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Status report on alcohol consumption, harm and policy responses in 30 European countries 2019

Data sources and methods

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ABSTRACT

Per capita alcohol consumption in the WHO European Region, including the European Union (EU), is the highest in the world, which results in proportionally higher levels of burden of disease attributable to alcohol use compared to other regions. While there have been welcome improvements in terms of overall mortality and alcohol-attributable mortality in EU+ countries (EU Member States, Norway and Switzerland), there was no statistically significant decline in total alcohol per capita consumption between 2010 and 2016 and the observed decreases in heavy episodic drinking seem to have come to a halt. Assessment of alcohol policies in the 10 areas defined in the *European action plan to reduce the harmful use of alcohol 2012–2020* revealed huge variability across the countries, including the implementation of the three WHO "best buys" policy measures to reduce noncommunicable diseases in related to alcohol. Countries scored relatively low on reducing the negative consequences of drinking and alcohol intoxication and very low in pricing policies, and scored generally high in the areas of leadership, awareness and commitment, drink–driving policies and countermeasures, and monitoring and surveillance. Further steps are needed to maintain reductions in alcohol-attributable harm, specifically in the implementation of evidence-based alcohol policies to decrease levels of per capita alcohol consumption and heavy episodic drinking. This resource provides information on data sources and methods used for the *Status report on alcohol consumption, harm and policy responses in 30 European countries 2019.*

KEYWORDS

ALCOHOL DRINKING – PREVENTION AND CONTROL
ALCOHOL DRINKING – ADVERSE EFFECTS
ALCOHOL-RELATED DISORDERS – PREVENTION AND CONTROL
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CONTENTS

Abbreviations iv

1. METHODOLOGY FOR MODELLING ALCOHOL EXPOSURE 1

Data on alcohol exposure 2

Modelling alcohol exposure 3

2. METHODOLOGY FOR BURDEN ESTIMATION 5

Data on mortality and morbidity 6

Population data 6

Mortality and morbidity attributable to alcohol consumption 6

Estimation of alcohol-attributable fractions 6

Relative risks 7

Modelling alcohol consumption 7

Uncertainty estimation 8

Specific models: estimating motor vehicle deaths 8

Estimation of alcohol-attributable fractions for motor vehicle accidents 8

Estimation of alcoholic cardiomyopathy mortality and morbidity 9

3. ADDITIONAL TABLES 11

REFERENCES 17

ABBREVIATIONS

AAF	alcohol-attributable fraction
CAHM	Centre for Addiction and Mental Health, Toronto, Canada
DALY	disability-adjusted life-years
EU	European Union
EU+	countries of the European Union, Norway and Switzerland
FAOSTAT	Food and Agriculture Organization of the United Nations statistical database
GDP-PPP	gross domestic product purchasing power parity
GENACIS	Gender, Alcohol and Culture: an International Study
HED	heavy episodic drinking
ICD	International Classification of Diseases
MVA	motor vehicle accident
PAF	population-attributable fraction (methodology)
RR	relative risks
UI	uncertainty intervals
YLD	years lived with disability
YLL	years of life lost

1.

METHODOLOGY FOR MODELLING ALCOHOL EXPOSURE

1. METHODOLOGY FOR MODELLING ALCOHOL EXPOSURE

Since the methodology underlying the *Status report on alcohol consumption, harm and policy responses in 30 European countries 2019 (1)* is the same as that for the *Global status report on alcohol and health 2018 (2)*, this complementary document on methodology for exposure and burden is also based on the global status report.

The most important data sources for alcohol-related information for all parts of the *Status report on alcohol consumption, harm and policy responses in 30 European countries 2019* and the *Global status report on alcohol and health 2018* reports is the WHO Global Survey on Alcohol and Health, the last iteration of which was conducted in 2016 in collaboration with all six WHO regional offices[1] and the European Commission (in countries of the European Union (EU). Specifically for the *Status report on alcohol consumption, harm and policy responses in 30 European countries 2019*, national counterparts or focal points of the WHO European Region in all EU countries, Norway and Switzerland who were officially nominated by their ministries of health were provided with access to the online survey data-collection tool for completion. Where this was not feasible, a hard copy of the tool was forwarded directly to those who requested it. The 2016 questionnaire was a modified version of that used in 2012. The 44 questions were divided into three sections: section A addressed alcohol policy; section B alcohol use; and section C surveillance system and health services' response on alcohol and drugs. The questionnaire, originally in English, was translated into French, Portuguese, Russian and Spanish.

By the end of 2016, 174 WHO Member States had responded to the WHO Global Survey on Alcohol and Health. This represents a response rate of 89.2% (2012, 90.8%), covering 98.3% (2012, 97.3%) of the world's population. Whenever information was incomplete or in need of clarification, the questionnaire was returned to the country concerned for revision. Amendments to the survey responses were then resubmitted by email or electronically. The Global Survey on Alcohol and Health addresses the situation at national level in any given country with additional questions and space for comments on subnational specificities.[2] As described below, data from the United Nations Population Division and the World Bank have been crucial to presenting alcohol-related information by gender or income level throughout the report.

Population data in the report were obtained primarily from the United Nations Population Division and refer to the total adult (15 years or older (15+)) population, with data for males and females shown separately where available. Data are therefore weighted for the population size of the countries in these regions in the tables and figures presenting results by WHO regions and the world.

Data on alcohol exposure

Part 1 of the *Status report on alcohol consumption, harm and policy responses in 30 European countries 2019*, "Alcohol consumption as a risk factor for burden of disease in the European Union, Norway and Switzerland", utilizes two main sources of data: the Global Information System on Alcohol and Health *(3)* and published surveys. Several sources were utilized for the data on alcohol use, with official data on recorded alcohol per capita (15+ years) consumption supplied by Member States given priority. Twenty-four of the 30 EU+ countries covered by the report had governmental data on consumption, which constitutes the region with the highest availability (global overview, see WHO *(3)*). If these data were not available, data from economic operators[3] were used; and when these data were not consistently available, data supplied by the Food and Agriculture Organization of the United Nations statistical database (FAOSTAT) were used.

For recorded per capita consumption of alcohol, when data were not available for 2016 or 2017, data since 2012 were projected using a linear regression model. Data for these years were then averaged (2015, 2016, 2017) and used as an estimate of recorded consumption for 2016. If the trend was not statistically significant (the p-value was equal to or greater than 0.05), the recorded alcohol per capita consumption value for 2015 was carried forward and used as the estimate for 2016 and 2017. In

[1] WHO regional offices for Africa, the Americas, Europe, the Eastern Mediterranean, South-East Asia and the Western Pacific.

[2] Data for the United Kingdom refer mainly to England and Wales.

[3] Canadean; International Wine and Spirits Research; Organisation Internationale e la Vigne er du Vin; The Wine Institute.

cases where data for 2016 existed and where no significant trend in recorded alcohol per capita consumption was observed, the value for 2016 was carried forward and used as the estimate for 2017.

Unrecorded alcohol use was estimated as a percentage of total alcohol use. Country-level proportions of unrecorded alcohol use were estimated using a regression analysis including all WHO Member States globally *(4)*; for the final version, see Probst et al. *(5)*. Estimates of unrecorded alcohol use were obtained from four sources:

1. expert judgements from a WHO survey of experts based on whether any changes in unrecorded consumption had occurred since 2010 (that is, since the WHO *Global status report on alcohol and health 2014 (6)*), the magnitude of these changes, and documented supporting evidence;
2. a WHO and Centre for Addiction and Mental Health (CAHM), Toronto, Canada nominal expert group Delphi survey in 2013 assessing the proportion of unrecorded alcohol use in 42 WHO Member States (response rate: 74%) where unrecorded alcohol use was relatively large or considered a problem *(7,8)*;
3. a second WHO and CAMH nominal expert group Delphi survey in 49 WHO Member States in 2015/2016 (response rate: 86%) *(4)*; and
4. the STEPwise approach to surveillance (STEPS) surveys *(9)*.

Based on these input data, the percentage of unrecorded to total consumption was estimated via a regression model (for development of methodology, see Probst et al. *(4)*; for final results, see Probst et al. *(5)*).

Data for tourist estimations were obtained from the Institute for Health Metrics and Evaluation, which has based its calculations on the World Tourism Organization *(10)*. The litres of alcohol consumed by tourists (aged 15+) in a country were based on the number of tourists who visited a country, the average amount of time they spent, and how much these people drink on average in their countries of origin (estimated based on per capita consumption of recorded and unrecorded alcohol). Tourist alcohol use also accounted for the inhabitants of a country consuming alcohol while visiting other countries (based on the average time spent outside of their country and the amount of alcohol consumed in their country of origin). These estimations assumed the following: *(1)* that people drink the same amounts of alcohol when they are tourists as they do in their home countries; and *(2)* that global tourist consumption is equal to zero (meaning tourist consumption can be either net negative or positive).

Total per capita alcohol use was then estimated by adding recorded and unrecorded alcohol use and tourist alcohol use.

The main sources for data on alcohol drinking status and heavy episodic drinking (HED) were published survey reports or multicountry, nationally representative surveys, including but not limited to the STEPwise approach to surveillance *(9)* and Gender, Alcohol and Culture: an International Study (GENACIS) *(11)*. A full list of surveys used can be found in the *Global status report on alcohol and health 2018 (2)*. The main sources of data on young people (15–19 years) were the Global School-based Student Health *(12)* and European School Survey Project on Alcohol and Other Drugs *(13)* surveys.

Modelling alcohol exposure

Data on drinking status (lifetime abstainers, former drinkers and past 12-month abstainers) and the prevalence of HED were modelled with regression models that used data collected through a systematic search of all survey data on the previously mentioned measures of interest. The independent variables were per capita consumption, population structure (sex, age), the size of the Muslim population within the country, the region of the country, economic wealth (in gross domestic product purchasing power parity (GDP-PPP)) and the year from which the survey data were obtained. Model-specific covariates were added to account for variations in the outcomes, such as reference periods for the assessment of the current drinking status (30 days or 12 months, for example). The validity of the predicted estimates was assessed by comparing predicted estimates to actual estimates.

The estimates on prevalence of drinking status and HED is a result of mathematical modelling using the survey data available at the time of preparing the global status report on alcohol and health. All efforts were made to check the methodologic quality of the surveys conducted in various parts of the world, but it was not feasible to systematically verify or confirm whether:

(1) all surveys were reviewed, as appropriate, by relevant ethics review committees; (2) all survey results were published in peer-reviewed journals; or (3) how all surveys were funded, including the sources of funding.

As input for the burden calculations, survey estimates were triangulated with alcohol per capita consumption to adjust for underestimation by surveys often accounting for less than half of the actual amount of alcohol consumed (for reasoning, see Rehm et al. *(14)*; for procedures used, see Rehm et al. *(15)* and Kehoe at al. *(16)*). A value of 80% of alcohol per capita consumption was used to be conservative, and to account for spillage/waste and possible underestimation of epidemiological studies on risk relations *(17)*. More details are given below.

2.

METHODOLOGY FOR BURDEN ESTIMATION

2. METHODOLOGY FOR BURDEN ESTIMATION

Health consequences due to alcohol consumption were estimated based on: (1) the prevalence of alcohol-use disorders by age, sex and country; and (2) the deaths, years of life lost (YLL), years lived with disability (YLD) and disability-adjusted life-years (DALYs) lost attributable to alcohol consumption.

Data on mortality and morbidity

Deaths, YLL, YLD and DALYs lost were obtained from the WHO Global Health Estimates *(18)* by cause, age, sex and year (2010 and 2016). To match age-standardization data, deaths, YLL, YLD and DALYs lost were aggregated into the following age groups: 0–4, 5–9 and so on until 80–84, and 85 years and older. The extracted causes of death are presented in Table 1.

Population data

Population data for 2010 and 2016 by country, age and sex were obtained from the United Nations Population Division (2015 revisions) *(19).* Population age-standardized rates were based on the WHO standard population *(20).*

Mortality and morbidity attributable to alcohol consumption

The categories of mortality and morbidity included in the health burden estimates were based on the causal association of alcohol consumption with the occurrence of the diseases and injuries. The inclusion of diseases and the causal association of alcohol were assessed by the WHO Technical Advisory Group on Alcohol and Drug Epidemiology (see Table 1).

The number of deaths, YLL, YLD and DALYs lost attributable to alcohol consumption were estimated using a Levin-based population-attributable fraction (PAF) methodology *(21).* The association of alcohol and mortality is complex; alcohol has a protective effect (when compared to lifetime abstainers) on ischaemic heart disease, ischaemic stroke and diabetes for drinkers who consume low volumes of alcohol and do not binge-drink *(22–26).* The overall protective effect of alcohol consumption depends, however, on the risks of diseases and injuries associated with them and not associated with alcohol (competing risks) *(27).* In accordance with the methods of previous comparative risk assessment studies, the mortality and morbidity attributable to alcohol consumption were therefore estimated using a counterfactual scenario (theoretical minimum risk) of lifetime abstention (no historical consumption of alcohol) *(28).* For diseases and injuries where alcohol is a necessary cause (alcohol-use disorders (International Classification of Diseases (ICD-10) codes F10, G72.1, Q86.0 and X45)), the attributable fraction was assumed to be 1. For diseases and injuries where alcohol is a potential component cause (where alcohol raises the risk of disease or injury occurrence but the disease or injury may still occur in the absence of alcohol), a PAF was used to estimate the fraction of deaths, YLL, YLD and DALYs attributable to alcohol.

Estimation of alcohol-attributable fractions

With respect to noncommunicable diseases (other than cancer), no latency period was used in the estimation of the attributable fractions. For cancer mortality and morbidity attributable to alcohol consumption, a latency period of 10 years between the consumption of alcohol and the diagnosis and/or death from cancer was chosen, based on an observed approximate latency period of 11–12 years for breast, colorectal, oral cavity, esophageal (squamous cell carcinoma) and pharyngeal cancers, and 8–9 years for laryngeal and liver cancers *(29).*

The alcohol-attributable fractions (AAFs – the PAFs for alcohol) were estimated by combining data on the prevalence of former drinkers (P_{FD}) and current drinkers (P_{CD}) with the corresponding relative risks (RR), using Formula 1. Alcohol consumption among current drinkers (x) was modelled using an upper integration limit of 150 grams of pure alcohol per day. The upper limit of 150 grams per day was based on the observation that very heavy consumers of alcohol do not sustain alcohol consumption above 150 grams per day for prolonged periods of time *(30).*[4]

[4] There is little research about the duration of sustained heavy drinking above 150 grams per day on average. Clearly, the potential consequences are very harmful *(31).* In an attempt to be conservative, however, calculations were restricted to capping consumption at 150 grams of pure alcohol per day.

Formula 1.

$$AAF = \frac{P_{FD}(RR_{FD} - 1) + \int_{>0}^{150} P_{CD}(x)(RR_{CD}(x) - 1)dx}{P_{FD}(RR_{FD} - 1) + \int_{>0}^{150} P_{CD}(x)(RR_{CD}(x) - 1)dx + 1}$$

The fraction of ischaemic stroke, ischaemic heart disease and injuries the AAF is estimated based on Formulas 2a and 2b. These formulas incorporate the prevalence of former and current drinkers combined with the corresponding RRs. In the case of current drinkers, Formula 2b also accounts for the patterns of alcohol consumption (the prevalence of current drinkers who engage in binge drinking (P_{CDB}) and who do not engage in binge drinking (P_{CDNB})).

Formula 2a.

$$AAF = \frac{P_{FD}(RR_{FD} - 1) + P_{CD}(RR_{CD} - 1)}{P_{FD}(RR_{FD} - 1) + P_{CD}(RR_{CD} - 1) + 1}$$

Formula 2b.

$$P_{CD}(RR_{CD} - 1) = \int_{>0}^{60} P_{CDNB}(x)RR_{CDNB}(x)dx + \int_{>0}^{60} P_{CDB}(x)RR_{CDB}(x)dx + \int_{60}^{150} P_{CD}(x)RR_{CDB}(x)dx - P_{CD}$$

Relative risks

Where available, the selection of RRs was based on systematic reviews of meta-analyses (see Table 1). For Belarus, Estonia, Latvia, Lithuania, the Republic of Moldova, the Russian Federation and Ukraine, RRs from the Russian cohort study by Zaridze et al. were used to model mortality and morbidity from tuberculosis, lower respiratory infections, ischaemic heart disease, ischaemic stroke, haemorrhagic stroke, liver cirrhosis, pancreatitis, road injuries, other unintentional injuries, self-harm and interpersonal violence attributable to alcohol consumption *(32,33)*.

Modelling alcohol consumption

Alcohol consumption was modelled as: (1) drinking status (current drinkers, former drinkers and lifetime abstainers); (2) average daily volume of alcohol consumption among current drinkers, modelled based on per capita consumption, the prevalence of current drinkers and the amount of alcohol consumed among current drinkers by age and sex); and (3) heavy episodic drinkers, defined as drinking 60 grams or more of pure alcohol on one occasion, modelled based on the prevalence of current drinkers and the prevalence of heavy episodic drinkers among current drinkers (for the estimation procedures for current drinkers and heavy episodic drinkers, see the "Methodology for modelling exposure" section above). Data on alcohol consumption (drinking status and amount consumed by current drinkers) and HED were available by age (15–19, 20–24, 25–34, 35–49, 50–64 and 65 years and older) and sex.

The amount of alcohol consumed by current drinkers was adjusted using a correction factor of 0.8. This correction factor was used to account for: (1) alcohol that was not consumed; and (2) for the underreporting of alcohol consumption in medical observation studies from which the RR estimates used in this study were obtained *(34)*. A study by Stockwell et al. found that cohort studies of the relationship between alcohol consumption and all-cause mortality had a coverage rate (when compared to per capita consumption) of 61.71% (ranging from 29.19% for the Russian Federation to 96.53% for Japan) *(17)*. The adjustment of survey data can be justified by the observation that the underreporting of alcohol consumption in medical epidemiology studies *(35–37)* is much less than in population surveys; population-level surveys underestimate alcohol consumption due to the fact that on average, such surveys ask many fewer questions that are used to measure alcohol consumption compared to the number of such questions asked in medical epidemiology studies *(35–37)*. The undercoverage of population surveys is also affected by recruitment biases *(38)*, but the adjustment of survey data assumes that the undercoverage of alcohol consumption is constant by age and sex.

Average daily alcohol consumption among current drinkers was modelled using a Gamma distribution in accordance with the methodology outlined by Rehm et al. *(15)* and Kehoe et al. *(16)*. This methodology was developed using data from over 60 individual surveys conducted in both developing and developed countries. First, the method assumes that the average daily alcohol consumed among current drinkers can be accurately modelled using a Gamma distribution, which was the case in the surveys examined by both Rehm et al. and Kehoe et al. Secondly, this method assumes that the standard deviation of the Gamma distribution of alcohol consumption can be predicted based on the mean consumption of alcohol. Rehm et al. and Kehoe et al. observed a strong correlation between the mean and the standard deviation of the Gamma distribution (an r of 0.971). Based on the mean alcohol consumed (μ) by age and sex, the standard deviation (σ) was therefore estimated according to Formula 3 (the coefficient of sex is 1 for women and 0 for men in Formula 3).

Formula 3.

$$\hat{\sigma}_{shifted=}(1.171 + 0.087 * sex) * \hat{\mu}_{shifted}$$

Uncertainty estimation

The 95% uncertainty intervals (UI) were estimated using Monte Carlo-like simulations. These intervals were based on the 2.5th and 97.5th percentiles of the distribution of PAF estimates constructed using 1000 samples of the lowest-level parameters of alcohol consumption and RRs from their respective probability distributions *(39)*. Uncertainty from population figures and mortality and morbidity data were not incorporated into the 95% UIs. When modelled, alcoholic cardiomyopathy deaths also took into consideration uncertainty in the regression model and the regression inputs.

Specific models: estimating motor vehicle deaths

Using Formula 4 *(75)*, estimates of motor vehicle deaths due to alcohol consumption were stratified into those involving the driver and those involving others based on the fractions of motor vehicle deaths that involved drivers and involved people other than the driver as obtained from the WHO road traffic deaths database. This method estimates the number of deaths (D) among drivers (d) using the fraction (F) of injury events in a country that occurred among drivers by sex (indexed by i) and age (indexed by p, including people of 15+). The method of estimating the number of motor vehicle accident (MVA) injuries that involved drivers assumed that all MVA injuries to drivers occurred among people of 15+ (that is, all MVA injuries occurring among people 0–14 years involved people other than the driver). For countries where data were not available, the fractions of injuries among drivers and people other than the driver were imputed as the regional averages. To estimate the number of YLL, YLD and DALYs lost among drivers, the fraction of deaths among drivers compared to all MVA deaths (by age and sex) were used. All other MVA deaths, YLLs YLDs and DALYs affected people other than the driver.

Formula 4.

$$Dd_{p,i} = \frac{F_i \cdot F_p \cdot \sum_{p=1}^{pn} \sum_{i=1}^{in} D_{p,i}}{D_{p,i}}$$

Estimation of alcohol-attributable fractions for motor vehicle accidents

The AAF for MVAs affecting the driver were applied to the mortality and morbidity estimates. The AAF for MVAs affecting people other than the driver (non-drivers (nd)) was estimated using Formula 5 and used data on the deaths and AAFs for MVAs affecting the driver (d) by sex (indexed by p) and age (indexed by i). This method assumes that accidents involving an intoxicated driver also involve an equal number of passengers as accidents involving non-intoxicated drivers. It does not account for non-intoxicated drivers killed or injured by intoxicated drivers.

Formula 5.

$$AAF_{nd} = \frac{\sum_{p=1}^{pn} \sum_{i=1}^{in} D_{p,i} \cdot AAF_{p,i}}{\sum_{p=1}^{pn} \sum_{i=1}^{in} D_{p,i}}$$

Estimation of alcoholic cardiomyopathy mortality and morbidity

Deaths, YLL, YLD and DALYs lost due to alcoholic cardiomyopathy (ICD-10 code I42.6) are not estimated specifically by either WHO or the Institute for Health Metrics and Evaluation, and are contained in the larger category of cardiomyopathy, myocarditis and endocarditis mortality and morbidity (ICD-10 codes I30-I33, I38, I40, I42). The number of alcoholic cardiomyopathy deaths therefore was estimated using the methodology of Manthey et al. *(76,77).* First, the number of deaths from alcoholic cardiomyopathy was estimated using the WHO Global Health Observatory for countries that reported ICD-I42.6 deaths. As death data are not available for every year, an average of the number of alcoholic cardiomyopathy deaths was used from 2006 to 2014 for 2010, and from 2012 to 2017 for 2016 (where data were available). In cases where alcoholic cardiomyopathy deaths were not reported, the number of alcoholic cardiomyopathy deaths were imputed using the methodology of Manthey et al. *(76,77).* These imputations were based on a negative binomial regression model. For men, the regression model was based on per capita consumption and the number of cardiomyopathy, myocarditis and endocarditis deaths. For women, the regression model was based on per capita consumption of alcohol, the prevalence of alcohol-use disorders and the population size.

Table 1. Causes and sources of relative risks, and causality

Cause 2015	GHE[a] 2015 cause category	ICD-10 coding	Relative risk	Causality
10	I. Communicable, maternal, perinatal and nutritional conditions	A00-B99, D50-D53, D64.9, E00-E02, E40-E46, E50-E64, G00-G04, G14, H65-H66, J00-J22, N70-N73, O00-O99, P00-P96, U04		
20	A. Infectious and parasitic diseases	A00-B99, G00-G04, G14, N70-N73, P37.3, P37.4		
30	1. Tuberculosis	A15-A19, B90	Imtiaz et al., 2017 *(40)*	Rehm et al., 2009 *(41)*
100	3. HIV/AIDS	B20-B24	Rehm et al., 2017 *(42)*	Rehm et al., 2017 (42), Scott-Sheldon et al., 2016 *(43)*
380	B. Respiratory infectious	H65-H66, J00-J22, P23, U04		
390	1. Lower respiratory infections	J09-J22, P23, U04	Samokhvalov et al., 2010 *(44)*	Samokhvalov et al., 2010 *(44)*; Traphagen et al., 2015 *(45)*; Simet & Sisson, 2015 *(46)*
600	II. Noncommunicable diseases	C00-C97, D00-D48, D55-D64 (minus D 64.9), D65-D89, E03-E07, E10-E34, E65-E88, F01-F99, G06-G98 (minus G14), H00-H61, H68-H93, I00-I99, J30-J98, K00-K92, L00-L98, M00-M99, N00-N64, N75-N98, Q00-Q99, X41-X42, X44, X45, R95		
610	A. Malignant neoplasms	C00-C97		
620	1. Mouth and oropharynx cancers	C00-C14		
621	a. Lip and oral cavity	C00-C08	Bagnardi et al., 2015 *(47)*; Marron et al., 2010 *(48)*	IARC,[b] 2007, 2009 *(49,50)*
623	c. Other pharyngeal cancers	C09-C10, C12-C14	Bagnardi et al., 2015 *(47)*; Marron et al., 2010 *(48)*	IARC,[b] 2007, 2009 *(49,50)*
630	2 Oesophagus cancer	C15	Bagnardi et al., 2015 *(47)*; Marron et al., 2010 *(48)*	IARC,[b] 2007, 2009 *(49,50)*
650	4 Colon and rectum cancers	C18-C21	Bagnardi et al., 2015 *(47)*; Schütze et al., 2011 *(51)*	IARC,[b] 2007, 2009 *(49,50)*
660	5 Liver cancer	C22	Turati et al., 2015 *(52)*; WCRF,[c] 2015 *(53)*	IARC,[b] 2007, 2009 *(49,50)*
700	9 Breast cancer	C50	Bagnardi et al., 2015 *(47)*	IARC,[b] 2007, 2009 *(49,50)*
753	19 Larynx cancer	C32	Bagnardi et al., 2015 *(47)*; Marron et al., 2010 *(48)*	IARC,[b] 2007, 2009 *(49,50)*

Table 1 contd

Cause 2015	GHE[a] 2015 cause category	ICD-10 coding	Relative risk	Causality
800	C. Diabetes mellitus	E10-E14 (minus E10.2-E10.29, E11.2-E11.29, E12.2, E13.2-E13.29, E14.2)	Knott et al., 2015 *(25)*; Rehm et al., 2010 *(54)*	Knott et al., 2015 *(25)*; Rehm et al., 2010 *(54)*
820	E. Mental and substance use disorders	F04-F99, G72.1, Q86.0, X41-X42, X44, X45		
860	4 Alcohol use disorders	F10, G72.1, Q86.0, X45	–	–
940	F. Neurological conditions	F01-F03, G06-G98 (minus G14, G72.1)		
970	3 Epilepsy	G40-G41	Samokhvalov et al., 2010 *(55)*	Bartolomei, 2006 *(56)*; Barclay et al., 2008 *(57)*; Leach et al., 2012 *(58)*
1100	H. Cardiovascular diseases	I00-I99		
1120	2 Hypertensive heart disease	I10-I15	Puddey & Beilin, 2006 *(59)*; O'Keefe et al., 2014 *(60)*	Roerecke et al., personal communication
1130	3 Ischaemic heart disease	I20-I25	Roerecke et al., 2010, 2012, 2014 *(24,61,62)*	Mukamal & Rimm, 2001*(63)*; Collins et al., 2009 *(64)*; Roerecke & Rehm, 2014 *(24)*
1140	4 Stroke	I60-I69		
1141	a. Ischaemic stroke	G45-G46.8, I63-I63.9, I65-I66.9, I67.2-I67.848, I69.3-I69.4	Rehm et al., 2016, based on Patra et al., 2010 *(65)*	Puddey et al., 1999 *(59)*; Mazzaglia et al., 2001 *(66)*; Collins et al., 2009 *(64)*
1142	b. Haemorrhagic stroke	I60-I62.9, I67.0-I67.1, I69.0-I69.298	Patra et al., 2010 *(65)*; Larsson et al., 2016 *(67)*	Puddey et al., 1999 *(59)*; Mazzaglia et al., 2001 *(66)*; Collins et al., 2009 *(64)*
1150	5 Cardiomyopathy, myocarditis, endocarditis	I30-I33, I38, I40, I42	–	–
1210	H. Digestive diseases	K20-K92		
1230	2 Cirrhosis of the liver	K70, K74	Roerecke et al., personal communication	Gao & Bataller, 2011 *(68)*
1248	8 Pancreatitis	K85-K86	Samokhvalov et al., 2015 *(69)*	Gao & Bataller, 2011 *(68)*; Braganza et al., 2011 *(70)*; Yadav & Lowenfels, 2013 *(71)*; Lankisch et al., 2015 *(72)*; Majumder & Chari, 2016 *(73)*
1510	III. Injuries	V01-Y89 (minus X41-X42, X44, X45)		
1520	A. Unintentional injuries	V01-X40, X43, X46-59, Y40-Y86, Y88, Y89		
1530	1 Road injury	V01-V04, V06, V09-V80, V87, V89, V99*	Shield et al., in preparation	WHO, 2009 *(74)*
1540	2 Poisonings	X40, X43, X46-X48, X49	Shield et al., in preparation	WHO, 2009 *(74)*
1550	3 Falls	W00-W19	Shield et al., in preparation	WHO, 2009 *(74)*
1560	4 Fire, heat and hot substances	X00-X19	Shield et al., in preparation	WHO, 2009 *(74)*
1570	5 Drowning	W65-W74	Shield et al., in preparation	WHO, 2009 *(74)*
1575	6 Exposure to mechanical forces	W20-W38, W40-W43, W45, W46, W49-W52, W75, W76	Shield et al., in preparation	WHO, 2009 *(74)*
1590	8 Other unintentional injuries	Rest of V, W39, W44, W53-W64, W77-W99, X20-X29, X50-X59, Y40-Y86, Y88, Y89	Shield et al., in preparation	WHO, 2009 *(74)*
1600	B. Intentional injuries	X60-Y09, Y35-Y36, Y870, Y871		
1610	1 Self-harm	X60-X84, Y870	Shield et al., in preparation	WHO, 2009 *(74)*
1620	2 Interpersonal violence	X85-Y09, Y871	Shield et al., in preparation	WHO, 2009 *(74)*

[a] WHO Global Health Estimates. [b] International Agency for Research on Cancer. [c] World Cancer Research Fund.

3.
ADDITIONAL TABLES

3. ADDITIONAL TABLES

Additional data are presented in Tables 2–8.

Table 2. Alcohol-attributable proportion of mortality for major causes of death

Cause of death	Women	Men	Total
Communicable disease	2.3 (0.7–4.1)	8.9 (3.3–15.2)	5.4 (2.7–8.7)
Noncommunicable disease	2.6 (0.6–4.5)	50.6 (42.5–57.1)	4.7 (3.4–6.0)
Cancer	3.6 (3.0–4.4)	8.0 (7.1–8.8)	6.1 (5.5–6.7)
AUD[a]	100.0 (100.0–100.0)	100.0 (100.0–100.0)	1.0 (1.0–1.0)
CVD[b]	2.6 (–2.1 –7.0)	3.5 (–0.7–6.8)	3.0 (–0.2–5.9)
Liver cirrhosis	60.8 (52.7–67.7)	76.0 (68.6–81.7)	71.0 (65.6–75.4)
Injury	9.9– (7.3–13.6)	31.6 (22.1–42.3)	23.2 (17.6–29.7)
Unintentional injury	**9.6 (7.2–13.7)**	32.2 (22.1–43.7)	22.3 (16.4–29.3)
Intentional injury	10.9 (3.7–19.5)	30.6 (8.9–48.3)	25.2 (9.8–38.1)
Harm to others – traffic	**41.5 (31.5–60.0)**	42.4 (32.4–61.6)	42.1 (32.0-61.4)
Total	2.8 (1.0–4.6)	8.3 (6.8–9.6)	5.5 (4.3–6.7)

Note: disease categories in italics are subcategories (for instance, cancer is a subcategory of noncommunicable disease).
[a] AUD: alcohol-use disorders.
[b] CVD: cardiovascular disease.

Table 3. Age-standardized alcohol-attributable death rate per 1 litre of adult alcohol per capita consumption in EU+ for the year 2016 (and components)

Country	APC[a]	Alcohol-attributable mortality rate	Alcohol-attributable DALY rate	Alcohol-attributable mortality rate/litre	Alcohol-attributable DALY rate/litre	GDP-PPP
Austria	11.6	27.7	1 405.5	2.4	120.7	45 163
Belgium	12.1	30.1	1 452.8	2.5	119.8	40 311
Bulgaria	12.7	48.3	2 248.3	3.8	177.2	16 602
Croatia	8.9	39.9	1 822.8	4.5	203.9	20 209
Cyprus	10.8	17.7	816.2	1.6	75.8	26 879
Czechia	14.4	37.7	2 039.8	2.6	141.6	27 309
Denmark	10.4	28.9	1 352.2	2.8	130.3	43 300
Estonia	11.6	113.7	4 594.8	9.8	396.7	26 324
Finland	10.7	34.5	1 857.7	3.2	173.7	38 354
France	12.6	28.4	1 399.7	2.3	111.3	37 081
Germany	13.4	30.0	1 459.6	2.2	109.1	44 336
Greece	10.4	20.6	1 002.6	2.0	96.2	25 067
Hungary	11.4	52.7	2 347.1	4.6	205.9	23 319
Ireland	13.0	24.0	1 333.8	1.8	102.6	45 576
Italy	7.5	16.4	755.4	2.2	100.7	33 671
Latvia	12.9	149.8	5 757.8	11.6	446.8	24 239
Lithuania	15.0	166.0	6 273.9	11.1	418.5	26 657
Luxembourg	13.0	26.0	1 307.9	2.0	100.8	90 837
Malta	8.1	15.6	789.9	1.9	97.6	30 203
Netherlands	8.7	17.5	818.2	2.0	94.5	43 359
Norway	7.5	16.6	976.2	2.2	130.9	64 875
Poland	11.6	46.6	2 407.3	4.0	206.9	24 052
Portugal	12.3	30.8	1 354.8	2.5	110.3	25 648
Romania	12.6	66.0	2 796.7	5.2	221.1	18 498
Slovakia	11.5	51.8	2 522.2	4.5	220.2	27 277
Slovenia	12.6	41.6	2 134.0	3.3	169.0	27 992
Spain	10.0	19.3	904.0	1.9	90.4	32 061
Sweden	9.2	18.6	1 015.7	2.0	110.9	45 272
Switzerland	11.5	19.7	1 011.2	1.7	87.9	54 158
United Kingdom	11.4	24.7	1 221.6	2.2	106.7	36 347

[a] APC: adult alcohol per capita consumption.

Table 4. Alcohol-attributable proportion of mortality for major causes of YLL

Cause of death	Women	Men	Total
Communicable disease	2.0 (0.7–3.5)	11.4 (9.8–12.7)	5.3 (2.9–8.2)
Noncommunicable disease	3.8 (2.4–5.3)	9.2 (7.8–10.1)	6.8 (5.8–7.7)
Cancer	3.9 (3.3–4.6)	8.7 (7.8–9.5)	6.6 (6.0–7.2)
AUD[a]	100.0 (100.0–100.0)	100.0 (100.0–100.0)	100.0 (100.0–100.0)
CVD[b]	3.0 (–1.2–6.9)	3.7 (0.0–6.2)	3.4 (0.6–5.8)
Liver cirrhosis	62.8 (55.0–69.2)	76.8 (69.8–82.4)	72.6 (67.3–76.9)
Injury	14.4 (10.6–19.4)	35.5 (24.7–46.5)	29.4 (21.7–37.8)
Unintentional injury	14.9 (11.8–20.1)	37.4 (27.3–48.7)	30.3 (23.1–38.9)
Intentional injury	13.3 (4.3–23.9)	33.2 (9.4–51.6)	28.2 (10.8–42.3)
Harm to others – traffic	41.9 (31.8–61.2)	42.6 (32.6–61.8)	42.3 (32.3–61.6)
Total YLLs	4.2 (2.9–5.6)	11.4 (9.8–12.7)	8.3 (7.2–9.3)

Note: disease categories in italics are subcategories (for instance, cancer is a subcategory of noncommunicable disease).
[a] AUD: alcohol-use disorders.
[b] CVD: cardiovascular disease.

Table 5. Alcohol-attributable proportion of mortality for major categories of DALYs

Disease category/cause of death	Women	Men	Total
Communicable disease	1.3 (0.5–2.3)	6.0 (2.9–9.6)	3.7 (2.1–5.7)
Noncommunicable disease	2.5 (1.6–3.4)	7.4 6.4–8.0	5.0 (4.3–5.6)
Cancer	3.9 (3.3–4.6)	8.7 (7.7–9.4)	6.6 (6.0–7.2)
AUD[a]	100.0 (100.0–100.0)	100.0 (100.0–100.0)	100.0 (100.0–100.0)
CVD[b]	2.4 (–1.3–6.3)	3.5 (0.0–5.8)	3.0 (0.4–5.2)
Liver cirrhosis	62.5 (54.7–68.8)	76.5 (69.6–82.1)	72.3 (67.0–76.6)
Injury	14.9 (11.5–20.0)	35.3 25.6–45.4	27.7 (21.7–34.3)
Unintentional injury	15.2 (11.6–21.0)	36.3 (25.2–48.0)	27.7 (20.8–35.7)
Intentional injury	13.1 (4.3–23.5)	32.9 (9.3–51.3)	27.7 (10.7–41.4)
Harm to others – traffic	41.4 (31.2–60.7)	42.4 (32.3–61.7)	41.9 (31.8–61.3)
Total DALYs	3.2 (2.4–4.1)	10.1 (8.7–11.3)	6.8 (6.0–7.6)

Note: disease categories in italics are subcategories (for instance, cancer is a subcategory of noncommunicable disease).
[a] AUD: alcohol-use disorders.
[b] CVD: cardiovascular disease.

Table 6. Impact of alcohol exposure, all-cause mortality rate and economic wealth on level of age-standardized alcohol-attributable mortality rates per 100 000 in 2016 in EU+

Sex	Alc IV	R_2 in %	R_2 change in %	APC	APC LCI	APC UCI	HED	HED LCI	HED UCI	All-cause rate	All-cause rate LCI	All-cause rate UCI	GDP-PPP	GDP-PPP LCI	GDP-PPP UCI
W	APC	47.7		0.499	0.287	0.712							–0.019	–0.032	–0.005
W	APC	60.1	12.4	0.403	0.207	0.600				1.798	0.590	3.006	–0.005	–0.020	0.010
W	HED	79.1					0.110	0.088	0.133				–0.024	–0.033	–0.016
W	HED	78.9	–0.1				0.103	0.075	0.131	0.457	–0.558	1.473	–0.021	–0.033	–0.008
M	APC	55.4		0.119	0.067	0.170							–0.013	–0.0237	–0.002
M	APC	85.4	30.1	0.051	0.017	0.086				1.796	1.306	2.286	0.004	–0.003	0.012
M	HED	84.8					0.056	0.044	0.064				–0.023	–0.029	–0.017
M	HED	88.9	4.1				0.033	0.018	0.049	1.031	0.395	1.667	–0.009	–0.019	0.000
T	APC	47.3		0.189	0.097	0.281							–0.015	–0.027	–0.004
T	APC	73.2	25.9	0.107	0.034	0.181				1.98	1.196	2.759	0.002	–0.009	0.013
T	HED	81.6					0.072	0.058	0.087				–0.025	–0.032	–0.018
T	HED	83.5	1.8				0.057	0.036	0.078	0.809	–0.020	1.637	–0.016	–0.027	–0.004

W: women; M: men; T: total (both sexes); Alc. IV: main alcohol exposure independent variable; R_2: explained variance; R_2 change: explained variance after adding all-cause mortality rate to the model; APC: adult alcohol per capita consumption in litres of pure alcohol per year; HED: prevalence of heavy episodic drinking; LCI: lower confidence interval; UCI: upper confidence interval; all rates were logarithmized and age-standardized.

Table 7. Impact on level of age-standardized alcohol-attributable rates of YLL per 100 000 in 2016 in EU+

Sex	Alc IV	R_2 in %	R_2 change in %	APC	APC LCI	APC UCI	HED	HED LCI	HED UCI	All-cause rate	All-cause rate LCI	All-cause rate UCI	GDP-PPP	GDP-PPP LCI	GDP-PPP UCI
W	APC	51.6		0.479	0.294	0.664							–0.016	–0.028	–0.004
W	APC	70.9	19.2	0.344	0.187	0.501				1.750	0.921	2.578	–0.001	–0.012	0.011
W	HED	79.5					0.101	0.081	0.122				–0.021	–0.029	–0.013
W	HED	81.9	2.4				0.085	0.060	0.110	0.809	0.031	1.586	–0.013	–0.024	–0.002
M	APC	55.8		0.126	0.074	0.178							–0.013	–0.023	–0.002
M	APC	89.5	33.8	0.044	0.013	0.075				1.677	1.310	2.044	0.007	0.000	0.014
M	HED	84.3					0.056	0.045	0.066				–0.023	–0.029	–0.016
M	HED	91.1	6.8				0.027	0.013	0.042	1.168	0.653	1.682	–0.004	–0.013	0.005
T	APC	49.1		0.194	0.104	0.283							–0.014	–0.025	–0.003
T	APC	83.1	34.0	0.087	0.027	0.146				1.864	1.349	2.380	0.005	–0.004	0.014
T	HED	81.7					0.072	0.057	0.086				–0.024	–0.031	–0.017
T	HED	87.4	5.7				0.044	0.024	0.064	1.120	0.488	1.753	–0.008	–0.019	0.002

W: women; M: men; T: total (both sexes); Alc. IV: main alcohol exposure independent variable; R_2: explained variance; R_2 change: explained variance after adding all-cause mortality rate to the model; APC: adult alcohol per capita consumption in litres of pure alcohol per year; HED: prevalence of heavy episodic drinking; LCI: lower confidence interval; UCI: upper confidence interval; all rates were logarithmized and age-standardized.

Table 8. Impact factors on level of age-adjusted alcohol-attributable DALY rates per 100 000 in 2016 in EU+

Sex	Alc IV	R_2 in %	R_2 change in %	APC	APC LCI	APC UCI	HED	HED LCI	HED UCI	All-cause rate	All-cause rate LCI	All-cause rate UCI	GDP-PPP	GDP-PPP LCI	GDP-PPP UCI
W	APC	50.0		0.441	0.264	0.618							–0.016	–0.027	–0.004
W	APC	72.0	22.0	0.290	0.141	0.438				3.383	1.906	4.860	–0.003	–0.013	0.007
W	HED	83.4					0.098	0.080	0.115				–0.021	–0.027	–0.014
W	HED	86.7	3.2				0.079	0.059	0.100	1.617	0.408	2.852	–0.014	–0.022	–0.005
M	APC	54.2		0.112	0.065	0.160							–0.010	–0.020	–0.001
M	APC	90.7	36.5	0.038	0.012	0.064				2.084	1.669	2.499	0.005	–0.000	0.011
M	HED	85.5					0.051	0.042	0.060				–0.019	–0.025	–0.014
M	HED	92.5	7.0				0.025	0.013	0.037	1.433	0.856	2.011	–0.004	–0.012	0.003
T	APC	47.4		0.175	0.093	0.257							–0.012	–0.023	–0.002
T	APC	84.7	37.3	0.073	0.022	0.124				2.713	2.031	3.395	0.004	–0.003	0.011
T	HED	83.5					0.066	0.054	0.079				–0.021	–0.027	–0.015
T	HED	89.9	6.3				0.040	0.024	0.056	1.629	0.836	2.422	–0.008	–0.016	0.000

W: women; M: men; T: total (both sexes); Alc. IV: main alcohol exposure independent variable; R_2: explained variance; R_2 change: explained variance after adding all-cause mortality rate to the model; APC: adult alcohol per capita consumption in litres of pure alcohol per year; HED: prevalence of heavy episodic drinking; LCI: lower confidence interval; UCI: upper confidence interval; all rates were logarithmized and age-standardized.

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