluate how changes in population health and risk exposure would affect major disease outcomes. As the CRA restricted itself to disease burden, the burden estimates presented here exclude social harm other than the intentional injury categories captured by the *International Classification of Diseases* (for an overview of ICD categories where alcohol is causally related see [8,9]).

Two dimensions of alcohol were considered: average volume of alcohol consumption and patterns of drinking (for details see [4,10,11]). Patterns of drinking were operationalized by a riskiness score of cultural drinking pattern derived from multiple indicators of heavy drinking occasions (e.g. frequency of intoxication, average quantity per drinking occasion, level of festive drinking), and one indicator each for drinking with meals and drinking in public places. These patterns were found to load onto

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one dimension and were linked to burden of ischaemic heart disease and injury [4,10]. Average volume and patterns of drinking had to be separated as different dimensions, as it has been shown that each can influence burden of disease as well as social harm (see also [8,12]) independently of the other. Both dimensions of alcohol consumption were estimated on the country level and then aggregated to WHO regions [4,11]. The burden of various disease outcomes were estimated at the regional level based on epidemiological research on risk relations between average volume of alcohol consumption, patterns of drinking and different disease and injury categories [4,8].

MATERIALS AND METHODS

Definition of regions

The regional distribution used in this study was defined by the WHO [13] on the basis of high, low or very low levels of adult and of infant mortality. The relevant regions for Europe are displayed in Table 1.

The regional groups are organized as follows: A = low child and very low adult mortality, B = low child and low adult mortality, C = low child and high adult mortality, D = high child and high adult mortality and E = very high child and very high adult mortality [13]. As indicated in Table 1, only categories A, B and C are relevant.

Exposure estimates

The exact procedures used to estimate exposure to alcohol are described in detail elsewhere [4,10,11]. As mentioned, two dimensions of alcohol relevant for disease were included: average volume of alcohol consumption and a summary score for patterns of drinking. Although the usual method to assess alcohol consumption is overall volume, it is also important to take into account how this alcohol is consumed (in this case, the average pattern of consumption for countries and regions). This means that the impact of average volume of consumption on mortality or morbidity is moderated partly by the way alcohol is consumed by individuals. Past studies have linked detrimental patterns of drinking with both acute and chronic diseases, specifically ischaemic heart disease and cardiac death [14–17]; for an overview see [18].

In brief, the prevalence of average volume of alcohol consumption was estimated in four sex-specific drinking categories by age and country and measured in grams of pure alcohol per day (defined as: abstainer, drinking category I: women > 0 to < 20 g; men > 0 to < 40 g; drinking category II: women 20 to < 40 g; men 40 to < 60 g; drinking category III: women > 40 g; men > 60 g). These prevalence rates were estimated using a triangulation of country-specific adult per capita data and general population survey results [4,10,11], taken mainly from the Global Alcohol Database (http://www.who.int/alcohol). A score reflecting riskiness of cultural drinking pattern was calculated for each country using triangulation of general population results and key informant surveys relating to the extent that alcohol was consumed in heavy drinking occasions, without meals and in public places [4,10,11]. Uncertainty of the estimates for each dimension was also quantified [3], consistent with the general approach of the Global Burden of Disease 2000 study (http://www3.who.int/whosis/discussion_papers/pdf/paper36.pdf).

Outcome categories and estimates

Both event and gap measures were considered: mortality, as measured in number of deaths, was the event measure; years of life lost due to premature mortality (YLL) and burden of disease, as measured in disability adjusted life years (DALY), constituted the gap measures. The DALY measure combines YLL with years of life lived in disability into a summary measure (for general definitions see [6]. To give an example: if a male dies at age 40, one would

Table 1 Classification of countries in World Health Organization European regions by childhood and adult mortality [13].

Europe A: *very low childhood and very low adult mortality*	*Europe B:* *low childhood and low adult mortality*	*Europe C:* *high childhood and low adult mortality*
Andorra, Austria, Belgium, Croatia, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Luxembourg, Malta, Monaco, the Netherlands, Norway, Portugal, San Marino, Slovenia, Spain, Sweden, Switzerland, United Kingdom	Albania, Armenia,* Azerbaijan,* Bosnia and Herzegovina, Bulgaria, Georgia, Kyrgyzstan,* Poland, Romania, Slovakia, the Former Yugoslav Republic of Macedonia, Tajikistan,* Turkmenistan,* Turkey, Uzbekistan,* Yugoslavia	Belarus, Estonia, Hungary, Kazakhstan, Latvia, Lithuania, Republic of Moldova, Russian Federation, Ukraine

Definition of regions: the regional subgroupings used were defined by WHO in the World Health Report 2000 [13] on the basis of high, medium or low levels of adult and of infant mortality. *Countries marked with * in Europe B are classified as B 2 in Table 2; the rest of the countries in this category are in Europe B 1.

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assign the number of years up to his expected life expectancy as DALY lost where, for reasons of comparability, the life expectancy of Japan was used (80 years for men and 82.5 years for women). Similarly, if a person had an accident and would be paraplegic for the rest of his life, he would lose 0.5 DALYS per year, based on the specific disability weight for this disease. Estimates for mortality and DALY for 2002 were obtained directly by WHO Headquarters (Dr C. Mathers). YLL and DALY were discounted and age-weighted to be comparable with the GBD study.

Outcome categories followed the definitions used in the CRA and were defined to be consistent across several risk factors [2,3,19]. They corresponded to the categories used for the GBD 2000 study [7,19]. GBD 2000 categories of disease used were broader than ICD codes.

Risk relations

Alcohol consumption was found to be related to the following GBD categories [4,7,8]: low birth weight, mouth and oropharyngeal cancer, oesophageal cancer, liver cancer, breast cancer, unipolar major depression, epilepsy, alcohol use disorders, hypertensive disorders, ischaemic heart disease (IHD), cerebrovascular disease, diabetes mellitus, cirrhosis of the liver, motor vehicle accidents, drownings, falls, poisonings, self-inflicted injuries and homicide.

Details of the procedures to quantify the risk of disease attributable to alcohol are described elsewhere [4,8,9]. In general, for most chronic disease categories, alcohol-attributable fractions (AAFs) of disease were derived from combining prevalence and relative risk estimates based on meta-analyses [8,9,20–22] using the following formula [23,24]:

$$AF = [\Sigma^{k}_{i=1} P_i(RR_i - 1)]/[\Sigma^{k}_{i=0} P_i(RR_i - 1) + 1]$$

where i: exposure category with baseline exposure or no exposure $i = 0$; RR_i: relative risk at exposure level i compared to no consumption; P_i: prevalence of the i-th category of exposure.

AAFs thus derived can be interpreted as reflecting the proportion of disease that would disappear if there had been no alcohol consumption.

For depression, AAFs were derived from mental health surveys, taking into consideration the rates of comorbidity and time of onset for both conditions (alcohol use disorders, depression) compared to other mental diseases comorbid with alcohol [4]. For IHD, the interaction of average volume and patterns of drinking was modelled using multi-level analyses (for methods see: [4,25]; for results: [4,26]. This multi-level modelling was based on country-specific time-series of both disease rates and per capita consumption and modelled IHD disease rates by sex, using patterns of drinking as a mediating variable for per capita consumption, and controlling for year and gross domestic product. The multi-level approach was chosen after a methodological study on different statistical approaches to model these relationships [25]. For the final estimates relating to IHD, AAFs were based on these multi-level results for all countries except for the Europe A region with relatively favourable drinking patterns (see [4]). For Europe A, results of a meta-analysis were used [27]. For injuries, a multi-level methodological approach was taken to quantify the interaction of average volume of consumption and patterns of drinking in determining AAFs [4].

RESULTS

Country-level indicators of alcohol exposure and economic development are described in detail elsewhere [4]. Per capita adult consumption, including unrecorded consumption, varied 10-fold in European countries, from 2.9 litres (Uzbekistan) to almost 30 litres of pure alcohol (Republic of Moldova). The population-weighted average value in the WHO European regions was 12.1 litres, more than twice the global adult per capita consumption of 5.8 litres (see also Table 2). Overall, average volume of alcohol consumption in the European region broadly followed the WHO region categories:

- Western European countries and most EU countries are in Europe A, with an average consumption of 12.9 litres adult per capita consumption. The Nordic countries tended to have an average adult per capita consumption that was a little lower.
- Europe B can be divided into two different subregions. Europe B1 would consist of the southernmost of the former Socialist republics bordering Asia. Their consumption was relatively low (4.3 litres per capita), partly because of the strong influence of the Islamic religion. Europe B2 would be the Central and Eastern European countries of the former Socialist republics which have a relatively high gross national product (GNP) (and, thus, their mortality rates are lower than the rates in Russia and other countries with lower GNP). These countries have a relatively high consumption overall compared to the global average (9.3 litres per capita), but lower than both the western European countries or Russia and its surrounding countries (Europe C).
- Russia and the surrounding countries in the East of Europe comprise Europe C. These countries can be characterized by a very high per capita consumption (13.9 litres adult per capita consumption), which was the highest of all WHO regions around the world (see [12]) for a comparative table).

There was also divergence in drinking patterns between regions. Whereas Europe A overall showed the least detrimental patterns (with the exception of the

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Table 2 Characteristics of adult alcohol consumption in different regions of World Health Organization Europe 2000 (population weighted averages across countries; cf. [4,11,12]).

WHO Region drinkers[3] *(definition see above)*	*Beverage type mostly consumed*	*Total consumption*[1]	*% unrecorded of total*[2]	*% heavy drinkers*	*% drinkers among males*	*% drinkers among females*	*Consumption per drinker*[4]	*Average drinking pattern*[5]
Europe A (e.g. Germany, France, UK)	Wine and beer	12.9	10	15.7	90	81	15.1	1.3
Europe B 1 (e.g. Bulgaria, Poland, Turkey)	Spirits	9.3	40	9.9	77	57	14.3	2.9
Europe B 2 (e.g. Armenia, Azerbaijan, Tajikistan)	Spirits and wine	4.3	51	4.5	54	33	9.9	3.0
Europe C (e.g. Russian Federation, Ukraine)	Spirits	13.9	38	18.6	89	81	16.5	3.6
World	Spirits	5.8	40	5.1	60	32	12.3	2.5

[1]Estimated total alcohol consumption per resident aged 15 and older in litres of absolute alcohol (recorded and unrecorded). [2]Percentage of total adult per capita consumption (= column 3) which is estimated to be unrecorded. [3]Estimated percentage rate of heavy drinking (males ³ 40 g and females ³ 20 g) among those aged 15 +. [4]Estimated total alcohol consumption (in litres of absolute alcohol) per adult drinker aged 15 +. [5]Estimated average pattern of drinking (1–4 with 4 being the most detrimental pattern).

Nordic countries), all other regions had overall more harmful patterns, with Russia and the other countries of Europe C displaying the most detrimental patterns. Given the high adult per capita values, it is not surprising that the majority of males and females consume alcohol. The only exception is the region made up of the southernmost former Socialist republics under Islamic influence, where only one-third of the females drink.

Overall, alcohol consumption in Europe is high in all regions, and is combined with a detrimental drinking pattern in all countries except for the wealthiest part of the West and the Mediterranean region. For some countries in this region, more recent data suggest a more detrimental drinking pattern as well, especially in the young [28].

Alcohol consumption caused a considerable disease burden; 6.1% of all the deaths, 12.3% of all YLL and 10.7% of all DALY in Europe in 2002 could be attributed to this exposure, with most of the burden in Europe C (see Tables 3–5). The alcohol-attributable burden of disease in Europe C is the highest of all the WHO regions world-wide (see [4,29]). In addition, it seems to have increased slightly from 2000 (estimates for 2000: 5.5% of all deaths and 10.2% of all DALY).

In all regions, males had considerably higher mortality, disease burden and YLL than females. This reflects the fact, that in all countries, surveys indicated that males consumed the majority of alcohol, and also had far more heavy drinking compared to females. Injury, especially unintentional injury, was the category which accounted for most deaths (49.9%) and YLL (60.3%) and a considerable burden of disease (43.7%) in Europe, i.e. Europe A, B and C combined. The second most important contributor to burden of disease were the neuropsychiatric disorders (32.3%), a category made up almost entirely of alcohol use disorders. With regard to the proportion of neuropsychiatric disorders, the difference between deaths, YLL and DALY is due to the fact that alcohol use disorders cause high disability but are not necessarily lethal. The high level of alcohol use disorders in Europe was confirmed recently by a pooled analyses where different studies in many European Union countries showed consistently high rates of alcohol use disorders ([30]; see also [12]).

In terms of vascular diseases, an overall protective effect was predicted for ischaemic heart disease (the most important category) for Europe A because of its more favourable drinking pattern, i.e. relatively regular drinking without too many heavy drinking occasions. This pattern of drinking has been linked to protective effects on ischaemic diseases [14,31], and in individual-level European cohorts with regular drinking patterns, the cardioprotective effect has been confirmed (e.g. see literature cited in [9,20]. It should be noted that most aggregate-level studies failed to corroborate this effect (for an

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Table 3 Alcohol-attributable deaths (000s) in 2002 by disease and region (own calculations).

	WHO Europe region							
	A		*B*		*C*			*% of all alcohol-attributable deaths*
*Region WHO classification Sex**	*M*	*F*	*M*	*F*	*M*	*F*	*A, B and C Total*	*Total*
Maternal and perinatal conditions	0	0	0	0	0	0	0	0.06
Cancer	29	21	6	4	15	9	84	14.5
Neuropsychiatric conditions	12	4	4	1	11	3	35	6.0
Vascular conditions	−34	−117	47	11	129	40	76	13.1
Other non-communicable diseases	26	9	12	6	29	14	95	16.4
Unintentional injury	26	8	21	3	128	21	207	35.6
Intentional injury	7	2	7	1	57	10	83	14.3
All alcohol-attributable deaths	66	−74	98	25	370	96	581	100.0
All deaths in the region	1950	1970	993	872	1987	1792	9564	
% alcohol-attributable of all deaths	3.4	−3.8	9.9	2.9	18.6	5.4	6.1	

*M = male, F = female. Numbers are rounded to full thousands, i.e. 0 indicates that there are less than 500 alcohol-attributable deaths in the respective category.

Table 4 Alcohol-attributable potential years of life lost (YLL) (000s) in 2002 by disease category and region (own calculations).

	World Health Organization Europe region							
	A		*B*		*C*			*% of all alcohol-attributable YLL*
*Region WHO classification Sex**	*M*	*F*	*M*	*F*	*M*	*F*	*A, B and C Total*	*Total*
Maternal and perinatal conditions	1	1	4	3	2	1	12	0.1
Cancer	279	180	74	42	176	97	847	8.4
Neuropsychiatric conditions	186	54	75	19	207	48	589	5.8
Vascular conditions	227	−494	416	86	1 192	253	1 226	12.1
Other non-communicable diseases	332	121	176	77	454	195	1 355	13.4
Unintentional injury	510	91	489	57	2 727	397	4 271	42.2
Intentional injury	143	37	157	22	1 276	196	1 830	18.1
All alcohol-attributable YLL	1 224	−11	1 390	306	6 032	1 187	10 128	100
All YLL in the region	14 133	9830	11 891	8303	24 996	13 490	82 644	
% alcohol-attributable of all YLL	8.7	−0.1	11.7	3.7	24.1	8.8	12.3	

*M = male, F = female. YLL were calculated based on standard age weights and a discount rate of 0.03 for each year lost. Numbers are rounded to full thousands. e.g. 0 indicates that there are less than 500 alcohol-attributable YLL in the respective category.

overview see [31]). In all other European regions, the overall impact of alcohol consumption on vascular disease was estimated to cause a substantial amount of vascular disease, as predicted by the different biochemical processes related to irregular heavy drinking [31,32]. There is also recent epidemiological research confirming these estimates (e.g. [18,33,34]).

Tables 6 and 7 summarize the key gender and age distributions about alcohol-attributable deaths in Europe. It becomes clear that, contrary to most other risk factors for developed countries such as tobacco, hypertension or high cholesterol, alcohol impacts health detrimentally relatively early in life [2,3,30]. Conversely, the protective effects on IHD and other vascular disease occur later in life (see Table 6).

Table 7 shows the relative proportion of alcohol-attributable deaths to all deaths by gender and age. This proportion is highest in all regions and for both genders in the age group 15–29 years (with a small exception for females in Europe B). In other words, in young adulthood alcohol was the most important risk factor. This is also the age period when no protective effects can be seen (see recent meta-analyses on alcohol and all-cause mortality [35,36]).

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Table 5 Alcohol-attributable disease burden in DALY (000 s) in 2002 by disease category and region (own calculations).

	World Health Organization Europe region							
	A		*B*		*C*			*% of all alcohol-attributable DALY*
Region WHO classification							*A, B and C*	
*Sex**	*M*	*F*	*M*	*F*	*M*	*F*	*Total*	*Total*
Maternal and perinatal conditions	2	1	4	3	2	1	14	0.1
Cancer	288	203	75	45	179	102	893	5.5
Neuropsychiatric conditions	1 983	494	608	108	1 658	355	5 205	32.3
Vascular conditions	−185	−664	466	101	1 309	281	1 309	8.1
Other non-communicable diseases	389	142	218	102	546	251	1 648	10.2
Unintentional injury	625	135	641	80	3 067	473	5 021	31.2
Intentional injury	150	41	169	25	1 405	226	2 014	12.5
All alcohol-attributable DALY	3 252	352	2 181	464	8 166	1 689	16 105	100.0
All DALY in the region	27 329	24 396	20 302	17 395	36 250	24 650	150 322	
% alcohol-attributable of all DALY	11.9	1.4	10.7	2.7	22.5	6.9	10.7	

*M = male, F = female. Numbers are rounded to full thousands. e.g. 0 indicates that there are less than 500 alcohol-attributable DALY in the respective category.

Table 6 Age and sex distribution among alcohol-attributable deaths in World Health Organization Europe regions for 2002 (own calculations).

	Europe A	*Europe B*	*Europe C*
Males			
0–4	0.3%	0.5%	0.2%
5–14	0.4%	0.5%	0.2%
15–29	13.5%	10.2%	11.0%
30–44	22.4%	14.3%	20.7%
45–59	36.5%	22.8%	29.0%
60–69	21.4%	21.1%	19.7%
70–79	6.6%	21.1%	13.7%
80+	−1.0%	9.6%	5.5%
Total deaths in 1000	66	98	370
Females			
0–4	Not meaningful, as	0.8%	0.2%
5–14	there was a net	0.4%	0.2%
15–29	beneficial effect,	5.3%	5.8%
30–44	but there were no	10.3%	11.8%
45–59	net gains before	20.8%	22.7%
60–69	age 70	19.6%	18.0%
70–79		25.4%	22.0%
80+		17.3%	19.4%
Total deaths in 1000	−74	25	96

Table 8 compares the impact of alcohol with other risk factors. Overall in the European regions, alcohol is the third most important risk factor for burden of disease, surpassed only by hypertension (most important) and tobacco. In the region with the most alcohol-attributable health harm, Europe C, it is second only to hypertension.

DISCUSSION

Although alcohol is a major risk factor in several regions of the world, Europe has the highest alcohol-attributable burden of disease. Prevention of alcohol-attributable harm should then be a major public health priority in this region (see also [37]). Before discussing potential strategies for prevention, however, the strengths and limitations of the estimates presented should be examined. Clearly, the strength of this analysis is the standardized methodology developed originally for the CRA, as well as the use of official mortality and morbidity statistics (for general methodology to derive these statistics, see [7]). The resulting comparability between risk factors differentiates CRA-based risk factor analyses from other risk factor estimates, including the estimates of the 1990 Global Burden of Disease Study, where results could not be compared between risk factors [38].

On the negative side, global and regional alcohol-attributable burden of disease estimates based on the CRA methodology have some limitations, in that they

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Table 7 Proportion of alcohol-attributable deaths among all deaths in World Health Organization Europe regions among people aged less than 70 years for 2002 (own calculations).

	Age in years					
	0–4	*5–14*	*15–29*	*30–44*	*45–59*	*60–69*
Europe A						
Males						
Alcohol-attributable deaths *n*	171	247	8 931	14 832	24 141	14 180
All deaths *n*	12 765	3 487	33 435	76 981	228 911	347 525
Proportion of alcohol-attributable deaths	1.3%	7.1%	26.7%	19.3%	10.5%	4.1%
Females						
Alcohol-attributable deaths *n*	82	87	1 175	3 224	7 630	528
All deaths *n*	9 950	2 520	11 407	36 856	117 665	185 054
Proportion of alcohol-attributable deaths	0.8%	3.5%	10.3%	8.7%	6.5%	0.3%
Europe B						
Males						
Alcohol-attributable deaths	453	459	9 968	13 997	22 250	20 574
All deaths	66 834	11 344	40 949	72 825	167 880	213 655
Proportion of alcohol-attributable deaths	0.7%	4.0%	23.1%	18.5%	13.0%	9.6%
Females						
Alcohol-attributable deaths	208	102	1 344	2 598	5 243	4 946
All deaths	55 555	7 613	17 989	35 513	84 633	138 176
Proportion of alcohol-attributable deaths	0.4%	1.3%	7.5%	7.3%	6.2%	3.6%
Europe C						
Males						
Alcohol-attributable deaths	640	808	40 807	76 545	107 438	72 771
All deaths	25 692	8 449	100 406	249 401	476 815	484 263
Proportion of alcohol-attributable deaths	2.5%	9.6%	40.6%	30.7%	22.5%	15.0%
Females						
Alcohol-attributable deaths	190	196	5 545	11 277	21 779	17 247
All deaths	18 571	4 886	26 900	71 285	181 563	288 863
Proportion of alcohol-attributable deaths	1.0%	4.0%	20.6%	15.8%	12.0%	6.0%

require a number of assumptions to be made. The most crucial assumptions for alcohol-attributable burden of disease are as follows:

- estimates of per capita consumption and unrecorded consumption for different countries do not contain substantial measurement error;
- the distribution of consumption as derived from surveys is similar to the real distribution in the population; and
- alcohol–chronic disease relationships, as derived from meta-analyses of cohort and case–control studies, are stable between countries and regions and for different age groups.

There is some evidence that per capita consumption can be estimated reliably, and per capita information is available for the vast majority of countries (see above and [4,11]. However, most of the sources on per capita information are restricted to recorded consumption. When it comes to unrecorded consumption, there is substantial measurement error, making the estimates given here most problematic for those regions where unrecorded consumption constitutes a considerable portion of total alcohol, i.e. Europe B and C. With respect to survey information, we have the long-known problem of undercoverage [39,40], as most surveys cover only 60% or less of the per capita consumption. However, as the average volume per capita was based on production and/or sales estimates, the measure of volume of drinking overall can be perceived as relatively reliable [40].

This leaves the stability of alcohol–chronic disease relationships as the most crucial part of the estimates displayed above. There are some indications that the relative risks for countries outside the most developed countries (i.e. Europe A, North America, Japan, Australia) may not

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Table 8 Leading risk factors for disease burden in the different World Health Organization Europe regions in percentage of overall DALY for 2000 [3,19].

	Europe A		*Europe B*		*Europe C*			
	Males (000)	*Females (000)*	*Males (000)*	*Females (000)*	Females (000)	*Males (000)*	*All Total (000)*	*Rank*
Childhood and maternal undernutrition								
Underweight	10	9	367	324	32	29	771	15
Iron deficiency	87	211	166	271	110	161	1 006	11
Vitamin A deficiency	0	0	1	1	0	0	2	26
Zinc deficiency	0	0	65	56	5	4	130	23
Other diet-related risks and physical inactivity								
Blood pressure	2624	1828	2699	2180	5386	4632	19 349	1
Cholesterol	2062	1317	1461	996	4109	3211	13 156	4
Overweight	1922	1735	1420	1445	2578	2684	11 784	5
Low fruit and vegetable intake	785	413	777	511	2431	1684	6 601	6
Physical inactivity	852	654	636	494	1461	1236	5 333	7
Sexual and reproductive health risks								
Unsafe sex	114	202	50	240	134	295	1 035	10
Lack of contraception	–	3	–	83	–	47	133	22
Addictive substances								
Tobacco	4991	1464	3381	715	7230	832	18 613	2
Alcohol	3103	416	2183	446	7543	1570	15 261	3
Illicit drugs	764	365	179	82	717	225	2 332	8
Environmental risks								
Unsafe water, sanitation and hygiene	33	33	287	262	64	57	736	16
Urban air pollution	91	60	197	141	217	153	859	13
Indoor smoke from solid fuels	0	0	233	244	18	49	544	17
Lead exposure	75	43	304	189	424	211	1 246	9
Climate change	1	2	5	5	2	2	17	25
Occupational risks								
Risk factors for injury	180	22	243	19	495	41	1 000	12
Carcinogens	131	21	82	12	166	31	443	19
Airborne particulates	140	42	79	6	132	10	409	20
Ergonomic stressors	21	11	18	12	21	14	97	24
Noise	117	47	92	50	136	92	534	18
Other selected risks to health								
Unsafe health care injections	0	0	8	5	106	59	178	21
Childhood sexual abuse	61	175	72	158	132	205	803	14

be the same as in these countries [19]. Thus, the estimates of the CRA may turn out to be biased. However, some newer direct assessment epidemiological results in Russia and other countries of Europe C appear to be similar to the results indicated above [18,33,34]. In addition, there is some suggestion that the approximations used have been underestimated rather than overestimated due to the general shift in chronic disease and injury and due to the fact that the detrimental effect of alcohol seem to be more pronounced in interaction with poverty and malnutrition [41]. However, this is true only for age groups under age 70 years. For age groups above this age, we probably overestimate the effects of alcohol, as there is good evidence that relative risks converge to 1 in these age groups [42]. Moreover, for these age groups we have the problem of more unreliable death certificates [42]. The problem is present for both detrimental and beneficial health outcomes, but it should be noted that the majority of the beneficial effects occur in old age [42].

In any case, disease is only part of the burden related to alcohol. In some countries, the alcohol-attributable disease burden was actually less when compared to the social harm caused by alcohol [43]. Thus, effective alcohol policy and other interventions aiming to reduce alcohol-attributable disease burden may have additional side effects on reducing social harm [44]. Such measures to reduce alcohol-attributable burden are available [12,37,44–46] and for the European regions, given their epidemiological situation, four types of interventions should be given special attention:

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- The primary focus should be injury prevention including, but not limited to, those interventions that reduce alcohol-attributable traffic harm (i.e. *per se* laws on low levels of blood alcohol concentration in traffic with strict enforcement via random breath testing, administrative licence suspension, graduated licensing for novice drivers; see [12]).
- The overall volume of consumption should be reduced. Different interventions are available to achieve this goal, with taxation being one of the most successful and cost-effective measures [12,45], especially in young adults.
- Irregular heavy drinking should be reduced. Brief interventions have been shown to achieve this goal, but overall there few proven interventions to change patterns of drinking [12]. With brief interventions, however, the high burden of alcohol use disorders could be reduced.
- Specific interventions need to address alcohol-attributable harm in adolescence and young adulthood. This could include mandatory identification for age verification in both on- and off-licensed establishments [12].

Overall, there is a need for international, national and community leaders to plan effective changes that will reduce burden of disease and social harm related to alcohol. Initiative in this direction has begun under the umbrella of WHO Europe with the proposed new framework for alcohol policy in the WHO European Region (http://www.euro.who.int/Governance/RC/RC55/20050609-9), but it is up to the responsible national and international policy makers to implement these measures. Without these policy changes, given the patterns of disease related to alcohol, we expect further increases of alcohol-attributable disease burden in the European regions, even if the current levels of consumption do not increase [4].

Acknowledgements

The authors thank Colin Mathers for providing the 2002 estimates of burden of disease. Work was supported by WHO contracts to the principal author to prepare the first version of this paper for the 10th Meeting of National Counterparts for Alcohol Policy in the WHO European Region at Stockholm, Sweden, 2005.

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