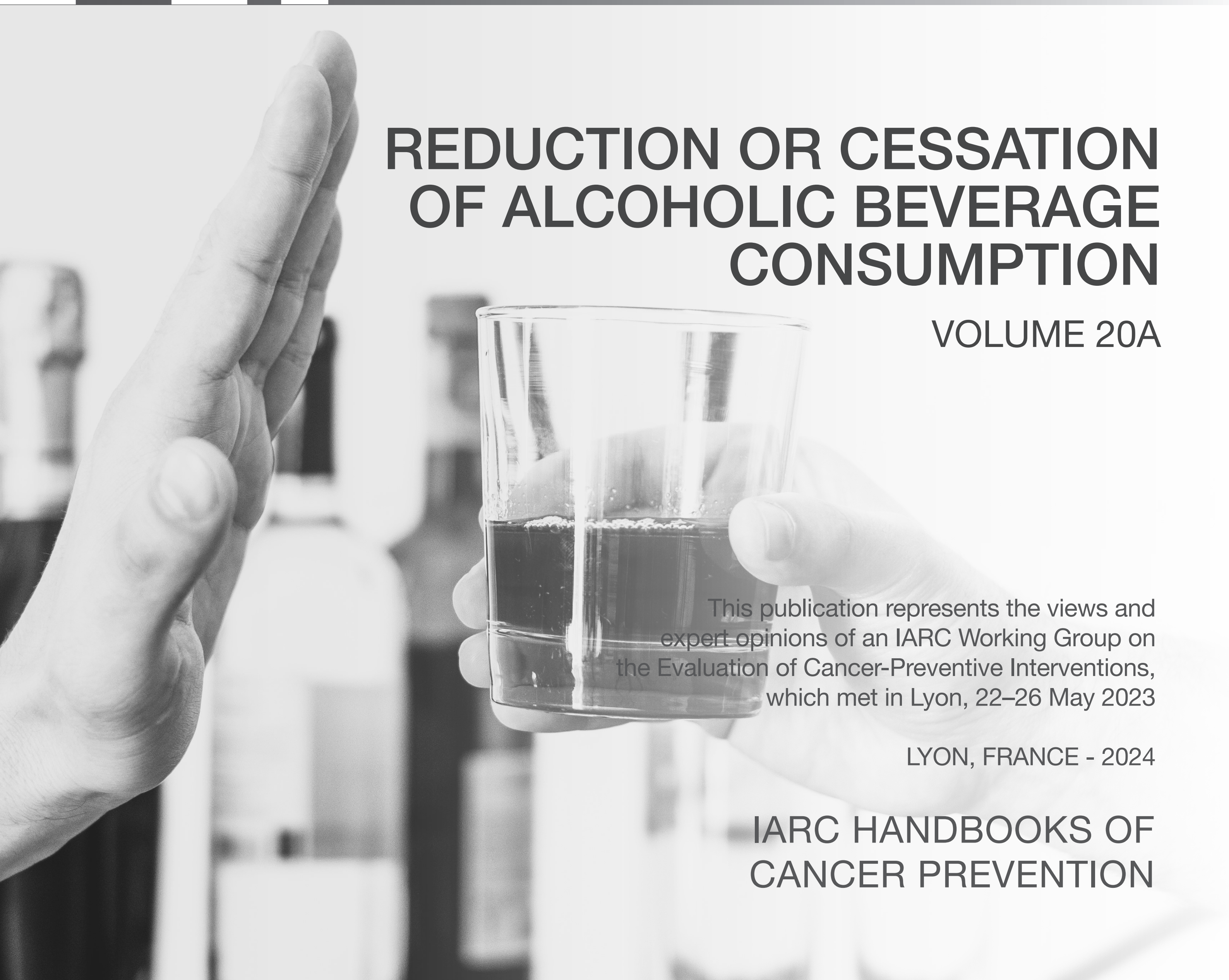
IARC HANDBOOKS



REDUCTION OR CESSATION OF ALCOHOLIC BEVERAGE CONSUMPTION

VOLUME 20A

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IARC HANDBOOKS OF CANCER PREVENTION

International Agency for Research on Cancer

World Health Organization

1. ALCOHOLIC BEVERAGES

1.1 Definitions and types of products

1.1.1 Types of products containing alcohol for human consumption

There are two main categories of products containing alcohol: (i) alcoholic beverages, which are liquids containing ethanol (or ethyl alcohol: C_2H_5OH) that are intended for consumption (WHO, 2018), and (ii) surrogate alcohol, which is non-beverage alcohol that is not officially intended for human consumption (WHO, 2021). Alcohol products for consumption can also be categorized as either (i) recorded alcohol, which refers to alcoholic beverages consumed according to the official statistics at the country level based on production, import, export, and sales or taxation data and intended for consumption, or (ii) unrecorded alcohol, which refers to alcohol products that are not taxed and are outside the official system of government control, such as home or informally produced (legal or illegal) alcohol, smuggled alcohol, surrogate alcohol, or alcohol products obtained through cross-border shopping (i.e. recorded in a different jurisdiction) (UNSTAT, 2020). In 2019, about 21% of global alcohol consumption was unrecorded (WHO, 2024).

Alcoholic beverages are typically produced through yeast fermentation of carbohydrate-rich staple foods such as cereals, grapes, fruits, vegetables, or potatoes, with or without subsequent distillation (Peterson, 2013). The main categories of alcoholic beverages are beer, wine, and spirits (WHO, 2010). Because ethanol is the main type of alcohol found in alcoholic beverages, the term "alcohol" is usually used as a synonym for ethanol and, by extension, for alcoholic beverages (European Commission, 2022). Most countries that have a legal definition for "alcoholic beverages" set ethanol content thresholds, which range from 0.8% volume in the World Health Organization (WHO) Region of the Americas to 1.3% volume in the WHO European Region (WHO, 2010, 2014, 2018). The ethanol content varies by the major type of beverage and also by country, because of local customs or regulations. Beer generally contains 4–5% volume of alcohol, but the content can range from < 2% to > 10% volume (alcohol content is lower in alcoholic beverages produced at home or locally, such as sorghum beer); wine is about 12% volume, with a range of 8–15% volume, and spirits range from 15–20% volume for liqueurs and aperitifs to > 40% volume for vodka and whiskey (IARC, 2010). Chinese strong spirits may contain ≥ 50% volume (Zheng and Han, 2016). Alcopops, hard seltzer, or other types of flavoured alcoholic drinks or pre-mixed packaged beverages typically contain 4–7% volume of alcohol (IARC, 2010). In recent decades, beverages with a reduced or lower volume of alcohol and non-alcoholic variants of alcoholic beverages have been developed (Anderson et al., 2021; Okaru and Lachenmeier, 2022). Table 1.1 provides an overview of the ethanol content of various alcoholic beverages.

Alcohol-containing commodities sold on regional and international markets include beer made from barley, wine made from grapes, and several types of distilled spirits. However, in many low- and middle-income countries, home-made, artisanal, or locally produced alcoholic beverages, such as sorghum beer, palm wine, and sugarcane spirits, are the main types of alcoholic beverages available (WHO, 2004; IARC, 2010).

1.1.2 Toxicants in alcohol products

The *IARC Monographs* programme has classified alcoholic beverages (Volumes 44, 96, and 100E), ethanol in alcoholic beverages (Volumes 96 and 100E), and acetaldehyde associated with consumption of alcoholic beverages (Volume 100E) as carcinogenic to humans (Group 1) (IARC, 1988, 2010, 2012a).

In addition to ethanol and acetaldehyde, alcoholic beverages may contain several toxicants that are derived from the raw materials used or that may arise during the production process (IARC, 2010; Fuller et al., 2011b). Some of these agents are carcinogenic (IARC, 2010) (Table 1.2).

Occasionally, toxic compounds that are not approved for use in commercial production are deliberately added to alcohol products, most often in unrecorded alcohol. Of these toxic compounds, methanol is the one associated with the greatest burden of morbidity, including blindness, and mortality (Fuller et al., 2011b). Methanol poisonings of individuals and groups of people associated with consumption of unrecorded alcohol have been regularly reported worldwide in recent decades (Lachenmeier et al., 2021).

1.1.3 Nutritional aspects of alcohol consumption

The primary components of most alcoholic beverages are alcohol and water; some sweet liqueurs may contain more sugar than ethanol (IARC, 2010).

Alcoholic beverages may also contain other macronutrients, such as carbohydrates, nitrogen (proteins and amino acids), and lipids (fats). Carbohydrates are present in significant amounts in fermented alcoholic beverages such as wine and beer, whereas nitrogen and lipids are present in relatively small amounts. All three macronutrients are typically absent from distilled spirits (Peterson, 2013). Alcohol provides 7 kcal/g [29 kJ/g] of energy, which is more than for carbohydrates or proteins and almost as much as for pure fat (EFSA Panel on Dietetic Products, Nutrition and Allergies (NDA), 2013; European Commission, 2022; WHO, 2022a). Alcoholic beverages can contribute significantly to total energy intake, and their calories have no nutritional value (Fuller et al., 2011a, b; WHO, 2022a). Alcohol consumption without a concomitant reduction in energy intake from carbohydrates, fats, and proteins can lead to an excess in energy intake (Fuller et al., 2011b). Evidence suggests that energy intake from alcohol is more likely to contribute to weight gain in people who have a high fat intake and a low level of physical activity, who are overweight, and who have a family history of obesity (WHO, 2022a).

1.2 Surveillance, prevalence, trends, and determinants of consumption

1.2.1 Monitoring of consumption at the population level

Alcohol consumption is monitored in many countries, and globally by WHO (Poznyak et al., 2013). The monitoring systems can be broadly

Table 1.1 Variety and strength of selected commercially and non-commercially produced alcoholic beverages worldwide

Product name	Country or region	Ethanol content (% volume)[a]
1. Fermented alcoholic beverages		
(a) Commercially produced		
Beer	USA	2.9–8.5
	Germany	3.2–7.8
	Bangladesh	4–8
Table wine	USA	6.0–20.0
Toddy	Bangladesh	5–10
(b) Local/homebrewed/unrecorded		
Tella (brewed from various grains)	Ethiopia	3.8–6.5
Tej (honey wine)	Ethiopia	8.9–13.2
Fruit wine	Poland	9.5–12.2
Unrecorded wine and fortified wine	Europe	9.6–23.5
2. Distilled alcoholic beverages		
(a) Commercially produced		
Bourbon	USA	32.3–50.7
Brandy	USA	28.0–40.0
Cognac	USA	38.7–40.7
Fruit spirits	Germany	31.2–49.1
Vodka	Ukraine	39.3–39.9
(b) Local/homemade/unrecorded		
Areki (distilled grain fermentation)	Ethiopia	34.0–39.9
Bai jiu	China	40.8–72.1
Samohon	Ukraine	32.5–52.2
Unrecorded spirits	Poland	18.8–85.3
Chang'aa	Kenya	42.8–85.8
Ogogoro	Nigeria	32.2–42.6
Unrecorded spirits	Europe	20.8–88.8
Ekchuani (rice spirits)	Bangladesh	30–40
3. Other types		
Alcopops	International	5–8
Low alcohol	International	0.5–1.2[b]
No alcohol or alcohol-free	International	< 0.5[b]

[a] Decimals as reported in the original article.

[b] Conventions for ethanol or alcohol content (% volume) in no and low (NoLo) alcohol products vary widely among countries (range for low alcohol, 0.05–2.8; range for no alcohol, ≤ 0.05–≤ 2.8) (Okaru and Lachenmeier, 2022).

Compiled by the Working Group (Lachenmeier and Musshoff, 2004; Ejim et al., 2007; Lachenmeier et al., 2009, 2010, 2011; Guelinckx et al., 2011; DiLoreto et al., 2012; Yohannes et al., 2013; Dewan and Chowdhury, 2015; Okaru et al., 2017; Newman et al., 2018; Okaru and Lachenmeier, 2022).

Table 1.2 IARC evaluations of agents that may be present in alcoholic beverages

Agent	Occurrence in alcoholic beverages[a]	IARC evaluation (Group)[b]
Acetaldehyde associated with consumption of alcoholic beverages[c]	All types	1
Acetaldehyde	All types	2B
Acrolein	All types	2A
Acrylamide	Beer	2A
Aflatoxins	Beer and unrecorded fermented products	1
Alcoholic beverages	–	1
Aniline	Historical use: wine adulterant	2A
Arsenic	All types	1
Benzene	Contaminated beer	1
Cadmium	All types	1
Crotonaldehyde	Beer and spirits	2B
Ethanol in alcoholic beverages	(1.5–80% volume)	1
Ethyl carbamate (urethane)	All types, with major occurrence in stone-fruit spirits	2A
Formaldehyde	All types	1
Furan	Beer	2B
Furfuryl alcohol	Wine and beer	2B
Glyphosate	Beer	2A
Lead compounds, inorganic	All types	2A
3-Monochloro-1,2-propanediol	Beer	2B
4-Methylimidazole	Some coloured products	2B
β-Myrcene	Beer and some flavoured products	2B
N-Nitrosodimethylamine	Beer	2A
Ochratoxin A	Wine and beer	2B
Pentachlorophenol	Oak-barrel aged beverages	1
Pulegone	Some flavoured products	2B
Safrole	Some spirits	2B
2,4,6-Trichlorophenol	Oak-barrel aged beverages	2B

IARC, International Agency for Research on Cancer.
[a] The concentrations of most compounds vary, depending on the origin of a beverage, differing production technologies, and the level of contamination, which typically is trace level. Most jurisdictions provide guidelines or regulations to mitigate contamination of beverages containing alcohol.
[b] Agents classified by the *IARC Monographs* programme. Group 1, carcinogenic to humans; Group 2A, probably carcinogenic to humans; Group 2B, possibly carcinogenic to humans; Group 3, not classifiable as to its carcinogenicity to humans. https://monographs.iarc.who.int/agents-classified-by-the-iarc/
[c] Refers to the acetaldehyde that forms in the body after ingestion of alcohol.
Compiled by the Working Group (Lachenmeier et al., 2012; Pflaum et al., 2016; Okaru and Lachenmeier, 2021; IARC, 1976, 1978, 1980, 1982a, 1982b, 1985, 1987a, 1987b, 1988, 1991, 1993a, 1993b, 1995a, 1995b, 1999, 2002, 2006a, 2006b, 2010, 2012a, 2012b, 2012c, 2013, 2015, 2017, 2018, 2019a, 2019b, 2021a, 2021b, 2022).

divided into two categories: monitoring based on routine government statistics, such as taxation, production, and imports and exports in a country (Rehm et al., 2007), and monitoring by national surveys (Nugawela et al., 2016).

Recorded alcohol consumption data for almost every country are based on routine statistics (Rehm et al., 2007; Poznyak et al., 2013). Unrecorded alcohol consumption data are based on surveys (such as the WHO STEPS survey) (WHO, 2005), derived from expert judgements (Rehm and Poznyak, 2015), or estimated statistically on the basis of economic data, levels of poverty and malnutrition, prohibition of alcohol, and region (Probst et al., 2019). Tourist consumption data are based on United Nations tourist statistics and take into account consumption by tourists visiting the country and consumption by inhabitants visiting other countries (UNSTAT, 2020). Total adult alcohol per capita consumption (APC) is defined as the total (sum of recorded and unrecorded alcohol) amount of alcohol consumed per person (individuals aged ≥ 15 years) over a calendar year, in litres of pure alcohol, adjusted for tourist consumption (UNSTAT, 2020). APC is the indicator of United Nations Sustainable Development Goal 3.5: Strengthen the prevention and treatment of substance abuse, including narcotic drug abuse and harmful use of alcohol, for 2030 (UNSTAT, 2017).

Although APC is considered the best indicator of alcohol consumption at the country level (Gmel and Rehm, 2004), it is only indicative of the overall level of consumption. To differentiate the level of alcohol consumption among different groups, data from surveys about variables such as sex, age, or sociodemographic status are needed. Because surveys tend to underestimate total APC, often by > 50% (Midanik, 1982; Rehm et al., 2010), they cannot be used to measure overall alcohol consumption.

Surveys enable estimation of the prevalence of abstinence (both lifetime abstention and current abstention among individuals who formerly consumed alcohol) and, through triangulation with APC, estimation of specific indicators such as APC per drinker or by sex, which serve as additional indicators globally (WHO, 2018). Triangulation of APC and surveys is also essential for estimating the alcohol-attributable burden of disease for comparative risk assessments (Rehm et al., 2010), which are important when setting priorities for disease prevention and alcohol control policies.

The third indicator of alcohol consumption available globally is for heavy episodic drinking (HED), which is also referred to as binge drinking.

1.2.2 Prevalence of and trends in alcohol consumption by WHO region

The countries included in each WHO region are listed in the Glossary.

(a) Prevalence and level of alcohol consumption in 2019

Alcohol is the most widely used psychoactive substance in the world (GBD 2019 Risk Factors Collaborators, 2020). Information about the indicators of alcohol consumption is provided for 2019 (Table 1.3; Fig. 1.1, 1.2, 1.3), because changes in alcohol consumption behaviours during the COVID-19 pandemic are not fully understood (Schmidt et al., 2021; Kilian et al., 2022; Sohi et al., 2022).

In 2019, 57% of adults abstained from alcohol consumption (WHO, 2024); 47% of adults had abstained throughout their lives, and 10% formerly consumed alcohol but were abstinent in the previous 12 months (WHO, 2024) (Table 1.3). However, the prevalence of alcohol abstention and consumption differs considerably by country and region.

In 2019, the highest APC overall was reported in the WHO European Region, followed by the WHO Region of the Americas and the WHO

Table 1.3 Characteristics of alcohol consumption behaviours in WHO regions in 2019

Alcohol consumption indicator[a]	WHO African Region	WHO Region of the Americas	WHO Eastern Mediterranean Region	WHO European Region	WHO South-East Asia Region	WHO Western Pacific Region	World
Overall							
APC (3-year moving average, L of pure alcohol)	4.52	7.51	0.31	9.20	3.84	6.06	5.45
Lifetime abstention (%)	61.3	18.2	92.4	26.3	64.0	34.0	46.6
Former alcohol consumption (%)	9.5	21.8	3.5	11.3	8.4	5.6	9.6
Current alcohol consumption (%)	29.2	60.0	4.1	62.4	27.6	60.4	43.8
HED (%)	15.2	26.0	0.8	26.1	10.4	19.1	16.7
APC per drinker (L)	15.50	12.53	7.44	14.74	14.01	9.85	12.35
Current alcohol consumption among individuals aged 15–19 years (%)	13.4	42.1	1.1	44.3	11.4	35.9	21.8
HED among individuals aged 15–19 years (%)	8.5	21.5	0.2	21.5	5.4	14.7	10.6
Women							
Lifetime abstention (%)	69.8	23.9	95.1	32.6	73.5	44.9	54.5
Former alcohol consumption (%)	9.2	24.2	2.7	12.5	7.8	6.2	10.1
Current alcohol consumption (%)	21.0	51.9	2.2	54.9	18.7	49.0	35.4
HED (%)	8.7	15.8	0.3	16.1	5.1	10.8	9.7
APC per drinker (L)	7.67	6.31	3.02	7.27	6.71	4.89	6.10
Current alcohol consumption among individuals aged 15–19 years (%)	12.2	40.0	1.0	42.3	10.2	33.3	20.3
HED among individuals aged 15–19 years (%)	7.4	18.4	0.2	18.0	4.5	12.5	9.0

Table 1.3 (continued)

Alcohol consumption indicator[a]	WHO African Region	WHO Region of the Americas	WHO Eastern Mediterranean Region	WHO European Region	WHO South-East Asia Region	WHO Western Pacific Region	World
Men							
Lifetime abstention (%)	52.6	12.3	89.8	19.5	54.7	23.2	38.7
Former alcohol consumption (%)	9.8	19.2	4.3	9.9	9.0	5.0	9.1
Current alcohol consumption (%)	37.6	68.5	5.9	70.7	36.3	71.8	52.2
HED (%)	22.2	35.9	1.4	36.1	15.7	26.6	23.5
APC per drinker (L)	19.98	17.45	8.96	21.05	17.66	13.24	16.63
Current alcohol consumption among individuals aged 15–19 years (%)	14.6	44.2	1.2	46.1	12.4	38.2	23.3
HED among individuals aged 15–19 years (%)	9.5	24.0	0.3	24.2	6.2	16.3	11.8

APC, alcohol per capita consumption; HED, heavy episodic drinking (≥ 60 g of ethanol [pure alcohol] at least once per month); WHO, World Health Organization.

[a] All proportions are based on the general population aged ≥ 15 years, except for current alcohol consumption among individuals aged 15–19 years and HED among individuals aged 15–19 years.

[b] 0 denotes proportions < 0.5%.

Modelled by the Working Group based on survey data collected for WHO (2022b). For modelling details, see Manthey et al. (2019); data are partially reported in WHO (2024).

Fig. 1.1 Prevalence of current alcohol consumption (previous 12 months) in 2019

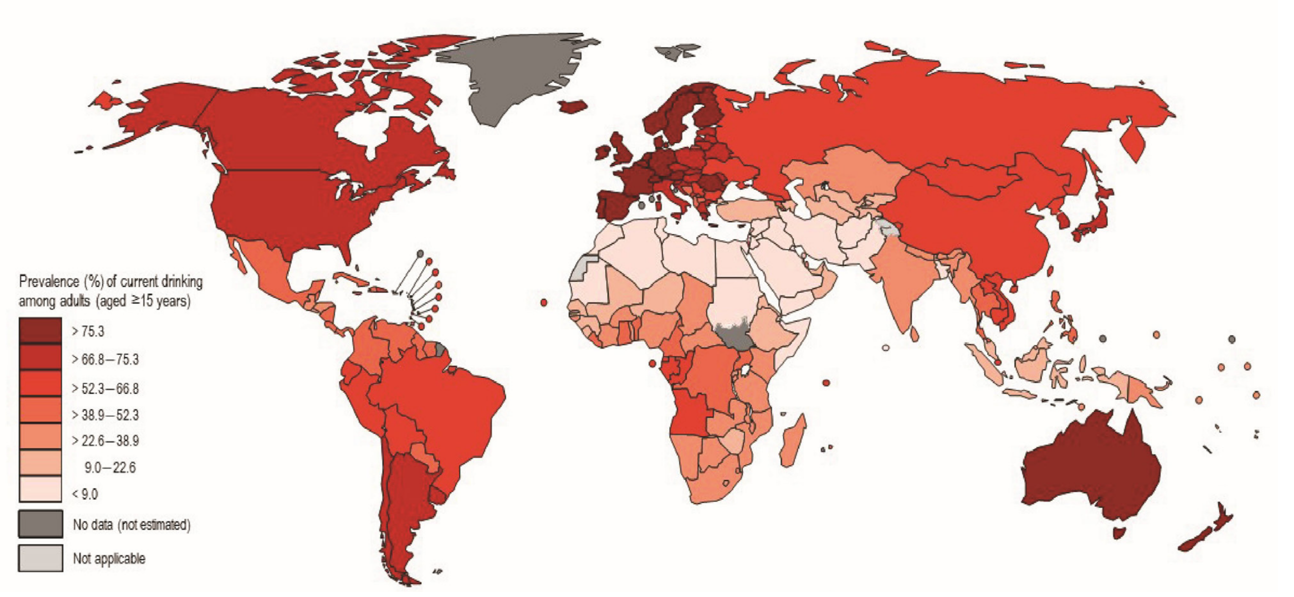


Figure modelled by the Working Group based on survey data collected for WHO (2022b); for modelling details, see Manthey et al. (2019).

Fig. 1.2 Prevalence of heavy episodic drinking in 2019

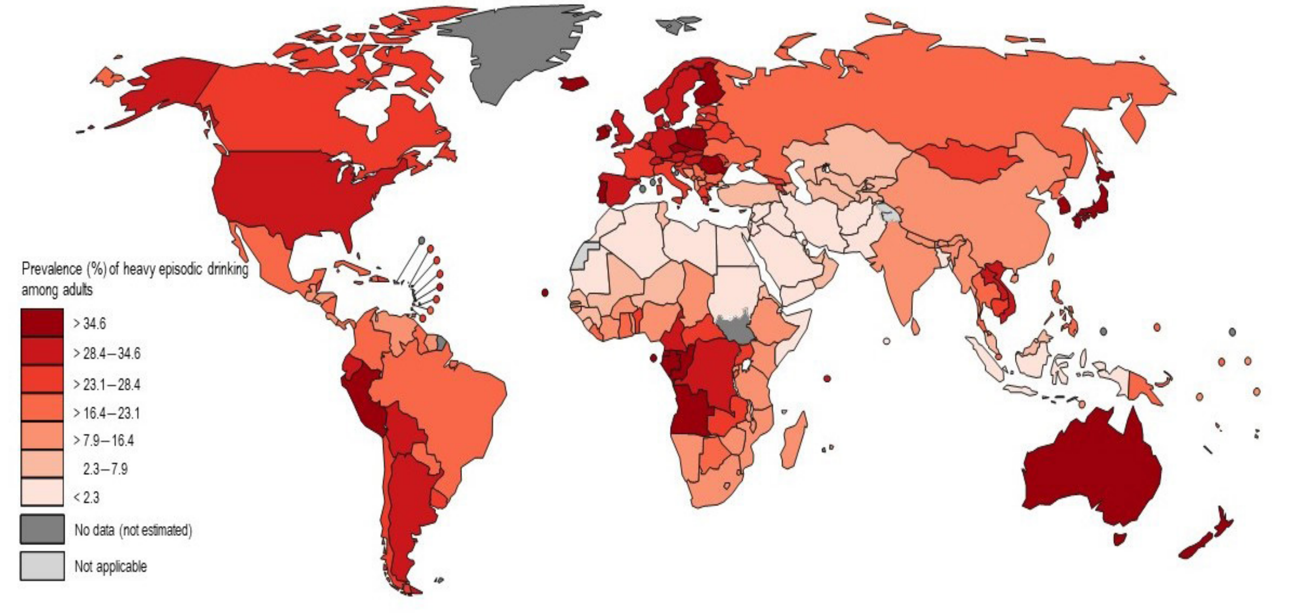


Figure modelled by the Working Group based on survey data collected for WHO (2022b); for modelling details, see Manthey et al. (2019).

Fig. 1.3 Adult alcohol per capita consumption among individuals who drink in 2019, in litres of pure ethanol

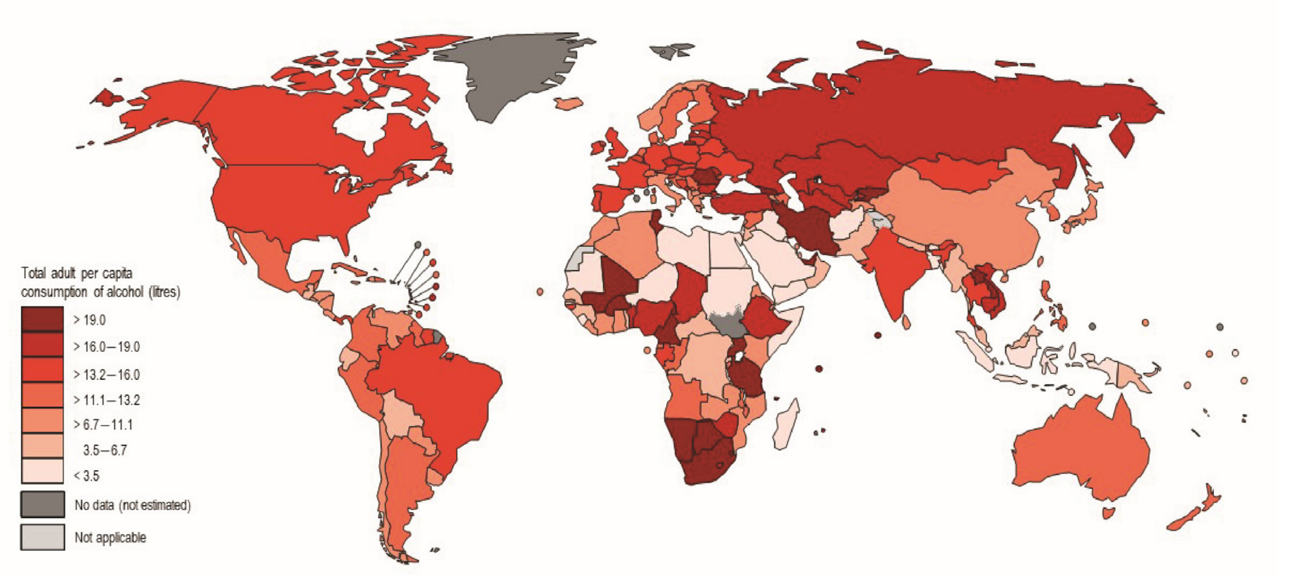


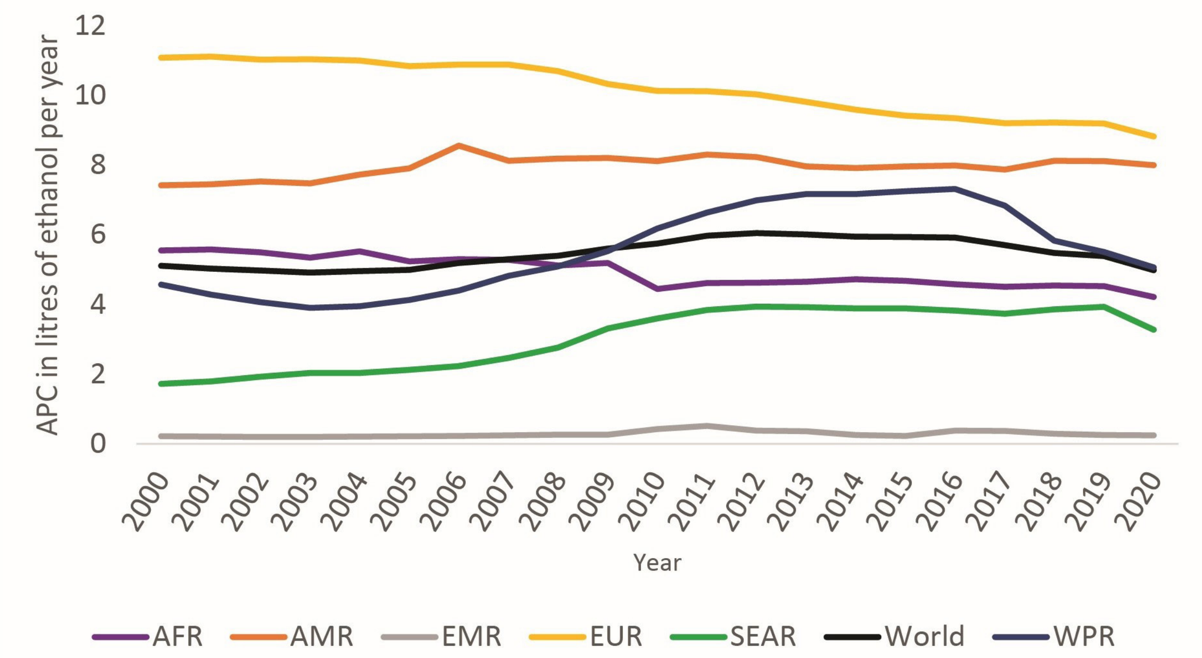
Figure modelled by the Working Group based on alcohol per capita consumption (APC) data and survey data collected for WHO (2022b); for modelling details, see Manthey et al. (2019).

Western Pacific Region (Table 1.3). The APCs in other regions were below the global average, and the WHO Eastern Mediterranean Region had the lowest APC. The level of consumption is also correlated with the prevalence of current alcohol consumption (any alcohol consumed in the previous 12 months; WHO, 2018) and has the same rank order as the APC. At the country level, the prevalence of alcohol consumption was highest in high-income countries in Europe and Australasia, where more than three quarters of adults consumed alcohol, and lowest in a belt of Muslim-majority countries that stretches from northern Africa across the Near and Middle East to Indonesia (Fig. 1.1).

Another indicator considers the amount of alcohol consumed by individuals who drink, i.e. adult APC per drinker (Fig. 1.3). The APC per drinker in 2019 was relatively stable, with some regional differences, i.e. highest in the WHO African Region and lowest in the WHO Eastern Mediterranean Region and the WHO Western Pacific Region (Table 1.3). Notably, some countries with low or relatively low APC have high adult APC per drinker, whereas countries with the highest overall APC also show a high prevalence of alcohol consumption. In some Muslim-majority countries, the prevalence of alcohol consumption is underestimated because of social norms; thus, the APC per drinker is overestimated.

HED does not have the same rank order as APC (Table 1.3), because it is an independent, but correlated, dimension that cannot be derived from the level of alcohol consumption alone (Rehm and Gmel, 2000; Rehm et al., 2004). Thus, with the same overall level of alcohol consumption, an individual could consume 10 g of alcohol (one standard drink in many countries) daily on weekdays or consume 70 g on the weekend and abstain on all weekdays. Whereas regional averages give an overview of HED, the prevalence of HED in 2019 shown in Fig. 1.2 reveals important between-country differences within regions.

Fig. 1.4 Trends in adult alcohol per capita consumption since 2000



AFR, WHO African Region; AMR, WHO Region of the Americas; APC, alcohol per capita consumption; EMR, WHO Eastern Mediterranean Region; EUR, WHO European Region; SEAR, WHO South-East Asia Region; WHO, World Health Organization; WPR, WHO Western Pacific Region.
Data source: WHO (2024).

Also, the prevalence of HED is only a rough indicator of HED because the average number of heavy drinking occasions may vary considerably, depending on the culture in a particular country (Gmel et al., 2003).

According to all alcohol indicators, men have more detrimental patterns of alcohol consumption than women do. Compared with women, men have a higher prevalence of consumption, have a higher APC (Manthey et al., 2019), and are more likely to engage in HED (Table 1.3; for details, see Section 1.2.3).

(b) Trends in alcohol consumption

Fig. 1.4 provides an overview of trends in the levels of alcohol consumption as measured in adult APC over the past two decades. Globally, the level of alcohol consumption was relatively stable, with an increase starting in 2000 and a decrease after 2016.

The WHO European Region reported reduced adult APC over the past two decades, which was driven mainly by decreased alcohol consumption in the eastern part of the region (Rehm et al., 2019) attributable largely to the implementation of strong alcohol control policies, particularly increased taxation (Berdzuli et al., 2020). The APC in the WHO Region of the Americas was stable overall (see also Monteiro et al., 2021).

The WHO Western Pacific Region had the greatest variability in alcohol consumption levels in recent decades, which was driven mainly by the largest country in the region, China. The increases until 2016 can be attributed largely to economic growth (Rehm et al., 2021). The sharp decrease after 2016 has often been attributed to “anti-corruption” regulations introduced in 2012, which prohibited alcohol consumption at military functions and serving alcohol as part of invitations for business events or public administration meetings and events, as well as to the implementation of other alcohol control policies (Shu and Cai, 2017; Guo and Huang, 2015; Hu et al., 2022).

In the WHO African Region, there was a relatively stable level of consumption (Morojele et al., 2021). In the WHO South-East Asia Region, in which India is the largest country, until the COVID-19 pandemic began, alcohol consumption had increased steadily due to economic growth (Rehm et al., 2021), coupled with a fractured response to control policies (Gururaj et al., 2021).

Finally, in Muslim-majority countries, where alcohol is often prohibited, a very low level of alcohol consumption in general has persisted over the past two decades, despite some loosening of alcohol control policies (Al-Ansari et al., 2016).

The trends in the prevalence of current alcohol consumption globally are much less pronounced than the trends in APC. Overall, the prevalence of current alcohol consumption has fluctuated between 43% and 45% over the past two decades, with a COVID-19-associated decrease of 1% in 2020 (WHO, 2024). Similarly, the prevalence of current alcohol consumption in different WHO regions has remained relatively stable. Again, there may be some subregional variations that are not fully reflected in the trends from the WHO regions. The most remarkable trend in recent years was the increase in alcohol consumption in countries in the WHO South-East Asia Region (Manthey et al., 2019; Sornpaisarn et al., 2020).

1.2.3 Determinants of consumption

(a) Sex and gender

Globally, 52% of males and 35% of females currently consume alcohol (WHO, 2024). Among individuals who consume alcohol, males also generally consume greater quantities than females do (reported daily mean of 36 g of pure ethyl alcohol for males vs 13 g for females) (WHO, 2024). Less of a difference has been observed between males and females in the prevalence and quantity of alcohol consumption in geographical areas with a high sociodemographic index (i.e. comparatively advantaged) than in areas with a lower sociodemographic index (GBD 2016 Alcohol Collaborators, 2018) and in the prevalence of HED in higher-income countries than in low- and middle-income countries (Grittner et al., 2020). Alcohol use disorders are more common among males than among females (Glantz et al., 2020).

Although sex-related differences in the prevalence of alcohol consumption persist, a meta-regression of 50 studies (primarily in North America and Europe) shows convergence over time, with a male-to-female ratio of 2.2 for individuals born in 1891–1910 compared with 1.1 for those born in 1991–2000, driven primarily by an increase in alcohol consumption among women (Slade et al., 2016). However, a review of published data for the prevalence of alcohol consumption in the USA (collected at various time points between 1975 and 2017, with all included studies reporting on data up to at least 2008) showed differences in alcohol consumption patterns by age group. Compared with previous generations, middle-aged and older females consumed more alcohol, whereas males consumed about the same amount of alcohol. In general, adolescents and younger adults have been found to consume less alcohol than previous generations, and consumption is decreasing more among males than among females (Keyes et al., 2019).

The sex-related differences in the prevalence and patterns of alcohol consumption are also related to gender influences (i.e. socially constructed roles and norms) (Hughes et al., 2016), which contribute to the generally narrower gap between males and females in some countries and cultures than in others (Sudhinaraset et al., 2016). Furthermore, when considering sex-related differences in alcohol consumption, it is important to acknowledge that evidence is lacking about the prevalence of alcohol consumption and cessation in intersex and transgender subpopulations (Gilbert et al., 2018).

(b) Age and life-course

Globally, consumption of alcohol often begins in adolescence or in the early 20s, and there is a clear increase in the prevalence of current alcohol consumption and HED between individuals aged 15–19 years and individuals aged 20–24 years in all regions of the world and among both males and females. The prevalence of current consumption then remains relatively stable from the late 20s to the 50s and decreases at older ages (WHO, 2024) (Table 1.4).

The age at which alcohol consumption peaks varies by location. A synthesis of nine cohort studies in the United Kingdom (using data collected in 1979–2013, with the age at data collection ranging from 15 years to > 90 years) showed a steep increase in the quantity of alcohol consumption in adolescence, with a peak in the mid-20s, followed by a decrease and plateau in middle age and a further decrease in the 60s and 70s (Britton et al., 2015). In contrast, in the USA, a slightly earlier peak in various alcohol consumption-related outcomes (in the early 20s) has been observed, with a subsequent decrease for the remainder of the lifespan (Lee and Sher, 2018).

Although most individuals reduce their alcohol consumption as they age relative to their own earlier consumption, it is important to contextualize this observation in relation to general population trends, which point toward overall increased levels of consumption among older people compared with earlier cohorts, particularly in higher-income countries (Han et al., 2017; Bye and Moan, 2020), and a slower rate of decrease in alcohol consumption among recent cohorts of older people compared with earlier cohorts (Moore et al., 2005).

(c) Race, ethnicity, and cultural and religious factors

Globally, the prevalence, pattern, and nature of alcohol consumption are highly variable between, and sometimes within, cultural groups, and therefore cannot easily be summarized. In considering alcohol consumption by race, ethnicity, culture, and religion, it is important to acknowledge that these concepts overlap and are socially constructed, multidimensional, and subject to change, particularly in the context of migration and globalization (Savic et al., 2016; Hunt et al., 2018; Aresi and Bloomfield, 2021). In general, there is also more evidence about ethnicity-related alcohol consumption patterns in high-income countries that have well-established data collection systems, such as the USA, the United Kingdom, and European countries, than from other geographical areas. Also, some genetic polymorphisms in some racial and ethnic groups are known to affect alcohol metabolism, making such individuals less likely to consume alcohol, or likely to consume less (see Section 3.1.1). The concomitant role of environmental factors in influencing consumption has also been studied (Wall et al., 2016). Furthermore, in some countries, colonization and ensuing intergenerational trauma have had a profound effect on patterns of alcohol consumption among some Indigenous groups, which is not representative of traditional culture (King et al., 2009). Despite these caveats, examining alcohol consumption by race, ethnicity, culture, and religion can offer some insights into potential disparities, as illustrated by the deliberately diverse examples presented here.

A 2014 survey in Yunnan Province in China examined the alcohol consumption of people aged 12–35 years from Han (Chinese ethnic majority), Lisu, and Yi backgrounds using a variety of measures (He et al., 2016). Compared with people in the other two groups, the individuals with a Lisu background consumed

Table 1.4 Prevalence of current alcohol consumption and heavy episodic drinking by age group, sex, and WHO region

Alcohol consumption indicator by region	Age group (years)																	
	Males						Females						Overall					
	15–19	20–24	25–34	35–49	50–64	≥ 65	15–19	20–24	25–34	35–49	50–64	≥ 65	15–19	20–24	25–34	35–49	50–64	≥ 65
Prevalence of current alcohol consumption (%)																		
World	23.3	47.2	56.3	58.5	58.5	52.3	20.3	34.7	37.5	40.5	38.5	30.4	21.8	41.1	47.1	49.6	48.4	40.1
WHO African Region	14.6	38.4	46.8	46.0	40.0	28.0	12.2	24.7	25.0	24.6	19.1	10.4	13.4	31.5	35.8	35.2	29.0	18.2
WHO Region of the Americas	44.2	71.1	76.0	74.6	70.9	58.0	40.0	58.1	57.3	57.8	52.2	38.5	42.1	64.7	66.7	66.2	61.3	47.2
WHO Eastern Mediterranean Region	1.2	5.0	7.7	7.7	6.0	3.7	1.0	2.5	2.7	2.7	2.0	1.0	1.1	3.7	5.3	5.3	4.0	2.2
WHO European Region	46.1	67.0	72.8	75.0	74.4	68.8	42.3	57.0	57.9	61.1	57.6	46.1	44.3	62.2	65.4	68.0	65.6	55.4
WHO South-East Asia Region	12.4	34.8	43.5	43.3	38.6	28.2	10.2	21.6	22.2	22.2	17.9	10.2	11.4	28.4	33.1	33.0	28.3	18.5
WHO Western Pacific Region	38.2	70.3	78.0	78.4	74.7	64.4	33.3	54.7	55.8	56.6	48.8	33.7	35.9	62.9	67.3	67.8	61.7	47.5
Prevalence of HED (%)																		
World	11.8	24.2	27.8	27.5	24.0	12.6	9.0	13.1	10.8	9.9	7.1	3.5	10.4	18.8	19.5	18.8	15.4	7.6
WHO African Region	9.5	24.2	28.6	26.9	21.4	9.8	7.4	13.0	11.1	9.7	6.4	2.4	8.5	18.6	19.8	18.2	13.5	5.7
WHO Region of the Americas	24.0	40.6	43.4	41.0	35.0	16.5	18.4	23.4	18.6	16.1	11.2	4.8	21.2	32.1	31.1	28.4	22.7	10.0
WHO Eastern Mediterranean Region	0.3	1.4	2.1	1.9	1.3	0.4	0.2	0.5	0.4	0.3	0.2	0.0	0.2	0.9	1.3	1.2	0.7	0.2
WHO European Region	24.2	38.2	40.8	40.6	35.9	18.8	18.0	22.3	17.8	16.4	11.3	5.0	21.2	30.5	29.5	28.4	23.1	10.7
WHO South-East Asia Region	6.2	17.1	20.7	19.5	15.3	6.3	4.5	8.0	6.6	5.6	3.5	1.2	5.4	12.8	13.8	12.7	9.4	3.5
WHO Western Pacific Region	16.3	29.9	32.2	31.1	25.1	12.9	12.5	16.2	12.2	10.8	7.3	3.8	14.5	23.4	22.6	21.2	16.1	7.9

Table 1.4 (continued)

Alcohol consumption indicator by region	Age group (years)																	
	Males						Females						Overall					
	15–19	20–24	25–34	35–49	50–64	≥ 65	15–19	20–24	25–34	35–49	50–64	≥ 65	15–19	20–24	25–34	35–49	50–64	≥ 65
Prevalence of HED among individuals who currently consume alcohol (%)																		
World	50.6	51.3	49.4	47.0	41.0	24.1	44.2	37.6	28.8	24.5	18.5	11.6	47.7	45.7	41.4	37.9	31.9	18.8
WHO African Region	64.9	63.2	61.2	58.5	53.6	35.1	60.6	52.8	44.3	39.4	33.4	22.9	62.9	59.1	55.3	51.8	46.6	31.2
WHO Region of the Americas	54.2	57.2	57.2	54.9	49.3	28.5	46.0	40.2	32.4	27.8	21.4	12.5	50.4	49.7	46.6	43.0	37.0	21.3
WHO Eastern Mediterranean Region	23.9	27.5	26.6	24.8	20.9	10.0	20.1	18.7	14.4	12.2	8.7	4.2	22.2	24.7	23.7	21.8	18.0	8.7
WHO European Region	52.4	57.0	56.1	54.1	48.3	27.4	42.5	39.1	30.8	26.8	19.7	10.8	47.8	49.0	45.1	41.8	35.2	19.3
WHO South-East Asia Region	49.7	49.2	47.6	45.0	39.7	22.3	44.4	37.3	29.6	25.3	19.8	11.6	47.4	44.9	41.8	38.5	33.4	19.1
WHO Western Pacific Region	42.7	42.5	41.3	39.7	33.6	20.0	37.6	29.7	21.9	19.2	14.9	11.4	40.5	37.2	33.6	31.3	26.1	16.6

HED, heavy episodic drinking (≥ 60 g of ethanol [pure alcohol] at least once per month); WHO, World Health Organization.
Calculated by the Working Group.

significantly more alcohol (daily and annually), and proportionately more of them reporting binge drinking. In contrast, a significantly larger proportion of the participants with a Han background reported experiencing intoxication.

The potential impact of globalization on patterns of alcohol consumption in China was evident from a survey of university students from northern, central, and southwestern China. The students who had a "Western cultural orientation" (as assessed with the Chinese Cultural Orientation Questionnaire) were > 3 times as likely to have consumed alcohol within the previous 30 days as those who did not have such a cultural orientation (Wang et al., 2016).

Another study examined alcohol consumption patterns among Ghanaians who lived in rural and urban areas of Ghana and in three European cities (London, Berlin, and Amsterdam). The prevalence of consumption was generally highest among Ghanaians living in Europe (except for males living in London, of whom fewer consumed alcohol compared with their counterparts in rural Ghana). The number of years since migration was positively associated with the prevalence of alcohol consumption (Addo et al., 2018).

A meta-analysis of 41 studies of alcohol consumption patterns among Australian Aboriginal and Torres Strait Islander (Indigenous) people found that 59% of almost 60 000 individuals currently consumed alcohol (Conigrave et al., 2020). About one third of the individuals consumed four or more standard drinks on a single occasion (i.e. were at single-occasion risk), and about one fifth averaged more than two drinks per day (i.e. were at lifetime risk). However, there was substantial variation within and between samples, and factors such as geography, local alcohol policy context, study design, and diversity among Indigenous communities must be considered.

(d) Smoking

Smoking tobacco and consuming alcohol are recognized as overlapping behaviours, with a higher likelihood of concomitancy (Shiffman and Balabanis, 1996; Room, 2004; Anand and Roy, 2016; Francisco et al., 2019). The extent to which the two behaviours overlap varies between populations (Noble et al., 2015; Meader et al., 2016; Wu et al., 2023). A recent review and meta-analysis estimated that smoking is associated with an almost 3-fold risk of HED, although the magnitude of this effect varies by sex and nationality (Molaeipour et al., 2023), and a study in Brazil found that individuals who smoked were more likely to consume alcohol than those who did not smoke (Francisco et al., 2019). Smoking tobacco and consuming alcohol concurrently increases the risk of developing cancer in a multiplicative manner (Ho et al., 2021).

(e) Socioeconomic status

In general, people with higher socioeconomic status consume alcohol more often and in larger quantities compared with individuals with lower socioeconomic status, although individuals from disadvantaged groups are at a greater risk of alcohol-related harm per litre of alcohol consumed (Collins, 2016; Probst et al., 2021; Xu et al., 2022; Room and Rehm, 2023).

However, there are some exceptions to the generally linear association between alcohol consumption and socioeconomic status. A 2018 review of 23 studies in 10 countries in South-East Asia and Africa found that alcohol consumption was more prevalent among individuals with low income and no formal education in South-East Asia, especially men (Allen et al., 2018). In upper-middle-income countries, HED was found to be more likely among people with low socioeconomic status, whereas the opposite was observed in low-income countries (Xu et al., 2022).

Unrecorded alcohol accounts for a larger proportion of the total alcohol consumed in low- and lower-middle-income countries than in higher-income countries (Probst et al., 2018; Probst et al., 2019). Furthermore, evidence indicates that in some countries, consumption of counterfeit and surrogate alcohol is associated with socioeconomic measures such as lower per capita income and unemployment (Neufeld et al., 2016; Kotelnikova, 2017).

(f) Social role transition

Among young adults, the transition to full-time work has been associated with HED and negative outcomes from alcohol consumption (Lee et al., 2018).

Separation and divorce have been associated with increased alcohol consumption, especially among men (Kretsch and Harden, 2014; Salvatore et al., 2020).

The transition to retirement has been associated with an increase in alcohol consumption (or no change or a decrease among a minority of individuals), and the differences in these outcomes have been attributed to context and personal characteristics (e.g. job satisfaction and stress before retirement, social roles and networks, involuntary retirement, gender, and previous alcohol consumption), rather than to retirement itself (Kuerbis and Sacco, 2012; Halonen et al., 2017; Holdsworth et al., 2017; Holton et al., 2019). Britton and Bell (2015) found that changes in roles and social connections among older individuals can be a risk factor for alcohol consumption, with self-reported increases in alcohol consumption among people older than 60 years being attributed to participating in more social events and having fewer responsibilities.

1.2.4 Determinants of reduction or cessation

In this section, a distinction is made between a factor experienced by an individual that contributes to a reduction or cessation of alcohol consumption and any *interventions* that may have contributed to it. For example, the affordability of alcohol, which may influence an individual's decision about whether to consume alcohol, is discussed here. However, alcohol pricing policies, which may as a precursor have influenced affordability, are not discussed.

(a) Age

Multiple reports have shown a decrease in alcohol consumption since the early 2000s among adolescents and young adults (Ng Fat et al., 2018; Pape et al., 2018; De Looze et al., 2019; Holmes et al., 2022). A recent analysis of survey data published between 1995 and 2017 explored the relative timing and magnitude of this trend among adolescents in 39 of 80 high-income countries (Vashishtha et al., 2021). A decrease in the prevalence of alcohol consumption in the previous month was first observed in the late 1990s in North America, followed by decreases in northern Europe, western Europe, and Australasia, with the largest decrease noted in northern Europe and the British Isles. Similarly, between 2000 and 2016, the reported prevalence of HED decreased among young people in many regions, with the largest decrease noted in the WHO European Region (10.5% among individuals aged 15–19 years and 12.1% among individuals aged 20–24 years) and a smaller decrease in the WHO Region of the Americas, the WHO African Region, and the WHO Eastern Mediterranean Region (WHO, 2018). It remains to be seen whether the reported decreases in alcohol consumption among young people will continue as these cohorts age and/or will persist into future generations.

The tendency for alcohol consumption to decrease at older ages has been widely observed. An international study of alcohol consumption in later life combined longitudinal survey data collected in 1998–2016 for adults aged > 50 years in 21 countries. Overall, there was a decreasing trajectory in alcohol consumption with age, although those who were younger (aged 50–64 years) consumed more alcohol but less frequently than those who were older (aged ≥ 65 years) (Calvo et al., 2020). Biological changes that affect alcohol metabolism that occur as people age may partly explain this phenomenon and include decreased ability to metabolize alcohol because of reduced enzymatic activity, increased liver size, changes in body water volume, and increased susceptibility to the unpleasant effects of alcohol consumption (Meier and Seitz, 2008). The potential for interactions with medication and an increased risk of falls may also contribute to reduced alcohol consumption by some people at older ages (65–103 years) (Pringle et al., 2006).

(b) Health

Health-related reasons for reducing alcohol consumption generally fall into two broad categories: preserving or improving health, and being ill (sick quitters) (Shaper et al., 1988; Dawson et al., 2013). Numerous studies that have elicited self-reports from individuals about their reasons for reducing alcohol consumption or abstaining have identified physical health-related and mental health-related factors as predominant contributors, among both the general population and people who engage in HED: a systematic review of studies on cessation (Rosansky and Rosenberg, 2020), studies on reduction and possibly cessation (Britton and Bell, 2015; Beard et al., 2017), and studies on both cessation and reduction (Pennay et al., 2019). The specific health reasons measured vary across studies but commonly include the following: as a health precaution, for weight loss, concern about kilojoules/effects on body weight, psychological health, medical advice, or current health problems. For example, 40% of participants in the Whitehall II Cohort Study, who were aged 60–85 years when they completed the 2012–2013 follow-up questionnaire, reported reducing their alcohol consumption in the previous decade. Of these individuals, 41.6% indicated that they did so as a health precaution, 21.0% reduced their alcohol consumption due to illness or because of a medication they were taking, and 2.0% gave past problems with alcohol consumption as the reason (Britton and Bell, 2015).

Several cohort studies have tracked measures of alcohol consumption and health over time, and evidence suggests that moving from consumption to abstinence (Wannamethee and Shaper, 1988; Dawson et al., 2013; Park et al., 2017), or to abstinence or consumption only on special occasions (Ng Fat et al., 2015), may be associated with various measures of poor health.

Emerging health conditions may also lead to abstinence. For example, Sarich et al. (2019) found that the emergence of three cardiovascular disease-related conditions (heart disease, stroke, and blood clot) predicted abstinence, whereas Park et al. (2017) found no relationship between the emergence of cardiovascular disease and abstinence.

(c) Smoking

A survey of households in the USA found that among adults who consume alcohol regularly, the likelihood of ceasing alcohol consumption was higher if they did not smoke than if they did smoke, and that smoking cessation was associated with a greater likelihood of ceasing alcohol consumption (Dawson et al., 2013). This contrasts with a prospective cohort study conducted in the United Kingdom, the USA, Australia, and Canada, which found that people who ceased smoking for ≥ 6 months were not more likely to change their alcohol consumption compared with people who continued to smoke (Kahler et al., 2010).

Studies have also shown that tobacco control policies have some effect on alcohol consumption. At the population level, Krauss et al. (2014) found that smoke-free air policies and higher tobacco taxes were associated with decreases in APC. At the individual level, Kasza et al. (2012)

found that smoke-free bars were associated with minor decreases in the amount of alcohol typically consumed in hazardous alcohol consumption (i.e. consumption of > 14 drinks per week by men and > 7 drinks per week by women).

In a review of studies of people being treated for alcohol use disorders, not smoking or reducing smoking was significantly associated with reduced alcohol consumption and/or a higher likelihood of maintaining abstinence from alcohol consumption in about half of the included studies. However, participating in a smoking cessation intervention while being treated for alcohol use disorders did not improve alcohol consumption outcomes in most studies (van Amsterdam and van den Brink, 2022). Furthermore, one study found that whereas smoking increased the overall likelihood of relapse to alcohol consumption, the number of cigarettes smoked may have an independent effect on outcomes (i.e. the higher the number of cigarettes smoked per day, the lower the likelihood of relapse to alcohol consumption) (Hufnagel et al., 2017).

A review of natural and intervention studies found that alcohol consumption was associated with a lapse or relapse to smoking and a shorter duration of smoking cessation in most of the included studies (van Amsterdam and van den Brink, 2023). Smoking cessation intervention studies have found that a reduction in smoking is associated with reduced alcohol consumption overall and reduced HED, and that the greater the reduction in smoking, the greater the reduction in alcohol consumption (Philibert et al., 2021; Yonek et al., 2021).

(d) Social role transition

A large body of cross-sectional and longitudinal evidence links social roles and transitions between roles (e.g. establishing a romantic partnership or marriage, parenthood, and retirement) with reductions in alcohol consumption.

Multiple studies have found that, among both men and women, the transition to marriage or cohabitation is predictive of reduced alcohol consumption (e.g. Hajema and Knibbe, 1998; Kretsch and Harden, 2014; Staff et al., 2014; Evans-Polce et al., 2020; Leggat et al., 2020; Salvatore et al., 2020).

Pregnancy and the transition to motherhood have been identified as protective against alcohol consumption for most women (Pryor et al., 2017; Borschmann et al., 2019; Voutilainen et al., 2022). However, the strength of the protective effect of motherhood may vary based on an individual's sociodemographic characteristics. For example, older mothers are more likely to consume alcohol, and women with more children are less likely to consume alcohol (Vicario et al., 2023), but these effects may diminish over time (Borschmann et al., 2019; Leggat et al., 2021). The impact of pregnancy on alcohol consumption by a male partner has been associated with both reduced (Högberg et al., 2016) and unchanged (Borschmann et al., 2019) alcohol consumption relative to the period before the pregnancy. Similarly, the gap in HED between parents and non-parents was lower for men than for women, particularly among individuals in their mid-20s to mid-30s (Evans-Polce et al., 2020).

The transition to retirement has been associated with a decrease in alcohol consumption among a minority of individuals, and an increase or no change in alcohol consumption in other people (see Section 1.2.3). These findings have been attributed to context and personal characteristics (e.g. job satisfaction and stress before retirement, social roles and networks, involuntary retirement, gender, and previous alcohol consumption), rather than to retirement itself (Kuerbis and Sacco, 2012; Halonen et al., 2017; Holdsworth et al., 2017; Holton et al., 2019). Britton and Bell (2015) found that changes in roles and social connections among older individuals can also be protective against alcohol consumption by older individuals, with self-reported reductions in alcohol consumption attributed to participation in fewer social events.

(e) Social networks

The understanding of how alcohol consumption patterns shift within a population has long been informed by Skog's theory of collectivity of "drinking cultures", which postulates that as the population average of alcohol consumption increases or decreases, so does the distribution of alcohol consumption across the population (Skog, 1985). The proposed mechanism of this effect is the "direct and indirect influences between drinkers in a social network" (Skog, 1985), which may shape alcohol consumption across an entire population. This notion of collectivity has been influential in public health responses to reduce alcohol consumption and harms, and empirical evidence has tended to support the theory (Raninen and Livingston, 2020). However, more recently, studies have identified patterns of reduction in alcohol consumption within populations that are less pronounced in some groups than in others (i.e. "soft collectivity") or that indicate polarization between groups, suggesting that there may be barriers to social transmission of behaviour across some groups (e.g. by age) (Oldham et al., 2020; Raninen and Livingston, 2020; Mojica-Perez et al., 2022). Even if collectivity does not hold true across an entire population, there is evidence that interactions within an individual's immediate social network, including their social media contacts, may influence when they begin consuming alcohol and whether they maintain, increase, or reduce their alcohol consumption (Studer et al., 2014; Reid et al., 2015; Knox et al., 2019; Pennay et al., 2019; Morris et al., 2020; Lau-Barraco et al., 2022). This influence may occur through shared behaviour or informal social control (Skog, 1985). For example, in a sample of people with "high-risk" alcohol consumption – defined as scoring ≥ 8 on the Alcohol Use Disorders Identification Test (AUDIT) or ≥ 5 on questions 1–3 of the AUDIT – who were currently trying to reduce their consumption, 6% indicated that something that their family, friends, or children had said contributed to their decision (Beard et al., 2017).

(f) Religion

Although religions differ in their beliefs and values regarding alcohol consumption, religiosity generally has been shown to be a protective factor against initiation of alcohol consumption and a high level of alcohol consumption, and it is associated with abstinence (Porche et al., 2015; Lin et al., 2020). For example, in a two-wave study in the USA, individuals who reported former alcohol consumption in both waves were more likely to have attended religious services at least twice a week and to regard their religious beliefs as "very important" than those who started consuming alcohol again between the study waves; this suggests that both public and intrinsic aspects of religiosity may support continued alcohol cessation (Lin et al., 2020). However, a cross-sectional study among young people in Australia found that, compared with individuals who did not identify as being part of a religious group, those who did were less likely to decrease their alcohol consumption or cease alcohol consumption (Raggatt et al., 2019). Periods of religious significance or fasting, such as Islamic Ramadan, Buddhist Lent, and Orthodox Christian Lent, have also been linked to temporary periods of reduced alcohol consumption or abstinence in the countries where they are observed (Çelen, 2015; Jirarattanasopha et al., 2019; Necula and Mann, 2020).

(g) Affordability and availability

Alcohol affordability is a function of both income and price and has been associated with population levels of alcohol consumption, such that consumption is higher when alcohol is more affordable and lower when it is less affordable (Rabinovich et al., 2009; Wall and Casswell, 2013). There is strong evidence from several countries that budgetary constraints associated with periods of economic downturn (i.e. potentially lower affordability) are connected to less spending on alcohol, and hence lower consumption (i.e. a pro-cyclical effect) (de Goeij et al., 2015). This effect is exemplified through the relationship between alcohol sales (which correlate with total population alcohol consumption) and gross domestic product in Sweden from 1861 to 2000, between alcohol consumption and regional gross domestic product in Finland from 1982 to 2001, and between alcohol consumption and unemployment rates in the USA from 1987 to 1999 (Ruhm and Black, 2002; Johansson et al., 2006; Krüger and Svensson, 2010). Unfavourable economic conditions have been associated with a shift from heavier to lighter consumption of alcohol, rather than to increased abstention (Ruhm and Black, 2002; Johansson et al., 2006). However, the pro-cyclical effect linked to affordability described previously may not hold true for all individuals, because there is also evidence that some people, particularly men, respond to the stress of reduced income from unemployment, or the threat of this, by consuming more alcohol than they previously did (Dee, 2001; de Goeij et al., 2015). That is, there may be a counter-cyclical effect of economic downturn, even when the overall population effect may be pro-cyclical.

Survey-based studies provide further evidence that affordability (indirectly measured through reasons such as "to save money" and because alcohol is "too expensive") is a contributing factor in the decision to reduce alcohol consumption or abstain for a minority of people, for example 9.9% of older people who had already reduced their alcohol consumption (Britton and Bell, 2015) and 7.6% of individuals who were trying to cut down their "high-risk" consumption (defined previously) (Beard et al., 2017). However, affordability does not appear to be the most salient factor in this decision. In a review of studies of reasons for abstinence among individuals who had abstained all their lives, were currently abstinent, and had a history of "problematic drinking" but no longer consumed alcohol, "financial reasons" were rarely among the top three reasons for abstinence (Rosansky and Rosenberg, 2020).

During the COVID-19 pandemic, there was an overall reduction in alcohol consumption, and probably a lower 12-month prevalence of consumption due to the lower availability of alcohol, partly because of limitations on gatherings, especially in low- and middle-income countries. Globally, APC decreased by about 8% during the first year of the pandemic (WHO, 2024).

1.3 Population attributable fraction

1.3.1 Definitions and general considerations

Population attributable fraction (PAF) in the context of alcohol consumption and cancer includes abstinence as the theoretical-minimum-risk exposure (Shield et al., 2020; Rumgay et al., 2021a). However, the proportion of alcohol-attributable cancer cases that could be prevented is likely to be smaller than PAFs because public health interventions are unlikely to completely eliminate alcohol consumption in the entire population. Several studies have estimated that the population preventable fraction represents the level that can be attained by interventions, although the attainable level may vary across studies (Mons et al., 2018; Young et al., 2018; Grevers et al., 2019). Because contemporary estimates for population preventable fraction are lacking worldwide, this section highlights global and regional PAF estimates for 2020, as reported by IARC (Rumgay et al., 2021b).

The calculation of PAF for cancers generally requires information about the prevalence of exposure levels, relative risks for the association between the exposure and the cancer of interest, and cancer counts or rates. Researchers frequently use risk-factor exposure data from representative surveys, which often are adjusted for underestimation by self-report (see below), cancer data from cancer registries or vital statistics databases, and relative risks from a single study or pooled analyses or meta-analyses (preferably of prospective cohort studies). Most studies take into consideration lag time between exposure and cancer occurrence (usually 10 years) (Rehm et al., 2010; Shield et al., 2020; Rumgay et al., 2021a).

There are several considerations when interpreting PAF estimates for alcohol consumption and cancer (Greenland, 2015). First, because data about alcohol consumption and cancer may not be available for some countries or populations, researchers may impute this information by modelling subnational, regional, or other available data (Shield et al., 2020; GBD 2019 Cancer Risk Factors Collaborators, 2022). Second, some studies may not include former alcohol consumption when estimating PAFs, which may result in underestimation of PAFs (Wilson et al., 2018; Chen et al., 2019; Goding Sauer et al., 2021), largely because of the sparsity of reliable data about former alcohol consumption or associated relative risks. Some other studies may impute data on former alcohol consumption by using modelling of other available data about such consumption (Shield et al., 2020). Third, because alcohol consumption is generally highly underreported in surveys, researchers may adjust data about consumption based on production, sales, or taxation statistics using different methods (Islami et al., 2018; Esser et al., 2022). However, these statistics generally are not stratified by age, sex, or other demographic characteristics, whereas the extent of underreporting may differ across population groups. Fourth, studies have generally used the same cancer-specific relative risks for all evaluated populations; therefore, variations in PAFs across populations reflect differences in alcohol consumption and distribution of cases by cancer site. However, the burden of a cancer associated with alcohol in a population may be substantially high due to other risk factors, which may result in overestimation of the number of alcohol-attributable cases for that cancer site and, consequently, overestimation of the total number and proportion of alcohol-attributable cases (all cancers combined) in that population. Fifth, previous studies generally have not taken into account possible interactions between alcohol consumption and genetic or potentially modifiable risk factors (e.g. cigarette smoking, viral hepatitis), which may result in misestimation of PAFs. Finally, PAF estimates may vary across studies because of differences in the list of cancer sites included in the analyses.

1.3.2 Cancer cases attributable to alcohol consumption

Whereas the APC reported in the previous section was reported by WHO region, this section describes regional patterns using the United Nations geographical regions (UNSTAT, 2024).

(a) All cancers combined

(i) Global patterns

In 2020, an estimated 741 300 new cancer cases, or 4.1% of all new cancer cases globally, were attributable to current alcohol consumption (Rumgay et al., 2021b) (Table 1.5). About three quarters of those cancers occurred among males (568 700 cases among males, and 127 600 cases among females), resulting in a larger proportion of alcohol-attributable new cancer cases among males (6.1%) than among females (2.0%). Although consuming > 60 g of alcohol per day contributed the most alcohol-attributable new cancer cases (346 400 cases; 46.7%), followed by consuming 20–60 g of alcohol per day (291 800 cases; 39.4%), consuming a moderate amount of alcohol (< 20 g per day) also contributed a considerable number of cases (103 100 cases; 13.9%) (Rumgay et al., 2021a).

Table 1.5 Number and proportion of new cancer cases in 2020 attributable to alcohol consumption by cancer site, sex, and region, all ages combined

Cancer site (ICD-10 codes) by region	Overall		Males		Females	
	PAF (95% CI)	Alcohol-attributable cases (95% CI)[a,b]	PAF (95% CI)	Alcohol-attributable cases (95% CI)[a,b]	PAF (95% CI)	Alcohol-attributable cases (95% CI)[a,b]
All sites excluding non-melanoma skin cancer (C00–C97 excluding C44)						
Global	4.1 (3.1–5.3)	741 300 (558 500–951 200)	6.1 (4.6–7.9)	568 700 (422 500–731 100)	2.0 (1.6–2.5)	172 600 (135 900–220 100)
Africa						
Eastern Africa	2.6 (1.8–3.4)	8300 (5800–11 100)	4.9 (3.4–6.4)	6000 (4200–7900)	1.1 (0.8–1.6)	2300 (1700–3100)
Middle Africa	2.5 (1.7–3.5)	2600 (1700–3700)	4.3 (2.8–5.8)	1900 (1200–2600)	1.2 (0.8–1.7)	740 (510–1000)
Northern Africa	0.3 (0.1–3.3)	990 (420–9800)	0.6 (0.2–6.5)	820 (350–9500)	0.1 (0.0–0.2)	180 (80–370)
Southern Africa	3.9 (2.7–5.0)	4200 (2900–5400)	5.7 (4.2–7.0)	2800 (2100–3500)	2.3 (1.4–3.3)	1400 (830–1900)
Western Africa	2.9 (1.8–4.2)	7000 (4300–10 100)	4.5 (2.6–6.5)	4400 (2500–6300)	1.8 (1.3–2.6)	2700 (1900–3700)
Asia						
Eastern Asia	5.7 (3.6–7.9)	332 100 (208 800–460 200)	8.6 (5.4–11.8)	275 900 (172 600–378 400)	2.1 (1.4–3.1)	56 300 (36 200–81 900)
South-central Asia	3.5 (2.0–6.9)	68 100 (37 900–133 800)	6.2 (3.5–12.0)	59 200 (33 200–114 800)	0.9 (0.5–1.9)	8900 (4800–19 000)
South-eastern Asia	2.6 (1.6–3.7)	27 700 (17 500–39 700)	4.4 (2.7–6.4)	23 000 (14 100–33 400)	0.8 (0.6–1.1)	4700 (3300–6400)
Western Asia	0.7 (0.5–1.2)	3000 (2000–5200)	1.0 (0.7–1.7)	2300 (1500–3900)	0.4 (0.2–0.6)	750 (480–1300)
Europe						
Central and eastern Europe	5.6 (4.6–6.6)	71 400 (57 800–84 200)	7.8 (6.5–9.0)	49 900 (41 100–57 300)	3.4 (2.6–4.3)	21 500 (16 700–26 900)
Northern Europe	3.9 (3.0–4.8)	24 800 (19 200–30 300)	4.7 (3.8–5.5)	15 600 (12 600–18 300)	3.0 (2.2–4.0)	9200 (6600–12 100)
Southern Europe	3.6 (2.8–4.4)	32 400 (25 200–39 400)	4.8 (3.8–5.7)	23 100 (18 300–27 400)	2.3 (1.7–3.0)	9300 (6900–12 000)
Western Europe	4.2 (3.3–5.1)	52 800 (41 300–63 500)	5.1 (4.1–6.0)	34 400 (27 500–40 300)	3.2 (2.4–4.1)	18 400 (13 800–23 200)
Americas						
Latin America and the Caribbean	2.8 (2.1–3.5)	39 300 (29 600–49 400)	3.9 (3.0–4.7)	26 800 (20 600–32 300)	1.8 (1.3–2.4)	12 600 (9100–17 100)
North America	3.0 (2.1–4.0)	59 600 (40 600–77 800)	3.8 (2.7–4.8)	38 500 (27 000–48 400)	2.2 (1.4–3.0)	21 200 (13 500–29 400)
Oceania						
Australia and New Zealand	4.1 (3.0–5.1)	6800 (5000–8600)	4.8 (3.7–5.8)	4200 (3200–5100)	3.3 (2.2–4.4)	2600 (1700–3500)
Melanesia, Micronesia (Federated States of), and Polynesia	1.2 (0.2–2.2)	190 (40–370)	2.1 (0.4–4.1)	160 (30–310)	0.4 (0.1–0.7)	30 (10–60)

Table 1.5 (continued)

Cancer site (ICD-10 codes) by region	Overall		Males		Females	
	PAF (95% CI)	Alcohol-attributable cases (95% CI)[a,b]	PAF (95% CI)	Alcohol-attributable cases (95% CI)[a,b]	PAF (95% CI)	Alcohol-attributable cases (95% CI)[a,b]
Lip and oral cavity (C00–C06)						
Global	20.2 (12.1–32.3)	74 900 (44 600–119 600)	25.9 (15.6–40.9)	66 700 (40 000–105 300)	7.3 (4.1–12.7)	8200 (4600–14 300)
Africa						
Eastern Africa	13.5 (7.2–21.1)	630 (340–980)	20.1 (10.8–30.9)	540 (290–830)	4.5 (2.4–7.7)	90 (50–150)
Middle Africa	19.7 (11.1–29.2)	280 (160–420)	27.4 (15.5–40.0)	240 (140–350)	7.5 (4.0–12.1)	40 (20–70)
Northern Africa	2.3 (1.0–15.8)	70 (30–510)	4.0 (1.7–28.5)	70 (30–490)	0.4 (0.1–1.2)	6 (< 5–20)
Southern Africa	27.3 (14.4–40.9)	580 (310–870)	37.3 (20.1–53.8)	490 (260–700)	11.5 (5.4–20.4)	100 (40–170)
Western Africa	18.4 (10.8–27.8)	520 (310–790)	27.3 (16.4–40.2)	430 (260–630)	7.5 (3.9–12.7)	100 (50–160)
Asia						
Eastern Asia	22.4 (11.7–33.9)	9700 (5100–14 800)	31.1 (16.2–46.3)	8300 (4400–12 400)	8.4 (4.5–14.0)	1400 (750–2300)
South-central Asia	14.5 (6.3–30.2)	25 300 (11 100–52 700)	18.2 (8.1–36.4)	23 800 (10 500–47 500)	3.3 (1.3–11.9)	1400 (550–5200)
South-eastern Asia	12.7 (6.9–19.8)	2300 (1300–3600)	18.0 (9.8–27.9)	2000 (1100–3100)	4.2 (2.4–6.9)	300 (170–490)
Western Asia	7.2 (3.7–15.4)	320 (160–670)	10.7 (5.5–23.0)	290 (150–620)	1.6 (0.7–2.9)	30 (10–50)
Europe						
Central and eastern Europe	38.6 (22.5–53.6)	10 100 (5900–14 000)	45.3 (26.5–62.0)	9000 (5300–12 300)	17.0 (9.4–26.6)	1100 (580–1700)
Northern Europe	31.4 (18.3–45.4)	2800 (1700–4100)	41.7 (24.7–58.8)	2300 (1400–3300)	14.8 (8.0–23.8)	510 (280–820)
Southern Europe	27.3 (15.6–39.4)	3400 (1900–4900)	36.7 (21.1–52.1)	2900 (1700–4100)	10.6 (5.9–16.9)	470 (260–750)
Western Europe	32.2 (18.9–45.6)	5700 (3400–8100)	42.2 (24.8–58.9)	4700 (2800–6500)	15.3 (8.9–23.5)	1000 (590–1600)
Americas						
Latin America and the Caribbean	24.3 (13.5–35.7)	4300 (2400–6400)	32.9 (18.3–47.5)	3800 (2100–5600)	8.1 (4.4–13.3)	500 (270–820)
North America	28.0 (15.3–41.4)	7700 (4200–11 400)	36.0 (19.8–52.8)	6700 (3700–9800)	11.3 (6.0–17.8)	1000 (540–1600)
Oceania						
Australia and New Zealand	33.2 (19.1–47.6)	1000 (590–1500)	41.9 (24.4–58.9)	870 (510–1200)	15.6 (8.4–24.9)	160 (90–260)
Melanesia, Micronesia (Federated States of), and Polynesia	6.3 (0.6–14.3)	80 (8–190)	9.1 (0.9–21.0)	70 (7–170)	1.7 (0.2–3.7)	8 (< 5–20)

Table 1.5 (continued)

Cancer site (ICD-10 codes) by region	Overall		Males		Females	
	PAF (95% CI)	Alcohol-attributable cases (95% CI)[a,b]	PAF (95% CI)	Alcohol-attributable cases (95% CI)[a,b]	PAF (95% CI)	Alcohol-attributable cases (95% CI)[a,b]
Pharynx (C09–C10, C12–C13)						
Global	22.0 (9.0–37.8)	39 400 (16 100–67 800)	25.3 (10.4–43.4)	37 000 (15 200–63 400)	7.4 (2.8–13.4)	2500 (940–4400)
Africa						
Eastern Africa	16.1 (5.9–27.5)	250 (90–430)	19.1 (7.0–32.4)	230 (90–400)	5.5 (2.0–10.5)	20 (7–40)
Middle Africa	23.6 (9.32–38.0)	180 (70–300)	26.5 (10.4–42.4)	170 (70–280)	7.5 (2.8–13.7)	9 (< 5–20)
Northern Africa	1.9 (0.6–16.5)	20 (6–170)	3.1 (1.0–28.2)	20 (6–170)	0.4 (0.1–1.1)	< 5 (< 5–5)
Southern Africa	27.0 (10.3–45.0)	200 (80–330)	32.2 (12.4–52.8)	180 (70–300)	10.2 (3.3–20.0)	20 (6–30)
Western Africa	15.9 (6.2–27.1)	140 (50–230)	22.7 (9.1–37.5)	110 (40–180)	7.3 (2.4–13.7)	30 (9–50)
Asia						
Eastern Asia	24.5 (9.3–39.9)	4900 (1900–8000)	27.1 (10.2–44.0)	4700 (1800–7700)	7.5 (3.0–12.9)	200 (80–340)
South-central Asia	12.3 (4.1–33.1)	8100 (2700–21 900)	14.5 (4.9–39.0)	7700 (2600–20 800)	2.9 (0.7–8.6)	370 (90–1100)
South-eastern Asia	15.2 (5.7–26.7)	1500 (560–2600)	17.9 (6.7–31.4)	1400 (530–2500)	3.4 (1.3–6.3)	60 (20–120)
Western Asia	8.5 (3.2–17.0)	90 (30–170)	12.4 (4.7–24.7)	80 (30–160)	1.4 (0.4–3.0)	< 5 (< 5–10)
Europe						
Central and eastern Europe	37.1 (15.5–56.0)	7500 (3100–11 300)	40.3 (16.9–60.2)	7100 (3000–10 600)	15.9 (6.0–27.2)	420 (160–710)
Northern Europe	31.3 (12.9–48.4)	1800 (740–2800)	36.9 (15.3–56.2)	1600 (660–2400)	13.6 (5.5–23.9)	190 (80–330)
Southern Europe	29.1 (11.7–45.2)	1900 (750–2900)	32.8 (13.3–50.6)	1800 (710–2700)	9.6 (3.6–16.8)	100 (40–170)
Western Europe	31.6 (13.2–48.9)	5000 (2100–7800)	37.5 (15.8–57.1)	4500 (1900–6800)	14.1 (5.3–24.3)	560 (210–970)
Americas						
Latin America and the Caribbean	24.7 (9.6–40.1)	2800 (1100–4500)	28.4 (11.1–45.9)	2600 (1000–4300)	7.4 (2.9–13.3)	150 (60–270)
North America	28.2 (11.1–45.5)	4600 (1800–7500)	32.1 (12.7–51.4)	4300 (1700–6900)	10.4 (3.9–18.5)	310 (120–550)
Oceania						
Australia and New Zealand	33.7 (14.1–52.4)	430 (180–660)	37.4 (15.7–57.8)	400 (170–610)	14.4 (5.7–25.0)	30 (10–50)
Melanesia, Micronesia (Federated States of), and Polynesia	6.8 (0.5–16.6)	10 (< 5–30)	7.5 (0.6–18.1)	10 (< 5–20)	1.6 (0.3–3.8)	< 5 (< 5–< 5)

Table 1.5 (continued)

Cancer site (ICD-10 codes) by region	Overall		Males		Females	
	PAF (95% CI)	Alcohol-attributable cases (95% CI)[a,b]	PAF (95% CI)	Alcohol-attributable cases (95% CI)[a,b]	PAF (95% CI)	Alcohol-attributable cases (95% CI)[a,b]
Larynx (C32)						
Global	15.0 (8.6–23.6)	27 600 (15 700–43 300)	16.6 (9.5–26.1)	26 400 (15 100–41 600)	4.7 (2.5–7.0)	1200 (620–1700)
Africa						
Eastern Africa	11.6 (6.2–17.9)	260 (140–410)	13.4 (7.2–20.7)	250 (130–380)	3.5 (1.9–5.4)	10 (8–20)
Middle Africa	13.7 (7.4–20.2)	90 (50–130)	15.6 (8.4–23.0)	80 (50–120)	3.6 (1.9–5.6)	< 5 (< 5–6)
Northern Africa	1.9 (0.9–26.4)	90 (40–1200)	2.1 (1.0–29.2)	90 (40–1200)	0.2 (< 0.1–0.5)	< 5 (< 5–< 5)
Southern Africa	19.0 (10.1–28.9)	180 (100–280)	21.7 (11.7–32.8)	170 (90–260)	6.5 (3.0–10.7)	10 (5–20)
Western Africa	14.8 (8.3–22.5)	230 (130–350)	17.2 (9.6–26.0)	220 (120–330)	4.8 (2.5–7.8)	10 (7–20)
Asia						
Eastern Asia	17.3 (8.8–26.7)	6200 (3200–9600)	18.8 (9.6–28.9)	6100 (3100–9300)	4.7 (2.3–7.5)	180 (90–290)
South-central Asia	8.5 (3.5–22.0)	4200 (1700–10 800)	9.6 (3.9–25.1)	4100 (1700–10 600)	1.7 (0.6–3.2)	110 (40–220)
South-eastern Asia	9.1 (4.9–14.2)	1000 (560–1600)	9.9 (5.4–15.4)	1000 (550–1600)	2.5 (1.3–3.9)	30 (20–50)
Western Asia	5.5 (2.7–11.2)	380 (190–780)	6.0 (3.0–12.3)	380 (190–770)	1.0 (0.5–1.7)	6 (< 5–10)
Europe						
Central and eastern Europe	26.6 (15.4–38.0)	4800 (2800–6900)	28.2 (16.4–40.1)	4700 (2700–6700)	10.3 (5.5–15.1)	160 (90–230)
Northern Europe	22.8 (12.9–32.5)	870 (490–1200)	25.7 (14.6–36.5)	810 (460–1100)	9.1 (4.8–13.9)	60 (30–90)
Southern Europe	20.1 (11.6–29.4)	1900 (1100–2700)	22.0 (12.7–32.0)	1800 (1000–2600)	6.7 (3.5–9.9)	70 (40–110)
Western Europe	22.8 (13.0–32.8)	2000 (1100–2800)	25.9 (14.9–37.1)	1800 (1000–2600)	9.4 (5.0–14.0)	150 (80–220)
Americas						
Latin America and the Caribbean	16.4 (8.8–24.4)	2600 (1400–3900)	18.6 (10.0–27.5)	2500 (1300–3700)	5.1 (2.7–8.0)	130 (70–210)
North America	18.7 (9.9–27.6)	2500 (1300–3700)	21.7 (11.5–31.9)	2300 (1200–3400)	7.0 (3.5–11.0)	190 (100–300)
Oceania						
Australia and New Zealand	23.7 (13.5–34.4)	160 (90–230)	25.7 (14.7–37.1)	150 (90–220)	9.3 (4.8–14.6)	7 (< 5–10)
Melanesia, Micronesia (Federated States of), and Polynesia	4.4 (0.9–8.4)	7 (< 5–10)	5.3 (1.1–10.2)	7 (< 5–10)	1.1 (0.4–2.1)	< 5 (< 5–< 5)

Table 1.5 (continued)

Cancer site (ICD-10 codes) by region	Overall		Males		Females	
	PAF (95% CI)	Alcohol-attributable cases (95% CI)[a,b]	PAF (95% CI)	Alcohol-attributable cases (95% CI)[a,b]	PAF (95% CI)	Alcohol-attributable cases (95% CI)[a,b]
Oesophagus (C15)						
Global	31.6 (18.4–45.7)	189 700 (110 900–274 600)	39.2 (22.7–55.6)	163 100 (94 200–231 000)	14.3 (9.0–23.5)	26 600 (16 700–43 700)
Africa						
Eastern Africa	25.2 (13.2–37.3)	4100 (2100–6000)	37.3 (19.1–53.8)	3200 (1600–4600)	11.6 (6.6–18.8)	880 (500–1400)
Middle Africa	26.9 (14.7–39.2)	580 (310–840)	35.7 (19.4–51.4)	480 (260–690)	12.1 (6.9–18.5)	100 (50–150)
Northern Africa	2.7 (1.1–11.2)	90 (40–360)	4.2 (1.8–18.9)	70 (30–330)	0.9 (0.3–2.3)	10 (< 5–30)
Southern Africa	35.5 (17.4–53.7)	1300 (630–1900)	47.4 (23.1–67.8)	1000 (490–1400)	18.8 (9.3–33.9)	280 (140–510)
Western Africa	22.2 (12.2–33.4)	530 (290–800)	31.2 (16.9–45.7)	410 (220–600)	11.3 (6.5–18.5)	120 (70–200)
Asia						
Eastern Asia	37.7 (21.2–53.1)	133 800 (75 200–188 700)	46.4 (26.0–64.0)	115 500 (64 700–159 400)	17.2 (9.9–27.6)	18 300 (10 500–29 300)
South-central Asia	17.8 (9.4–40.2)	18 700 (9800–42 200)	24.5 (12.9–52.3)	16 000 (8400–34 100)	6.7 (3.5–20.4)	2700 (1400–8100)
South-eastern Asia	29.7 (16.5–43.2)	4300 (2400–6200)	34.7 (19.2–50.4)	4000 (2200–5800)	9.2 (5.7–13.9)	260 (160–400)
Western Asia	7.5 (3.7–22.6)	320 (160–970)	11.3 (5.6–25.1)	260 (130–580)	3.0 (1.5–19.8)	60 (30–390)
Europe						
Central and eastern Europe	48.5 (28.0–63.9)	7500 (4300–9900)	53.5 (30.8–69.1)	6700 (3900–8700)	27.2 (15.7–41.4)	790 (460–1200)
Northern Europe	15.8 (9.5–21.4)	2000 (1200–2800)	15.6 (9.3–20.3)	1400 (840–1800)	16.4 (10.2–23.9)	640 (400–930)
Southern Europe	34.0 (20.4–45.7)	2100 (1300–2900)	38.7 (23.1–51.5)	1900 (1100–2500)	17.5 (11.0–25.4)	250 (160–360)
Western Europe	28.9 (17.4–38.1)	5300 (3200–7000)	31.4 (18.8–40.9)	4400 (2600–5700)	20.7 (13.0–29.4)	900 (560–1300)
Americas						
Latin America and the Caribbean	30.6 (17.5–43.0)	5800 (3300–8200)	35.7 (20.2–49.9)	5100 (2900–7200)	14.6 (8.9–21.6)	670 (410–990)
North America	14.2 (8.3–19.5)	3000 (1700–4100)	14.4 (8.3–19.5)	2400 (1300–3200)	13.3 (8.2–19.5)	600 (370–880)
Oceania						
Australia and New Zealand	18.9 (11.3–25.6)	360 (220–490)	18.3 (10.8–23.9)	250 (150–330)	20.5 (12.7–30.2)	110 (70–160)
Melanesia, Micronesia (Federated States of), and Polynesia	5.0 (1.0–9.4)	10 (< 5–20)	6.0 (1.3–11.3)	10 (< 5–20)	2.9 (0.6–5.6)	< 5 (< 5–5)

Table 1.5 (continued)

Cancer site (ICD-10 codes) by region	Overall		Males		Females	
	PAF (95% CI)	Alcohol-attributable cases (95% CI)[a,b]	PAF (95% CI)	Alcohol-attributable cases (95% CI)[a,b]	PAF (95% CI)	Alcohol-attributable cases (95% CI)[a,b]
Colorectum (C18–C20)						
Global	8.4 (6.3–10.6)	156 700 (116 800–196 500)	13.0 (9.7–16.2)	134 300 (100 500–167 200)	2.7 (2.0–3.5)	22 400 (16 300–29 400)
Africa						
Eastern Africa	4.9 (3.2–6.5)	790 (520–1100)	8.2 (5.3–10.7)	650 (430–860)	1.7 (1.1–2.4)	140 (90–200)
Middle Africa	5.6 (3.9–7.6)	270 (190–370)	9.2 (6.4–12.3)	240 (160–310)	1.6 (1.0–2.3)	40 (20–50)
Northern Africa	0.7 (0.3–1.2)	140 (50–250)	1.3 (0.5–2.2)	130 (50–220)	0.1 (< 0.1–0.3)	10 (< 5–30)
Southern Africa	9.6 (6.4–12.7)	690 (460–910)	15.1 (10.6–19.4)	560 (390–720)	3.8 (2.0–5.4)	130 (70–190)
Western Africa	8.0 (5.9–10.2)	950 (690–1200)	12.1 (9.1–15.3)	790 (590–990)	3.0 (2.0–4.1)	160 (110–220)
Asia						
Eastern Asia	7.9 (4.8–10.9)	57 600 (35 000–80 200)	12.3 (7.7–16.7)	51 400 (32 000–69 900)	2.0 (0.9–3.3)	6200 (2900–10 300)
South-central Asia	4.1 (1.6–5.9)	3900 (1600–5700)	6.2 (2.5–8.8)	3500 (1400–5000)	0.9 (0.3–1.6)	360 (130–640)
South-eastern Asia	4.0 (2.8–5.5)	4200 (2900–5700)	6.3 (4.4–8.4)	3700 (2600–5000)	1.1 (0.7–1.7)	500 (300–770)
Western Asia	2.1 (1.1–2.9)	860 (470–1200)	3.3 (1.8–4.4)	760 (420–1000)	0.6 (0.3–0.9)	100 (50–160)
Europe						
Central and eastern Europe	13.0 (9.8–16.2)	22 200 (16 700–27 700)	19.8 (15.1–24.3)	17 500 (13 300–21 500)	5.8 (4.1–7.5)	4800 (3400–6200)
Northern Europe	11.5 (8.4–14.7)	9100 (6700–11 700)	17.4 (13.1–21.9)	7600 (5700–9600)	4.2 (2.8–5.9)	1500 (980–2100)
Southern Europe	9.7 (7.1–12.4)	11 800 (8600–15 100)	14.7 (10.8–18.6)	10 300 (7600–13 000)	2.9 (2.0–4.0)	1500 (1000–2000)
Western Europe	11.7 (8.8–14.7)	15 900 (12 000–20 000)	17.7 (13.5–21.8)	13 300 (10 200–16 500)	4.3 (2.9–5.8)	2600 (1800–3500)
Americas						
Latin America and the Caribbean	7.6 (5.5–9.9)	9900 (7100–12 700)	12.7 (9.3–16.1)	8300 (6100–10 500)	2.5 (1.6–3.5)	1600 (1000–2200)
North America	9.4 (6.2–12.7)	16 100 (10 500–21 800)	14.8 (10.1–19.5)	13 700 (9300–18 000)	3.1 (1.6–4.9)	2500 (1300–3900)
Oceania						
Australia and New Zealand	11.7 (8.2–15.5)	2200 (1600–2900)	17.9 (12.9–22.9)	1800 (1300–2300)	4.5 (2.7–6.8)	400 (230–590)
Melanesia, Micronesia (Federated States of), and Polynesia	2.1 (0.5–3.9)	20 (< 5–30)	3.3 (0.9–6.1)	20 (< 5–30)	0.3 (< 0.1–0.7)	< 5 (< 5–5)

Table 1.5 (continued)

Cancer site (ICD-10 codes) by region	Overall		Males		Females	
	PAF (95% CI)	Alcohol-attributable cases (95% CI)[a,b]	PAF (95% CI)	Alcohol-attributable cases (95% CI)[a,b]	PAF (95% CI)	Alcohol-attributable cases (95% CI)[a,b]
Liver (C22)						
Global	17.3 (4.9–31.6)	154 700 (43 700–281 500)	22.7 (6.4–40.9)	141 300 (39 600–255 000)	5.0 (1.5–9.8)	13 400 (4100–26 400)
Africa						
Eastern Africa	11.4 (2.9–21.7)	1400 (360–2700)	16.5 (4.2–31.1)	1200 (300–2200)	4.0 (1.1–8.4)	200 (60–430)
Middle Africa	12.5 (3.3–23.5)	760 (200–1400)	16.4 (4.2–30.6)	690 (180–1300)	3.8 (1.2–7.4)	70 (20–140)
Northern Africa	1.5 (0.1–25.8)	460 (40–8200)	2.1 (0.2–39.7)	440 (30–8100)	0.2 (< 0.1–0.9)	30 (< 5–100)
Southern Africa	19.3 (5.0–35.4)	500 (130–920)	27.0 (6.9–47.9)	440 (110–780)	6.4 (1.7–14.7)	60 (20–140)
Western Africa	15.5 (4.2–28.6)	2700 (730–5000)	20.7 (5.5–37.7)	2400 (640–4400)	5.3 (1.5–11.1)	320 (90–670)
Asia						
Eastern Asia	20.4 (5.6–37.1)	97 400 (26 800–177 600)	25.8 (7.0–46.6)	89 700 (24 500–162 300)	5.9 (1.7–11.7)	7700 (2200–15 300)
South-central Asia	7.8 (1.7–20.6)	4300 (940–11 300)	11.1 (2.4–27.8)	4000 (870–10 100)	1.5 (0.4–6.5)	290 (80–1200)
South-eastern Asia	11.6 (3.1–21.6)	11 500 (3100–21 400)	15.0 (4.0–27.9)	10 800 (2900–19 900)	2.7 (0.8–5.4)	750 (230–1500)
Western Asia	4.7 (1.1–13.5)	530 (130–1500)	7.0 (1.7–20.5)	490 (120–1400)	1.0 (0.3–2.2)	40 (10–90)
Europe						
Central and eastern Europe	24.2 (7.0–40.2)	6000 (1700–10 000)	32.6 (9.5–52.4)	5000 (1400–8000)	10.8 (3.2–21.1)	1000 (300–2000)
Northern Europe	17.5 (5.0–29.6)	2100 (600–3500)	25.3 (7.1–42.0)	1900 (530–3100)	4.5 (1.4–8.9)	200 (60–400)
Southern Europe	19.7 (5.3–33.8)	4900 (1300–8400)	26.2 (6.9–44.5)	4400 (1200–7500)	5.7 (1.9–10.7)	450 (150–840)
Western Europe	23.8 (6.9–39.7)	6200 (1800–10 400)	30.6 (8.9–50.5)	5700 (1600–9400)	7.1 (2.3–13.3)	540 (170–1000)
Americas						
Latin America and the Caribbean	12.8 (3.5–22.9)	5000 (1400–9000)	20.2 (5.5–36.0)	4300 (1200–7700)	3.9 (1.1–7.4)	710 (200–1300)
North America	21.5 (6.0–37.6)	10 000 (2800–17 500)	28.1 (7.8–48.6)	9100 (2500–15 800)	6.5 (2.0–12.2)	920 (280–1700)
Oceania						
Australia and New Zealand	23.8 (6.6–40.1)	800 (220–1300)	30.2 (8.3–50.0)	730 (200–1200)	6.9 (2.3–13.6)	60 (20–120)
Melanesia, Micronesia (Federated States of), and Polynesia	4.3 (0.7–9.7)	40 (8–100)	6.5 (1.1–14.6)	40 (7–90)	0.8 (0.1–1.8)	< 5 (< 5–7)

Table 1.5 (continued)

Cancer site (ICD-10 codes) by region	Overall		Males		Females	
	PAF (95% CI)	Alcohol-attributable cases (95% CI)[a,b]	PAF (95% CI)	Alcohol-attributable cases (95% CI)[a,b]	PAF (95% CI)	Alcohol-attributable cases (95% CI)[a,b]
Breast, female (C50)						
Global	–	–	–	–	4.4 (3.0–5.8)	98 300 (68 200–130 500)
Africa						
Eastern Africa	–	–	–	–	2.1 (1.3–3.0)	940 (570–1400)
Middle Africa	–	–	–	–	2.7 (1.5–4.1)	480 (270–730)
Northern Africa	–	–	–	–	0.2 (< 0.1–0.4)	120 (50–230)
Southern Africa	–	–	–	–	4.6 (2.5–6.9)	750 (420–1100)
Western Africa	–	–	–	–	3.9 (2.4–5.7)	1900 (1200–2800)
Asia						
Eastern Asia	–	–	–	–	4.1 (2.5–6.0)	22 300 (13 200–32 600)
South-central Asia	–	–	–	–	1.5 (0.7–2.5)	3700 (1700–6500)
South-eastern Asia	–	–	–	–	1.8 (1.1–2.5)	2800 (1800–4000)
Western Asia	–	–	–	–	0.8 (0.5–1.3)	520 (310–760)
Europe						
Central and eastern Europe	–	–	–	–	8.3 (5.7–11.2)	13 200 (9000–17 800)
Northern Europe	–	–	–	–	7.3 (4.8–10.0)	6100 (4000–8300)
Southern Europe	–	–	–	–	5.4 (3.6–7.2)	6500 (4400–8700)
Western Europe	–	–	–	–	7.5 (5.1–9.9)	12 700 (8600–16 800)
Americas						
Latin America and the Caribbean	–	–	–	–	4.2 (2.8–6.0)	8800 (5900–12 600)
North America	–	–	–	–	5.6 (3.5–8.0)	15 700 (9800–22 400)
Oceania						
Australia and New Zealand	–	–	–	–	7.7 (5.1–10.9)	1800 (1200–2500)
Melanesia, Micronesia (Federated States of), and Polynesia	–	–	–	–	0.7 (0.3–1.3)	20 (7–30)

Table 1.5 (continued)

Cancer site (ICD-10 codes) by region	Overall		Males		Females	
	PAF (95% CI)	Alcohol-attributable cases (95% CI)[a,b]	PAF (95% CI)	Alcohol-attributable cases (95% CI)[a,b]	PAF (95% CI)	Alcohol-attributable cases (95% CI)[a,b]
All 7 cancer types associated with alcohol consumption combined						
Global	11.7 (8.8–15)	741 300 (558 500–951 200)	21.6 (16–27.7)	568 700 (422 500–731 100)	4.7 (3.7–5.9)	172 600 (135 900–220 100)
Africa						
Eastern Africa	8.4 (5.9–11.2)	8300 (5800–11 100)	20.5 (14.1–26.9)	6000 (4200–7900)	3.3 (2.4–4.5)	2300 (1700–3100)
Middle Africa	7.8 (5.2–10.8)	2600 (1700–3700)	18.7 (12.1–25.6)	1900 (1200–2600)	3.1 (2.1–4.4)	740 (510–1000)
Northern Africa	0.8 (0.3–8.1)	990 (420–9800)	2.1 (0.9–24.5)	820 (350–9500)	0.2 (0.1–0.5)	180 (80–370)
Southern Africa	12.4 (8.6–16)	4200 (2900–5400)	28.1 (20.6–34.6)	2800 (2100–3500)	5.7 (3.5–8.1)	1400 (830–1900)
Western Africa	8.1 (5.0–11.6)	7000 (4300–10 100)	19.2 (11.0–27.9)	4400 (2500–6300)	4.2 (2.9–5.8)	2700 (1900–3700)
Asia						
Eastern Asia	15 (9.5–20.9)	332 100 (208 800–460 200)	25.3 (15.8–34.7)	275 900 (172 600–378 400)	5.0 (3.2–7.3)	56 300 (36 200–81 900)
South-central Asia	8.5 (4.7–16.7)	68 100 (37 900–133 800)	15.4 (8.6–29.8)	59 200 (33 200–114 800)	2.1 (1.2–4.6)	8900 (4800–19 000)
South-eastern Asia	6.6 (4.2–9.5)	27 700 (17 500–39 700)	13.4 (8.2–19.4)	23 000 (14 100–33 400)	1.9 (1.4–2.6)	4700 (3300–6400)
Western Asia	2.3 (1.5–4.0)	3000 (2000–5200)	5.4 (3.6–9.3)	2300 (1500–3900)	0.9 (0.6–1.4)	750 (480–1300)
Europe						
Central and eastern Europe	16.4 (13.3–19.4)	71 400 (57 800–84 200)	29.3 (24.2–33.7)	49 900 (41 100–57 300)	8.1 (6.3–10.2)	21 500 (16 700–26 900)
Northern Europe	12.1 (9.3–14.8)	24 800 (19 200–30 300)	21.4 (17.2–25)	15 600 (12 600–18 300)	6.9 (5.0–9.1)	9200 (6600–12 100)
Southern Europe	10.8 (8.4–13.1)	32 400 (25 200–39 400)	20.4 (16.2–24.2)	23 100 (18 300–27 400)	5.0 (3.7–6.4)	9300 (6900–12 000)
Western Europe	13.5 (10.6–16.2)	52 800 (41 300–63 500)	24.9 (20.0–29.2)	34 400 (27 500–40 300)	7.3 (5.4–9.1)	18 400 (13 800–23 200)
Americas						
Latin America and the Caribbean	8.9 (6.7–11.2)	39 300 (29 600–49 400)	19.7 (15.2–23.8)	26 800 (20 600–32 300)	4.1 (3.0–5.6)	12 600 (9100–17 100)
North America	10.3 (7.0–13.5)	59 600 (40 600–77 800)	20.9 (14.7–26.4)	38 500 (27 000–48 400)	5.4 (3.4–7.5)	21 200 (13 500–29 400)
Oceania						
Australia and New Zealand	12.9 (9.5–16.4)	6800 (5000–8600)	23.8 (18.2–28.7)	4200 (3200–5100)	7.4 (5.0–10.0)	2600 (1700–3500)
Melanesia, Micronesia (Federated States of), and Polynesia	3.1 (0.6–5.9)	190 (40–370)	6.7 (1.2–12.9)	160 (30–310)	0.9 (0.3–1.6)	30 (10–60)

CI, confidence interval; ICD-10, International Statistical Classification of Diseases and Related Health Problems, 10th revision; PAF, population attributable fraction.

[a] Numbers > 10 are rounded to the nearest 10 or 100, depending on the value.

[b] Number of cases suppressed if < 5.

Data are from the Global Cancer Observatory (Rumgay et al., 2021b). For methodology, see Rumgay et al. (2021a).

When former alcohol consumption was included, the PAF and the number of alcohol-attributable new cancer cases globally in 2020 increased to 5.2% and 925 900 cases overall (7.7% and 713 200 cases among males, and 2.4% and 212 700 cases among females) (Rumgay et al., 2021a).

(ii) Regional and national patterns

The largest regional PAFs and numbers of alcohol-attributable new cancer cases in 2020 were in eastern Asia (5.7%; 332 100 cases) and central and eastern Europe (5.6%; 71 400 cases). The smallest regional PAFs in 2020 were in northern Africa (0.3%) and western Asia (0.7%) (Rumgay et al., 2021b) (Table 1.5; Fig. 1.5).

The largest regional PAFs among males were in eastern Asia (8.6%), European subregions (ranging from 4.7% in northern Europe to 7.8% in central and eastern Europe), south-central Asia (6.2%), southern Africa (5.7%), eastern Africa (4.9%), and Australia and New Zealand (4.8%), although the PAFs were not substantially smaller in four other regions (western Africa, middle Africa, Latin America and the Caribbean, and north America), where they ranged from 3.8% to 4.5% (Table 1.5). The smallest PAFs among males in 2020 were in the three remaining regions: northern Africa (0.6%), western Asia (1.0%), and Melanesia, the Federated States of Micronesia, and Polynesia (2.1%). Most of the countries with the largest PAFs among males were in eastern and south-eastern Asia and central and eastern Europe, but several countries in sub-Saharan Africa also had large PAFs among males (Fig. 1.5A).

In every region, PAFs of all new cancer cases in 2020 were smaller among females than among males (Table 1.5). The largest regional PAFs among females were in Europe (ranging from 2.3% in southern Europe to 3.4% in central and eastern Europe), Australia and New Zealand (3.3%), southern Africa (2.3%), and north America (2.2%). Most of the countries with the largest PAFs among females were in central and eastern Europe (Fig. 1.5B).

(b) Specific cancer sites

For all cancer sites associated with alcohol consumption, PAFs among both sexes in 2020 were largest in central and eastern Europe and smallest in northern Africa (Table 1.5). The regional variations in PAFs for each cancer site were generally similar to variations for all cancers combined (described previously), except for oesophageal cancer and colorectal cancer (see below). The largest regional PAFs among both males and females were generally in Europe, Australia and New Zealand, and southern Africa. In addition, the largest regional PAFs were in east and south-central Asia and eastern Africa among males, and in north America among females.

(i) Lip and oral cavity cancer

Globally, the proportion of new lip and oral cavity cancer cases in 2020 attributable to alcohol consumption was 20.2% (Table 1.5). The PAF was substantially larger among males (25.9%; 66 700 cases) than among females (7.3%; 8200 cases). The largest PAFs were in central and eastern Europe among both males (45.3%) and females (17.0%), and the smallest PAFs were in northern Africa among both males (4.0%) and females (0.4%).

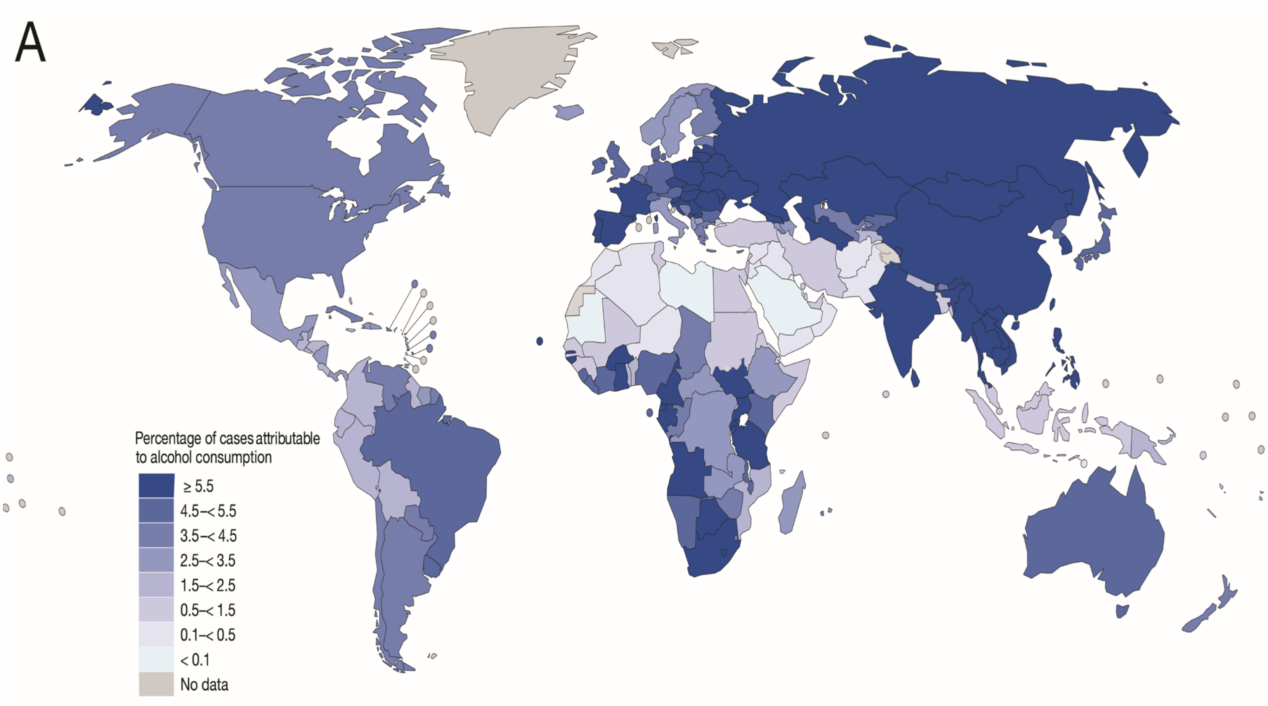
(ii) Pharyngeal cancer

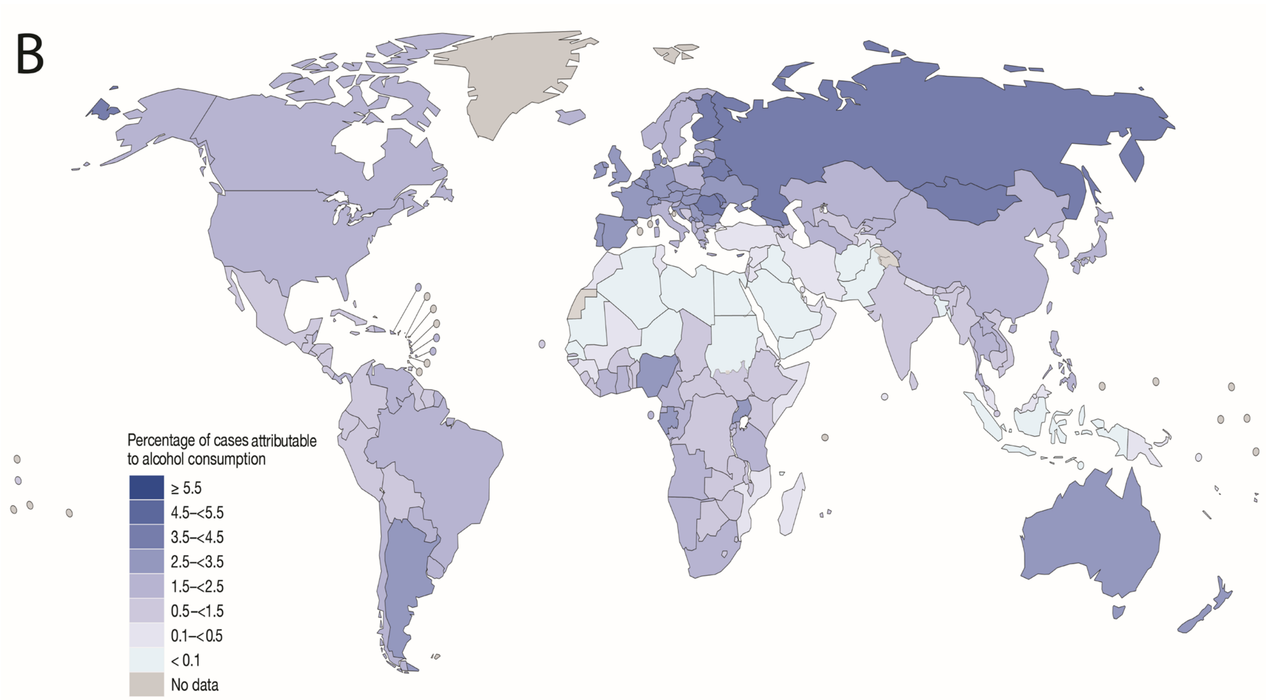
Globally, the proportion of new pharyngeal cancer cases in 2020 attributable to alcohol consumption was 22.0% (Table 1.5). The PAF was substantially larger among males (25.3%; 37 000 cases) than among females (7.4%; 2500 cases). The largest PAFs were in central and eastern Europe among both males (40.3%) and females (15.9%), and the smallest PAFs were in northern Africa among both males (3.1%) and females (0.4%).

(iii) Laryngeal cancer

Globally, the proportion of new laryngeal cancer cases in 2020 attributable to alcohol consumption was 15.0% (Table 1.5). The PAF

Fig. 1.5 Proportion of new cancer cases in 2020 attributable to alcohol consumption by country, in males (A) and females (B)





From Rumgay et al. (2021b).

and the number of alcohol-attributable laryngeal cancer cases were larger among males (16.6%; 26 400 cases) than among females (4.7%; 1200 cases). The largest PAFs were in central and eastern Europe among both males (28.2%) and females (10.3%), and the smallest PAFs were in northern Africa among both males (2.1%) and females (0.2%).

(iv) Oesophageal cancer

Squamous cell carcinoma is the only subtype of oesophageal cancer that has an established association with alcohol consumption (IARC, 2012a), but previous studies have often reported the corresponding PAFs as the proportion of all oesophageal cancers. Globally, the largest PAF by cancer site in 2020 was for oesophageal cancer (31.6%), which contributed the most cases (189 700 cases) to the global burden of alcohol-attributable cancer cases (Table 1.5). The PAF was substantially larger among males (39.2%; 163 100 cases) than among females (14.3%; 26 600 cases).

Among males, regional patterns of PAFs for oesophageal cancer differed from patterns for all cancers combined (described previously). Notably, several additional subregions were among the regions with the largest PAFs for oesophageal cancer, including central and eastern Europe (53.5%), southern Africa (47.4%), eastern Asia (46.4%), southern Europe (38.7%), eastern Africa (37.3%), Latin America and the Caribbean (35.7%), middle Africa (35.7%), and south-eastern Asia (34.7%). In contrast, Australia and New Zealand (18.3%), northern Europe (15.6%), and north America (14.4%) – regions with relatively large PAFs for all cancers combined – were among the regions with relatively small PAFs for oesophageal cancer among males. This discrepancy may be due, in part, to the higher incidence rates for oesophageal adenocarcinoma (which has not been linked to alcohol consumption) in those three regions compared with the rest of the world, especially among males (Arnold et al., 2015; Li et al., 2022). The smallest PAF for oesophageal cancer among males was in northern Africa (4.2%). The PAFs for oesophageal cancer among females ranged from 0.9% in northern Africa to 27.2% in central and eastern Europe. The regions with the largest PAFs for oesophageal cancer among females were those with the largest PAFs for all cancers combined (PAFs ≥ 13.3%), as well as eastern Asia (17.2%) and Latin America and the Caribbean (14.6%).

(v) Colorectal cancer

Globally, the proportions of new colon cancer cases (8.1%) and rectal cancer cases (9.0%) in 2020 attributable to alcohol consumption were comparable (Rumgay et al., 2021a). Globally, the proportion of new cases of colon and rectal cancer combined (colorectal cancer) in 2020 attributable to alcohol consumption was 8.4% (Table 1.5). The PAF was substantially larger among males (13.0%; 134 300 cases) than among females (2.7%; 22 400 cases). Unlike regional patterns for all cancers combined, no Asian or African subregions were among the regions with the largest PAFs for colorectal cancer among males, which included regions in Europe (ranging from 14.7% in southern Europe to 19.8% in central and eastern Europe), Australia and New Zealand (17.9%), and north America (14.8%). The PAF was ≤ 12.7% in all other regions and was smallest in northern Africa (1.3%). The PAFs for colorectal cancer among females ranged from 0.1% in northern Africa to 5.8% in central and eastern Europe. The regions with the largest PAFs for colorectal cancer among females were those with the largest PAFs for all cancers combined (PAFs ≥ 2.9%), as well as western Africa (3.0%).

(vi) Liver cancer

Hepatocellular carcinoma is the only subtype of liver cancer that has an established association with alcohol consumption (IARC, 2012a), but previous studies have often reported the corresponding PAFs as the proportion of all liver cancers. Globally, the proportion of new liver cancer cases in 2020 attributable to alcohol consumption was 17.3% (Table 1.5). The PAF and the number of alcohol-attributable liver cancer cases were larger among males (22.7%; 141 300 cases) than among females (5.0%; 13 400 cases). The largest PAFs were in central and eastern Europe among both males (32.6%) and females (10.8%), and the smallest PAFs were in northern Africa among both males (2.1%) and females (0.2%).

(vii) Female breast cancer

In 2020, breast cancer was the most commonly diagnosed cancer among females worldwide and in most countries (154 of 185) (Sung et al., 2021). It also contributed the most alcohol-attributable cancer cases among females globally (98 300 cases) and in each region (Table 1.5). Globally, the proportion of new cases of female breast cancer in 2020 attributable to alcohol consumption was 4.4%. Similar to PAFs for all cancers combined, the largest PAFs for female breast cancer were in Europe (ranging from 5.4% in southern Europe to 8.3% in central and eastern Europe), Australia and New Zealand (7.7%), north America (5.6%), and southern Africa (4.6%). The smallest PAF for female breast cancer was in northern Africa (0.2%).

(viii) All seven cancer types associated with alcohol consumption combined

Globally, the 741 300 new cancer cases in 2020 that were attributable to alcohol consumption accounted for 11.7% of all cases of the seven cancer sites associated with alcohol consumption (lip and oral cavity, pharynx, larynx, oesophagus, colorectum, liver, and female breast) combined; this proportion was 21.6% among males and 4.7% among females (Table 1.5). Oesophageal cancer contributed the most alcohol-attributable cases globally in 2020 (189 700 cases, accounting for 25.6% of all cancer cases attributable to alcohol consumption), followed by colorectal cancer (156 7600 cases; 21.1%), liver cancer (154 700 cases; 20.9%), female breast cancer (98 300 cases; 13.3%), lip and oral cavity cancer (74 900 cases; 10.1%), pharyngeal cancer (39 400 cases; 5.3%), and laryngeal cancer (27 600 cases; 3.7%). The proportion of all seven alcohol-related cancers combined that were attributable to alcohol consumption was largest in central and eastern Europe among both males (29.3%) and females (8.1%) and smallest in northern Africa among both males (2.1%) and females (0.2%).

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