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Prevalence of Alcohol-Interactive Prescription Medication Use among Current Drinkers: United States, 1999–2010

Rosalind A. Breslow, PhD, MPH,

Division of Epidemiology and Prevention Research, National Institute on Alcohol Abuse and Alcoholism, National Institutes of Health, Bethesda, Maryland

Chuanhui Dong, MD, PhD, and

University of Miami, Miami, Florida

CSR, Incorporated, Arlington, Virginia

Aaron White, PhD

Division of Epidemiology and Prevention Research, National Institute on Alcohol Abuse and Alcoholism, National Institutes of Health, Bethesda, Maryland

Abstract

Background—The majority of Americans consume alcoholic beverages. Alcohol interacts negatively with numerous commonly prescribed medications. Yet, on a population level, little is known about use of alcohol interactive (AI) prescription medications among drinkers.

Purpose—To determine the prevalence of AI prescription medication use among current drinkers in the US population.

Methods—Data were from the National Health and Nutrition Examination Survey (NHANES 1999–2010); 26,657 adults aged ≥20 years had data on past year alcohol consumption and past month prescription medication use. Analyses were adjusted for covariates: age, race/ethnicity, education, marital status, and smoking. Statistical procedures accounted for survey stratification, clustering, and non-response. Analyses were weighted to be nationally representative.

Results—The unadjusted total prevalence of AI medication use was 42.8% (95% CI [CI] 41.5–44.0). Among current drinkers, adjusted prevalence was 41.5% (CI 40.3–42.7). Among participants aged ≥65 total prevalence of AI medication use was 78.6% (CI 77.3–79.9) and adjusted prevalence among current drinkers was 77.8% (CI 75.7–79.7). The AI medications most commonly used by current drinkers were cardiovascular agents, central nervous system (CNS) agents, and metabolic agents.

Conclusions—Our results suggest that there could be substantial simultaneous exposure to alcohol and AI prescription medications in the US population. Given the adverse health risks of combining alcohol with AI prescription medications, future efforts are needed to collect data to determine actual simultaneous prevalence.

Keywords

alcohol consumption; drinking patterns; drinking behavior; drugs; medications; prescription medications; cross-sectional survey; National Health and Nutrition Examination Survey, NHANES

INTRODUCTION

According to recent estimates, 71% of American adults consume alcoholic beverages (Substance Abuse and Mental Health Services Administration 2013). Numerous commonly prescribed medications interact negatively with alcoholic beverages including cardiovascular agents such as diuretics, central nervous system agents such as narcotics, psychotherapeutic agents such as antidepressants, and others (National Consumers League 2013; National Institute on Alcohol Abuse and Alcoholism 2014a; Weathermon and Crabb 1999). Yet, little is known about the prevalence of alcohol-interactive (AI) prescription medication use among US drinkers.

To our knowledge, only four population-based studies have been performed (Adams 1995; Forster et al. 1993; Jalbert et al. 2008; Pringle et al. 2005). Two, published in the 1990's, were community-based studies of elderly individuals (Adams 1995; Forster, Pollow, & Stoller 1993). Another, published in 2005, was a state-based study of seniors enrolled in a prescription benefits program (Pringle, Ahern, Heller, Gold, & Brown 2005). The only nationally representative study, published in 2008 by Jalbert et al. (Jalbert, Quilliam, & Lapane 2008), used data from the 1999–2002 National Health and Nutrition Examination Surveys (NHANES).

In the Jalbert et al. study, alcohol consumed in the past year was categorized by its potential (low, moderate, high) to result in adverse events. Medications used in the past month were considered AI if they “could intensify the effects of alcohol, resulting in increased sedation, drowsiness, or dizziness.” The study found that 13.5% of participants took one or more AI medications and, of those, 60.5% consumed alcohol, which suggested that some participants drank on days they used AI medications. However, the results provided limited information about the national prevalence of AI prescription medication use among drinkers because usual drinking was not the focus and a selected subset of AI medications was examined.

Given the risks involved in combining alcohol with AI prescription medications which range from overdoses to liver damage or heart problems (National Institute on Alcohol Abuse and Alcoholism 2014a; Weathermon and Crabb 1999), we considered it important to update and expand the NHANES 1999–2002 study (Jalbert, Quilliam, & Lapane 2008). NHANES 1999–2010 included data on participants' quantity and frequency of drinking which could be used to characterize usual drinking. The survey also included a database of 1,309 generic medications which could be characterized according to AI status. Furthermore, combining 12 years of NHANES data would yield a large sample (n=26,657) resulting in enhanced ability to obtain precise estimates of association, particularly for less frequently used therapeutic classes of medications. It would also enable separate estimates for persons aged

65 years and older, a group at particularly high risk for alcohol-medication interactions (Moore et al. 2007).

The purpose of our study was to determine the national prevalence of AI prescription medication use among current drinkers in the US adult population using data from NHANES 1999–2010.

SUBJECTS AND METHODS

Study Population and Design

Data were from the 1999–2010 National Health and Nutrition Examination Survey (NHANES), a continuing cross-sectional, nationally representative survey of the health and nutrition of the US non-institutionalized civilian population conducted by the Centers for Disease Control and Prevention (Centers for Disease Control and Prevention 2014). The survey employs a complex, stratified multistage probability sample design and oversamples persons aged 60 and older. In-person interviews are conducted in-home and at a mobile examination center (MEC). Our study used data from participants who completed a MEC interview. Unweighted response rates for the MEC sample were 76%, 80%, 76%, 77%, 75%, and 77% in 1999–2000, 2001–2002, 2003–2004, 2005–2006, 2007–2008, and 2009–2010, respectively (Centers for Disease Control and Prevention 2013).

Alcohol Consumption in the Past Year

During the MEC visit participants aged 20 and older were asked about usual alcohol consumption over their lifetime: “In your entire life, have you had at least 12 drinks of any type of alcoholic beverage?”; “In the past 12 months, how often did you drink any type of alcoholic beverage?”; and “In the past 12 months, on those days that you drank alcoholic beverages, on the average how many drinks did you have?” (Centers for Disease Control and Prevention 2012a). We determined drinking status (never, former, current) as follows: participants who had not consumed alcohol in the past year were categorized as never drinkers if they also consumed less than <12 drinks in their lifetime, or as former drinkers if they also consumed 12 drinks during their lifetime and 12 drinks in any previous year. Both never and former drinkers were considered non-drinkers. Participants were categorized as current drinkers if they consumed 12 drinks during their lifetime and drank on at least 1 day in the past year. Drinking frequency was characterized as zero days per year (non-drinker), >0–4 days per week, and 5–7 days per week. Drinking levels were characterized as moderate and heavier. For women of all ages and men 65 years and older moderate drinkers were those who consumed >0–7 drinks per week; heavier drinkers > 7 drinks per week; for men ages 20 to 64, moderate drinkers consumed >0–14 drinks per week, and heavier drinkers > 14 drinks per week (National Institute on Alcohol Abuse and Alcoholism 2014b; United States Department of Agriculture 2010).

Use of Alcohol-Interactive (AI) Prescription Medications

Prescription medication data were obtained from the in-home interview. Participants were asked: “In the past month, have you used or taken medication for which a prescription is needed?”. Those who answered “yes” were asked to show medication containers (if

available) to the interviewer; approximately 85% (unweighted) of medications taken by the analytic sample were seen by the interviewer. Medication brand names were converted to generic equivalents by the interviewer and assigned nested 3-level therapeutic classification codes using the NHANES Multum Lexicon, a comprehensive database of all prescription and some non-prescription drug products available in the US drug market (Centers for Disease Control and Prevention 2012b). The 1999–2010 Multum Lexicon included 1,309 medications.

Our study used the following first level therapeutic classification categories: cardiovascular agents, central nervous system (CNS) agents, coagulation modifiers, gastrointestinal agents, metabolic agents, psychotherapeutic agents, and respiratory agents. We limited use of second level categories to medications with the greatest prevalence of use within a given first level category (for example, anticonvulsants [second level] within CNS agents [first level]). The only third level categories used were for narcotics and nonsteroidal anti-inflammatory agents (NSAIDs); for both the first level category was CNS agents and the second level, analgesics.

Medications are generally considered AI if their combination with alcohol alters “the metabolism or activity of the medication and/or alcohol metabolism resulting in potentially serious medical consequences” (Weathermon & Crabb 1999). One of the authors (C.D.) determined whether each of the medications listed was AI. The primary resources were two databases: Drugs.com (Drugs.com 2013) and Caremark.com (Caremark.com 2010). Additional information was obtained from the Healthline.com (Healthline.com 2006) and DailyMed databases (DailyMed.com 2014) and three publications on alcohol-medication interactions (National Consumers League 2013; National Institutes of Health 2014a; Weathermon & Crabb 1999). The following decision rules were used to conclude that a medication was AI: (1) mentioned as an AI medication or had information on potential alcohol-medication interaction in the medication description on both Drugs.com and Caremark/Healthline.com databases (567 medications), (2) mentioned as an AI medication or had information on potential alcohol-medication interaction in the medication description only on Drugs.com or on Caremark/Healthline.com, and was mentioned in DailyMed or any of the three publications (15 medications), or (3) was listed as an AI medication only in one of the three publications (9 medications). Based on these decision rules 591 (45%) of prescription medications listed in the Multum Lexicon were classified as AI.

Statistical Analysis

All analyses used weighted samples and accounted for stratification and clustering of the NHANES design in deriving estimates (prevalence) generalizable to the U.S. population. To estimate annual averages, a 12-year weight variable was generated that took two-sixths for the 4-year Mobile Examination Center (MEC) examination weight for each subject sampled in 1999–2002 and one-sixth for the 2-year MEC examination weight for each person sampled in 2003–2010. Data analyses were performed with survey procedures in SAS 9.3 (SAS Institute Inc, Cary, NC) and SUDAAN version 11.0 (RTI, Research Triangle Park, NC) to incorporate the stratification, clustering, and the 12-year sample weight. Briefly, the Taylor series (linearization) method was employed to estimate standard errors and 95%

confidence intervals (CI) based on complex sample designs (Woodruff RS 1971). For each of the classes of alcohol interactive (AI) prescription medications and the number of AI prescription medications, prevalence estimates and 95% CIs were calculated for the total sample and by alcohol drinking status in the past year (non-drinker, current drinker). Univariate analyses with Rao-Scott chi-square tests (Rao and Scott 1981) were conducted to examine differences in the distribution of sample characteristics and the prevalence of use of AI prescription medications between non-drinkers and current drinkers. Multivariable analyses with logistic regression modeling were performed to compute predictive margins (Graubard and Korn 1999) to estimate the prevalence of using AI medication when controlling for the following covariates: age (in years), race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, non-Hispanic other), educational level (less than high school, high school, some college, college graduate or beyond), marital status (married/cohabiting, widowed/divorced/separated, never married), cigarette smoking status (current, former, never). All tests of significance were 2-tailed, with the level of significance set at $p < 0.05$.

Analytic Sample

Among 30,752 participants aged 20 years or older who completed a MEC interview, we excluded 1,264 women who were pregnant or breastfeeding, 2,808 with missing or insufficient data on alcohol consumption in the past year, and 23 without data on prescription medications or the number of prescription medications taken in the past month. This left a final analytic sample of 26,657 adults (13,557 men, 13,100 women). The sample size in adjusted analyses is 26,182 due to missing data on covariates for 475 participants.

RESULTS

Analytic Sample Characteristics

Most participants were non-Hispanic white, had at least a high school education, and were married or cohabiting (Table 1). The majority of participants (about three-fourths of men and two-thirds of women) were current drinkers. Current drinkers were more likely to be current smokers than non-drinkers.

Prevalence of AI Medication Use

The unadjusted prevalence of any AI medication use was 37.7% (95% CI: 36.3–39.1) for men, 47.7% (95% CI: 46.3–49.1) for women, and 42.8% (95% CI 41.5 – 44.0) for all participants (Table 2). The adjusted (for age, race/ethnicity, education, marital status, smoking, and sex if applicable) prevalence of any AI medication use was significantly lower in current drinkers compared to non-drinkers for men (36.7% versus 42.3%), women (46.3% versus 50.5%), and all participants (41.5% versus 46.4%), with results driven mainly by differences in use of 3 or more AI prescription medications (Online Supplemental Table 1).

Table 3 shows prevalence of AI medication use according to therapeutic medication classes. Among all participants, the total prevalence of AI medication use by therapeutic classes was greatest for cardiovascular agents which were used by almost one-fourth of the analytic sample. Other therapeutic classes with total prevalence between about 10% and 16% included CNS agents, metabolic agents, and psychotherapeutic agents. Among current

drinkers, the prevalence of AI medication use by therapeutic classes was likewise greatest for cardiovascular agents which were used by almost one-fourth of the analytic sample. Other therapeutic classes with prevalence ranging from about 9% to 15% included CNS agents, metabolic agents, and psychotherapeutic agents.

Table 4 shows prevalence of AI medication use by therapeutic classes for adults aged 65 years and older. Among all elderly participants, more than 60% used cardiovascular agents, more than 25% used CNS agents, and close to 40% used metabolic agents; almost 11% used psychotherapeutic agents. Among elderly current drinkers, 77.8% used AI medications (total, all therapeutic classes).

Table 5 shows prevalence of AI medication use by therapeutic classes by drinking frequency. Among the most frequent drinkers (5–7 days per week) about 38% used AI prescription medications (total, all therapeutic classes). The prevalence of AI medication use by therapeutic classes did not differ between more frequent (5–7 days/week) and less frequent (>0–4 days/week) drinkers for cardiovascular agents, CNS agents, or psychotherapeutic agents. However, more frequent drinkers were significantly less likely to use metabolic agents.

Supplemental Analyses

Results of additional analyses are presented online by therapeutic medication class for moderate versus heavier drinkers, former versus never drinkers, and for current drinkers aged 20 to 64 years. Briefly, Online Supplemental Table 2 shows that prevalence of use for AI cardiovascular agents, CNS agents, and psychotherapeutic agents was similar among moderate and heavier drinkers. Online Supplemental Table 3 shows that prevalence of use for AI cardiovascular agents, CNS agents, and psychotherapeutic agents was significantly higher among former drinkers than among persons who never consumed alcohol (never drinkers). Online Supplemental Table 4 shows that among adults aged 20 to 64 years who were current drinkers the prevalence of AI medication use was about 16% for cardiovascular agents and ranged between about 9% to 14% for CNS agents, metabolic agents, and psychotherapeutic agents. Online Supplemental Table 5 compares the characteristics and unadjusted AI medication use of participants in the analytic sample to participants who were excluded from analyses due to missing or insufficient data on alcohol or medications.

DISCUSSION

In this large-scale nationally representative study of the US population, 41.5% of adult current drinkers used AI medications. Prevalence was higher among elderly current drinkers, 77.8%. Regardless of age, the AI medications most commonly used by current drinkers were cardiovascular agents and CNS agents.

The high prevalence of AI medication use we found among current drinkers suggests but does not prove or quantify a substantial prevalence of simultaneous exposure. While previous US population-based studies (Adams 1995;Forster, Pollow, & Stoller 1993;Ilomaki et al. 2013;Jalbert, Quilliam, & Lapane 2008;Pringle, Ahern, Heller, Gold, & Brown 2005) characterized their results as “concurrent” or “concomitant”, their methods did not meet

dictionary definitions of those terms. The definition of concurrent is “operating or occurring at the same time (MerriamWebster.com 2014).” The definition of concomitant is “happening at the same time as something else.” Neither the previous studies nor ours had same-time data.

Adams et al. (Adams 1995) measured alcohol over an unspecified recall period and AI prescription medication use during the past month. Forster (Forster, Pollow, & Stoller 1993) measured both alcohol and AI prescription medication use over the past 6 months. Pringle (Pringle, Ahern, Heller, Gold, & Brown 2005) determined alcohol over an unspecified duration and AI prescription claims within a 45 day window. Jalbert et al. (Jalbert, Quilliam, & Lapane 2008) and our study measured alcohol over the past year and prescription medication use in the past 30 days. Furthermore, all of the studies queried drinking behavior independent of AI medication use.

In order for there to be an interaction between alcohol and a prescription medication both must be simultaneously present in the body. To obtain estimates of prevalence questions should ask whether alcohol and a broad range of prescription medications were taken at-or-close-to the same time. Of course, the issue is complicated by differing windows of opportunity for interactions based on drinking frequency and half-lives of medications as well as changes in distribution of alcohol and selected medications with increasing age as total body water decreases and total body fat increases. For example, the benzodiazepine diazepam (Valium), a fat-soluble medication, has a half-life of roughly 20 hours in adults aged 20 years and 60 hours in adults aged 60 years (DailyMed.com 2014). In contrast, the beta-blocker, propranolol (Inderal) has a half-life of about 5 hours for people in their 20s, and roughly 11 hours for patients over 60. In addition, it may or may not be possible to factor medication-specific half-lives into questionnaires of general population surveys due to the importance of limiting respondent burden. It should be noted that the National Alcohol Surveys (Public Health Institute 2014) include a questionnaire on simultaneous use focused predominantly on drugs of abuse that could serve as a useful reference for the development of a more global questionnaire.

Our study included all AI prescription medications listed in the NHANES Multum Lexicon database (Centers for Disease Control and Prevention 2012b) whereas the previous NHANES study (Jalbert, Quilliam, & Lapane 2008) limited prescription medications to specific types of CNS agents that intensified alcohol’s effects (benzodiazepines, antipsychotics, antidepressants, narcotics, sleep medications, muscle relaxants) “resulting in increased sedation, drowsiness, or dizziness”. In other words, that study focused on alcohol’s pharmacodynamic interactions with prescription medications.

As described by Weathermon and Crabb (Weathermon & Crabb 1999) there are two types of alcohol-medication interactions; pharmacodynamic and pharmacokinetic. The former enhances medication effects, particularly in the CNS while the latter interferes with medication metabolism. Pharmacodynamic interactions are of considerable public health concern as they increase the risk of falls, traffic accidents, and alcohol poisoning and fatal overdoses. However, it is also important to consider pharmacokinetic interactions which involve altered metabolism of alcohol, an AI medication, or both. Certain medications,

including H2 histamine receptor antagonists used to treat ulcers and heartburn, can decrease first pass metabolism of alcohol and lead to slightly higher blood alcohol levels. Similarly, certain antibiotics, over the counter pain relievers, and some heart medications and diabetes treatments, can interfere with the metabolism of acetaldehyde, a product of alcohol metabolism, leading to toxic reactions that include flushing, nausea, sweating and vomiting after alcohol consumption. Alcohol can also increase coagulation time among those receiving anticoagulant therapy.

We examined AI medication use among the elderly and found considerably higher usage in that age group. Elderly, when they drink, may be at higher risk of alcohol-medication interactions than the general population (Moore, Whiteman, & Ward 2007; National Institute on Alcohol Abuse and Alcoholism 2014). We examined drinking frequency (5–7 days per week versus >0–4 days per week) because participants who drank most frequently might be more likely to have same-day exposure to prescription medications. Over one-third of the most frequent drinkers used an AI prescription medication. Some medications are taken on a regular basis and these would obviously pose greater risk of simultaneous alcohol exposure among the most frequent drinkers. Use of multiple medications would also increase risk.

Although the focus of our study was on current drinkers we provided estimates for former and never drinkers (Online Supplemental Table 3). Our finding that former (compared to never) drinkers had significantly higher usage of cardiovascular agents, CNS agents, gastrointestinal agents and agents in the ‘all other medications’ category may be useful to researchers in context of the “sick quitter” hypothesis (Shaper et al. 1988) which posits that many former drinkers quit drinking due to health problems.

Our study had several limitations. Our initial analysis plan sought to examine the simultaneous prevalence of alcohol and AI prescription medications defined as use at the same-time-of-day, on the same-day, or within the same-48-hours or other restricted time period when alcohol and particular medications would likely interact; however, we were unable to identify nationally representative datasets containing the needed variables. We used the NHANES Multum Lexicon nested 3-level therapeutic classification system to categorize AI prescription medications which resulted in NSAIDs being categorized as CNS agents; future studies may wish to consider other systems. Our sample size, though large, was not sufficient to consider individual medications within therapeutic classes which might interact differently with alcohol or with specific alcoholic beverages. About 9% of MEC participants were excluded from our analytic sample due to missing data on alcohol or prescription medications (Online Supplemental Table 5) so the sample may not be fully representative of the US population. However, the characteristics on which the excluded participants differed from those included in the study were controlled for in statistical models. We did not study alcohol quantity per se as we considered frequency a more likely predictor of potential exposure. However, higher quantity at any given frequency would clearly increase the likelihood of exposure by increasing the length of time it takes alcohol to be eliminated from the circulation. Among current drinkers aged 65 and older analyses by drinking frequency were not conducted due to smaller numbers of participants. Our study may have overestimated the actual prevalence of AI prescription medication use among current drinkers because drinking was assessed over the past year and medication use over

the past month. Current drinkers may not drink on the day they take a particular medication. Furthermore, not all medications may be taken daily.

Our study had several strengths. The data were nationally representative and are generalizable to the US population. We determined through a labor-intensive process whether each of the 1,309 generic medications listed in the NHANES Multum Lexicon was AI based on decision rules carried out by checking major drug databases and relevant publications. Our sample size was large, enabling more precise estimates than in previous studies as well as estimates within therapeutic classes. Recent data were included. Estimates were provided for participants aged 65 years and older. Data on alcohol quantity and frequency were used in various ways to examine usual drinking. Our tables provide data for non-drinkers so interested readers can make drinker versus non-drinker comparisons. Our supplemental tables also provide additional data on prescription medication use by moderate versus heavier drinkers, by former drinkers, and by drinkers aged 20 to 64 years.

Our results highlight the need for physicians to discuss with patients, particularly those who are elderly, the potential risks of combining alcohol with AI prescription medications. A recent report (McKnight-Eily et al. 2014) found that only 15.7% of US adults had ever discussed alcohol use with a health professional; among current drinkers the prevalence was 17.4%.

Our study is the most comprehensive examination of drinking and AI prescription medication by the US population conducted in the last 20 years of which we are aware. We were surprised by the lack of data to determine simultaneous prevalence given the serious consequences of combined alcohol-AI medication use. The findings of our study highlight a major gap in available data and the need to collect it. Given the potential for negative interactions between alcohol and medications, it is critical to understand in greater detail relationships between alcohol consumption and AI medication in the US population. Such information will inform future research, clinical practice, and public health policy.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1

Distributions of alcohol drinking status (non-drinker, current drinker) among men and women by selected characteristics, adults aged 20 years and older, United States, 1999–2010¹

	Men (n=13,557) ²				Women (n=13,100) ²			
	Non-drinker		Current drinker		Non-drinker		Current drinker	
	N	%	N	%	N	%	N	%
Total analytic sample	3829	23.3	9728	76.7	5404	34.3	7696	65.7
Age, years								
20–39	730	26.6	3710	43.2	1054	23.4	2863	39.1
40–64	1468	46.0	4024	44.9	2206	44.2	3419	47.8
65+	1631	27.3	1994	11.9	2144	32.4	1414	13.1
Race/ethnicity								
Non-Hispanic white	1941	70.5	4941	72.3	2300	64.9	4204	75.7
Non-Hispanic black	852	12.4	1772	9.2	1251	14.7	1369	9.6
Hispanic	887	11.3	2664	13.8	1614	13.4	1867	10.6
Non-Hispanic other	149	5.7	351	4.7	239	7.0	256	4.0
Education								
Less than high school	1528	26.9	2704	17.4	2238	29.4	1624	13.5
High school	928	27.6	2328	24.9	1322	28.1	1808	23.5
Some college	800	25.0	2543	29.5	1228	27.0	2499	33.9
College graduate or beyond	566	20.2	2144	28.1	603	15.3	1759	29.0
Marital status								
Married/cohabiting	2658	71.8	6337	65.9	2691	56.2	4193	59.9
Widowed/divorced/separated	654	12.6	1436	12.3	2030	30.7	2017	21.9
Never married	465	13.4	1800	19.8	594	11.5	1359	16.4
Smoking								
Current	624	16.7	2864	29.3	664	14.4	1832	24.4
Former	1473	34.1	2881	27.7	988	18.3	1720	23.1
Never	1728	49.1	3975	42.9	3746	67.1	4140	52.4

¹ Data source: National Health and Nutrition Examination Survey 1999–2010. Sample size (N) is unweighted; percentage estimates are weighted. N and percent may not add to full sample due to missing data.

² All p values are <0.0001 for chi square tests of drinking status by all characteristics in both men and women.

Table 2

Prevalence of alcohol-interactive (AI) prescription medication use by alcohol drinking status (non-drinker, current drinker), adults aged 20 years and older, United States, 1999–2010¹

No. of AI medication used	Unadjusted (n=26,657)						Adjusted (n=26,182) ²					
	Total (n=26,657)			Non-drinker (n=9,233)			Current drinker (n=17,424)			Non-drinker (n=9,064)		
	N	%	95% CI	N	%	95% CI	N	%	95% CI	N	%	95% CI
Men³												
0	7810	62.3	(60.9–63.7)	1631	49.3	(46.6–52.0)	6179	66.3	(64.9–67.6)	1600	57.7	(55.3–60.1)
1	5747	37.7	(36.3–39.1)	2198	50.7	(48.0–53.4)	3549	33.7	(32.4–35.1)	2168	42.3	(39.9–44.7)
Women³												
0	6586	52.3	(50.9–53.7)	2236	43.4	(41.0–45.7)	4350	56.9	(55.3–58.5)	2194	49.5	(47.2–51.7)
1	6514	47.7	(46.3–49.1)	3168	56.6	(54.3–59.0)	3346	43.1	(41.5–44.7)	3102	50.5	(48.3–52.8)
All³												
0	14396	57.2	(56.0–58.5)	3867	45.7	(43.6–47.9)	10529	61.9	(60.7–63.1)	3794	53.6	(51.6–55.7)
1	12261	42.8	(41.5–44.0)	5366	54.3	(52.1–56.4)	6895	38.1	(36.9–39.3)	5270	46.4	(44.3–48.4)

¹ Data source: National Health and Nutrition Examination Survey 1999–2010. Sample size (N) is unweighted; percentage estimates are weighted.

² Percentage is adjusted for age, race-ethnicity, education, marital status, smoking and sex if applicable using logistic regression. N may not add to full sample due to missing data on covariates

³ P values <0.0001 for chi square test of number of AI medications for non-drinkers vs. current drinkers.

Table 3

Prevalence of alcohol-interactive (AI) prescription medication use by alcohol drinking status (non-drinker, current drinker) and therapeutic medication class, adults aged 20 years and older, United States, 1999–2010^a

Medication class	Total (n=26,657)			Non-drinker (n=9,064) ^b			Current drinker (n=17,118) ^b			P
	N	%	95% CI	N	%	95% CI	N	%	95% CI	
Cardiovascular agents	8132	24.9	(23.8–26.0)	3884	27.5	(26.0–29.1)	4131	23.8	(22.7–25.0)	<.0001
Angiotensin converting enzyme	2668	7.8	(7.3–8.3)	1274	9.0	(8.2–9.7)	1361	7.3	(6.7–7.9)	0.0002
Angiotensin II inhibitor	1017	3.1	(2.9–3.4)	511	3.5	(3.0–4.1)	497	3.0	(2.6–3.4)	0.09
Antiadrenergic	927	2.4	(2.2–2.6)	443	2.8	(2.4–3.2)	469	2.1	(1.9–2.4)	0.006
Antiarrhythmic	1042	3.2	(3.0–3.5)	557	4.0	(3.5–4.5)	464	2.7	(2.4–3.1)	0.0001
Beta-adrenergic blocking	2616	7.9	(7.4–8.5)	1239	8.4	(7.6–9.3)	1347	7.8	(7.2–8.4)	0.21
Calcium channel blocking	1366	3.6	(3.3–3.9)	717	4.1	(3.7–4.7)	627	3.2	(2.9–3.6)	0.0007
Diuretics	2313	6.6	(6.1–7.1)	1209	7.7	(7.1–8.5)	1070	5.9	(5.4–6.5)	<.0001
Central nervous system agents	4507	16.2	(15.4–17.0)	2045	19.7	(18.2–21.3)	2392	14.6	(13.9–15.4)	<.0001
Anticonvulsant	1066	3.8	(3.5–4.2)	542	5.8	(5.1–6.5)	511	3.0	(2.7–3.4)	<.0001
Anxiolytic/sedative/hypnotic	895	3.5	(3.1–3.9)	413	4.3	(3.6–5.1)	472	3.2	(2.8–3.5)	0.0006
Muscle relaxant	458	1.7	(1.5–1.9)	190	2.3	(1.9–2.8)	263	1.5	(1.3–1.8)	0.002
Narcotic	1123	4.0	(3.6–4.4)	532	5.5	(4.7–6.5)	574	3.3	(2.9–3.7)	<.0001
Nonsteroidal anti-inflammatory	1086	3.8	(3.4–4.1)	439	4.0	(3.5–4.7)	620	3.6	(3.2–4.0)	0.24
Coagulation modifiers	587	1.6	(1.4–1.8)	309	2.0	(1.7–2.3)	271	1.4	(1.2–1.6)	0.003
Anticoagulant	554	1.5	(1.4–1.7)	290	1.8	(1.6–2.1)	257	1.3	(1.1–1.6)	0.005
Gastrointestinal agents	786	2.7	(2.4–3.0)	356	3.2	(2.7–3.8)	416	2.4	(2.2–2.7)	0.002
H2 antagonist	616	2.0	(1.8–2.3)	274	2.3	(1.9–2.7)	334	1.9	(1.6–2.1)	0.03
Metabolic agents	5114	15.3	(14.6–15.9)	2516	17.5	(16.5–18.6)	2534	14.2	(13.5–15.0)	<.0001
Antidiabetic	2537	6.5	(6.1–6.9)	1432	8.9	(8.1–9.6)	1067	5.1	(4.7–5.5)	<.0001
Antihyperlipidemic	3607	11.4	(10.8–12.0)	1671	12.2	(11.3–13.3)	1904	11.1	(10.5–11.8)	0.03
Psychotherapeutic agents	2275	9.8	(9.3–10.3)	935	11.3	(10.3–12.4)	1310	9.2	(8.6–9.8)	0.0005
Antidepressant	2137	9.3	(8.8–9.8)	862	10.5	(9.5–11.6)	1248	8.8	(8.3–9.5)	0.006
Antipsychotic	307	1.1	(0.9–1.3)	157	1.9	(1.5–2.4)	145	0.8	(0.7–1.0)	<.0001
Respiratory agents	902	3.9	(3.6–4.3)	334	4.1	(3.6–4.8)	550	3.8	(3.5–4.2)	0.34
Antihistamines	700	3.1	(2.8–3.4)	236	3.1	(2.7–3.6)	454	3.2	(2.9–3.5)	0.83

Medication class	Total (n=26,657)			Non-drinker (n=9,064) ²			Current drinker (n=17,118) ²			P
	N	%	95% CI	N	%	95% CI	N	%	95% CI	
All other medications	987	3.8	(3.5–4.0)	418	4.4	(3.9–5.0)	562	3.5	(3.2–3.9)	0.007
Total, all therapeutic classes	12261	42.8	(41.5–44.0)	5270	46.4	(44.3–48.4)	6798	41.5	(40.3–42.7)	<.0001

¹ Data source: National Health and Nutrition Examination Survey 1999–2010. Sample size (N) is unweighted for individuals who used the AI medication in the class; percentage estimates are weighted.

² Percentage is adjusted for age, sex, race-ethnicity, education, marital status and smoking using logistic regression. N may not add to full sample due to missing data on covariates.

Table 4

Prevalence of alcohol-interactive (AI) prescription medication use by drinking status (non-drinker, current drinker) and therapeutic medication class, adults aged 65 years and older, United States, 1999–2010¹

Medication class	Total (n=7,183)			Non-drinker (n=3,713) ²			Current drinker (n=3,347) ²			P
	N	%	95% CI	N	%	95% CI	N	%	95% CI	
Cardiovascular agents	4543	63.3	(61.7–64.9)	2461	65.6	(63.4–67.8)	2012	61.3	(58.9–63.7)	0.01
Angiotensin converting enzyme	1449	19.6	(18.4–20.9)	792	20.9	(19.1–22.7)	636	18.4	(16.6–20.3)	0.07
Angiotensin II inhibitor	616	8.6	(7.8–9.4)	351	9.3	(8.1–10.8)	261	8.1	(7.0–9.4)	0.21
Antiadrenergic	650	8.3	(7.5–9.0)	331	9.2	(8.1–10.5)	308	7.5	(6.5–8.7)	0.06
Antiarrhythmic	627	9.4	(8.4–10.3)	361	10.4	(9.1–11.7)	252	8.2	(7.0–9.7)	0.03
Beta-adrenergic blocking	1602	23.1	(21.4–24.8)	842	23.8	(21.5–26.3)	743	22.8	(20.9–25.0)	0.50
Calcium channel blocking	843	10.7	(9.9–11.6)	497	11.9	(10.8–13.1)	334	9.7	(8.4–11.1)	0.03
Diuretics	1460	20.6	(19.3–21.8)	827	22.7	(20.9–24.6)	611	18.5	(16.9–20.3)	0.002
Central nervous system agents	1815	26.1	(24.8–27.4)	1063	29.6	(27.4–32.0)	720	22.4	(20.7–24.3)	<0001
Anticonvulsant	386	5.7	(5.0–6.3)	251	7.6	(6.5–8.9)	130	3.9	(3.2–4.8)	<0001
Anxiolytic/sedative/hypnotic	357	5.6	(4.8–6.4)	208	6.4	(5.2–8.0)	143	4.6	(3.9–5.5)	0.01
Muscle relaxant	98	1.4	(1.1–1.7)	56	1.6	(1.2–2.1)	40	1.1	(0.8–1.6)	0.11
Narcotic	383	5.6	(4.9–6.3)	243	7.4	(6.1–8.8)	131	3.7	(3.0–4.4)	<0001
Nonsteroidal anti-inflammatory	374	5.1	(4.5–5.7)	206	5.3	(4.4–6.4)	161	4.8	(3.8–6.0)	0.53
Coagulation modifiers	468	6.8	(6.1–7.5)	258	7.8	(6.7–9.0)	206	6.0	(5.1–7.2)	0.03
Anticoagulant	440	6.4	(5.8–7.1)	242	7.2	(6.3–8.2)	194	5.8	(4.9–6.8)	0.05
Gastrointestinal agents	369	5.5	(4.8–6.2)	203	6.2	(5.2–7.3)	160	4.7	(4.0–5.6)	0.03
H2 antagonist	298	4.2	(3.6–4.9)	162	4.7	(3.9–5.7)	132	3.7	(3.0–4.5)	0.05
Metabolic agents	2818	38.8	(37.4–40.3)	1570	41.6	(39.3–43.8)	1214	36.5	(34.6–38.4)	0.0007
Antidiabetic	1243	14.9	(13.9–15.9)	813	18.4	(16.8–20.1)	411	11.3	(10.1–12.6)	<0001
Antihyperlipidemic	2163	31.3	(30.0–32.5)	1139	32.4	(30.3–34.5)	1006	30.6	(28.9–32.4)	0.22
Psychotherapeutic agents	683	10.8	(9.8–11.7)	391	12.1	(10.8–13.7)	283	9.6	(8.4–10.9)	0.01
Antidepressant	643	10.2	(9.3–11.1)	362	11.4	(10.0–12.9)	273	9.2	(8.0–10.5)	0.02
Antipsychotic	65	0.9	(0.6–1.2)	50	1.4	(0.9–2.0) ³	14	0.5	(—) ³	0.01
Respiratory agents	319	4.9	(4.2–5.5)	163	5.2	(4.3–6.2)	152	4.6	(3.8–5.5)	0.34
Antihistamines	237	3.7	(3.1–4.3)	111	3.7	(3.0–4.7)	125	3.8	(3.1–4.6)	0.93

Medication class	Total (n=7,183)				Non-drinker (n=3,713) ²				Current drinker (n=3,347) ²				P
	N	%	95% CI		N	%	95% CI		N	%	95% CI		
All other medications	448	6.8	(6.1–7.6)		217	6.4	(5.4–7.6)		228	7.4	(6.3–8.6)		0.22
Total, all therapeutic classes	5554	78.6	(77.3–79.9)		2941	79.7	(77.7–81.6)		2524	77.8	(75.7–79.7)		0.20

¹ Data source: National Health and Nutrition Examination Survey 1999–2010. Sample size (N) is unweighted for individuals who used the AI medication in the class; percentage estimates are weighted.

² Percentage is adjusted for age, sex, race-ethnicity, education, marital status and smoking using logistic regression. N may not add to full sample due to missing data on covariates.

³ Relative standard error (RSE) of 20%–30%, or 95% CI not shown if RSE>30%.

Prevalence of alcohol-interactive (AI) prescription medication use by alcohol drinking frequency and therapeutic medication class, adults aged 20 years and older, United States, 1999–2010/

Table 5

Medication class	Alcohol drinking frequency (No. of drinking days in past year) ²						p ⁴	p ⁵			
	0 d/year (n=9,064)		>0–4 d/week (n=15,079))		5–7 d/week (n=2,039)						
	N	%	95% CI	N	%	95% CI	N	%	95% CI		
Cardiovascular agents	3884	27.5	(25.9–29.1)	3441	24.0	(22.9–25.2)	690	22.9	(21.0–24.9)	<.0001	0.24
Angiotensin converting enzyme	1274	9.0	(8.2–9.7)	1135	7.4	(6.8–8.0)	226	6.7	(5.7–7.8)	0.0005	0.21
Angiotensin II inhibitor	511	3.5	(3.0–4.1)	412	2.9	(2.5–3.3)	85	3.3	(2.5–4.3)	0.19	0.44
Antiadrenergic	443	2.8	(2.4–3.2)	361	2.1	(1.8–2.5)	108	2.1	(1.7–2.7)	0.02	0.97
Antiarrhythmic	557	4.0	(3.5–4.5)	383	2.8	(2.4–3.2)	81	2.6	(2.0–3.4)	0.0003	0.74
Beta-adrenergic blocking	1239	8.4	(7.6–9.3)	1105	7.9	(7.3–8.6)	242	7.2	(6.1–8.4)	0.28	0.25
Calcium channel blocking	717	4.1	(3.7–4.7)	511	3.2	(2.8–3.6)	116	3.4	(2.8–4.2)	0.003	0.51
Diuretics	1209	7.7	(7.1–8.5)	909	6.1	(5.6–6.7)	161	4.7	(3.9–5.7)	<.0001	0.008
Central nervous system agents	2045	19.7	(18.2–21.2)	2067	14.9	(14.0–15.7)	325	13.2	(11.6–15.0)	<.0001	0.10
Anticonvulsant	542	5.7	(5.1–6.5)	448	3.1	(2.8–3.5)	63	2.4	(1.8–3.3)	<.0001	0.10
Anxiolytic/sedative/hypnotic	413	4.3	(3.6–5.1)	395	3.1	(2.7–3.5)	77	3.8	(2.8–5.0)	0.0009	0.21
Muscle relaxant	190	2.3	(1.9–2.8)	241	1.6	(1.4–1.9)	22	0.9	(0.6–1.5) ³	0.0001	0.04
Narcotic	532	5.5	(4.7–6.5)	498	3.4	(3.0–3.8)	76	3.0	(2.3–4.0)	<.0001	0.50
Nonsteroidal anti-inflammatory	439	4.0	(3.5–4.7)	545	3.7	(3.2–4.1)	75	3.2	(2.5–4.2)	0.31	0.42
Coagulation modifiers	309	2.0	(1.7–2.3)	207	1.4	(1.2–1.8)	64	1.2	(0.9–1.6)	0.004	0.22
Anticoagulant	290	1.8	(1.6–2.1)	199	1.4	(1.2–1.7)	58	1.1	(0.8–1.5)	0.006	0.18
Gastrointestinal agents	356	3.2	(2.7–3.8)	347	2.4	(2.1–2.7)	69	2.6	(1.9–3.5)	0.006	0.66
H2 antagonist	274	2.3	(1.9–2.7)	274	1.8	(1.6–2.1)	60	2.0	(1.5–2.9)	0.07	0.56
Metabolic agents	2516	17.5	(16.5–18.6)	2139	14.7	(14.0–15.5)	395	11.9	(10.5–13.5)	<.0001	0.001
Antidiabetic	1432	8.8	(8.1–9.6)	975	5.6	(5.2–6.1)	92	2.4	(1.8–3.2)	<.0001	<.0001
Antihyperlipidemic	1671	12.2	(11.3–13.2)	1566	11.4	(10.8–12.1)	338	9.9	(8.6–11.3)	0.02	0.04
Psychotherapeutic agents	935	11.3	(10.3–12.4)	1135	9.2	(8.6–9.9)	175	8.9	(7.4–10.7)	0.002	0.75
Antidepressant	862	10.5	(9.5–11.6)	1081	8.9	(8.3–9.6)	167	8.5	(7.1–10.2)	0.02	0.64
Antipsychotic	157	1.9	(1.5–2.4)	132	0.8	(0.7–1.1)	13	0.6	(–) ³	<.0001	0.44

Medication class	Alcohol drinking frequency (No. of drinking days in past year) ²								p ⁴	p ⁵	
	0 d/year (n=9,064)				>0–4 d/week (n=15,079))						5–7 d/week (n=2,039)
	N	%	95% CI	N	%	95% CI	N	%	95% CI		
Respiratory agents	334	4.1	(3.6–4.8)	484	3.9	(3.6–4.3)	66	3.2	(2.4–4.3)	0.36	0.23
Antihistamines	236	3.1	(2.7–3.6)	396	3.2	(2.9–3.5)	58	2.9	(2.1–3.8)	0.77	0.50
All other medications	418	4.4	(3.9–5.0)	490	3.6	(3.3–4.1)	72	2.7	(2.1–3.5)	0.002	0.03
Total, all therapeutic classes	5270	46.4	(44.4–48.4)	5799	42.0	(40.8–43.3)	999	38.2	(35.7–40.7)	<.0001	0.004

¹ Data source: National Health and Nutrition Examination Survey 1999–2010. Sample size (N) is unweighted for individuals who used the AI medication in the class; percentage estimates are weighted.

² Percentage is adjusted for age, sex, race-ethnicity, education, marital status and smoking using logistic regression. N may not add to full sample due to missing data on covariates.

³ Relative standard error (RSE) of 20%–30%, or 95% CI not shown if RSE>30%.

⁴ P-value for global test.

⁵ P-value for >0–4 d/week drinker vs. 5–7 d/week drinker.