Alcohol consumption in Germany, health and social consequences and derivation of recommendations for action

Position statement of the German Nutrition Society (DGE)

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Abstract

Alcohol is a psychoactive substance that has been identified as a causal factor in more than 200 adverse health outcomes including diseases and accidents. However, the relationship between alcohol consumption and health is complex. There is evidence that alcohol consumption may reduce the risk of developing a few chronic diseases. This DGE position statement aims to provide recommendations for individual drinking behaviour regarding alcoholic beverages, taking into account the health effects of alcohol and other sustainability aspects. It also provides information on health policies that help to minimise harmful effects on the health of the population.

The findings indicate that no quantity of alcohol can be considered health-promoting and safe for consumption. Accordingly, the DGE recommends to avoid consuming alcoholic beverages. For individuals who consume alcoholic beverages, it is advisable to avoid excessive intake. This is particularly pertinent to young people. Children, adolescents, pregnant women and breastfeeding mothers should generally avoid consuming alcohol. In consideration of estimates of the amount of alcohol required to minimise the risk of adverse health consequences, the DGE also derives recommendations for action on alcohol consumption.

In Germany, further behavioural and population-based prevention efforts are needed to reduce alcohol consumption, related health and social problems, and alcohol-related mortality. The DGE position statement on alcohol replaces the reference value for alcohol intake previously published by the DGE.

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Introduction and objectives

Consumption of alcoholic beverages is a leading risk factor for a wide range of diseases and premature death. At the same time, it is part of many cultural, religious and social practices worldwide [1–3].

The psychoactive and harmful effects of alcoholic beverages are largely attributed to the ethanol they contain (⬥ Box 1) or its breakdown products in the body, particularly acetaldehyde. In addition to ethanol, alcoholic beverages may also contain other alcohols

> **Box 1: Ethanol/Alcohol**
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> - Molecular formula: C_2H_5OH.
> - The terms 'ethanol' and 'alcohol' are often used interchangeably.
> - Ethanol is a non-essential nutrient that provides energy.
> - When degraded in the body, 1 g of alcohol provides 29 kJ or 7 kcal [5].
> - The alcohol content of beverages is expressed in percent by volume (% vol). The amount of alcohol in a beverage in grams is calculated by:
>
> Alcohol content [g] =
>
> $$\text{Volume of the beverage [mL]} \times \frac{\text{Alcohol content [\% vol]}}{100} \times 0.8 \text{ [g/mL]}^*$$
>
> * Specific gravity of alcohol.

such as methanol. Other compounds in alcoholic beverages, such as aflatoxins, formaldehyde and heavy metals, contribute only minimally to the adverse effects [1, 3, 4].
This DGE position statement refers only to alcohol from beverages in the form of ethanol and uses the terms 'alcohol' and 'ethanol' interchangeably. Amounts of alcohol in grams refer to pure alcohol, unless otherwise stated.

Alcohol is a psychoactive substance, has teratogenic, carcinogenic, neurotoxic and hepatotoxic effects, and has been identified as a causal risk factor in more than 200 adverse health outcomes (diseases and accidents) [3, 6, 7]. However, the relationship between alcohol consumption and health is complex. Overall, the burden of morbidity and mortality caused by alcohol is substantial worldwide and particularly in Europe:
According to the World Health Organization (WHO), in 2016, the European Region had the highest alcohol consumption, the highest proportion of people consuming alcoholic beverages and the highest rates of alcohol-related morbidity and mortality in the world. Approximately one in eight disability-adjusted life-years (DALYs) and one in ten deaths in the region were attributable to alcohol consumption. On average, 2545 adults died every day from alcohol-related causes in the European Region in 2016 [8]. Average alcohol consumption in Germany in 2019 was more than twice the global average. This has significant consequences for public health [9]. In Germany in 2017, alcohol-related disorders caused 245 and 797 DALYs per 100,000 individuals for women and men, respectively. Men and women aged 20–24 years were most affected, with 959 DALYs per 100,000 individuals. Thus, alcohol-related disorders were the second leading cause of disease burden in this age group, after pain disorders [10].
Alcohol consumption is also associated with foetal developmental disorders, accidents, injuries and violence as well as psychosocial impairment of people who drink alcohol and their social environment [11]. Many sustainable development goals are also affected by alcohol consumption, as described by the Alcohol Atlas Germany 2022 (*Alkoholatlas Deutschland 2022*) [12]; these include no poverty, zero hunger and malnutrition, equitable and quality

primary and secondary education and achieve higher levels of economic productivity.
In 2000, the German, Austrian and Swiss Nutrition Societies published a reference value for the maximum tolerable alcohol intake; a guideline value for low-risk consumption. The reference values for nutrient intake indicate quantities for intake of energy and nutrients to maintain and improve health and quality of life [13]. As part of the revision process of the reference values for nutrient intake, a reference value for alcohol will no longer be published to avoid giving the impression that alcohol consumption is recommended.

> **This DGE position statement replaces the reference value for alcohol intake previously published by the DGE.**

This DGE position statement aims to provide recommendations for individual drinking behaviour regarding alcoholic beverages, taking into account the health effects of alcohol and other sustainability aspects. It also provides information on health policies that help to minimise harmful effects on the health of the population. Target groups of the DGE position statement and the recommendations for action are people without alcohol use disorders and (health) policymakers.

Alcohol consumption of the population

Alcohol consumption is widespread in Germany, although exact consumption estimates vary between surveys due to different reference periods and survey methods. In addition, many different parameters are used to describe alcohol consumption behaviour, such as the number of alcoholic beverages or amount of pure alcohol, the amount of different beverages e.g. wine or beer, and the frequency of consumption. A distinction is also made between different forms of hazardous alcohol consumption (⬥ Box 2).
For Germany, the German Centre for Addiction Issues (*Deutsche Hauptstelle für Suchtfragen e. V.*, DHS) publishes the annual Yearbook Addiction with current statistics on alcohol consumption, alcohol-related offences and addictive substances in relation to road traffic [16]. In addition, the Alcohol Atlas Germany 2022, published by the German Cancer Research Centre (*Deutsches Krebsforschungszen-*

trum, DKFZ), provides numerous overviews of the production and consumption of alcohol, health and social consequences, and alcohol prevention in Germany and Europe [12].

The information summarised in this chapter is based on the previously used threshold values for harmful alcohol consumption (◆ Box 2). An update of these thresholds is presented in the "Summary and recommendations for action" section of this position statement. If the updated threshold values were used, the proportion of people with harmful alcohol consumption would be higher than indicated below.

> **In Germany, the proportion of adults with harmful alcohol consumption by age and sex in different surveys ranged from 9% to 23% for women and from 16% to 21% for men. Among children and adolescents, depending on age, around 45% or almost 70% had drunk alcohol in the last 4 weeks. Almost 9% of young people aged 12–17 years drank alcohol at least once per week.**

Adults

Recent representative data on **average consumption of alcoholic beverages** in Germany are not available. Data from the National Nutrition Survey II (*Nationale Verzehrsstudie II*, NVS II, 2005–2007) showed a consumption of 81 g per day for women and 308 g per day for men. On average, men drank almost four times more alcoholic beverages than women [17].

In the Epidemiological Survey of Substance Abuse (*Epidemiologischer Suchtsurvey 2021*) 2021, 66% of women and 75% of men aged 18–64 years reported having **drunk alcohol in the last 30 days**. One-fifth of these (women: 23%; men: 21%) reported **harmful alcohol consumption** (women: ≥12 g/day; men: ≥24 g/day) and one-third (women: 23%; men: 42%) reported at least **one episode of heavy drinking** (five or more glasses of alcoholic beverages = about 70 g of pure alcohol) [15].

In the study German Health Update (*Gesundheit in Deutschland aktuell*, GEDA 2019/2020-EHIS), the proportion of people with **low-risk alcohol consumption** in the German population was analysed separately by age group. These are people who reported no alcohol consumption or amounts below the limit for harmful consumption (women: ≤10 g/day; men: ≤20 g/day). In total, 89% of women and 84% of men were low-risk drinkers. The proportion of individuals with low-risk alcohol consumption was highest among women aged 30–44 years (91.4%) and lowest among men aged 45–64 years (82%) [18].

The Global Burden of Disease (GBD) Study 2020 indicates the proportion of people who **drink more alcohol than the so-called non-drinker equivalence** (NDE) **level**. This is the level of alcohol consumption at which the risk of health loss for a person who drinks alcohol is equivalent to that of an abstinent person. The NDE varies by age, sex and region (for values see "Estimation of alcohol intake to minimise the risk of adverse health consequences"). ◆ Table 1 shows the proportion of people in Germany with alcohol consumption above the NDE for different age groups.

An analysis of nine cross-sectional surveys of the Epidemiological Survey of Substance Abuse showed an average downward **trend in the prevalence of harmful alcohol consumption** (women: ≥12 g/day; men: ≥24 g/day) for both sexes between 1995 and 2018 [19]. However, between 2018 and 2021, the proportion of people with harmful alcohol consumption increased again for both sexes [12]. The **prevalence of heavy episodic drinking** (consumption of ≥5 glasses of alcoholic beverages = about 70 g of pure alcohol on at least one of the last 30 days), decreased on average for both sexes between 1995 and 2018. The decrease was slightly greater for men than for women. For both sexes, the prevalence

of heavy episodic drinking was highest among 18–29-year-olds between 1995 and 2018, with an increase observed particularly among women [19].

According to data from the Epidemiological Survey of Substance Abuse, 1.5% of women and 4% of men in Germany **abused alcohol** in 2018; less than 2% of women and almost 5% of men were **alcohol-dependent**. People aged from 18 years to younger than 24 years and men were particularly frequently affected by alcohol abuse and dependence [12].

A higher level of education was positively associated with the frequency of alcohol consumption, but negatively associated with the frequency of binge drinking and alcohol problems [20].

Children and adolescents

The EsKiMo II study (eating study published as KiGGS [German Health Interview and Examination Survey for Children and Adolescents, *Studie zur Gesundheit von Kindern und Jugendlichen in Deutschland*] module; 2015–2017) provides data on **alcohol consumption among children and adolescents**. Among 12–14-year-olds, 42% of girls and 45% of boys reported having consumed alcohol at least once during the 4-week survey period. The mean alcohol consumption of girls was 0.3 g per day, which was less than that of boys of the same age with 0.5 g per day. Among adolescents aged 15–17 years, 66% of females and 68% of males consumed alcohol at least once during the 4-week survey period. Daily intake was 2.4 g for girls, which was lower than the 4.3 g intake for boys [21].

The results of a survey conducted by the Federal Centre for Health Education (*Bundeszentrale für gesundheitliche Aufklärung*, BZgA) in 2021 indicated that about 9% of adolescents (7% of girls and 11% of boys) aged 12–17 years consumed alcohol regularly (at least once per week). About 4% of adolescents consumed harmful amounts of alcohol and 11% reported at least one episode of heavy drinking (five or more glasses). Since 2001, the proportion of adolescents who consume alcohol regularly, consume harmful amounts and report heavy drinking has been declining [22].

Pregnant women

In the KiGGS study (2003–2006), less than 1% of the women surveyed reported regular alcohol consumption during pregnancy; 14% reported occasional consumption. The terms 'regularly' and 'occasionally' were defined neither in the publication of the results nor in the KiGGS questionnaire [23].

In an analysis of alcohol-related biomarkers in blood samples from 2,182 pregnant women in Saxony-Anhalt (2015–2017), 13.8% of the women had an elevated level of at least one biomarker that indicated harmful alcohol consumption [24].

Breastfeeding

In the study Breast-feeding Habits in Bavaria (*Stillverhalten in Bayern*, 2005–2006), 39% of the mothers surveyed reported consuming alcohol at least once while breastfeeding; 29% in the first 3 months after giving birth and 23.6% only on certain occasions. The results indicated that 4.7% of the participants consumed 1–3 alcoholic beverages on a single occasion, while 0.7% reported consuming more than three alcoholic beverages on a single occasion [25].

Age group [years]	Women	Men
15–39	70.8%	83.6%
40–64	54.9%	66.7%
≥65	23.8%	42.7%

Tab. 1: **Proportion of people in Germany with alcohol consumption above the NDE[1] [2]**
[1] NDE = non-drinker equivalence: level of alcohol consumption at which the risk of health loss for a person who drinks alcohol is equivalent to that of an abstinent person

Impact of alcohol consumption on health

Consumption of alcohol and subsequent production of its breakdown products, particularly acetaldehyde, damages all organs and disrupts a multitude of metabolic processes. The consequences of alcohol consumption include injuries sustained in road traffic accidents and through violence, cancer, cardiovascular and liver diseases, and suicide. Furthermore, alcohol consumption is a contributing factor in the transmission of various infectious diseases, including tuberculosis and HIV/AIDS. In addition to the individual consequences for the person consuming alcohol, people in their environment can also be affected by the consequences of alcohol consumption, e.g., as a result of accidents or acts of violence [1–3, 7; 8, 12].

Short-term consequences of alcohol consumption

The acute effects of alcohol on the brain and central nervous system include impairment of visuomotor coordination, of divided or focused attention, increased reaction time, perturbation of reaction inhibition and of working memory [26]. These effects increase the risk of injuries, falls and accidents under the influence of alcohol [1, 3, 12, 27]. Evidence suggests that binge drinking has neurotoxic effects on individuals aged 10–24 years. These effects are observed in brain regions associated with reward seeking, incentive sensitivity and executive control. Consequently, cognitive deficits and maladaptive alcohol associations emerge. These deficits can further increase the propensity of young people to engage in risky activities, including use and abuse of and dependence on alcohol and other drugs [28]. Alcohol consumption can also impair cognitive

functions and the performance of everyday tasks such as driving with a significant time delay (colloquially known as alcohol hangover) [29].

Alcohol can also influence the effects of various medications. The effects of drugs can be accelerated or delayed, depending on the active ingredient and dosage form, which can result in a reduction of the desired effect or emergence of adverse effects, even coma and death. This issue is reinforced when patients take multiple medications and consume alcohol [12].

Consumption of alcohol, particularly heavy episodic drinking, is associated with the occurrence of aggression and violence (physical, psychological and sexual). There is also evidence that alcohol consumption can exacerbate the severity of violence. Various factors impact the relationship between alcohol consumption and violence, e.g., the effects of alcohol on the personality, beliefs and attitudes of people who consume alcohol, the immediate context of alcohol consumption and the drinking culture. Avoidance of alcohol consumption, especially binge drinking, reduces the risk of alcohol-related violence [1, 30].

Long-term consequences of alcohol consumption

Long-term alcohol consumption carries an inherent risk of addiction, causes a significant burden of disease and mortality, and is a leading risk factor for both communicable and non-communicable diseases [1, 2, 6, 12, 16, 31].

Chronic high alcohol consumption is associated with a reduction in the volume of grey matter in certain brain regions, which may be related with impairments of cognitive, attentional, emotional and perceptual functions [32]. Alcohol consumption during childhood, adolescence and young adulthood can have a long-term negative impact on brain development due to its neurotoxicity and can be a risk factor for the development of an alcohol use disorder [33].

Alcohol-related diseases encompass a range of conditions that are directly caused by alcohol or its metabolic breakdown products. These include, but are not limited to, the following:

- cancer (especially breast and colon cancer),
- cardiovascular diseases,
- gastrointestinal diseases, e.g., liver cirrhosis and pancreatitis,
- diabetes mellitus, and
- neuropsychiatric disorders, including Alzheimer's disease, other dementias and cognitive decline.

Alcohol is considered one of the four main risk factors contributing to the global burden of non-communicable diseases [3].
◆ eSupplement Table e1 presents an overview of the associations between alcohol consumption and non-communicable diseases that are prevalent in Germany, including obesity, cancer, cardiovascular disease, liver disease, type 2 diabetes and dementia, as well as selected potential mechanisms of action. In addition to non-communicable diseases, alcohol consumption indirectly contributes to the development of infectious diseases, including tuberculosis, pneumonia, HIV and other sexually transmitted infections [1, 6, 34, 35]. There is a lack of reliable data concerning the relationship between alcohol consumption and mental health (development of depression, anxiety and suicidal ideation). The available research indicates that alcohol consumption has minimal to no effect on the development of depression and anxiety. However, there is a potential increased risk of suicidal ideation due to alcohol consumption, particularly in the context of heavy episodic alcohol consumption or binge drinking [36].

> **In addition to the short-term effects of alcohol consumption, which include an increased risk of accidents, injuries and violence, alcohol consumption is a contributing factor in the development of various diseases. Alcohol consumption increases the risk of developing cancer, particularly breast and colon cancer, cardiovascular disease and liver disease.**

Alcohol use disorders, especially alcohol dependence, also increase the risk of malnutrition, a low body mass index or even underweight. This may result from the substitution of meals with alcohol, alterations of appetite and disturbances of nutrient digestion, absorption and metabolism [37, 38]. Chronic high alcohol consumption[1] was reported to be associated with a thiamin deficiency in 80% of cases. The underlying causes are insufficient nutrient intake due to malnutrition, which is frequently observed in alcohol-dependent individuals, reduced intestinal absorption and intracellular uptake, and impaired thiamin utilisation. Untreated thiamin deficiency can lead to Wernicke-Korsakoff syndrome, an acutely life-threatening neurological disorder [39].

Consumption of alcohol during pregnancy also has a detrimental impact on the foetus through prenatal exposure and increases the risk of adverse outcomes, including foetal alcohol syndrome (FAS) and foetal alcohol spectrum disorder (FASD). The impact of alcohol on foetal health and the social consequences later in life are significant [40]. A register-based study of the quantification of external risks due to alcohol consumption in Germany in 2014 reported that the incidences of FAS and FASD in newborns were 41 and 177 children per 10,000 live births, respectively. Considering the number of newborns

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[1] Due to the different definitions used in the surveys, it is not feasible to assign a precise quantity to the concept of high alcohol consumption.

in Germany in 2014, this equates to 2,930 children with FAS and 12,650 children with FASD [41].

Alcohol can pass into breast milk through passive diffusion. The alcohol concentration in breast milk is largely consistent (about 95%) with the maternal blood alcohol concentration at all times [42]. Despite a lack of reliable data on the adverse effects of alcohol consumption during lactation, based on a preventive approach, it is advised to avoid consuming alcohol during breastfeeding and particularly during exclusive breastfeeding in order to protect the health of both the mother and child [43].

Mortality

The reliability of meta-analyses of cohort studies examining the relationship between alcohol consumption and all-cause mortality is significantly constrained by inherent methodological difficulties. In addition to general difficulties in evaluating the relationship between alcohol consumption and diseases (see "Limitations of epidemiological studies on alcohol consumption"), there are further limitations with regard to all-cause mortality. These include the dependence of the risk relationship on the distribution of causes of death in a cohort, which is often different from that in the overall population. Additionally, endpoints with a clear relationship to alcohol, such as tuberculosis and liver cirrhosis, are often not recorded in cohort studies due to the rarity of these conditions in the study samples [44]. Furthermore, estimates of the alcohol-related mortality risk also vary considerably depending on the study design and are therefore difficult to interpret.

The findings of a systematic review with meta-analysis suggest that there are no statistically significant differences in mortality risk between individuals who consume alcohol on an occasional basis (<1.3 g/d), in small quantities (1.3–<25 g/d) and at a moderate level (25–<45 g/d) compared with lifelong abstinent individuals. Individuals who consumed alcohol at levels classified as high (45–<65 g/d; relative risk [RR] = 1.19; 95% confidence interval [CI] 1.07–1.32) and very high (≥65 g/d; RR = 1.35; 95% CI 1.23–1.47) had a significantly higher mortality risk than individuals who abstained from alcohol throughout their lifetime [45]. Harmful alcohol consumption (according to AUDIT scores[2]) [47] and heavy episodic alcohol consumption (≥ 5 drinks for men and ≥ 4 drinks for women per drinking occasion) [48] were associated with an elevated mortality risk compared with moderate alcohol consumption [45].

In Germany, the estimated prevalence of alcohol-related mortality was 5.2% of all deaths in 2016 (women: 2.7%; men: 7.9%). The proportion of alcohol-related deaths was notably elevated among young people, reaching 16% among individuals aged 15–19 years and 23% among those aged 20–24 years across Europe. The majority of deaths attributed to alcohol consumption were due to non-communicable diseases (79%), with the remainder attributed to injuries (17%) and communicable and other diseases (4%) [8].

Limitations of epidemiological studies on alcohol consumption

When recording alcohol intake, there are methodological issues that need to be taken into account when collecting, analysing and interpreting the data. Self-reported consumption can result in biased data due to misreporting. This encompasses under- and over-reporting of both the quantity consumed and the frequency of consumption. Furthermore, individuals who participate in surveys of alcohol consumption tend to consume less alcohol than those who do not [49, 50].

Furthermore, the definitions of light/low, medium/moderate, heavy/high and occasional alcohol consumption used in different publications vary considerably. Even the amount of alcohol in a standard drink varies substantially, with a range of approximately 8–15 g [51].

As a control group, some studies use people who do not drink alcohol. In some cases, no distinction is made between lifelong abstainers and former alcohol drinkers. This can result in a J-shaped relationship, which may be erroneously perceived as a risk-reducing effect in favour of light-to-moderate alcohol consumption. This is attributable to the inclusion of individuals who terminated their alcohol consumption due to health-related concerns, who are colloquially designated as 'ill quitters'. Therefore, individuals with low alcohol consumption may appear to have a lower risk of disease than the abstinent comparison group because they have a poorer general state of health [45, 50, 52, 53].

> **Despite these limitations, the data demonstrate a clear association between alcohol consumption and morbidity and mortality. However, it is not possible to determine a specific threshold for the development of individual diseases caused by alcohol consumption.**

[2] AUDIT-C (Alcohol Use Disorders Identification Test) is a short screening instrument for recording and identifying hazardous and harmful alcohol consumption. A maximum of 12 points can be achieved (up to 4 points per question). From a score of 4 for men and 3 for women, there is an increased risk of alcohol use disorders. A score of 5 for men and 4 for women indicates harmful alcohol consumption [46].

Social aspects of alcohol consumption

The short- and long-term health consequences of alcohol consumption have an impact on the social environment and society. Impairment of health or performance can result in loss of employment, which in turn can lead to financial difficulties, loss of housing and social exclusion [12]. This has a detrimental effect on the family environment, particularly on the children of individuals with alcohol use disorders. Families with alcohol-related issues often have a lower socio-economic status than families without substance abuse issues. Children from families with substance abuse issues tend to have lower school performance and less favourable health behaviour and are more likely to experience social exclusion and stigmatisation [54–57].

Furthermore, alcohol consumption can precipitate physical, psychological and sexual violence (see "Impact of alcohol consumption on health") and (traffic) accidents. Alcohol consumption can have adverse effects on both individuals who consume alcohol and those in their social surroundings, with the potential for physical and psychological harm, including death [12]. In Germany, there is a considerable amount of alcohol-related health damage (morbidity and mortality) among third parties. It is estimated that in 2014, alcohol was responsible for 1,214 fatal road traffic accidents involving third parties ($\triangle$ 45.1% of all third-party deaths in road traffic accidents) and 55 deaths due to interpersonal violence ($\triangle$ 14.9% of all deaths due to interpersonal violence) [41].

The financial burden imposed by alcohol consumption on society is considerable. This encompasses alcohol-related illnesses and the resulting incapacity to work and rehabilitation, personal injury and property damage, violence and accidents, and production losses [12]. The annual economic burden of alcohol consumption in Germany is estimated to be approximately €57 billion. Of this, €16.6 billion consists of direct costs for the healthcare system (e.g., treatment costs, hospitalisation and medication) and around €40 billion indirect costs (e.g., loss of production due to incapacity to work, unemployment, early retirement and premature death) [58]. By contrast, alcohol-related tax revenues in 2022 amounted to only approximately €3 billion [59].

Ecological aspects of alcohol consumption

To assess the environmental sustainability of alcoholic beverages, it is necessary to consider several different production and processing steps [60]. These include agricultural production of raw materials and processing, packaging, storage and transport of the products themselves [60, 61]. The most important factors influencing the environmental sustainability of alcoholic beverages are summarised in ◆ eSupplement Table e2.

Sustainability indicators enable an ecological assessment and comparison of diverse products [62–64]. In the context of alcoholic beverages, relevant indicators include land use, soil and water protection, biodiversity, water use, energy use and greenhouse gas emissions (◆ eSupplement Table e3) [60, 62, 64, 65]. To compare products and provide an informed assessment of their ecological benefits and risks, a comprehensive analysis of the entire product life-cycle is essential. The results of ecological assessments from differing sources vary considerably for analogous products due to a multitude of factors, including the specific product, the processes and indicators of the assessment, and the analytical methodologies used [66–68]. In addition to the aforementioned aspects, it may be relevant whether the raw materials are suitable for direct consumption or whether by-products such as fallen fruit and pomace are utilised. However, it should be noted that, in general, environmental sustainability plays a minor role compared with health and social dimensions when assessing the consumption of alcoholic beverages.

Estimation of alcohol intake to minimise the risk of adverse health consequences

The Canadian Centre on Substance Use and Addiction published Canada's Guidance on Alcohol and Health in 2023 [1]. The aim was to utilise mathematical modelling in order to determine the amount of alcohol that is associated with the lowest risk of alcohol-related physical, mental and social consequences. An investigation of the short- and long-term risks and benefits of alcohol consumption was conducted based on a systematic literature search. The quality of the publications was evaluated by the criteria established by AMSTAR 2 (A Measurement Tool to Assess Systematic Reviews 2) and GRADE (Grading of Recommendations, Assessment, Development and Evaluation). The literature review revealed the absence of recent high-quality systematic reviews on mental health and social aspects such as violence. Therefore, these aspects could not be included in the modelling. In total, the risk functions from 16 systematic reviews with meta-analyses were included in the analysis. Two of these reviews focused on the short-term consequences of alcohol consumption, one on road injury and the other on intentional und unintentional injuries. The other 14 reviews addressed long-term consequences such as cancer, cardiovascular disease, liver disease and pancreatitis. The reference group for the modelling consisted of lifetime abstainers [1].

For the majority of the considered diseases and injuries, consumption of alcohol in any quantity had a detrimental effect on health. However, for diabetes mellitus (in women only), pancreatitis (in women only) and ischaemic stroke, low alcohol consumption was associated with a risk-reducing effect. For ischaemic heart disease and intracerebral haemorrhage, low alcohol consumption was associated with neither a negative nor protective effect [1].

The modelling was based on the years of life lost (YLLs) due to alcohol consumption. A threshold value of 17.5 YLLs or one death per 1,000 and 100 lifetimes was assumed to indicate low and moderate risk, respectively. The modelling demonstrated a low risk of alcohol-related consequences with consumption of two standard drinks[3] per week and a moderate risk with consumption of six standard drinks per week (◆ Table 2) [1].

The threshold values for the number of standard drinks per week for a low or moderate risk from alcohol consumption were similar for women and men in this analysis. Nevertheless, the risk of adverse health outcomes associated with alcohol consumption in the harmful range (>6 standard drinks per week) increased more steeply for women than for men due to various biological factors. By contrast, far more injuries, violence and deaths result from men's alcohol use, especially in the case of per-occasion drinking [1].

A supplementary estimate indicates that the lifetime risk of death and disability attributable to alcohol use increases as the amount of alcohol use increases. Low alcohol consumption had neither a risk-reducing nor a risk-increasing effect (no J-shaped curve). For individuals who consume one drink per week, there was no statistically significant association compared with lifelong abstainers [1].

From these results, the Canadian working group derived recommendations on alcohol consumption under the headline "Drinking less is better". The graphical representation of the recommendations illustrates the risk of adverse health consequences depending on alcohol consumption (number of standard drinks) and indicates the quantities of various alcoholic beverages that correspond to a standard drink (the ethanol content of a standard beverage is 13.45 g here). Furthermore, it offers tips to reduce alcohol consumption (◆ Fig. 1) [1].

	Number of standard drinks[1] per week	
	Women	Men
Low risk (1 death or 17.5 YLL per 1,000 lifetimes)	2 (95% CI: <1–6)	2 (95% CI: <1–8)
Moderate risk (1 death or 17.5 YLL per 100 lifetimes)	6 (95% CI: <1–10)	6 (95% CI: <1–11)

Tab. 2: **Threshold values for the number of standard drinks[a] per week for a low or moderate risk from alcohol consumption, determined by mathematical modelling [1]**
CI: confidence interval, YLLs: years of life lost
[a] The ethanol content of a standard beverage is 13.45 g here.

The GBD study also established the quantity of alcohol consumption that is associated with the least adverse health outcomes. The objective was to minimise the adverse health effects associated with alcohol consumption in a population. According to the 2016 GBD study, this amount was zero drinks per day [69]. In a reassessment of current studies with data up to 2020, the theoretical minimum exposure level (TMREL, ◆ Box 3) was estimated for 21 regions by age group, sex, and year. This was achieved by using systematic reviews and meta-regressions. The assessment contained region-specific data pertaining to 22 diseases and injuries. In addition, the NDE level (◆ Box 3 and see "Alcohol consumption of the population") was reported. TMREL and NDE did not vary significantly by sex or year. The global TMREL was at 0.5 standard drinks per day. TMREL and NDE significantly vary by age group. Individuals in the younger age groups (15–39 years) had much lower TMREL and NDE than those aged 40 years and older. The GBD data for Central Europe are presented in ◆ Table 3. For women up to 24 years old and men up to 29 years old, TMREL is zero drinks per day. Based on this evaluation, women and men up to 54 years old experience minimal health loss at a maximum of half a standard drink per day (the ethanol content of a standard beverage is 10 g here). For older individuals, this value rises to about one standard drink per day. NDE increases in a pronounced manner with advancing age. For individuals younger than 40 years, NDE is a maximum of half a standard drink per day. It rises to more than five standard drinks per day for the highest age group. The proportion of people with high alcohol consumption is particularly high among younger people; therefore, measures to minimise alcohol consumption among young adults should be high priority [2].

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[3] The alcohol content of a standard beverage can vary considerably between studies, see "Limitations of epidemiological studies on alcohol consumption".

Drinking less is better

We now know that even a small amount of alcohol can be damaging to health.

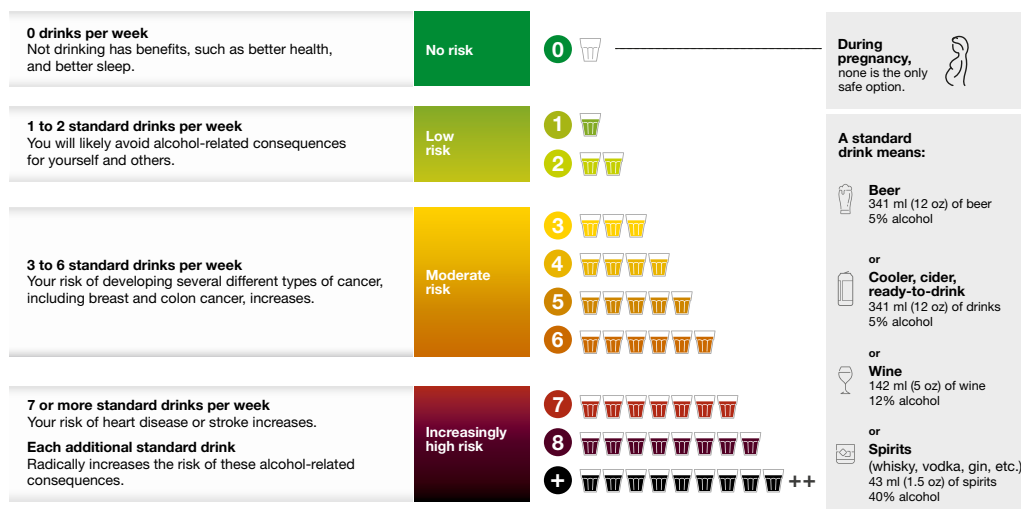Science is evolving, and the recommendations about alcohol use need to change.

Research shows that no amount or kind of alcohol is good for your health.
It doesn't matter what kind of alcohol it is—wine, beer, cider or spirits.

Drinking alcohol, even a small amount, is damaging to everyone,
regardless of age, sex, gender, ethnicity, tolerance for alcohol or lifestyle.

That's why if you drink, it's better to drink less.

Alcohol consumption per week

Drinking alcohol has negative consequences. The more alcohol you drink per week, the more the consequences add up.

0 drinks per week
Not drinking has benefits, such as better health, and better sleep.

No risk — 0

During **pregnancy**, none is the only safe option.

1 to 2 standard drinks per week
You will likely avoid alcohol-related consequences for yourself and others.

Low risk — 1, 2

A standard drink means:

Beer
341 ml (12 oz) of beer
5% alcohol

or

Cooler, cider, ready-to-drink
341 ml (12 oz) of drinks
5% alcohol

3 to 6 standard drinks per week
Your risk of developing several different types of cancer, including breast and colon cancer, increases.

Moderate risk — 3, 4, 5, 6

or

Wine
142 ml (5 oz) of wine
12% alcohol

7 or more standard drinks per week
Your risk of heart disease or stroke increases.

Each additional standard drink
Radically increases the risk of these alcohol-related consequences.

Increasingly high risk — 7, 8, + ++

or

Spirits
(whisky, vodka, gin, etc.)
43 ml (1.5 oz) of spirits
40% alcohol

Aim to drink less

Drinking less benefits you and others. It reduces your risk of injury and violence, and many health problems that can shorten life.

Here is a good way to do it

Count how many drinks you have in a week.

Sunday | Monday | Tuesday | Wednesday | Thursday | Friday | Saturday | TOTAL

Set a weekly drinking target. If you're going to drink, **make sure you don't exceed 2 drinks on any day.**

Good to know

You can reduce your drinking in steps! Every drink counts: any reduction in alcohol use has benefits.

It's time to pick a new target

What will your weekly drinking target be?

0 1 2 3 4 5 6

Tips to help you stay on target

- Stick to the limits you've set for yourself.
- Drink slowly.
- Drink lots of water.
- For every drink of alcohol, have one non-alcoholic drink.
- Choose alcohol-free or low-alcohol beverages.
- Eat before and while you're drinking.
- Have alcohol-free weeks or do alcohol-free activities.

Canadian Centre on Substance Use and Addiction

Box 3: Definitions of theoretical minimum risk exposure level (TMREL) and non-drinker equivalence (NDE) [2]

TMREL (theoretical minimum risk exposure level): the level of consumption that minimises health loss from alcohol consumption for a population.

NDE (non-drinker equivalence): the level of alcohol consumption at which the risk of health loss is equivalent to that of an abstinent person.

Age group (years)	TMREL[1] [Number of standard drinks[3] per day]		NDE[2] [Number of standard drinks[3] per day]	
	Women	Men	Women	Men
15–19	0.0	0.0	0.0	0.0
20–24	0.0	0.0	0.1	0.0
25–29	0.1	0.0	0.2	0.0
30–34	0.2	0.1	0.4	0.2
35–39	0.3	0.3	0.5	0.5
40–44	0.4	0.4	0.7	0.8
45–49	0.4	0.5	1.0	1.1
50–54	0.5	0.5	1.2	1.4
55–59	0.6	0.6	1.5	1.8
60–64	0.6	0.6	2.1	2.3
65–69	0.7	0.7	2.8	2.9
70–74	0.7	0.7	3.6	3.6
75–79	0.7	0.7	4.2	4.3
≥ 80	0.9	0.9	5.3	5.4

Tab. 3: **Theoretical minimum risk exposure level (TMREL)[1] and non-drinker equivalence (NDE)[2] in Central Europe, expressed as the number of standard drinks[3] per day by age and sex [2]**
[1, 2] For the definition, see Box 3.
[3] The ethanol content of a standard beverage is 10 g here.

Public health measures to reduce alcohol consumption and prevent health problems

Alcohol-related health protection includes behavioural prevention measures, which focus on the behaviour of individuals or target groups, as well as population-based prevention measures, i.e., changes to the social environment. The aims of these measures include to [12]:
• delay or even prevent the onset of consumption,
• reduce the amount of alcohol consumed and binge drinking,
• identify and counteract harmful drinking behaviour at an early stage, and
• prevent dependence.

A combination of behavioural and population-based prevention measures (policy mix) is considered particularly effective to reduce alcohol consumption and prevent related harm [70]. Successful alcohol prevention is therefore a cross-cutting social task that is the responsibility of the federal government, federal states, local authorities, self-government and also employers, trade unions and addiction prevention organisations [71].

The WHO has established the Global Information System on Alcohol and Health (GISAH) to assess and monitor the health situation and trends in alcohol consumption, alcohol-related harm and policy measures in countries. The GISAH has compiled various public health measures to restrict alcohol consumption and prevent health damage (alcohol control policies). Examples include pricing and tax measures, restrictions on advertising and sponsorship, sales restrictions and health warning labels (for further measures, ⬥ eSupplement Table e4) [72].

Examples of the implementation of measures in Germany

In Germany, behavioural prevention measures are carried out, for example, by the BZgA, DHS and *Blaues Kreuz Deutschland e. V.* (BKD). Examples aimed at people in different age groups or special population groups are [73, 74]:
• *Null Alkohol volle Power* (Zero alcohol full power, by BZgA),
• *Alkohol? Kenn Dein Limit* (Alcohol? Know your Limit!, by BZgA),
• *Aktionswoche Alkohol* (Alcohol Action Week, by DHS and BKD),
• *Alkoholfrei Sport genießen* (Enjoy sports alcoholfree, by BZgA),
• Individualised, risk-adapted, internet-based intervention to reduce alcohol, and tobacco consumption in pregnant women (by BZgA).

Population-based alcohol use prevention measures in Germany include the legal regulations in the Protection of Young Persons Act (*Jugendschutzgesetz*, JuSchG) and the law for restaurants *Gaststättengesetz* (GastG), which regulate, for example, the ban on serving alcoholic beverages (Section 19 GastG[4]) and the age limit for the sale and consumption of alcoholic beverages in public (Section 9 JuSchG[5]) [71]. In Germany, the blood alcohol limit for drivers of cars, motorcycles and e-scooters is

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[4] https://dejure.org/gesetze/GastG/19.html
[5] https://www.gesetze-im-internet.de/juschg/__9.html

0.5‰ (= administrative offence), with 0.3‰ already considered as indicative of an inability to drive. In this case, conspicuous driving could result in a criminal offence. For cycling, the limit is 1.6 ‰, although incidents with a lower blood alcohol level are also penalised. For novice drivers on probation or younger than 21 years, there is an absolute alcohol ban with a blood alcohol limit of 0.0 ‰ [75]. The law on the imposition of a special tax on alcohol-containing sweet drinks (alcopops) for the protection of young people (*Alkopopsteuergesetz* – AlkopopStG), which has been in force since July 2004, is a public health instrument for alcohol consumption by teenagers and young adults in Germany. The alcopop tax is around four times higher than the usual alcohol tax and is levied on top of it [76].

Further examples of the implementation of measures in Germany and information on the effectiveness of alcohol use prevention measures are summarised in the Alcohol Atlas Germany 2022. For example, increasing the price of alcoholic beverages reduces alcohol consumption, the amount and frequency of drinking, and the adverse consequences of alcohol consumption. Measures to restrict alcohol availability as well as a ban on advertising alcoholic beverages are cost-effective; health warnings and education campaigns can provide information and improve awareness of the harmful effects of alcohol consumption [12].

In an international comparison conducted by the WHO in 2014, Germany is below average in the implementation of measures through programmes to prevent harmful alcohol consumption:
- In the area of policy/education, Germany ranks 23rd out of 29 countries.
- In the area of prevention in the workplace/community, Germany ties with Austria for second to last place out of 29 countries.
- In the area of measures against drunk driving, Germany ranks 26th out of 30 countries.
- Germany ranks second to last out of 53 countries in implementing measures against illegal alcohol trade and production.
- In the area of restricting the availability of alcohol, Germany ranks last out of 30 countries [77].

High alcohol consumption in Germany is one of the reasons for the lower life expectancy of people in Germany than in other high-income countries [78].

Summary and recommendations for action

This DGE position statement summarises data on alcohol consumption and its health effects. The objective was to derive recommendations for individual drinking behaviour and to provide information on health policy measures that help to minimise harmful effects in the German population. The DGE position statement on alcohol replaces the reference value for alcohol intake previously published by the DGE.

In the 2019/2020 German Health Survey, more than 80% of women and men in Germany reported alcohol consumption below the previously specified threshold for harmful consumption

(♦ Box 2) [18]. However, depending on age and sex, up to one-fifth of adults consumed alcohol in quantities that can be classified as harmful; one-third of respondents reported at least one episode of heavy drinking within the last 30 days [15]. Furthermore, surveys of children, adolescents and pregnant women indicate that these population groups consume alcoholic beverages, sometimes in quantities defined as harmful or in the form of binge drinking (see "Alcohol consumption of the population"). The average amount of alcohol consumed in Germany is more than twice as high as the global average. **This means Germany is a country with a high level of alcohol consumption** [2, 16].

Alcohol consumption is associated with more than 200 adverse health outcomes (diseases and accidents) [6, 3, 7]. In particular, consumption of harmful amounts of alcohol and heavy episodic drinking reduce quality of life and increase the risk of morbidity and mortality. For specific endpoints, including type 2 diabetes, ischaemic heart disease, ischaemic stroke, dementia and kidney cancer, the findings indicate a potential risk reduction with low-to-moderate alcohol consumption. Nevertheless, this can be attributed, at least in part, to use of methodologically inadequate study designs. Furthermore, the same quantity of alcohol is associated with an increased risk of other adverse health outcomes, including breast and colon cancer, hypertension and liver disease (see "Impact of alcohol consumption on health"). **Consequently, no quantity of alcohol consumption can be considered health-promoting or free of risk.** The health consequences of alcohol consumption can have an impact on the social environment, particularly in instances of harmful alcohol consumption, heavy episodic drinking and alcohol use disorders. The social consequences for both the individuals who consume alcohol and those in their social surroundings include unfavourable health behaviours, stigmatisation as well as physical, psychological and sexual violence. Furthermore, the economic costs associated with alcohol-related diseases, personal injury and property damage due to violence and accidents, as well as production losses are considerable and ultimately borne by society. Consequently, they must also be considered as social consequences of alcohol consumption (see "Social aspects of alcohol consumption").

As is the case for all foods, the environmental impact of alcoholic beverage production is determined by a multitude of factors. These include production and processing of raw materials, manufacture of packaging materials, and transport, storage and distribution of finished products. Ecological sustainability plays a minor role compared with health and social dimensions when assessing the consumption of alcoholic beverages (see "Ecological aspects of alcohol consumption").

To derive recommendations regarding alcohol intake, it is primarily necessary to consider the sustainability dimensions of health and social aspects. Despite the inherent challenges associated with collection of data on the relationship between alcohol consumption and disease endpoints, particularly mortality, the presented results clarify that:

> **No quantity of alcohol consumption is considered potentially healthy and safe for consumption. The DGE therefore recommends to avoid consuming alcoholic beverages. For individuals who consume alcoholic beverages, it is advisable to avoid excessive intake. This is particularly pertinent to young people. Children, adolescents, pregnant women and breastfeeding mothers should generally avoid consuming alcohol.**

These recommendations are consistent with the DHS recommendations on alcohol use, which also emphasise that even low levels of alcohol intake can contribute to the development of diseases and that alcohol consumption should be reduced to improve physical health, regardless of the amount consumed. To maintain physical health, it is best not to drink alcohol [79].

Considering the findings pertaining to the effects of alcohol consumption, as well as the calculations of the Canadian Centre on Substance Use and Addiction [1] and the GBD Study 2020 [2] (see "Estimation of alcohol intake to minimise the risk of adverse health consequences"), the DGE also derives the following recommendations for action on alcohol consumption:

- There is no risk-free alcohol consumption in terms of health; adults should therefore abstain from consuming alcohol or consume as little as possible. It is particularly beneficial for young people to abstain from alcohol consumption.

- For healthy adults who are not pregnant or breastfeeding, consumption of 1–2 alcoholic drinks per week (<27 g alcohol/week) is considered low risk, consumption of 2–6 alcoholic beverages per week (27–81 g alcohol/week) is associated with a moderate risk of disease and consumption of more than 6 alcoholic drinks per week (>81 g alcohol/week) is considered to have a high risk of secondary damage (♦ Table 4). There are no sex-specific differences in the risk of health consequences for low- and moderate-risk consumption. According to the calculations of the Canadian Centre on Substance Use and Addiction [1], low-risk consumption is significantly lower than the previously assumed limits, especially for men (♦ Box 2).

- Due to the increasing risk of adverse consequences when consuming large amounts of alcohol, consumption of harmful amounts of alcohol and heavy episodic drinking should be strictly avoided.

- Children and adolescents should abstain from alcohol due to its acute neurotoxic effects, potential adverse effects on their physical and cognitive development and the risk of subsequent harmful alcohol consumption and development of alcohol use disorders.

- Pregnant women and those who are breastfeeding should abstain from alcohol consumption because alcohol can be toxic to the foetus or infant.

- Individuals with pre-existing health conditions that may be caused or exacerbated by alcohol consumption and those taking medications should not consume alcohol due to possible undesirable interactions.

- Individuals who do not currently drink alcohol are advised to remain abstinent because any alcohol consumption increases the risk of damage to health.

In Germany, further efforts are necessary to improve social consciousness regarding the detrimental effects of (excessive) alcohol consumption and to reduce alcohol intake, alcohol-related health issues, alcohol-related mortality and adverse social outcomes [80]. This requires the implementation of a multidimensional approach, encompassing a combination of behavioural and population-based prevention measures, and their regular evaluation and adaptation. Although a considerable number of state and nationwide target group-specific prevention campaigns and programmes already exist, Germany is notably below the global average in the implementation of measures and programmes to prevent harmful alcohol consumption [77]. The main areas of action for population-based

Alcohol consumption	Amount of alcohol/week	Corresponding quantity of beer (alcohol content 5% vol.)	Corresponding quantity of wine (alcohol content 12% vol.)	Corresponding quantity of spirits (alcohol content 38% vol.)
risk-free	0 g	0	0	0
low risk	<27 g	1–2 small bottles (up to a total of 660 mL)	1–2 small glasses (up to a total of 280 mL)	2–4 glasses of 0.02 L (up to a total of 80 mL)
moderate risk	27–81 g	up to 6 small bottles or 4 half-litre bottles (up to a total of 2 L)	up to 5 small glasses (up to a total of approximately 825 mL)	up to 6 glasses of 0.04 L (up to a total of 250 mL)
high risk	>81 g	more than 6 small bottles or 4 half-litre bottles (>2 L)	more than 5 small glasses (>825 mL)	more than 6 glasses of 0.04 L (>250 mL)

Tab. 4: **Calculation of the quantities of beer, wine or spirits per week for low-, moderate- and high-risk alcohol consumption**

prevention are the limitation of availability, e.g., through spatial or temporal constraints, regulatory measures pertaining to advertising, particularly on social media platforms, enhancements of screening and counselling services within the healthcare system for individuals with elevated alcohol consumption, and increased taxation [12].

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