

NCI Monograph 24

Tobacco and Alcohol: Understanding Co-Use to Reduce Cancer Incidence and Mortality

Chapter 1
Introduction and Overview

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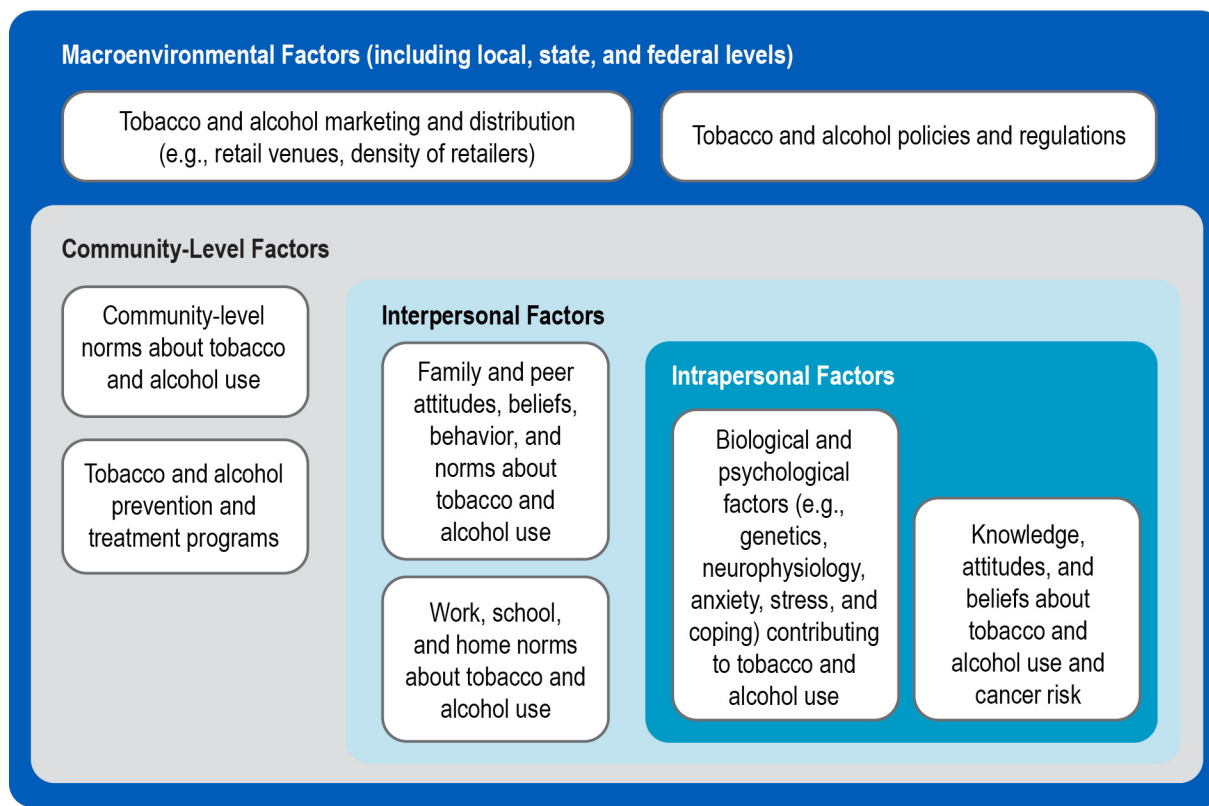
Chapter 1

Introduction and Overview

Introduction

Tobacco and alcohol are two of the most widely used addictive and carcinogenic substances in the United States.^{1,2} Nicotine, found in tobacco, and ethanol (also known as ethyl alcohol or grain alcohol) have psychoactive effects and can create strong dependence, especially when used in high doses.³⁻⁵ Importantly, all tobacco products contain, or generate, many carcinogenic compounds when used as intended. Combusted tobacco products—such as cigarettes, cigars and pipes—pose the greatest cancer risks due to exposure to carcinogens in the product and additional exposure to the diverse toxicants produced by combustion.^{6,7} For alcohol products, exposure to the main psychoactive and addictive ingredient, ethanol, and its metabolite acetaldehyde, are the major cause of alcohol-induced carcinogenesis.⁸ Separately and together, tobacco and alcohol have enormous effects on the U.S. burden of disease.^{1,9} Tobacco use has long been the primary modifiable risk factor for cancer incidence and mortality in the United States.⁷ In 2019, tobacco use was responsible for an estimated 344,000 cancer cases and almost 170,000 cancer deaths.¹ In 2019, alcohol use was the third leading cause of cancer, responsible for almost 97,000 cancer cases and more than 24,000 cancer deaths.¹ Tobacco and alcohol co-use, defined as the use of both substances within a given time frame (e.g., same hour, same day, past month), is of particular concern for tobacco control, reducing the harms of tobacco and alcohol, and improving cancer control.

Together, tobacco and alcohol account for almost 25% of cancer cases in the United States, more than one-half of all cancer cases attributed to modifiable risk factors,¹ making their use—and the factors influencing their use—primary targets for cancer prevention and control. When considering all causes of death (i.e., not just cancer) worldwide, tobacco and alcohol are leading preventable risk factors. Globally, more than 7 million people die from tobacco use every year and 2.6 million die from alcohol use.^{10,11} Tobacco and alcohol are often used separately, as well as in complex patterns of co-use. Use patterns are influenced by numerous intersecting factors, including intrapersonal (biological and psychological), interpersonal (family, peer), and social, (community) as well as macro-environmental factors such as the policies, systems, and environments that shape accessibility, affordability, and marketing of these substances (represented in Figure 1.1). Understanding how tobacco and alcohol use intersect across these factors is essential for enhancing cancer prevention, preventing tobacco use and alcohol use, and supporting tobacco cessation and the reduction or cessation of alcohol use.

Figure 1.1 Multilevel Factors Affecting Tobacco and Alcohol Co-Use

Individuals often use both tobacco and alcohol during the same time period, and co-use often extends across the lifespan.^{12,13} Co-use of these substances has been shown to contribute to cancer risk, including synergistic risk for head and neck cancers.¹⁴⁻¹⁶ Furthermore, co-use of tobacco and alcohol may influence the probability of continued use and present a barrier to successful tobacco cessation and reduction in harmful drinking.^{17,18} As discussed in chapters 2 and 3 of this volume, the overall population prevalence of tobacco and alcohol co-use has declined as overall tobacco use has declined; however, associations between tobacco and alcohol use have persisted, particularly among people with heavier use of both substances and those with an alcohol use disorder.^{12,19-25} These associations are observed across demographic groups that differ in the overall prevalence of tobacco and/or alcohol use. Despite dramatic reductions in overall tobacco use¹³ and declines in drinking among adolescents and adults,^{2,26} the burden of cancer and other chronic diseases caused by tobacco and alcohol use and co-use remains extremely high.^{1,27} Continued investment in research and public health measures addressing tobacco and alcohol use is needed to reduce this burden.

The Need for a Monograph on Tobacco and Alcohol Co-Use

Both tobacco and alcohol are known causes of cancer,^{28,29} and reducing their use and co-use is vital for cancer prevention and control. The primary goal of this monograph is to synthesize research to provide insight into the state of the science concerning tobacco and alcohol co-use. Specifically, the monograph is intended to advance cancer prevention efforts by summarizing the evidence on tobacco and alcohol co-use and identifying research needs. Multiple levels are

considered, including individual use and co-use, cancer etiology, biological mechanisms underlying tobacco and alcohol use, interventions for prevention and cessation, and the social, policy and economic environment in which these factors occur. Figure 1.1 portrays these multilevel biological, psychological, and social processes that influence tobacco and alcohol use and co-use, their health consequences, and interventions addressing different aspects of these processes. The focus of this volume is to better understand the relationships and synergies between tobacco and alcohol co-use from a health, treatment, and prevention perspective. Achieving this goal will contribute to the overall health and well-being of the nation.

The monograph is primarily aimed at informing researchers. However, others seeking to understand and reduce the harms of tobacco and alcohol use and improve cancer control will find this volume useful. Diverse entities, including health departments, funding agencies, community-based organizations, those working with adolescents and young adults, substance use treatment specialists, health care providers, and health systems, will also be able to use the volume to inform their work and point them towards promising new directions for tobacco and alcohol co-use interventions.

Effects of Tobacco and Alcohol Co-Use

Based on pooled data from the 2015–2019 National Survey on Drug Use and Health, an estimated 11.8% (95% confidence interval [CI], 11.7%–12.0%) of U.S. adults (approximately 30 million in total) both smoked cigarettes and drank alcohol in the past month, and people who smoked in the past month were more likely to report binge drinking or drinking >7/14 drinks per week for women/men than people who never or formerly smoked (described in more detail in chapter 2). People who smoke and drink alcohol represent a significant subpopulation for whom intervention is an important, but often overlooked, goal. There is a strong correlation between alcohol use and nicotine dependence. Individuals who are alcohol dependent are three times more likely to have nicotine dependence than the general population, and individuals who are dependent on tobacco are nearly four times more likely to be alcohol dependent than people without nicotine dependence.³⁰ Furthermore, people who smoke and are alcohol dependent or report heavy drinking have more severe nicotine dependence and experience greater difficulty quitting smoking than people who smoke and do not drink heavily,^{31,32} and lapses during quit attempts occur more frequently when individuals are drinking alcohol, especially during heavy drinking days.³³ A growing body of literature also highlights the adverse consequences associated with tobacco and alcohol co-use, including less frequent use of both substances. People who smoke tobacco and drink heavily have worse health outcomes for conditions such as cancer and cardiovascular disease than people who use either tobacco or alcohol alone,^{15,34,35} and have a faster cognitive decline relative to people who drink moderately and do not smoke.³⁶ Although both tobacco and alcohol broadly share some common pathways to morbidity and mortality (e.g., accumulated chronic exposure resulting in carcinogenic processes, damage to organ systems),^{7,37,38} important differences exist. Deaths caused by tobacco primarily occur in middle- and old-age, and are largely due to cancer, heart disease and stroke, and respiratory disease, among other causes.⁷ Deaths caused by alcohol occur at younger ages and in different ways than deaths caused by tobacco.³⁹ The U.S. Centers for Disease Control and Prevention estimates that about two-thirds of alcohol-related deaths were due to chronic conditions (e.g., cancer, heart disease, liver disease, and alcohol use disorder), while one-third of alcohol-related deaths result from a specific occasion of binge or excessive drinking,

including motor vehicle crashes, alcohol-involved substance overdoses, alcohol poisonings, and deaths by suicide.⁴⁰ However, the probability of binge or excessive drinking is also related to alcohol use disorder and the drinking history of individuals.^{41,42} substance overdoses, alcohol poisonings, and deaths by suicide.⁴⁰⁻⁴²

The harms of tobacco and alcohol use are not limited to the individuals who use these products. Exposure to secondhand smoke is well-established to increase risk of cancer and other negative health outcomes related to tobacco.⁷ Alcohol use problems can also result in social, economic, and psychological harms to coworkers, families, friends, and social connections. These include job losses or other consequences, motor vehicle crashes, unintentional injuries, sexually transmitted infections, unintended pregnancies, and family breakdowns.⁴³ These effects provide additional strong motivation to address tobacco and alcohol use and co-use.

Cancer Risk and Mortality

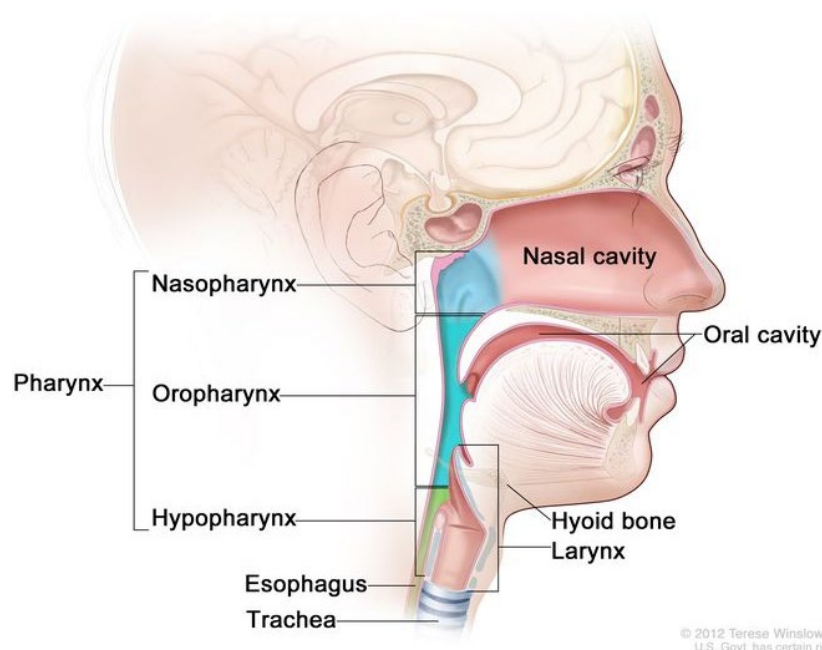
Both tobacco and alcohol increase the risk of cancer at multiple sites and their combined use results in synergistic increases in risk for head and neck cancers.^{28,29} In the United States, tobacco use was responsible for an estimated 19.3% of cancer cases and 28.5% of cancer deaths in 2019, while alcohol was responsible for an estimated 5.4% of cancer cases and 4.1% of cancer deaths.¹ This monograph reviews the conclusive evidence that tobacco and alcohol exposures independently and jointly cause multiple types of cancer through a wide variety of distinct and overlapping mechanisms. The carcinogenic mechanisms associated with tobacco use vary by the type of tobacco product used, with combusted tobacco products generally resulting in greater exposure to toxicants than other tobacco products. Notably, it is also well established that smokeless tobacco use causes several cancers, including oral, head, and neck cancers.^{6,7} Combustion of tobacco produces thousands of harmful, mutagenic, and carcinogenic products, such as polycyclic aromatic hydrocarbons (PAHs), N-nitrosamines, aromatic amines, 1,3-butadiene, benzene, aldehydes, and ethylene oxide. It is also well-established that cigarette smoke contains at least 80 known carcinogens.⁴⁴ The 2014 Surgeon General's report, *The Health Consequences of Smoking—50 Years of Progress*, concluded that cigarette smoking causes various forms of cancer, including (but not limited to) cancers of the oral cavity, pharynx, larynx, esophagus, lung (including trachea and bronchus), stomach, liver, pancreas, kidney and ureter, bladder, cervix, colorectum, and blood (acute myeloid leukemia).⁷ In 2020, the report *Smoking Cessation: A Report of the Surgeon General* reaffirmed the cancer risks of smoking and highlighted the benefits of cessation on cancer and other health outcomes.⁵

Alcohol acts as a carcinogen through multiple mechanisms. All alcoholic beverages contain ethanol, the major cause of cancer associated with alcohol use through its direct physiological effects and via its primary metabolite, acetaldehyde, a potent carcinogen.³⁸ The carcinogenicity of alcoholic beverages and of ethyl carbamate (urethane), a frequent contaminant of fermented foods and alcoholic beverages, especially distilled spirits, was the topic of the 1988 and 2010 International Agency for Research on Cancer (IARC) Monographs.^{28,45} The 2010 IARC Monograph, *Evaluation of Carcinogenic Risks to Humans: Alcohol Consumption and Ethyl Carbamate (Volume 96)*, noted that the consumption of alcohol is one of the top 10 risks for worldwide burden of disease. There is a strong scientific consensus that alcohol use causes oral cavity, pharynx (throat), esophageal, liver, larynx (voice box), female breast, and colorectal cancer.²⁸ Additionally, inverse associations have been observed for kidney cancer,²⁸ thyroid

cancer,⁴⁶ and non-Hodgkin lymphoma (see chapter 4).²⁸ Nevertheless, the reduced number of cases of these cancers that might be attributable to alcohol consumption are much lower than the increased number of cancers observed at other sites. For both tobacco and alcohol, the risk of cancer increases as the amount consumed increases. With regard to alcohol, for certain cancers, like female breast, oral cavity, and throat cancers, this risk may increase around one or fewer drinks per day.³⁸ In 2024, IARC reviewed the evidence that reductions in alcohol use lead to reduced risk of cancer. They concluded that there was sufficient evidence that alcohol reduction or cessation reduces oral and esophageal cancer risk; limited evidence for laryngeal, colorectal, and female breast cancer risk; and inadequate evidence for pharyngeal and liver cancer risk.^{47,48} For cancers for which the evidence was limited or inadequate, few high-quality studies have been carried out, indicating the need for further epidemiological research.

Key Findings From Previous Reports Related to Tobacco and Alcohol Co-Use and Health

Research on the use of tobacco and alcohol has identified synergistic effects of the use of both substances on cancer risk. A synergistic relationship between tobacco and alcohol use and cancer risk has been observed for cancers of the head and neck (oral cavity, larynx, pharynx) and esophagus; the anatomy of the oral cavity, pharynx, and larynx is depicted in Figure 1.2. These findings, as well as conclusions for other cancer sites, are summarized in Tables 1.1 and 1.2. Acetaldehyde, the primary metabolite of ethanol, is also one of the main volatile compounds and carcinogens present in tobacco smoke. Acetaldehyde damages DNA in multiple ways, interfering with DNA synthesis and repair, causing point mutations, and damaging chromosomes.⁴⁹ Consumption of both tobacco and alcohol products results in increased exposure to acetaldehyde.^{6,28,29,45} Importantly, the oral microbiome plays a role in the rapid conversion of ethanol to acetaldehyde, increasing exposure to this compound in the head and neck. Alcohol consumption also may result in increased absorption and increased activation of the carcinogens present in tobacco products, serving as the basis for a synergistic effect on cancer risk.^{38,50-52} Chapter 4 of this monograph reviews additional and more recent epidemiological literature to summarize what is known as of 2026 about the synergistic effects of the use of tobacco and alcohol on cancer risk, including among different populations and by tobacco and alcohol product type.

Figure 1.2 Anatomy of the Oral Cavity, Pharynx, and Larynx

Source: National Cancer Institute 2025.⁵³

Table 1.1 Findings about the Health Effects of Tobacco and Alcohol Use from Key Reports

Findings from the 2014 Surgeon General's report, <i>The Health Consequences of Smoking—50 Years of Progress</i>	
The evidence is sufficient to infer a causal relationship between smoking and the following cancers—	• Acute myeloid leukemia • Bladder • Cervix • Colorectal* • Esophageal • Kidney and ureter • Laryngeal • Liver* • Lung (including trachea and bronchus) • Ovary • Oral cavity and pharyngeal • Pancreatic • Stomach
In cancer patients, the evidence is sufficient to infer a causal relationship between cigarette smoking and—	• Adverse health outcomes • Increased all-cause mortality and cancer-specific mortality • Increased risk for second primary cancers known to be caused by cigarette smoking, such as lung cancer
The evidence is suggestive, but not sufficient, to infer a causal relationship between—	• Tobacco smoke and breast cancer* • Active smoking and breast cancer* • Exposure to secondhand tobacco smoke and breast cancer*
In patients with prostate cancer, the evidence is suggestive of—	• Higher risk of death from prostate cancer in smokers than in nonsmokers* • Higher risk of advanced-stage disease and less well-differentiated cancer in smokers than in nonsmokers*

Table 1.1 (continued)

Findings from the 2014 Surgeon General's report, <i>The Health Consequences of Smoking—50 Years of Progress</i>	
The evidence is inadequate to infer the presence or absence of a causal relationship between smoking cigarettes and—	• Ovarian cancer
The evidence is suggestive of no causal relationship between smoking and—	• Adult brain cancer in men and women • Risk of incident prostate cancer
Findings from the 2010 IARC Monograph, <i>Evaluation of Carcinogenic Risks to Humans: Alcohol Consumption and Ethyl Carbamate (Volume 96)</i>	
There is sufficient causal evidence of an association between alcohol consumption and risk of cancer of the—	• Oral cavity and pharynx • Larynx • Esophagus • Liver • Female breast • Colon and rectum

Note. An asterisk (*) indicates a new conclusion from the 2014 report. Statements without an asterisk were made in the 2004 Surgeon General's reports and reaffirmed in the 2014 report.

Source: IARC 2010,²⁸ USDHHS 2014.⁷

Table 1.2 Summary of Findings on Independent and Synergistic Cancer Risk Related to Tobacco Smoking and Alcohol

Cancer site	Cancer caused by tobacco use	Cancer caused by alcohol use	Evidence of synergy
Esophagus	Yes	Yes	Yes
Larynx	Yes	Yes	Yes
Oral cavity and pharynx	Yes	Yes	Yes
Colon and rectum	Yes	Yes	-
Liver	Yes	Yes	-
Stomach	Yes	Yes	-
Bladder	Yes	-	-
Blood (acute myeloid leukemia)	Yes	-	-
Cervix	Yes	-	-
Kidney and renal pelvis	Yes	*	-
Lungs, bronchus, trachea	Yes	-	-
Pancreas	Yes	-	-
Breast (female)	-	Yes	-

Note. Findings are drawn from IARC monographs, World Cancer Research Fund/American Institute for Cancer Research (WCRF/AICR) Continuous Update Project, and Surgeon General's reports. Cancers are presented in order of evidence of synergy (caused by tobacco and alcohol), caused by tobacco but not alcohol, caused by alcohol but not tobacco, or caused by neither; they are then listed alphabetically within those clusters. A dash (-) indicates that as of 2026, there is no conclusive evidence regarding a causal relationship with tobacco or alcohol use or synergy related to tobacco and alcohol use. An asterisk (*) indicates inverse association.

Source: IARC 2010,²⁸ IARC 2012,²⁹ IARC 2024,⁴⁸ USDHHS 2014,⁷ WCRF/AICR 2018.⁵⁴

Awareness of Cancer Risk Related to Tobacco and Alcohol Co-Use

As leading modifiable risk factors for cancer in the United States, it is important for the public to be aware of the risk of tobacco and alcohol use and co-use to prevent and reduce cancer-related morbidity and mortality. Greater awareness of cancer-related risk could influence public attitudes toward alcohol use and help people make more informed decisions about their behavior.

Although the vast majority of the public are aware that smoking cigarettes causes cancer,⁵⁵ awareness of the link between alcohol use and cancer is much lower, albeit increasing in recent years.⁵⁶⁻⁵⁸ Data from the 2022 Health Information National Trends Survey (HINTS) found that only 40.6% of U.S. adults recognized that alcohol consumption increases cancer risk.⁵⁷ In addition, data from the 2020 HINTS survey showed that perceptions of an alcohol-cancer link were higher for liquor (31.2%) than for beer (24.9%) or wine (20.3%),⁵⁹ despite epidemiological evidence suggesting that the total amount of ethanol consumed determines cancer risk rather than differences between beverage types.³⁸ Other nationally representative surveys, such as the American Institute for Cancer Research's Cancer Risk Awareness Survey, also demonstrate that less than half of the U.S. population is aware that alcohol use is a risk factor for cancer, whereas 89% are aware that tobacco use causes cancer.⁶⁰ Further, analysis of 2014 Medical Expenditure Panel Survey data found that only 41.0% of adults ages 35 and older received screening and counseling for alcohol misuse from a healthcare provider.⁶¹ In January 2025, the U.S. Surgeon General released an advisory on alcohol and cancer risk, highlighting the causal link between alcohol use and increased risk for several cancers.³⁸ Surveys of U.S. adults conducted before and after the advisory was released found that, as of February 2025, 56% of respondents said that regular consumption of alcohol increases your chances of later developing cancer, an increase from 40% in September 2024.⁵⁶ Given the large number of people who use both substances, increasing awareness of the link between cancer and tobacco and alcohol co-use is an important aspect of making progress on addressing these modifiable risk factors for cancer. However, although awareness of the cancer related risks of tobacco and alcohol co-use and alcohol consumption is an important part of behavior change, it is vital to invest in prevention and treatment interventions and policy approaches to achieve reductions in prevalence.

About This Monograph

This monograph is the 24th volume in the series of monographs on tobacco control produced by the National Cancer Institute (NCI) of the National Institutes of Health, an agency of the U.S. Department of Health and Human Services. Other recent topics addressed as part of the Tobacco Control Monograph Series include treating people with cancer who smoke (volume 23), health disparities caused by tobacco (volume 22), the economics of tobacco control (volume 21), genetic studies of nicotine use and dependence (volume 20), and the role of the media in promoting and reducing tobacco use (volume 19).

Preparation of the Monograph

This monograph underwent a rigorous development process led by five senior editors forming the Scientific Editorial Committee (SEC). The senior editors were selected based on their expertise in tobacco control; alcohol research; health behavior research; genetics of tobacco and alcohol addiction; clinical treatment of tobacco, alcohol, and other substance use; and tobacco control policy research. The SEC developed a shared vision of the monograph's purpose and focus. Given responsibility for specific topics, SEC members were joined by chapter leads to

develop chapter outlines; identify chapter contributors and reviewers; and contribute to the development, writing, reviewing, and editing of the monograph. Chapter leads and contributors drafted chapters in accordance with the outlines and under the guidance of the SEC. The individuals who contributed to this monograph are listed on pages xxiii–xxix. Across chapters, literature searches and expert knowledge were used to identify important sources, including peer-reviewed articles and existing reviews of the literature, but new systematic reviews were not carried out. Searches were generally restricted to studies conducted in the United States and those in English and specified a relevant age range depending on the topical domain (e.g., adults 18 years and older or adolescents and young adults <25 years). Additionally, across chapters and depending on the topic, international literature was reviewed, particularly where no U.S.-based evidence was available. Each chapter within the volume provides an overview of the literature search strategies that were conducted for this monograph and for the specific chapter or subsection within a chapter. In addition, new analyses of nationally representative survey data (Monitoring the Future, National Alcohol Surveys, and National Survey on Drug Use and Health) were conducted to characterize patterns of tobacco and alcohol co-use among adults and adolescents in the United States. Chapters 2 and 3 provide details regarding the measures and approach used for these analyses.

In addition to internal reviews by the editorial team, each chapter was reviewed by multiple external expert peer reviewers, followed by extensive expert peer review of the full monograph volume. NCI also conducted a final review of the monograph before publication. In all, 51 experts reviewed all or part of the monograph.

Monograph Organization

The monograph is organized into five major topic areas pertaining to the intersection of tobacco and alcohol: the surveillance and behavioral epidemiology of tobacco and alcohol use (chapters 2 and 3); the epidemiology of tobacco and alcohol use as it relates to cancer risk (chapter 4); the physiological, cellular, molecular, and genetic basis of addiction and carcinogenesis as they relate to the co-use of tobacco and alcohol (chapters 5 and 6); tobacco use treatment and prevention in the context of alcohol use (chapters 7 and 8); and the economic, environmental, and policy factors affecting both tobacco and alcohol use and co-use (chapter 9). The final chapter, 10, provides conclusions for the monograph and further highlights important research needed to help reduce the harms of tobacco and alcohol use and co-use.

The monograph comprises the following chapters:

Surveillance and Behavioral Epidemiology of Tobacco and Alcohol Use Among Adolescents and Adults in the United States. Chapter 2 describes measures of tobacco and alcohol co-use in the United States and provides details on patterns of co-use from the literature and from new analyses of National Alcohol Surveys (NAS) and National Survey on Drug Use and Health (NSDUH) data. This chapter also considers the most appropriate measures of tobacco and alcohol co-use for public health surveillance.

Surveillance and Behavioral Epidemiology of Tobacco and Alcohol Use Among Population Subgroups in the United States. Chapter 3 provides a summary of tobacco and alcohol co-use in specific population subgroups of adults based on a review of the literature and new analyses of NAS and NSDUH data. The chapter reviews tobacco and alcohol co-use among groups by race and/or ethnicity, educational attainment, income, geographic location, sexual minority status, veteran status, and presence of comorbidities including cancer, chronic health conditions, HIV, mental health conditions, and pregnancy.

Cancer Epidemiology of Tobacco and Alcohol Co-Use. Chapter 4 summarizes the epidemiologic research examining associations between cancer risk and use of tobacco and alcohol products independently, as well as the synergistic risk of cancer with use of both types of products resulting in a higher risk of cancer in specific sites. This chapter also evaluates available data on the synergistic effects of tobacco and alcohol use on cancer risk by demographic subgroups and efforts to examine the type of tobacco and alcohol product used to better understand their individual and joint effects on cancer risk.

Physiological, Cellular, Molecular, and Genetic Basis of the Combined Effects of Tobacco and Alcohol Use on Carcinogenesis. Chapter 5 provides an overview of mechanistic interactions between tobacco and alcohol exposures, focusing on how alcohol may influence the main mechanisms of tobacco carcinogenesis. It reviews the evidence for genetic susceptibility to tobacco and alcohol use and co-use and describes how this influences mechanisms for carcinogenesis. Other topics include the limited literature on interaction of nicotine and alcohol as carcinogens and evidence supporting the reversibility of these mechanisms for carcinogenesis and, consequently, the beneficial effects of tobacco use cessation and alcohol use reduction or cessation.

Shared Physiological and Genetic Factors Contributing to Tobacco and Alcohol Co-Use. Chapter 6 describes overlapping genetic factors and neurophysiology contributing to co-use of tobacco and alcohol. The topics reviewed in the chapter highlight the need to understand both environmental and genetic factors that contribute to the development of dependence and disease.

Treatment Approaches for Tobacco and Alcohol Use. Chapter 7 reviews the evidence on approaches to treating tobacco and alcohol use concurrently and the effectiveness of pharmacological and behavioral treatments for concurrent cigarette smoking and alcohol use. Topics reviewed include the neurobiological and behavioral overlap between smoking and alcohol consumption, highlighting key mechanisms that drive co-use and could inform treatment targets, and the use of individual and combined pharmacological and behavioral therapies to treat tobacco and alcohol co-use.

Prevention of Tobacco Use in Relation to Alcohol. Chapter 8 summarizes the evidence regarding the extent to which alcohol-focused and more general substance use prevention programs are effective in preventing tobacco use among adolescents and young adults. It also evaluates the extent to which tobacco-focused and more general substance use preventions are

effective in preventing alcohol use. Topics include psychosocial prevention programs and policies delivered at the individual level (e.g., text-based programs), group level (e.g., school-based and family-based programs), and population level (e.g., minors' access policies, mass media and social media) that focus on tobacco, alcohol, and multisubstance use prevention where tobacco use is a measured outcome.

Economic, Environmental, and Policy Factors Related to Tobacco and Alcohol Use.

Chapter 9 reviews the evidence on the influence of economic, environmental, and policy factors for tobacco and alcohol use on tobacco initiation, use, and cessation. The chapter describes how the retail environment for tobacco and alcohol (which includes quantity, type, and location of tobacco and alcohol retailers), and the marketing environment for tobacco and alcohol may interact to influence tobacco use and tobacco and alcohol co-use. It also reviews the evidence related to tobacco and alcohol policy effects on co-use, such as (1) the interaction of tobacco and alcohol taxes on tobacco and alcohol use behavior, (2) the influence of restricting alcohol availability on tobacco use, (3) the effect of smokefree bar policies on alcohol use.

Future Research Directions. Chapter 10 summarizes the key findings from this report and identifies priority areas for future research. The chapter highlights the challenges and opportunities in understanding and addressing how alcohol use influences tobacco use initiation and progression, and the resulting increased cancer risk.

Key Terminology and Concepts

Identifying perfectly aligned and appropriate terminology across two domains of substance use is challenging as tobacco and alcohol have their own research and treatment contexts. The monograph is purposeful in its choices of the terms and concepts used throughout to be consistent with the literature as of 2026 and to avoid stigmatizing language.⁶² Key terms used in the monograph and their definitions are highlighted in the “Other Terms” section below.

Tobacco and Alcohol Treatment Terminology

The Diagnostic and Statistical Manual of Mental Disorders (DSM) is the standard classification of psychiatric disorders used for clinical, research, policy, and reimbursement purposes in the United States. This important volume has widespread influence on how such disorders are diagnosed, treated, and investigated. Since the publication of the first DSM in 1952, knowledge about psychiatric disorders, including substance use disorders, has advanced greatly.⁶³

Over time, there have been changes in how the DSM—and thus how clinicians, counselors, and researchers—identifies and treats people who use tobacco and alcohol (and people who use both). The most recent edition, DSM-5-TR, was published in 2022.⁶⁴ The classification of substance use disorders in the DSM-5-TR combines both the abuse and dependence criteria from the DSM-IV into a single diagnostic tool for substance use disorder and does not use the terms “abuse” and “dependence”; instead, it indicates a level of severity of substance use disorder as mild, moderate, or severe depending on how many criteria are endorsed by the person.⁶³

The substance use disorder diagnosis can apply to people who use both tobacco and alcohol as well as use other substances.

Tobacco and alcohol use disorders are each considered a form of substance use disorder, but researchers and clinicians do not always use the terms “alcohol use disorder” or “tobacco use disorder” to describe treatment for people who use tobacco and alcohol. In the tobacco use treatment literature, terms describing both treating use and dependence are varied and often used interchangeably. For example, the treatment may be described as for “nicotine addiction,” “nicotine dependence,” “tobacco dependence,” “tobacco use,” “tobacco dependence” or “tobacco use disorder.” The DSM-IV used the term “nicotine dependence,” whereas the DSM-5-TR replaced “nicotine dependence” with the diagnosis “tobacco use disorder.” In this monograph, treatment of tobacco use, dependence and use disorder are described with the terms used in the cited studies. This reflects the terminology used most often in research literature and in the most recent (2008) Public Health Service Clinical Practice Guideline, *Treating Tobacco Use and Dependence*,⁶⁵ which is widely used by both clinicians and researchers.

As is seen in the field of tobacco research and treatment, alcohol researchers and clinicians employ a variety of terms to characterize alcohol use problems and their treatment.⁶² The terms have changed over time and are not used consistently. In the alcohol use treatment literature, the terms often reflect the criteria and terminology of the DSM, reflecting the more severe continuum of alcohol use and harms. The DSM-5-TR uses the term “alcohol use disorder” (AUD), characterizing the diagnosis by its level of severity (mild, moderate, or severe). Previous versions of the DSM used the terms “alcohol abuse” or “alcohol dependence”, and these terms are included in this monograph when the cited studies used older DSM-IV criteria for alcohol abuse or dependence as primary outcomes or eligibility criteria.

Other Terms

Where possible, this monograph uses standardized terms to define tobacco and alcohol use. Some definitions of standardized terms are as follows:

- **Dependence** – A condition marked by physical withdrawal symptoms and continued use despite known adverse consequences to the user (e.g., physical and mental health, social).⁴³
- **Co-use** – Use of two substances (e.g., tobacco and alcohol) within the same reference period, such as within the past hour, day, week, month, or year. A subcategory of co-use may be referred to as simultaneous use, which is the coadministration of two substances in the same product, at the same time, or on the same occasion. U.S. national health surveys most commonly assess use of tobacco and alcohol in the past month and/or past year, and co-use is analyzed from these separate variables. Co-use is sometimes called “concurrent” use.
- **Standard drink** – In the United States, a standard drink is defined as any beverage containing 0.6 fluid ounces or 14 grams of ethanol.⁶⁶ A standard drink is equivalent to 12 fluid ounces of beer at 5% alcohol by volume, 5 fluid ounces of wine at 12% alcohol by volume, or 1.5 fluid ounces of distilled spirits at 40% alcohol by volume. Throughout this monograph the term “drink” refers to a standard drink as defined here unless otherwise specified.⁶⁷
- **Heavy drinking** – Consumption of 5 or more drinks on any day or 15 or more per week for men and consumption of 4 or more drinks on any day or 8 or more drinks per week for women.⁶⁶

- **Synergy** – When the interaction between two factors (i.e., tobacco and alcohol use) results in a total effect (e.g., cancer risk) that is different from the sum of the individual effects. Synergy may be positive or negative, and additive or multiplicative.^{68,69}
- **Tobacco use** – In this monograph, tobacco use or tobacco smoking refers to commercial tobacco products including cigarettes, e-cigarettes, smokeless tobacco, pipe tobacco, cigars, hookah, heated tobacco products, and nicotine pouches. It does not refer to the sacred and traditional use of tobacco by some American Indian and other Indigenous communities.⁷⁰⁻⁷²
- **Types of tobacco and alcohol use patterns** – In some cases, it is necessary to refer to the terms that describe use patterns provided in the literature to accurately discuss published research findings. For example, the terminology used to describe various patterns of nondaily tobacco use may vary across studies; therefore, this monograph provides the exact terminology used in the referenced article (e.g., by using terms such as nondaily, occasional, light, or social).
- **Race, ethnicity, and ancestry** – This monograph recognizes that the terms race, ethnicity, and ancestry are not uniformly defined and applied throughout the literature, and key differences exist in the use of these terms, especially between the genetics field and other disciplines. Furthermore, the categories used for race and ethnicity in federal surveys have changed over time. Although the applications of these terms continue to evolve, this monograph uses the terminology as defined in the studies or surveys cited and analyzed.
- **Cancer survivor** – A person is considered a cancer survivor from the time of diagnosis through the balance of life. There are many types of survivors, including those living with cancer and those free of cancer.⁷³

Tobacco and Alcohol Products

Most of the research in this monograph focuses on the co-use of tobacco in the form of cigarettes and alcohol of all types (i.e., beer, wine, and distilled spirits), where cancer risks are clearly established and where much past research has focused. Over the past 20 years, there have been considerable changes in both the tobacco and alcohol marketplaces, with many new products being added to the market.⁷⁴⁻⁷⁷ However, there is limited literature available on new products and several other important topics, including the co-use of other tobacco products, such as e-cigarettes, with alcohol and/or other substances and the potential cancer risks of these co-use patterns.

The monograph also recognizes that tobacco and alcohol are increasingly co-used with cannabis. Results from National Survey on Drug Use and Health indicate that cannabis, also referred to as marijuana, has become the most commonly reported substance after tobacco and alcohol.² In 2024, 35.0% of young adults ages 18 to 25 (12.2 million people) reported using cannabis in the past year.² Use of cannabis is more common among people who smoke cigarettes or drink alcohol than among those who do not.^{2,78-81} Although outside the scope of this monograph, the use of cannabis among people who use tobacco and alcohol is an important public health issue and has implications across the tobacco control landscape. Future studies of the use of all three substances (polysubstance use) are needed, such as effects of polysubstance use on tobacco use,

initiation, and cessation; cancer risk; and the policy and commercial landscape of tobacco, alcohol, and cannabis sales and marketing, among other topics.

Monograph Strengths and Limitations

One goal of this monograph is to synthesize and discuss the state of the science of how tobacco and alcohol co-use affects tobacco control. The volume presents what is known about tobacco and alcohol co-use as of 2026 and opportunities for future research efforts. In addition to synthesizing the existing scientific literature, new analyses were conducted of patterns of tobacco and alcohol co-use overall and among population subgroups (highlighted in chapters 2 and 3). This volume concludes that further research to address the co-use of tobacco and alcohol could significantly strengthen cancer prevention and control and that addressing alcohol use in the context of tobacco control is likely to accelerate progress in preventing tobacco use initiation, improving rates of cessation, and avoiding relapse to smoking. Like other monographs in the Tobacco Control Monograph Series, formal systematic reviews were not conducted as part of the monograph development process; rather, the monograph is an expert, narrative review of the existing literature. Specific measurement challenges and limitations of the existing literature are discussed in each chapter, and conclusions made reflect the strength of the existing evidence.

Major Conclusions

The following volume-level conclusions emerged from the monograph chapters.

1. **Tobacco and alcohol are addictive and carcinogenic substances that are commonly used together.** Approximately 12% of adults in the 2015–2019 National Survey on Drug Use and Health reported co-use of cigarettes and alcohol in the past month, representing nearly 30 million people. Adults who use tobacco (e.g., cigarettes, smokeless tobacco, cigars) are more likely to engage in alcohol use, binge drinking, and risky weekly alcohol use than those who do not use tobacco.
2. **Co-use of tobacco and alcohol occurs from the earliest ages of substance use initiation, and its prevalence is substantially higher among certain population subgroups.** Tobacco and alcohol use often begins in adolescence, and long-term use of these two substances makes it more difficult to quit or reduce their use. Adults who report nondaily use of tobacco report the highest prevalence of alcohol use, binge drinking, and risky weekly alcohol use compared with other tobacco use groups. Tobacco use is positively associated with alcohol use across all racial and/or ethnic groups. Compared with the U.S. adult population overall, tobacco and alcohol co-use is elevated in a number of subgroups, including veterans, people living in rural areas, people who are part of a sexual minority group, and people with some types of mental health conditions.
3. **Tobacco use and alcohol consumption individually increase the risk for numerous types of cancer, even at low levels of use, and there is a synergistic increase in risk of squamous cell cancers of the head and neck and esophagus caused by tobacco and alcohol co-use.** In 2019, an estimated 19.3% of incident cancer cases and 28.5% of cancer deaths in the United States were attributable to cigarette smoking. Smoking one or fewer cigarettes per day increases the risk of numerous cancers. Further, an estimated 5.4% of incident cases of cancer and 4.1% of cancer deaths in the United States in 2019 were attributable to alcohol consumption. The risk for head and neck cancers increases

with one drink per day and possibly at lower levels of consumption, and the risk of breast cancer increases at one or fewer drinks per day. Strong evidence from multiple countries demonstrates a synergistic relationship between tobacco and alcohol use and risk for squamous cell cancers of the head and neck and esophagus.

4. **Tobacco and alcohol co-use results in substantially increased acetaldehyde exposure.** Acetaldehyde is a potent carcinogen which damages DNA in multiple ways; it is both a component of tobacco smoke and an important metabolite of ethanol. Acetaldehyde plays a crucial role in the synergistic increases in risk observed for squamous cell head and neck and esophageal cancers in response to tobacco and alcohol co-use.
5. **People with genetic variants that reduce the rate of metabolism of acetaldehyde are at significantly increased risk of cancer if they consume alcohol.** An estimated 540 million people worldwide have genetic variants that reduce the rate of metabolism of acetaldehyde by aldehyde dehydrogenase 2 (ALDH2); these genetic variants are most common in East Asian populations. People with this variant who drink alcohol are at increased risk of squamous cell head and neck and esophageal cancers. Addressing alcohol use and tobacco and alcohol co-use represents important education and intervention opportunities to reduce the burden of cancer in this population.
6. **Tobacco and alcohol use affect multiple, complex neurophysiological processes in the brain.** Networks of brain regions influence how people respond to nicotine and ethanol. Shared biologic pathways in the brain, including those involved in risk-taking and impulsivity, interact and drive use of substances including tobacco and alcohol and substance use disorders.
7. **Studies have identified a substantial number of genetic variants that are associated with both alcohol use and tobacco use across populations, providing evidence for shared underlying mechanisms.** A better understanding of the shared biological mechanisms from additional genetic studies will inform efforts to prevent use disorders and develop pharmacotherapies for tobacco and alcohol co-use and polyuse with other substances.
8. **Smoking cessation interventions are effective for people who smoke and have an alcohol use disorder.** Engaging in smoking cessation treatment during treatment for alcohol use disorder does not jeopardize sobriety outcomes. However, many people in treatment for alcohol use disorder who smoke do not receive smoking cessation treatment. This is a missed opportunity to reduce the burden of cancer in this population.
9. **Addressing alcohol use as a part of smoking cessation treatment is highly likely to advance tobacco cessation goals.** Alcohol use, especially heavy alcohol use, is a barrier to quitting smoking. For this reason, people trying to quit smoking should be advised and assisted to reduce or stop their alcohol use. Integrated tobacco use treatments that address both tobacco and alcohol use may increase reach and effectiveness across multiple settings, including inpatient and outpatient clinical settings and community settings.

10. **Ensuring broad access to, and use of, evidence-based therapies for tobacco and alcohol treatment will help reduce cancer incidence and mortality.** Pharmacological and behavioral therapies for both tobacco and alcohol treatment are underutilized, especially the combined use of both types of therapies, which is the most effective treatment approach for both substances. Moreover, increased understanding of individual genetic variation may inform precision medicine approaches to addressing tobacco and alcohol use.
11. **Prevention programs and interventions that address both tobacco and alcohol may be effective to prevent initiation and ongoing use of both substances.** Effective interventions to prevent tobacco and alcohol use, especially among adolescents and young adults, exist at multiple levels, including the individual, group, community, mass media, and policy levels. Evidence suggests that prevention programs that address both tobacco and alcohol use are feasible. Integrated interventions are needed to prevent both tobacco and alcohol use early in life and across different population subgroups. In addition, intervention studies that focus on either tobacco or alcohol but measure effects on both substances will be highly informative.
12. **Factors pertaining to the marketing, sale, and distribution of tobacco and alcohol products (and the policies to address them) influence patterns and prevalence of tobacco and alcohol use individually and may also influence co-use.** Co-exposure to tobacco and alcohol product marketing and retail availability in the same outlets is common, suggesting the potential for cross-product effects. Greater retail availability of tobacco is associated with greater tobacco use among adults, and some evidence shows that greater availability of alcohol is positively associated with alcohol use among adults. In addition, both tobacco and alcohol retail outlets tend to be concentrated in neighborhoods characterized by greater socioeconomic disadvantage. Assessing how tobacco and alcohol industries' strategies for marketing and distribution of their products influence the marketplace and contribute to tobacco and alcohol co-use is important. Improved understanding of such influences can inform policy approaches to reduce the harms caused by tobacco, alcohol, and their co-use.
13. **Addressing the co-use of tobacco and alcohol has the potential to strengthen tobacco control and reduce cancer incidence and mortality.** Further research on tobacco and alcohol co-use will accelerate progress in preventing tobacco use initiation, improving rates of cessation, and avoiding smoking cessation lapses.
14. **Increased public awareness of both tobacco and alcohol as modifiable risk factors for cancer is an important step towards reducing the cancer burden.** Cancer prevention efforts have primarily focused on smoking and heavy alcohol use. The complex marketplace of available products, the high prevalence of co-use of tobacco and alcohol, and the fact that even moderate alcohol consumption and low levels of tobacco use increase cancer risk, pose challenges to researchers and clinicians. Increased public awareness of the cancer risks associated with tobacco and alcohol co-use will help reduce cancer incidence and mortality.

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