

Rethinking Unhealthy Alcohol Use in the United States: A Structured Review

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ABSTRACT: Greater than moderate alcohol use spans a continuum that includes high levels of total alcohol consumed per period (heavy drinking) as well as episodes of intense drinking (binges) and can give rise to alcohol use disorder (AUD) when associated with an inability to control alcohol use despite negative consequences. Although moderate drinking and AUD have standard, operable definitions in the United States (US), a significant “gray area” remains in which an individual may exceed recommended drinking guidelines but does not meet the criteria for AUD (hereafter referred to as unhealthy alcohol use). To address this need, we conducted a structured literature search to evaluate how this gray area is defined and assess its burden within the US. For purposes of this review, we will refer to this gray area as “unhealthy alcohol use.” Although numerous terms are used to describe various unsafe drinking practices, our review did not find any studies in which the specific prevalence and/or burden of unhealthy alcohol use was evaluated. That is, we found no studies that focus exclusively on individuals who exceed moderate drinking guidelines but do not meet AUD criteria. Furthermore, we did not discover an established framework for identifying individuals with unhealthy alcohol use. The lack of a consistent framework for identifying unhealthy alcohol users has significant implications for patient management and disease burden assessment. Therefore, we propose the following framework in which unhealthy alcohol use comprises 2 distinct subpopulations: those at risk of experiencing alcohol-related consequences and those who have subthreshold problems associated with use. The former, termed “risky drinkers,” are defined by exceeding recommended guidelines for moderate drinking (≤ 1 or 2 drinks per day for women and men, respectively). People with subthreshold problems associated with use, defined as exhibiting exactly 1 AUD symptom, would be classified as “problematic drinkers” within this proposed framework. These definitions would help bring the core elements of unhealthy alcohol use into focus, which in turn would help identify and provide management strategies sooner to those affected and reduce the overall burden of unhealthy alcohol use.

KEYWORDS: Unhealthy alcohol use, problematic drinking, risky drinking, heavy drinking, binge drinking

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Introduction

Current recommendations for moderate alcohol consumption in the United States (US) are up to 1 standard drink (defined as 14g of ethanol) per day for women and up to 2 drinks per day for men.^{1,2} The consequences of excessive alcohol consumption remain largely unaddressed in the US, as evidenced by it remaining a leading cause of preventable death and disability, a significant contributor to health and social problems, and imposing a substantial economic burden.^{3–9} Indeed, from 2011 to 2015, there were an estimated annual average of 95 158 deaths and 2.8 million years of potential life lost attributable to alcohol.⁴ The most recent analysis estimates the 2010 economic burden of excessive drinking in the US to be \$249 billion.⁷ The burden of alcohol use in the US is likely only continuing to increase. Between 1990 and 2016, the rates of mortality and years of life lost due to alcohol-attributable liver disease both rose over 9%.⁶

Greater than moderate alcohol use spans a continuum of behaviors that include high levels of total alcohol consumed per period (heavy drinking) and episodes of intense drinking (binges). Heavy drinking or binge drinking associated with an inability to control alcohol use despite negative consequences to oneself or others characterizes alcohol use disorder (AUD).^{10,11}

AUD is determined by meeting at least 2 of 11 symptoms as defined in the Diagnostic and Statistical Manual of Mental Disorders (DSM-5). These symptoms fall along the following 3 dimensions: (1) compulsive use and craving, (2) adverse psychosocial consequences, and (3) physiological adaptation (tolerance and withdrawal). The compulsive use dimension refers to a relationship with alcohol that is represented by (1) drinking more than intended, (2) being unable to cut down on drinking, (3) spending a lot of time drinking, or (4) craving alcohol. This impaired use and obsessive relationship with alcohol persists despite negative social, occupational, or health consequences.^{10,11} The second dimension of the criteria for AUD involves the adverse psychosocial consequences of drinking alcohol, including drinking that (1) interferes with home or work responsibilities, (2) causes trouble with friends and family, (3) replaces activities that were pleasurable, (4) puts one at risk for unsafe activities, or (5) leads to depression or anxiety. These criteria are met when someone drinks despite these psychosocial consequences. The final dimension refers to physiological adaptation to alcohol that develops over time, including (1) an increase in tolerance to alcohol such that it takes more alcohol to get the desired effect and the usual number of drinks has less overall effect or (2) physical withdrawal symptoms as the effects of



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alcohol wear off. The typical withdrawal symptoms include shakes, sweating, rapid heart rate, or in severe cases, seizures.

Each DSM-5 criterion carries equal weight in diagnosing AUD, which is viewed as a continuum with mild cases (2-3 symptoms), moderate cases (4-5 symptoms), and severe cases (6 or more symptoms). There is no single necessary or sufficient symptom to define AUD and thus no clear boundaries to define when drinking becomes a distinct disorder. For example, how do we classify those who do not meet AUD criteria but report exactly 1 AUD symptom or a large group of people who exceed recommendations for moderate drinking but have no clear symptoms of AUD? The field has attempted to address this “gray area” in several ways.

In the US, moderate drinking and AUD have standard, operable definitions^{1,2,10}; however, a significant gray area exists between these 2 behaviors in which an individual may exceed recommended drinking guidelines but does not meet AUD criteria (hereafter referred to as unhealthy alcohol use). Myriad terms defining various unsafe drinking practices and reflecting unhealthy alcohol use, such as “heavy,” “harmful,” “high-risk,” and “problematic” drinking, have been used in the literature. Although these terms reflect elements of unhealthy alcohol use and AUD, no consistent or logical framework exists for identifying individuals who exhibit drinking behaviors in this space.

The lack of a consistent framework for identifying individuals with unhealthy alcohol use has significant implications for patient management and disease burden assessment. A substantial portion of drinkers in the US occupy this gray area of unhealthy alcohol use^{12,13} and are at risk for many health and social problems.¹⁴⁻¹⁸ Because of the lack of a consistent standard, people with unhealthy alcohol use may not be aware of it and may not seek appropriate remedies. Therefore, increased awareness of unhealthy alcohol use and improved methods for identification would help improve access and use of effective management tools and ensure that health policy priorities are properly aligned.

Although several comprehensive reviews focused on the burden of AUD have been previously published,¹⁹⁻²² few such studies exploring the consequences and multifaceted nature of unhealthy alcohol use specifically have been conducted. Furthermore, because the literature lacks a formal framework for identifying unhealthy alcohol use, a better understanding is needed of the core elements and disease burden contribution of this drinking behavior to provide optimal and early interventions. In order to help address this gap in the literature, we attempted to examine what is known about the burden of excessive alcohol use that does not meet AUD criteria. To this end, we conducted a structured literature search to attempt to improve the methods of defining unhealthy alcohol use and its burden in the US.

Materials and Methods

We conducted a structured search of the US literature to evaluate how drinking that exceeds recommended guidelines but fails to meet AUD criteria (referred to here as “unhealthy

alcohol use”) is defined and to assess its burden in the US. We examined how unhealthy alcohol use was defined in terms of the quantity and frequency of consumption, as well as the occurrence of alcohol-related consequences. Definitions of other harmful drinking patterns, such as heavy drinking, binge drinking, and problematic drinking, were also assessed. With respect to burden of disease, we sought publications that evaluated the incidence and prevalence of unhealthy alcohol use, its effects on morbidity and mortality, the health risks associated with unhealthy alcohol use, and its economic burden. To better focus on the consequences of unhealthy alcohol use relative to AUD, studies in which the dose-response relationship between alcohol consumption and disease burden was evaluated were of particular interest.

The literature search was conducted in December 2020. Published literature with the terms “alcohol” or “drinking” in the title were retrieved through searches of PubMed and Embase. In addition to these databases, abstract books of relevant congresses not fully captured by Embase, namely the American Association for the Study of Liver Diseases, the American College of Neuropsychopharmacology, and the College on Problems of Drug Dependence, were retrieved. Results were restricted to guidelines, reviews, and observational studies based on data from the US published in English between 2015 and 2020. In addition, a filter was applied to the search results to capture studies that were applicable to the US. Briefly, results were only included if “United States” or “USA” appeared in the title, in the abstract, or as a MeSH term. Furthermore, results with data from only a single state or individual ethnic or racial group were excluded as well as those focusing on interventions to reduce alcohol consumption. Because of the potential for systematic reviews and meta-analyses to have data relevant to the US despite not being focused on the US exclusively, a separate search of PubMed and Embase for these publications from 2019 and 2020 was also conducted. The websites of relevant government research organizations, including the National Institute on Alcohol Abuse and Alcoholism (NIAAA), the Center for Disease Control and Prevention (CDC), and the Substance Abuse and Mental Health Services Administration (SAMHSA) were also reviewed because they are sources of disease burden statistics and definitions of unhealthy drinking patterns. Titles and abstracts from the search results were evaluated for relevance. Representative publications across topics of interest were chosen from the relevant search results for further discussion within this report.

Results

Summary of search

The search yielded 3517 potentially relevant records. After reading the titles and abstracts, 625 publications were considered relevant to the search topics. From these, we selected 29 publications for further discussion in this report. In addition,

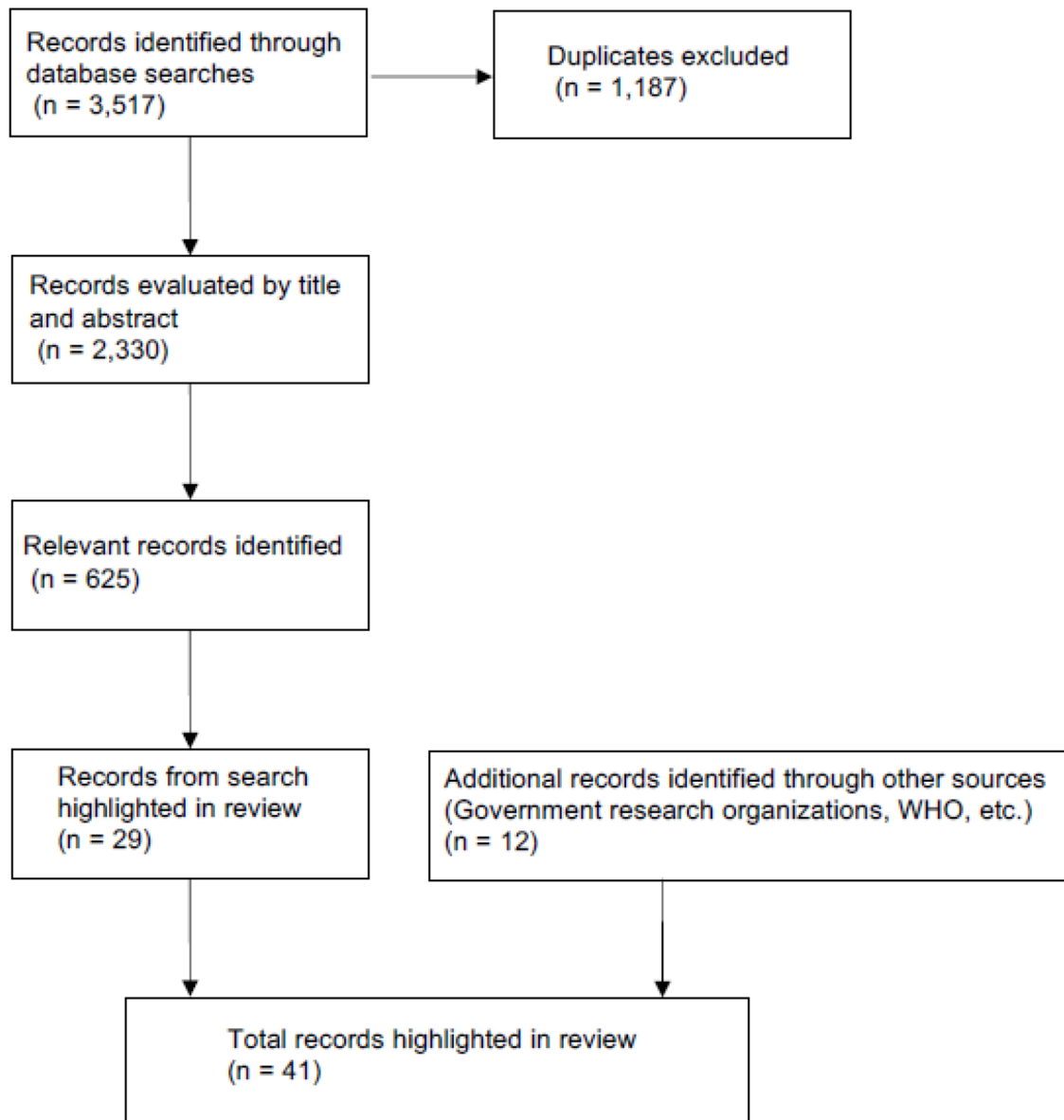


Figure 1. Search flow diagram.
Abbreviation: WHO, World Health Organization.

12 references from other sources not captured by the systematic search were also included based on author assessment. The selection process is outlined in Figure 1.

Defining the spectrum of alcohol use

In terms of quantity and frequency measures, public health organizations in the US have formally defined several drinking patterns. Notably, none of the drinking patterns we found in our search explicitly exclude those with AUD from their definition. The drinking patterns most commonly described and defined by US public health organizations are “binge drinking” and “heavy drinking” (Table 1).^{1,23-25} Binge drinking is distinguishable from other drinking patterns in that it is typically defined around blood alcohol concentration (BAC). Across organizations, binge drinking is most commonly defined as a

pattern of drinking that brings BAC to at least 0.08%. Typically, this pattern corresponds to 5+ drinks for a man or 4+ drinks for a woman in a 2-hour period.^{1,23,25} In contrast, SAMHSA defines binge drinking as 5+ drinks for a man or 4+ drinks for a woman on a single occasion and does not specify a particular BAC or time window.²⁵

The definition of heavy drinking is more variable.^{1,24,25} For example, the NIAAA defines heavy drinking as 4+/5+ drinks on any day or 8+/15+ drinks per week for women/men.¹ The CDC utilizes only the weekly threshold for defining heavy drinking.²⁴ SAMHSA defines heavy drinking based on the frequency of binge drinking, namely binge drinking on 5 or more days in the past 30 days.²⁵

Compared with these US-based organizations, the WHO utilizes a unique 4-tier system that uses past-year mean alcohol consumption to calculate mean number of drinks per drinking

Table 1. Summary of alcohol use definitions.

ORGANIZATION	TERM	DEFINITION	PREVALENCE, % ^a	REFERENCE(S)
CDC	Excessive alcohol use	Binge drinking, heavy drinking, and any alcohol use by pregnant women or anyone younger than 21 y		CDC ²⁴
	Binge drinking ^b	A pattern of drinking alcohol that brings BAC to 0.08%; typically 4+/5+ drinks in 2h for women/men	25.8	CDC, ²³ SAMHSA ²⁵
	Heavy drinking	8+/15+ Drinks per week for women/men	5.1	Boersma et al, ²⁶ CDC ²⁴
NIAAA	Moderate drinking	≤1 Drink per day for women and ≤2 drinks per day for men		NIAAA ¹
	Binge drinking ^b	A pattern of drinking alcohol that brings BAC to 0.08%; typically 4+/5+ drinks in 2h for women/men	27.8	NIAAA ¹
	Heavy alcohol use	4+/5+ Drinks on any day or 8+/15+ drinks per week for women/men		NIAAA ¹
SAMHSA	Binge drinking ^b	4+/5+ Drinks on the same occasion for women/men	25.8	SAMHSA ²⁵
	Heavy drinking	5+ Days of 4+/5+ drinks in the past 30 d for women/men	6.3	SAMHSA ²⁵
USDA	Moderate alcohol consumption	≤1 Drink per day for women and ≤2 drinks per day for men		USDA ²
	Binge drinking ^b	A pattern of drinking alcohol that brings BAC to 0.08%; typically 4+/5+ drinks in 2h for women/men	25.8	USDA, ² SAMHSA ²⁵
WHO	Low-risk drinking	1-20 g (<1.4 drinks) per drinking day for women; 1-40 g (<2.9 drinks) per drinking day for men	50.9-90.2	Knox et al ²⁷⁻²⁹
	Moderate drinking	20-40 g (1.4-2.9 drinks) per drinking day for women; 40-60 g (2.9-4.3 drinks) per drinking day for men	4.8-23.2	Knox et al ²⁷⁻²⁹
	High-risk drinking	40-60 g (2.9-4.3 drinks) per drinking day for women; 60-100 g (4.3-7.1 drinks) per drinking day for men	2.5-13.2	Knox et al ²⁷⁻²⁹
	Very-high-risk drinking	>60 g (>4.3 drinks) per drinking day for women; >100 g (>7.1 drinks) per drinking day for men	2.5-12.7	Knox et al ²⁷⁻²⁹
	Hazardous alcohol use	Use that increases the risk for health consequences		WHO ³⁰
	Harmful alcohol use	Use that has resulted in health consequences		WHO ³⁰
DSM-5	Alcohol Use Disorder	A problematic pattern of alcohol characterized by an impaired ability to manage alcohol use despite negative consequences to oneself or others	5.3	APA, ¹⁰ SAMHSA ²⁵
ASAM	Unhealthy use	Any use that increases the risk or likelihood for health consequences or has already led to health consequences		Saitz et al ³¹
	Hazardous/at-risk use	Use that increases the risk for health consequences		Saitz et al ³¹
	Harmful use	Use that has resulted in health consequences		Saitz et al ³¹
WHO	AUDIT/AUDIT-C	A questionnaire intended to screen for heavy drinking and/or AUD		Babor et al, ³² Bush et al ³³

Abbreviations: ASAM, American Society of Addiction Medicine; AUD, alcohol use disorder; AUDIT-C, Alcohol Use Disorders Test – Consumption; BAC, blood alcohol concentration; CDC, Centers for Disease Control and Prevention; DSM-5, Diagnostic and Statistical Manual of Mental Disorders, 5th edition; NIAAA, National Institute on Alcohol Abuse and Alcoholism; SAMHSA, Substance Abuse and Mental Health Services Administration; USDA, United States Department of Agriculture; WHO, World Health Organization.

^aPrevalence estimates include individuals with AUD.

^bBinge drinking is also referred to as heavy episodic drinking and risky single-occasion drinking.

day and categorize drinking patterns based on the associated health risks.²⁷⁻²⁹ The highest risk level (very-high-risk) corresponds to more than 100 g of ethanol (7.1 standard drinks) per drinking day for men and more than 60 g of ethanol (4.3 standard drinks) for women. The second highest risk level (high-risk) corresponds to 60 to 100 g of ethanol (4.3-7.1 standard drinks) per drinking day for men and 40 to 60 g of ethanol (2.9-4.3 standard drinks) for women. Moderate- and low-risk drinking constitute the 2 lowest drinking levels.

In addition, the WHO and ASAM define excessive alcohol consumption by whether the individual is at risk for developing alcohol-related consequences or if those consequences have already occurred. For example, alcohol use that increases the risk for health consequences has been referred to as “hazardous,” “at-risk,” or “risky” drinking.^{30,31} Conversely, drinking that has resulted in health consequences has been termed “harmful” use (Table 1).^{30,31}

Burden of unhealthy alcohol use in the United States

Prevalence of unhealthy alcohol use. Our literature search did not capture any studies in which an attempt was made to quantify the prevalence of unhealthy alcohol use specifically. That is, all prevalence estimates found in our search included individuals with AUD. Nevertheless, based on our proposed definition, unhealthy alcohol use in the US is likely quite common. According to the National Epidemiologic Survey on Alcohol and Related Conditions III, 12.6% of adult drinkers met exactly 1 criterion for AUD, typically related to an individual’s unhealthy relationship with alcohol (eg, drinking more than intended).¹³ For comparison, estimates of adult drinkers who met criteria for mild, moderate, and severe AUD were 10.6%, 4.4%, and 4.9%, respectively.¹³

Although we could not find any estimates of the overall prevalence of NIAAA-defined heavy drinking, frequencies of its component criteria have been measured.¹ Based on data from the 2018 National Health Interview Survey, 5.1% of adults consumed an average of 8+/15+ drinks per week for women/men.²⁶ An extrapolation of this prevalence based on national population estimates would correspond to 12.9 million adult heavy drinkers.^{26,34} In addition to heavy drinking, binge drinking in the US is also prevalent. According to the 2019 National Survey on Drug Use and Health, 64.7 million adults (25.8%) consumed 4+/5+ drinks on the same occasion for women/men in the past month.²⁵ Based on data from the National Epidemiologic Survey of Alcohol and Related Conditions (NESARC; 2001-2005), 2.5% to 12.7% of adults drank at the WHO very-high-risk level, 2.5% to 13.2% drank at the high-risk level, and 4.8% to 23.2% drank at the moderate-risk level.²⁷⁻²⁹

Prevalence of unhealthy alcohol use among subgroups of interest. In addition to the harm that unhealthy alcohol use poses to the

general population, certain demographic subgroups have an increased risk for alcohol-related negative consequences at any dose of alcohol. For this review, we chose to focus on the following subgroups of interest: underage individuals (aged ≤ 21 years), pregnant women, and college students.

Underage drinking and pregnant women. Underage individuals and pregnant women are 2 groups who are particularly susceptible to negative consequences from small amounts of alcohol. Consequently, the CDC has defined any alcohol consumed by these groups as excessive.²⁴ Despite these risks, alcohol use in these groups remains prevalent. For example, in a survey from 2013, 22.8% of individuals aged 12 to 20 years reported use of any alcohol in the last month.³⁵ Between 2012 and 2014, 14.4% of individuals aged 12 to 20 years reported binge drinking in the past month.³⁶ Among pregnant women, 9.8% aged 12 to 44 years reported drinking and 4.5% reported binge drinking in the past month based on data from 2015 to 2018.³⁷

College students. College students are another subgroup of interest as they tend to engage in unhealthy alcohol use at higher rates than older individuals and noncollege peers.³⁸ One analysis found that those between the ages of 18 and 20 years were most likely to transition from low-risk to unhealthy (at-risk) drinking.³⁹ In a latent class analysis of college attendees, 38.0% drank at twice the binge threshold (8+/10+ drinks for women/men in a single occasion), 24.2% were frequent drinkers with occasional bingeing, and 7.4% were infrequent drinkers with occasional bingeing.³⁸ In another study, students attending a 4-year college and not living with their parents had significantly higher odds of binge and high-intensity drinking than other peer groups.⁴⁰

Health and social risks of unhealthy alcohol use. No studies captured in our literature search evaluated the burden specifically associated with unhealthy alcohol use in that AUD was not excluded from their assessments. Therefore, we chose to summarize the health risks of alcohol consumption in general while using available dose-response studies to consider the potential specific burden of unhealthy alcohol use.

Dose-response relationship between alcohol consumption and health risks. Although a large body of evidence links unhealthy alcohol use to short- and long-term health and social consequences (Table 2), it could be argued that these harmful effects may primarily occur at very high levels of overall alcohol consumption, which are not reached by many people with unhealthy alcohol use. Although past findings have suggested a potential protective effect of low to moderate drinking on all-cause mortality, recent analyses with more robust methodologies have concluded that all-cause mortality risk increases monotonically with alcohol use and that no level of consumption decreases risk.^{15,18,41} In terms of overall health, a global comparative risk assessment found that the amount of alcohol that minimized the risk of all health loss was zero, and risk increased monotonically as a function of daily drinks consumed.¹⁵

Table 2. Long- and short-term health risks associated with unhealthy alcohol use.

HEALTH RISK/ OUTCOME	FINDING	REFERENCE(S)
All-cause mortality	<ul style="list-style-type: none"> From 2011 to 2015, annual average of 95 158 alcohol-attributable deaths and 2.8 million YPLL 51 078 deaths (53.7%) and 1.1 million YPLL (40%) from chronic conditions^a 44 080 deaths (46.3%) and 1.7 million YPLL (60%) from acute conditions^b Average annual alcohol-attributable deaths and YPLL increased compared with 2006-2010 In 2016, alcohol-attributable deaths represented 2.3% (females) and 6.7% (males) of all attributable deaths (aged ≥ 15 year) 4.2 million DALYs due to alcohol, 1.4% and 5.1% of all attributable DALYs for females and males, respectively 	Esser et al ⁴ Griswold et al ¹⁵
	Age-standardized rate of alcohol-attributable deaths increased 34.8% from 2000 to 2016	Spillane et al ⁴²
Liver disease	Alcohol consumption increases risk of liver disease/cirrhosis	Knox et al, ²⁷ Parker et al, ⁴³ Roerecke et al, ⁴⁴ WHO ⁸
Type 2 diabetes mellitus	Hazardous drinking increases risk of type 2 diabetes mellitus	Parker et al ⁴³
Neurological conditions	Chronic alcohol consumption causally linked to polyneuropathy, cerebellar degeneration, dementia, Wernicke encephalopathy, Korsakoff syndrome, and Marchiafava-Bignami disease	Planas-Ballvé et al ⁴⁵
Cancer	<ul style="list-style-type: none"> Any alcohol increases risk of mouth, pharynx/larynx, esophagus, and breast cancer ≥ 2 Drinks/d increases risk of colorectal cancer ≥ 3 Drinks/d increases risk of stomach and liver cancers 	AICR ¹⁴
Homicide	<ul style="list-style-type: none"> From 2011 to 2015, 7334 alcohol-attributable deaths due to homicide Third leading cause of alcohol-attributable acute deaths after poisoning (11 839 deaths) and suicide (9937 deaths) 36.5%-37.5% of homicide victims tested positive for alcohol 63.9%-67.6% of homicide victims had a BAC ≥ 0.08 g/dL 	Esser et al ⁴ Lira et al ⁴⁶ Nazarov and Li ⁴⁷
Risky sexual behavior	<ul style="list-style-type: none"> Alcohol consumption associated with increased intention to engage in unprotected sex Possible causal relation to HIV infection and other STIs 	Scott-Sheldon et al ⁴⁸

Abbreviations: BAC, blood alcohol concentration; DALY, disability-adjusted life year; HIV, human immunodeficiency virus; STI, sexually transmitted infection; YPLL, years of potential life lost; USDA, United States Department of Agriculture.

^aChronic conditions included diseases fully (eg, alcoholic liver disease, fetal alcohol syndrome, alcohol dependence syndrome) or partially (eg, cancer, hypertension) attributable to drinking in excess of USDA guidelines.

^bAcute conditions included events such as injuries, poisonings, and homicides in which decedents had a BAC ≥ 0.10 g/dL.

In addition to overall mortality and health, results of studies in which the dose-dependent effects of alcohol across multiple disease states were evaluated have found increased risks and no protective effects or perceived benefit at any level of alcohol use. Alcohol use is linearly associated with alcohol-related cancer risk and cancer-related mortality, and higher levels of consumption increase the risk of colorectal, stomach, and liver cancers.^{14,18} A meta-analysis of 9 studies found an exponential dose-response relationship between alcohol consumption and relative risk of liver cirrhosis.⁴⁴ In a combined analysis of individual-participant data from 83 studies, the level of alcohol consumption was linearly associated with all non-myocardial infarction cardiovascular disease subtypes.¹⁸ In addition, the World Health Organization evaluated the impact of changing drinking risk levels on various health outcomes after 3 years of follow-up.²⁷⁻²⁹ Very-high-risk drinkers who decreased their drinking risk level had a significantly lower prevalence of liver disease, drug use disorder, and persistent or new anxiety/

depression disorders at follow-up than those who continued to drink at a very-high-risk level.²⁷⁻²⁹ Conversely, low-, moderate-, and high-risk drinkers who increased their drinking level had a significantly higher prevalence of drug use disorder at follow-up than those who did not change their drinking risk level.²⁸ Low-risk drinkers who increased their drinking level had an increased prevalence of liver disease as well as new and persistent anxiety/depression disorders.²⁹ Large doses of alcohol, such as through binge drinking, also pose numerous acute health and social consequences such as physical harm, cognitive impairment, legal problems, and risky sexual behavior.⁴⁹ Taken together, these findings indicate that unhealthy alcohol use poses myriad risks that are likely to contribute to the future health and social consequences of unhealthy alcohol use.

Additional social consequences of unhealthy alcohol use. In addition to the physical health risks, unhealthy alcohol use is associated with a number of social consequences (Table 2). One study of alcohol-attributable deaths from 2011 to 2015 found

7334 alcohol-attributable deaths due to homicide making it the third leading cause of alcohol-attributable acute deaths after poisoning (11 839 deaths) and suicide (9937 deaths).⁴ A separate analysis of toxicological testing data for homicide victims from 2004 to 2016 found that 37.5% of homicide victims were positive for alcohol; among those testing positive, the mean BAC was 0.13 g/dL and 63.9% had a BAC \geq 0.08 g/dL.⁴⁷ Similar findings were obtained in a study specifically examining homicides related to intimate partner violence.⁴⁶ Research also suggests a link between alcohol consumption and risky sexual behavior. A meta-analysis of 30 studies found that alcohol consumption directly affects sexual decision-making in that it increases intentions to engage in unprotected sex and is associated with increased sexual risk behavior and incident HIV.⁴⁸ Furthermore, binge drinking, in particular, is associated with an increased risk of multiple social consequences including driving after drinking, unplanned sex, and failure to meet work obligations.⁴⁹

The economic burden of alcohol consumption. We did not identify any studies in which the burden of unhealthy alcohol use specifically was assessed (ie, with AUD excluded) or in which levels of drinking were correlated with economic costs. Therefore, we focused our review on the significant economic burden posed by alcohol consumption in general. The overall economic burden in 2010 of excessive alcohol use, defined as binge drinking, heavy drinking, or any alcohol consumption by underage or pregnant individuals, was \$249 billion.⁷ Lost workplace productivity accounted for 71.9% of this total, healthcare costs accounted for 11.4%, and other costs (property damage, criminal justice system costs, motor vehicle crashes, fire losses, and fetal alcohol syndrome special education) were 16.7%.⁷ This value is likely an underestimation because of underreporting of alcohol use and the inability to quantify the humanistic burden in monetary terms.⁷ In addition, workplace productivity loss caused by unhealthy alcohol use may not be fully captured.⁵⁰

Although healthcare costs constitute a small percentage of the overall economic burden, the impact of alcohol consumption on the US healthcare system remains substantial. In 2014, nearly 5 million emergency department visits were alcohol-related, resulting in \$92.9 billion in emergency department and inpatient costs.⁵¹ Between 2010 and 2015, 1.1 million hospitalizations had an alcohol-related primary diagnosis, representing nearly 1% of all adult index hospitalizations.⁵² High-risk drinkers may disproportionately use acute care, as they had more emergency department visits and intensive care admissions, more days spent in acute care, and more 30-day readmissions than low-risk drinkers.^{53,54} Furthermore, the burden of alcohol consumption on hospitals has increased over time. Between 2006 and 2014, alcohol-involved emergency department visits increased 61.6%, and attributable costs increased 272% to \$15.3 billion.⁵¹ Between 2010 and 2015, the annual

rate of 30-day readmissions for alcohol-related hospitalizations rose 17.6%, whereas 30-day readmissions overall decreased.⁵²

Discussion

The lack of a standard operational definition of unhealthy alcohol use

We conducted a structured literature search to examine how unhealthy alcohol use is defined and to assess its burden in the US. Although numerous terms describe various unsafe drinking practices, our review did not find any framework for identifying individuals with unhealthy alcohol use (ie, exceed moderate drinking guidelines but do not meet AUD criteria). The lack of a standard model for identifying unhealthy alcohol users has significant consequences because a consistent framework is necessary for a thorough understanding of the burden produced by the consequences of unhealthy alcohol use. Most studies captured in our search did not directly address the burden of unhealthy alcohol use. However, given that most at-risk drinkers do not meet AUD criteria,¹³ and results of dose-response studies suggest that drinking patterns not captured by the AUD criteria are still linked with significant health consequences,^{15,18,41,44} the consequences of unhealthy alcohol use are likely substantial.

The lack of a consistent framework of unhealthy alcohol use makes it difficult to compare results across studies. Notably, the studies described in this review used a number of alcohol consumption frequency and/or intensity metrics (Table 1). In some instances, different sources apply the same term to distinct behavioral patterns, such as the definitions of heavy drinking promulgated by the CDC and SAMHSA. This discrepancy complicates the interpretation of the results of studies in which the consequences of excessive drinking were investigated. It also could create public confusion because it is possible for an individual to comply with one set of guidelines while exceeding another, leading to individuals who need treatment failing to seek it. A standard framework is also necessary for understanding the risk factors that influence transitioning from moderate drinking to unhealthy alcohol use. A better understanding of why individuals engage in unhealthy alcohol use would aid in the development and implementation of effective management.

Toward a framework for identifying people with unhealthy alcohol use in clinical practice

In this review, we endeavored to characterize the core elements of unhealthy alcohol use. In this examination of how moderate drinking guidelines and AUD have been defined, the results suggest that unhealthy alcohol use includes 2 distinct subpopulations: those at risk of experiencing alcohol-related consequences and those with subthreshold problems associated with alcohol use who are not being identified with current tools (eg, AUD screening).

People at risk of experiencing alcohol-related consequences could potentially be identified through quantity–frequency measures. Indeed, one framework suggested that defining AUD wholly through quantity–frequency measures (heavy use over time) would align with epidemiologic and biological findings and reduce stigmatization.⁵⁵ Individuals who exceed recommended drinking guidelines are at risk for developing alcohol-related problems. To this end, the NIAAA guidelines for alcohol use were designed to minimize the risks associated with drinking. Per NIAAA guidelines, heavy drinking increases AUD risk, and high frequency and/or intensity of consumption is causally linked to more than 200 disease and injury conditions (Table 2).^{1,8} Furthermore, the risk of negative consequences is likely to continue even after cessation of chronic drinking.⁵⁶ Thus, exceeding these recommendations captures a core element of unhealthy alcohol use. Further classifying this subgroup of unhealthy alcohol users would improve awareness of the risks of unhealthy consumption and may prompt those at risk of developing alcohol-related problems to seek treatment before the onset of negative consequences. Drinking that increases the risk for health consequences is commonly referred to as “at-risk” or “risky” drinking.^{38,39,57} This designation aligns with recommended terminology from the American Society of Addiction Medicine (ASAM).³⁰ We propose that risky drinking be included as a subset of unhealthy alcohol use within a framework for identifying unhealthy alcohol users.

However, the consequences of unhealthy alcohol use cannot be fully captured through quantity–frequency measures alone. Another core element of unhealthy alcohol use is characterized by the onset of alcohol-related problems that do not meet the level of AUD. These subthreshold problems associated with use can be physical, psychological, or social in nature and often center around an individual’s relationship with alcohol and their intentions and motivations for use. Indeed, impaired control over drinking has been shown to increase the risk of other negative consequences such as blackouts, injury, risky sexual behavior, and poor academic performance. For example, the amount one intends to drink and the ability to follow through on those intentions can have a strong effect on the risk of negative consequences, because intentionally drinking to intoxication, drinking more than intended, and underestimating future consumption have all been linked to negative alcohol-related consequences.^{58,59} Drinking motives can also affect the likelihood of alcohol-related consequences. Drinking as a coping mechanism is a key factor in differentiating high-risk and low-risk drinkers^{60,61} and increases the risk of solitary drinking, which is associated with subsequent substance use disorder symptoms.⁶² Drinking as a self-medicating or coping mechanism predicts alcohol misuse in individuals with mental illnesses such as post-traumatic stress disorder and bipolar disorder.^{60,63} Other motivations for drinking that can increase the risk of consequences include the desire to improve social interactions, to enhance mood, or to conform.^{64,65}

Although DSM-5 AUD criteria have evolved to better reflect multiple dimensions of a person’s relationship with alcohol, those with subthreshold problems are still overlooked. One analysis found that 12.6% of drinkers exhibited exactly 1 AUD symptom, more than the percentage of drinkers with mild (10.1%), moderate (4.4%), or severe (4.9%) AUD.¹³ Among those with exactly 1 AUD symptom, 27% wanted or tried unsuccessfully to cut back or stop drinking, 17% drank more than intended or for a longer period than intended, and 13% craved alcohol.¹³ Based on the core elements of unhealthy alcohol use outlined in this review, individuals with exactly 1 AUD symptom represent a distinct subset of unhealthy alcohol users. Considering the potential of alcohol-related problems and consequences, these individuals could benefit from management to reduce unhealthy alcohol use. However, they are not detected by traditional AUD screening measures.¹³ Therefore, we propose modifying the framework set by Gilbert and Marzell¹³ so that alcohol users who exhibit exactly 1 AUD symptom would be classified as “problematic drinkers” within the framework of unhealthy alcohol use. Clinically, people who meet this criterion should be advised to more closely monitor and modify their drinking. Clinicians can help in this task with consistent follow-up assessments. Further characterization of this unique group of unhealthy alcohol users will help bring awareness to individual negative relationships with alcohol and could spur implementation of management strategies.

The consequences of excessive alcohol consumption are not uniform and vary based on the type of behavior exhibited. For example, someone who regularly exceeds daily guidelines by small amounts could be at an increased risk for certain types of cancer whereas someone who frequently drinks more than intended or blacks out could be at risk for more acute consequences. We believe that differentiating between distinct subpopulations of unhealthy alcohol users will allow for the implementation of management strategies that can be tailored to provide patients with optimal care based on their individual needs.

It should be noted that the use of the term “unhealthy” does not imply a “healthy” or “safe” amount of drinking exists.³⁰ Although results of dose-response studies have found no level of alcohol consumption that decreases the risk of all-cause mortality or health loss,^{15,18,41} at the personal level, safety and risk tolerance depend on the unique characteristics of each person. Whether someone’s drinking merits behavior change is ultimately a decision that should be made individually or in consultation with a healthcare provider. Nevertheless, we believe these operable definitions will provide a logical framework for identifying and classifying unhealthy alcohol users.

How to address the burden of unhealthy alcohol use

The long-term goal of creating a framework for identifying unhealthy alcohol use is to assist in reducing its overall harm. Current strategies to identify and treat unhealthy alcohol users

have had limited impact. Indeed, although screening and brief intervention has been shown to reduce alcohol consumption,^{66,67} few people receive evidenced-based management for unhealthy alcohol use.^{67,68} One explanation is that people who engage in unhealthy alcohol use may not seek treatment because they are unaware of the risks. Awareness of the long-term health risks of alcohol use among the general population is low,⁶⁹⁻⁷¹ and people consuming unhealthy quantities of alcohol are less likely to believe that alcohol consumption contributes to health problems.⁷² Another possibility is that physicians may be unable or unwilling to identify and find appropriate management strategies for patients.^{73,74} Therefore, efforts should be made to educate the public and providers about unhealthy alcohol use to reduce stigma and encourage implementation of management strategies. One possible strategy is through integration of standard operational definitions of unhealthy, risky, and problematic drinking into clinical practice. Providing a logical framework for identifying and classifying unhealthy alcohol users would help allow for the implementation of management strategies that can be tailored to provide patients with optimal care based on their individual needs.

Broader implementation of existing screening tests and questionnaires could also help clinicians identify unhealthy drinkers. The Comprehensive Early Drinking History Form (CEDHF) is a questionnaire that gathers information on annual drinking behavior starting with the first year of at least monthly consumption.⁷⁵ The CEDHF was found to better predict concurrent and future alcohol problems than other measures, such as age of onset, age of first intoxication, and the Timeline Followback method.⁷⁵ The CAGE questionnaire is a set of 4 questions intended to be used as a screening instrument for unhealthy drinking: "Have you ever: (1) felt the need to *Cut* down your drinking; (2) felt *Annoyed* by criticism of your drinking; (3) had *Guilty* feelings about drinking; and (4) taken a morning *Eye* opener?"⁷⁶ The CAGE is shorter than the Alcohol Use Disorders Identification Test (AUDIT) and, unlike the AUDIT-Concise, does not ask about specific quantities or frequency of consumption. However, the personal and social aspects of drinking assessed by the CAGE questionnaire provide insight into the respondent's relationship with alcohol, a core aspect of unhealthy drinking. Despite its established track record and ease of use, the CAGE questionnaire has been underused⁷⁷; only 4 relevant primary studies that implemented the CAGE questionnaire were captured in our literature search.

It should be noted that while screening questionnaires can be useful as a means to help clinicians identify unhealthy drinkers, detection of the signs of unhealthy use of alcohol is distinct from defining in a precise and logical way what unhealthy alcohol use is. Indeed, others have suggested that more precise definitions may lead to improved screening measures.¹³ Improving screening tools with potentially more relevant questions (reflective of more logical and consistent definitions of unhealthy alcohol use) would help to identify and improve management

strategies for people with unhealthy alcohol use. Our proposed framework brings these subthreshold problems into focus and could help in including them in future screening measures.

Given the urgent need for effective management of unhealthy alcohol use, novel strategies and technologies should also be investigated to determine how best to integrate multiple treatment modalities (ie, screening and brief intervention, peer support, pharmacotherapy, and in-person and digital psychotherapy) to optimize outcomes. These methods may be substantially different compared with interventions targeting individuals who have already reached the AUD threshold. By focusing on the unique needs of unhealthy alcohol users, a greater number of individuals could be engaged at an earlier stage allowing for the prevention of greater harm with less intense management. A consistent understanding of the definition and burden of unhealthy alcohol use would also aid the implementation of new management and education strategies.

In addition to management strategies to improve individual outcomes, larger-scale public health policy should also be considered. The United States Community Preventive Services Task Force has recommended several evidenced-based policy changes to curb the burden of unhealthy alcohol use.^{46,78-81} Considering the demonstrable benefits, more restrictive alcohol policies and guidelines would be warranted.^{81,82} In recognition of the burden of low-risk alcohol use, the Advisory Committee for the Development of the 2020 to 2025 Dietary Guidelines for Americans recommended restricting alcohol use to no more than 1 drink per day for both men and women.² However, this guideline was ultimately left unchanged.² Nevertheless, the proposed revision could significantly reduce the burden of unhealthy alcohol use, as the results of 1 study found that applying current guidelines for women to men would avoid 13% of all-cause deaths in men.⁸³

Limitations of this review

The literature search results are necessarily limited by the search terms that are used. Given the variety of terms that unhealthy alcohol use encompasses, it is possible that not all definitions were captured in the search. Among publications captured in our search, few studies evaluated which specific features of unhealthy alcohol use, namely quantity consumed and qualitative relationship with alcohol, best predict future consequences. Correlating individual features of risky and problematic drinking with specific outcomes would further inform optimal management strategies. In order to limit our literature search to publications from the US, a filter was applied such that results were only included if "United States" or "USA" appeared in the title, in the abstract, or as a MeSH term. However, some publications of US data may not include this specification in any of these sections. Thus, some relevant publications may have been excluded because of this restriction. Another limitation of this review is the inability to quantify the burden of unhealthy alcohol use. Although the burden

of excessive alcohol use is well established, it is not always clear how much of this burden is due to AUD, as some definitions of unhealthy alcohol use fail to exclude individuals with AUD. Given the limited number of studies in which unhealthy alcohol use in the absence of AUD was evaluated, this review does not thoroughly analyze the burden of our proposed definitions of unhealthy, risky, and problematic drinking. Finally, only a small subset of publications captured by the search were discussed, and these references may not reflect the full scope of the available literature.

Conclusion

It is well established that AUD is associated with physiological and psychological consequences. Although the associated health risks and disease burden are substantial, alcohol use that exceeds recommended guidelines but does not meet AUD criteria (ie, unhealthy alcohol use) is an underrecognized and undertreated issue in the US. Risks to unhealthy alcohol users stem from subthreshold problems associated with using alcohol and/or a pattern of use that may not have immediate adverse consequences but predicts future adverse consequences. In either case, this gray area of alcohol consumption deserves more attention because additional interventions that target these subthreshold consequences or prevent the development of more severe consequences are needed. Furthermore, a precise and consistent framework for identifying people with unhealthy alcohol use is necessary for addressing this unmet need. When considering how to define unhealthy alcohol use, those at risk of developing future problems and those with subthreshold problems should be acknowledged. Furthermore, both the quantity of consumption and the individual's relationship with alcohol should be viewed as core elements. Our proposed definitions of unhealthy alcohol use, risky drinking, and problematic drinking would help bring these core elements into focus, which in turn would help identify and provide management strategies to those affected sooner and might reduce the overall burden of unhealthy alcohol use.


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Percy Menzies and Joseph R Volpicelli contributed to the conception and design of this review, provided critical revisions, and approved the final version of the manuscript.

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