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Smoke-free policies in drinking venues predict transitions in alcohol use disorders in a longitudinal U.S. sample

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Abstract

Background—Smoke-free legislation prohibiting smoking in indoor public venues, including bars and restaurants, is an effective means of reducing tobacco use and tobacco-related disease. Given the high comorbidity between heavy drinking and smoking, it is possible that the public health benefits of smoke-free policies extend to drinking behaviors. However, no prior study has examined whether tobacco legislation impacts the likelihood of alcohol use disorders (AUDs) over time. The current study addresses this gap in the literature using a large, prospective U.S. sample.

Method—Using data from the National Epidemiological Survey on Alcohol and Related Conditions (NESARC), we utilized logistic regression to examine whether the implementation of state-wide smoke-free legislation in bars and restaurants between Waves I (2001–2002) and II (2004–2005) predicted changes in DSM-IV AUD status (remission, onset, recurrence) in current drinkers at Wave I ($n = 19,763$) and participants who drank in public once per month ($n = 5913$).

Results—Individuals in states that implemented smoke-free legislation in drinking venues had a higher likelihood of AUD remission compared to participants in states without such legislation. Among public drinkers, smoke-free legislation was associated with a greater likelihood of AUD remission and a lower likelihood of AUD onset. These findings were especially pronounced among smokers, men, and younger age groups.

Discussion—These results demonstrated the protective effects of smoke-free bar and restaurant policies on the likelihood of AUDs; furthermore, these findings call attention to an innovative legislative approach to decrease the morbidity and mortality associated with AUDs.

Keywords

Smoke-free policies; Alcohol use disorders; Longitudinal

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Contributors

Authors McKee and Hyland designed the study. Author McKee managed the literature searches and summaries of previous related work. Author Young-Wolff undertook the statistical analysis and wrote the first draft of the manuscript and McKee, Hyland, Desai, Sindelar and Pilver contributed to further drafts. All authors contributed to and have approved the final manuscript.

Conflict of interest

All authors declare that they have no conflicts of interest.

1. Introduction

There is strong evidence indicating that tobacco use and heavy drinking frequently co-occur. Smokers are more than three times as likely as non-smokers to meet criteria for alcohol abuse or dependence (i.e., an alcohol use disorder, AUD) (McKee et al, 2007), and approximately 35% of individuals with an AUD are nicotine dependent (Grant et al., 2004a,b). Alcohol consumption is strongly associated with increased rates of smoking (McKee et al, 2006) and conversely, smoking increases alcohol consumption (Barrett et al., 2006). High comorbidity is particularly alarming given evidence that heavy alcohol consumption and smoking are leading causes of disease and death (Centers for Disease Control and Prevention [CDC], 2008; Meister et al., 2000; Mokdad et al., 2004), and the relative morbidity and mortality increases with combined versus singular abuse of alcohol and tobacco (Blot et al, 1988; Klatsky and Armstrong, 1992; Marrero et al., 2005; Pelucchi et al., 2007; Rosengren et al., 1988; Vaillant et al., 1991).

Empirical studies have provided consistent support for the public health significance of smoke-free policies. Smoke-free legislation prohibiting smoking in indoor public venues has been shown to decrease overall levels of smoking (Fichtenberg and Glantz, 2002). Moreover, such policies reduce exposure of non-smokers to passive smoke (Akhtar et al., 2007; Farrelly et al, 2005; Haw and Gruer, 2007; Heloma et al., 2001), decrease risk of respiratory symptoms (Eisner et al., 1998; Menzies et al, 2006) and reduce rates of coronary heart disease in the population (Barnoya and Glantz, 2006; Juster et al., 2007; Sargent et al., 2004). While growing recognition of the public health benefits of smoke-free legislation has contributed to the substantial increase in statewide smoke-free policies, a large number of US residents are still not covered by smoke-free laws (American NonSmokers' Rights Foundation [ANR], 2012). In an effort to reduce tobacco-related morbidity and mortality, United States Department of Health and Human Services (HSS) has repeatedly called for the establishment of laws that prohibit smoking in bars, restaurants, and worksites in all 50 states and the District of Columbia (DC) (HSS, Healthy People 2020 HSS, Healthy People 2011).

Despite extensive support for smoking-related benefits accrued by smoke-free policies, relatively few studies have investigated the influence of smoke-free policies on drinking outcomes. Using longitudinal data from the US Health and Retirement Survey (1992–2002), Picone et al. (2007) found that smoking restrictions reduced alcohol consumption in older adult women. However, this generalized population effect did not account for the timing of when specific state policies were enacted, nor did it evaluate reductions in alcohol consumption as a function of smoking or heavy drinking status. Using a prospective design, our group previously found that the implementation of smoke-free policies in Scotland were associated with significantly reduced drinking in pubs and bars among moderate- and heavy-drinking smokers compared to the rest of the United Kingdom without such legislation (McKee et al., 2009). Additionally, using data from a nationally representative sample of smokers from the United Kingdom, Australia, Canada, and the United States we found that smoke-free legislation was not associated with overall changes in alcohol consumption, but was associated with reductions in drinking frequency among heavy smokers and reductions

in drinking quantity among hazardous drinkers (Kasza et al., in press). Taken together, findings are consistent with the notion that alcohol and tobacco interactions are most pronounced in heavier drinkers (McKee et al., 2007), and suggest that disaggregating drinking and smoking behavior in bars reduces drinking behavior. Alcohol and tobacco are thought to potentiate each other's reinforcing effects (Rose et al., 2004; Shiffman and Balabanis, 1995), and smoking is predictive of frequent binge drinking (Harrison et al., 2008), which increases the risk of meeting criteria for alcohol use disorders.

In addition to limiting drinking behavior, smokefree policies in drinking venues may correspondingly reduce the likelihood of AUDs. The extent to which smoke-free legislation impacts risk for AUDs has substantial clinical relevance, yet the literature in this cross-cutting area is virtually non-existent. A better understanding of the differential impact of smoke-free legislation in drinking venues on the onset, remission, and recurrence of AUDs is needed to more fully understand the broader implications of such policies for prevention and treatment.

The goal of the current study was to examine the spillover impact of tobacco legislation to transitions in AUD status over time. This is particularly important as ignoring the full set of benefits associated with smoke-free policies could result in less investment in these policies than would be warranted. Using a prospective design, we aimed to: (1) investigate whether statewide smoke-free bar and restaurant policies influenced AUD remission, onset, and recurrence over time in a representative sample of U.S. drinkers, and in a subsample of drinkers who engage in frequent public drinking and thus would be more likely to be impacted by such policies; (2) examine whether the effects of smoke-free bar and restaurant policies on transitions in AUD status varied by smoking status, sex, and age. Smoke-free bar and restaurant legislation disaggregates opportunities to drink and smoke concurrently, and we predicted that smoke-free policies would have the strongest impact on AUDs among smokers. However, it was also possible that non-smokers may increase their drinking in smoke-free public venues; so we also (3) evaluated whether the impact of smoke-free bar and restaurant policies on AUD transitions was explained by changes in smoking status.

2. Methods

2.1. Participants

Our sample was comprised of participants who completed interviews for both assessments from the National Epidemiological Survey on Alcohol and Related Conditions (NESARC), a nationally representative, prospective longitudinal survey conducted by the National Institute on Alcohol Abuse and Alcoholism (NIAAA). As described elsewhere (Dawson et al., 2007; Grant et al., 2003a; Grant and Kaplan, 2005), the NESARC was collected via computer assisted personal interviews with civilian, non-institutionalized adults (18 years of age), residing in the U.S. over two waves (Wave I, 2001–2002, $n = 43,093$, 81% of those eligible; Wave II 2004–2005, $n = 34,653$, 86.7% of wave I participants). African Americans, Hispanics, and adults aged 18–24 were oversampled. The NESARC procedures were reviewed and approved by the U.S. Census Bureau and the U.S. Office of Management and Budget and all participants gave informed consent. State level smoke-free policy data was

obtained from the American Nonsmokers' Rights Foundation Ordinance Database (ANR, 2012).

Analyses were restricted to participants who lived in states without both smoke-free bar and restaurant legislation at Wave I. This included 16,555 participants from DC and 41 states without such policies at Wave II and 3208 participants from eight states that adopted comprehensive smoke-free bar and restaurant legislation between Waves I and II (Delaware, New York, Connecticut, Maine, Massachusetts, Rhode Island, Vermont, and Washington; ANR, 2012). California adopted comprehensive smoke-free legislation prior to Wave I and thus the 3932 participants from California were excluded from the current analyses. The final sample was limited to participants who reported any past-year alcohol use at Wave I ($n = 19,763$). It is important to note that of the eight states that implemented smoke-free bar and restaurant legislation between Waves I and II, five implemented smoke-free work place legislation. Supplementary analyses evaluating the impact of workplace bans did not substantively change the pattern of findings and this was not included as a covariate in the final models.

2.2. Measures

Current (occurring in the past-year) and past (in participant's lifetime prior to past-year) alcohol abuse and dependence criteria were assessed with the NIAAA Alcohol Use Disorders and Associated Disabilities Interview Schedule-version for DSM IV (AUDADIS-IV; Grant et al., 2001). The AUDADIS-IV has well-established validity (Grant et al., 1995, 2003b) and additional information on NESARC survey methods is available elsewhere (Grant et al., 2003a). We created three outcomes to reflect transitions in AUD status across waves: AUD remission, AUD onset, and AUD recurrence. Transition outcomes were assessed as a proportion of those at risk rather than a proportion of the total population. That is, participants were only included in analyses of: (a) AUD remission if they met the criteria for current AUD at Wave I (those unaffected at Wave II were coded as remitted = 1, all others = 0), (b) AUD onset if they were unaffected for both past and current AUD at Wave I (those affected at Wave II were coded as onset = 1, all others = 0), and (c) AUD recurrence if they met criteria for past AUD, but not for current AUD, at Wave I (those affected Wave II were coded as recurrent = 1, all others = 0). This method of coding allows for the differentiation of continued, new, and recurring episodes of AUD. As noted by Grant et al. (2011), this is an important distinction, as the likelihood of AUD transitions among participants "at risk" for each outcome are expected to vary from the likelihood of AUD transitions calculated as a proportion of the population overall.

Basic smoking status was assessed using the question, "*Did you smoke in the past 12 months?*" For each Wave, subjects were coded as to whether they are a current smoker (daily or non-daily smoking in the past 12 months) or non-smoker. A four-level variable was created to code whether participants were current smokers at Wave I (yes, no) and Wave II (yes, no). This variable was then recoded into four dummy variables "smoking persistence," "smoking remission," "smoking onset," and "never smoker."

Public drinking was assessed using the question “*During the last 12 months, how often did you drink in public places such as bars, restaurants, or arenas?*” We evaluated a subsample who indicated that they engaged in public drinking at least once a month ($n = 5913$).

We examined several potentially confounding variables that could affect the associations between smoke-free policy and transitions in AUDs, including years of education, educational attainment (<high school graduate, high school graduate, some college), race/ethnicity (Non-Hispanic White, Non-Hispanic Black, Hispanic, and other), family income (0–19,999, 20,000–34,999, 35,000–69,999, 70,000+), marital status (married or living together vs. single/widowed/separated/divorced), smoking status (current smoker vs. former or never smoker), and public drinking status (public drinking: once per month vs. <once per month). As the NESARC queried about outcomes that occurred in the 12 months prior to the interview, and some participants lived in a state with recently implemented smoke-free bar and restaurant policies, we also assessed whether time since the ban was implemented was a significant covariate.

2.3. Data analysis

We first evaluated the influence of smoke-free bar and restaurant legislation on transitions in AUD status across two waves of NESARC data using multiple logistic regression, after adjusting for a number of sociodemographic covariates. There was no effect of days since ban on AUD transitions among individuals in states with smoke-free legislation, and time since ban was not included in regression analyses. Next, we conducted a series of stratified logistic regression analyses to examine the influence of smoke-free policy change on AUD transitions separately by smoking status, sex, and age. Third, we investigated the influence of smoke-free legislation on changes in smoking status and evaluated whether any effects of smoke-free legislation on AUD transitions would remain after adjusting for changes in smoking status. This was done by adding three dummy variables (smoking remission, smoking onset and no smoking) as predictors to our logistic regression analyses. Persistent smoking (i.e., smoking at both Waves) was used as the reference group. All analyses were estimated in both the entire sample and the subset of public drinkers. Supplementary analyses with the full sample that included past-year abstainers were conducted (results not shown) and the overall pattern and significance of effects were virtually unchanged, indicating that excluding past-year abstainers did not affect our results.

Analyses were conducted using SAS software version 9.2 (SAS Institute, 2008). General Estimating Equations (GEEs) were used to account for the clustering of participants within states and to allow models to include state-level variables. GEE models are crucial to employ in this case in order to avoid underestimation of errors associated with state-level variables and natural clustering of data. While NESARC sampling weights have been constructed to provide nationally representative sample estimates, they were not utilized in these analyses for two reasons. First, sampling weights must be analyzed using SUDAAN software, which does not currently support calculation of GEE models (Research Triangle Institute, 2004). Second, since the analyses were concerned with relative effect sizes, and not making population-level estimates of the number of people affected, the sampling weights were not necessary to employ (Korn and Graubard, 1991).

3. Results

3.1. Influence of smoke-free policy on transitions in AUD status

Descriptive statistics are presented by policy change group and public drinking status in Table 1. Tables 2 and 3 show the odds ratios of AUD transitions in the total sample and the subset of public drinkers, respectively. Among individuals who reported any Wave 1 alcohol use (Table 2), smoke-free bar and restaurant legislation was associated with a significantly greater likelihood of AUD remission overall, as well as among men, participants aged 18–29, and participants aged 50 and older (as indicated by $p < 0.05$). Smoke-free legislation was protective against first AUD onsets in women and among those aged 40–49, and associated with less risk of AUD onset but greater risk for an AUD recurrence among smokers. In the subset of public drinkers (Table 3), smoke-free legislation was associated with AUD remission in the sample overall, as well as among smokers, men, participants aged 18–29, and those aged 50 or older. Protective effects of smoke-free legislation on AUD onset were found in the sample overall, and for all subgroups except participants aged 40 or older. Smoke-free legislation was not associated with AUD recurrence in the subset of public drinkers.

3.2. Changes in smoking status

In addition to the results presented in Tables 1–3, we also evaluated the impact of smoke-free bar and restaurant policy on changes in smoking status. Analyses (not shown) indicated that after adjusting for sociodemographic characteristics, smoke-free policy was not significantly associated with smoking remission among all smokers (OR = 0.95; 95% CI = 0.73, 1.24) nor among public drinking smokers (OR = 0.93; 95% CI = 0.68, 1.26). Similarly, smoke-free policy did not predict smoking onset among all non-smokers (OR = 1.14; 95% CI = 0.86, 1.50) nor among the subset of public drinking non-smokers (OR = 1.44; 95% CI = 0.93, 2.25). When evaluating whether changes in smoking status explained the effects of smoke-free legislation on AUD transitions, we found that adding smoking status transition dummy variables to our regression models (smoking onset, smoking remission, and non-smoking, with persistent smoking as the reference group) had no impact on the effect size ($OR < 0.02$) or significance of the main effects of smoke-free legislation on AUD transitions in the sample overall nor among the subset of public drinkers, results inconsistent with mediation.

4. Discussion

Despite clear evidence that smoking and AUDs co-occur, no previous study has investigated the extent to which tobacco legislation impacts the likelihood of AUD diagnoses over time. We used data from a large, prospective, population-based sample of U.S. adults in an innovative way to investigate concurrent effects of smoke-free bar and restaurant policies on the onset, remission, and recurrence of AUDs. Results indicated that the implementation of statewide smoke-free policies in drinking venues was associated with a higher likelihood of AUD remission among the entire sample, and this effect was more pronounced in the sub-sample who drank at least once per month in public venues. Further, those engaging in public drinking also had a lower likelihood of an AUD onset but not recurrent AUDs. It is

possible that eliminating opportunities to drink and smoke concurrently in public venues reduced the likelihood of new onset AUDs. These results, coupled with recent evidence that smoke-free policies are associated with reduced alcohol consumption in some studies (Kasza et al, in press; McKee et al., 2009; Picone et al, 2007), suggest that the true public health benefits of smoke-free policies will be systematically underestimated unless the broader effects on alcohol-related outcomes and costs are quantified.

Smoke-free policies were associated with a lower likelihood of an AUD onset among all smokers and in the subset of public drinking smokers. Public drinking smokers were also more likely to have an AUD remission when they lived in states that implemented smoke-free legislation. Importantly, non-smokers, who might increase drinking in smoke-free public venues did not demonstrate an increased likelihood of an AUD. In fact, nonsmoking public drinkers were less likely to experience an AUD onset if they lived in states with smoke-free legislation. Unexpectedly, the implementation of smoke-free bar and restaurant policies was associated with a greater likelihood of an AUD recurrence among smokers in the full sample, though this effect disappeared in the subset smokers who were also public drinkers. One reason considered is that some smokers may drink more at home following such legislation, though available evidence does not support this hypothesis (McKee et al., 2009). Further evaluation of the effects of smoke-free policies on the subgroup of non-public drinking smokers with a history of AUDs is needed to better understand this finding.

Smoke-free legislation in drinking venues was not predictive of smoking onset or remission. Importantly, the influence of bar and restaurant policies on AUD transitions was not attenuated after adjusting for changes in smoking, indicating that the effect of this legislation on AUD transitions is independent of changes in smoking behavior. There is some evidence that the impacts of smoke-free policies on smoking cessation are delayed, such that the likelihood of quitting increases over time (Bauer et al., 2005). While the current findings might suggest that smoke-free policies in drinking venues have a more immediate impact on AUD transitions than on changes in smoking status, additional prospective studies with greater detail on the timing of such changes over a longer period of time are needed to better examine this possibility.

While smoke-free policies were associated with protection against a first AUD episode among men and women, only men experienced a greater likelihood of AUD remission in the context of smoke-free legislation. These meaningful sex differences in type of AUD transition further reiterate the importance of examining how various demographic groups respond differently to smoke-free policies. Moreover, the implementation of smoke-free policy afforded the strongest protection against new AUD onsets among public drinkers aged 18–39. Given that the prevalence of alcohol-tobacco comorbidity is greatest in young adults (Falk et al, 2006), these findings are particularly important from a prevention perspective and suggest that statewide smoking bans may offer a broad approach to prevent AUD onset among individuals in the highest risk age group.

Tobacco legislation has broad population reach and has the potential to reduce alcohol consumption and its adverse health impacts. From a practical standpoint, evidence for the residual beneficial impact of smoke-free policies on AUD status over time could potentially

bring additional partners into smoke-free policy debates. As of January 2012, only 29 states had enacted 100% smoke-free legislation for bars and restaurants (ANR, 2012); however, in the remaining states, the policy debates continues. Resistance to such policies are based on concern over adverse economic consequences to the local hospitality industry. However, research has demonstrated that decreases in frequency of pub patronage among certain subgroups following the implementation of smoke-free policies are compensated for by increased frequency of pub patronage and spending among other subgroups (e.g., non-smokers; Hyland et al., 2008; McKee et al, 2009). Indeed, studies consistently show that smoke-free policies have no adverse economic effect on hospitality revenues (Cowling and Bond, 2005; Luk et al., 2006; Scollo et al., 2003). Additionally, there is some evidence that media attention on smoke-free legislation can increase smokers' support for smoke-free legislation (Nagelhout et al., 2012), and it is possible that greater awareness of and attention to the spillover impacts of such legislation on transitions in AUD status could raise support for smoke-free policies among smokers and drinkers alike.

While the current study is a first step toward quantifying the broader set of effects of smoke-free policies on changes in AUD status, statewide implementation of smoke-free bar and restaurant policies are likely associated with other secondary public health benefits that we do not consider in this paper. Our findings can pave the way for a productive line of future research on the impact of smoke-free policies and other alcohol-related outcomes, such as psychosocial consequences of heavy drinking (e.g., fights in bars), drunk driving, and alcohol-related morbidity and mortality. Identification of secondary health benefits that accrue following the enactment of smoke-free policies can be used to enhance support for the CDC Healthy People 2020 goal of establishing laws that prohibit smoking in public places and worksites in all 50 states and DC (HSS, Healthy People 2020 HSS, Healthy People 2011).

4.1. Limitations and strengths

This study should be interpreted within the context of several limitations. The NESARC policy data can only be analyzed at the state level. While municipalities may enact local bans, we are not able to assess this degree of specificity as the NESARC data only provides state-level geographic data for respondents. Many states were covered partially by local ordinances prior to the implementation of statewide smoke-free bar and restaurant legislation, which likely biased the estimates of the effects of statewide legislation downward making it more difficult to detect a result. We did not have information on participant residence at Wave II and it is possible that some participants moved in or out of states that implemented smoke-free policies. The effect of this limitation is likely to be nonsystematic, adding random error to our results and thus leading to an underestimation of the true effect of smoke-free policies on AUD transitions. In addition to comprehensive statewide smoke-free bar and restaurant legislation, work place bans enacted as part of separate legislation may have also impacted AUD transitions. However, we found that workplace bans did not substantively alter our findings. Smoking and drinking behaviors were retrospectively self-reported which may limit the accuracy of our findings. Additionally, cohort attrition could bias the results if those lost to follow-up had different smoking and alcohol-related outcomes. Finally, alcohol and smoking are associated with

significant morbidity and mortality, and results may be affected by selective survival among our older age groups.

The current study uses secondary data in creative ways to test the previously unexamined impact of smoke-free legislation on transitions in AUDs. The inclusion of a large representative U.S. sample and control states without smoke-free bar and restaurant policies provided a unique opportunity to investigate whether the public health benefits of smoke-free policies extend beyond smoking-related outcomes to AUDs. Given the high comorbidity between AUDs and smoking, these findings have significant clinical and public health implications and call attention to an innovative legislative approach to decrease morbidity and mortality associated with AUDs. Current findings can inform policy debates to more fully capture the public health benefits of implementing smoke-free legislation.

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Table 1

Demographic characteristics and smoking status among past-year drinkers and among the subset of past-year public drinkers.

Characteristics	Past-year drinkers <i>n</i> = 19,763		Past-year public drinkers <i>n</i> = 5913	
	<i>n</i>	%	<i>n</i>	%
Sex				
Female	10,507	53.2	2644	44.6
Male	9256	46.8	1041	55.4
Age (years)				
18–29	4279	21.6	1581	26.7
30–39	4678	23.7	1365	23.0
40–49	4404	22.3	1236	20.8
50+	6401	32.4	1748	29.5
Ethnicity				
White	13,016	65.9	4343	73.2
Black	3184	16.1	724	12.2
Hispanic	2899	14.7	690	11.7
Other	443	3.4	173	2.9
Education				
<High school	2185	11.0	424	7.1
High school	5427	27.5	1404	23.7
Some college	12,151	61.5	4102	69.2
Annual income				
0–19,999	7783	39.4	1849	31.2
20,000–34,999	5078	25.7	1519	25.6
35,000–69,999	5127	25.9	1733	29.2
70,000	1775	9.0	829	14.0
Marital status				
Married	10,773	54.5	2767	46.7
Not married	8990	45.5	3163	53.3
Wave I smoking ^a				
Current	5667	28.9	1897	32.2
Former	3979	20.2	1203	20.4
Never	9992	50.9	2793	47.4
Wave II smoking ^b				
Current	4958	25.2	1594	27.0
Former	5038	25.6	1600	27.1
Never	9673	49.2	2708	45.9

Notes. Past-year drinkers: includes all individuals from states without both bar and restaurant bans at Wave I who reported any Wave I alcohol use. Past-year public drinkers: includes all individuals from states without both bar and restaurant bans at Wave I who reported drinking in public at least once a month at Wave I. Demographic characteristics measured at Wave I.

^a 125 participants missing smoking status information at Wave I.

^b 94 participants missing smoking status information at Wave II.

Table 2

Changes in alcohol use disorder (AUD) status as a function of change in smoke-free bar and restaurant policies among past-year drinkers ($n = 19,763$).

Strata	Policy group	AUD remission				AUD onset				AUD recurrence			
		N	% remission ^e	OR	95% CI	P-Value	N	% onset ^e	OR	95% CI	P-Value	N	% recurrent ^e
Everyone ^a	No ban	2112	53.1%	Ref			10,309	6.7%	Ref			4134	15.2%
	Ban	322	59.0%	1.30	(1.01, 1.66)	0.04	2159	5.0%	0.85	(0.69, 1.04)	0.11	727	14.7%
Smoking ^b													
Non smokers	No ban	1056	57.7%	Ref			7903	5.5%	Ref			2624	13.1%
	Ban	166	61.4%	1.22	(0.98, 1.51)	0.07	1701	4.2%	0.85	(0.69, 1.04)	0.12	521	11.5%
Smokers	No ban	1050	48.6%	Ref			2328	10.2%	Ref			1489	18.9%
	Ban	153	56.9%	1.38	(0.87, 2.20)	0.17	442	8.1%	0.74	(0.55, 1.004)	0.05	205	22.9%
Sex ^c													
Men	No ban	1364	47.0%	Ref			3965	9.7%	Ref			2458	17.7%
	Ban	208	57.7%	1.62	(1.32, 1.98)	0.0001	825	8.5%	0.93	(0.79, 1.09)	0.38	291	16.7%
Women	No ban	748	64.3%	Ref			6344	4.8%	Ref			1676	11.4%
	Ban	114	61.4%	0.90	(0.63, 1.29)	0.57	1334	2.9%	0.68	(0.50, 0.93)	0.02	291	11.7%
Age ^d													
18–29	No ban	795	53.0%	Ref			2247	12.5%	Ref			630	21.7%
	Ban	116	62.9%	1.58	(1.11, 2.23)	0.01	396	12.1%	0.94	(0.73, 1.19)	0.59	95	22.1%
30–39	No ban	525	53.5%	Ref			2270	7.6%	Ref			1127	16.0%
	Ban	88	52.3%	1.04	(0.66, 1.61)	0.88	479	4.8%	0.72	(0.41, 1.26)	0.25	190	17.9%
40–49	No ban	468	47.9%	Ref			2153	6.1%	Ref			1074	16.3%
	Ban	68	54.4%	1.14	(0.85, 1.52)	0.39	445	2.9%	0.64	(0.41, 0.99)	0.05	196	13.4%
50+	No ban	324	60.5%	Ref			3639	2.9%	Ref			1303	10.4%
	Ban	50	68.0%	1.91	(1.01, 3.60)	0.05	839	2.3%	0.94	(0.71, 1.26)	0.68	246	10.6%

Notes. Sample includes all individuals from states without smoke-free legislation at Wave I who reported any Wave I alcohol use. Participants were eligible for AUD onset if they had no past or current AUD at Wave I and a current AUD at Wave II. Participants were eligible for AUD recurrence if they had a past AUD but no current AUD at Wave I and a current AUD at Wave II. AUD remission, onset, and recurrence are mutually exclusive. Ref, reference group. No ban: includes participants who lived in States that did not implement smoke-free bar and restaurant policies in between Waves I and II. Ban: includes participants who lived in states that implemented smoke-free bar and restaurant policies in between Waves I and II.

^aOR adjusted for Wave I public drinking and smoking status, sex, marital status, age, ethnicity, income, and education.

^bOR adjusted for Wave I public drinking, sex, marital status, age, ethnicity, income, and education.

^cOR adjusted for Wave I public drinking and smoking status, marital status, age, ethnicity, income, and education.

^dOR adjusted for Wave I public drinking and smoking status, marital status, sex, ethnicity, income, and education.

^eUnadjusted percentages.

Table 3

Changes in alcohol use disorder (AUD) status as a function of change in smoke-free bar and restaurant policies among public drinkers ($n = 5930$).

Strata	Policy group	AUD remission				AUD onset				AUD recurrence			
		N	% remission ^e	OR	(95% CI)	P-Value	N	% onset ^e	OR	(95% CI)	P-Value	N	% recurrent ^e
Everyone ^a	No ban	1274	50.2%	Ref			2286	10.7%	Ref			1329	21.1%
	Ban	221	60.6%	1.61	(1.28, 2.02)	0.0001	550	6.7%	0.66	(0.59, 0.74)	0.0001	270	15.2%
Smoking ^b													
Non smokers	No ban	635	53.9%	Ref			1742	9.0%	Ref			876	18.6%
	Ban	110	60.9%	1.34	(0.82, 2.18)	0.24	421	5.5%	0.61	(0.51, 0.74)	0.0001	212	13.2%
Smokers	No ban	634	46.7%	Ref			526	15.2%	Ref			446	26.5%
	Ban	108	61.1%	1.88	(1.16, 3.04)	0.01	126	11.1%	0.75	(0.57, 0.99)	0.04	57	22.8%
Sex ^c													
Men	No ban	857	45.9%	Ref			1049	13.5%	Ref			830	24.9%
	Ban	146	60.3%	1.83	(1.55, 2.15)	0.0001	241	8.7%	0.68	(0.59, 0.79)	0.0001	163	17.8%
Women	No ban	417	59.2%	Ref			1237	8.2%	Ref			499	14.8%
	Ban	75	61.3%	1.12	(0.69, 1.81)	0.64	309	5.2%	0.61	(0.44, 0.86)	0.005	107	11.2%
Age ^d													
18–29	No ban	513	51.3%	Ref			572	16.8%	Ref			257	27.6%
	Ban	82	63.4%	1.75	(1.13, 2.70)	0.01	115	11.3%	0.60	(0.46, 0.77)	0.0001	42	21.5%
30–39	No ban	313	49.2%	Ref			471	14.0%	Ref			338	22.5%
	Ban	65	53.8%	1.37	(0.99, 1.88)	0.05	109	4.6%	0.26	(0.15, 0.46)	0.0001	69	15.9%
40–49	No ban	257	46.3%	Ref			423	10.4%	Ref			336	22.9%
	Ban	38	52.6%	1.16	(0.73, 1.84)	0.54	114	8.8%	0.76	(0.38, 1.53)	0.44	68	11.8%
50+	No ban	191	54.5%	Ref			820	4.6%	Ref			398	14.3%
	Ban	36	75.0%	3.34	(1.59, 6.99)	0.001	212	4.2%	1.37	(0.85, 2.20)	0.20	91	14.3%

Notes. Sample includes all individuals from states without smoke-free legislation at Wave I who reported drinking in public at least once a month at Wave I. Participants were eligible for AUD remission if they had a current AUD at Wave I and no current AUD at Wave II. Participants were eligible for AUD onset if they had no past or current AUD at Wave I and a current AUD at Wave II. Participants were eligible for AUD recurrence if they had a past AUD but no current AUD at Wave I and a current AUD at Wave II. AUD remission, onset, and recurrence are mutually exclusive. Ref, reference group. No ban: includes participants who lived in States that did not implement smoke-free bar and restaurant policies in between Waves I and II. Ban: includes participants who lived in states that implemented smoke-free bar and restaurant policies in between Waves I and II.

^aOR adjusted for Wave I smoking status, sex, marital status, age, ethnicity, income, and education.

- ^b OR adjusted for sex, marital status, age, ethnicity, income, and education.
- ^c OR adjusted for Wave I smoking status, marital status, age, ethnicity, income, and education.
- ^d OR adjusted for Wave I smoking status, marital status, sex, ethnicity, income, and education.
- ^e Unadjusted percentages.