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State policies targeting alcohol use during pregnancy and alcohol use among pregnant women 1985-2016: evidence from the Behavioral Risk Factor Surveillance System

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Abstract

Background: Most states have at least one policy targeting alcohol use during pregnancy. The public health impact of these policies has not been examined.

Objective: To examine the relationship between state-level policies targeting alcohol use during pregnancy and alcohol use among pregnant women.

Methods: Data include state-level alcohol and pregnancy policy data and individual-level U.S. BRFSS data about pregnant women's alcohol use 1985–2016 (n=57,194). Supportive policies include Mandatory Warning Signs; Priority Substance Abuse Treatment; Reporting Requirements for Data and Treatment Purposes; and Prohibitions on Criminal Prosecution. Punitive policies include Civil Commitment; Child Protective Services Reporting Requirements; and Child Abuse/Neglect. Analyses include logistic regression models that adjust for individual- and state-level controls, include fixed effects for state and year, account for clustering by state, and weight by probability of selection.

Results: Relative to having no policies, supportive policy environments were associated with more any drinking, but not binge or heavy drinking. Of individual supportive policies, only the following relationships were statistically significant: Mandatory Warning Signs was associated with lower odds of binge drinking; Priority Treatment for Pregnant Women and Women with Children was associated with higher odds of any drinking. Relative to no policies, punitive policy environments were also associated with more drinking, but not with binge or heavy drinking. Of

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individual punitive policies, only Child Abuse/Neglect was associated with lower odds of binge and heavy drinking. Mixed policy environments were not associated with any alcohol outcome.

Conclusions: Most policies targeting alcohol use during pregnancy do not appear to be associated with less alcohol consumption during pregnancy.

Introduction

Alcohol is a known teratogen that causes fetal alcohol syndrome (FAS), fetal alcohol spectrum disorders (FASD), and other harms to fetuses (May et al., 2008; Russell & Skinner, 1988; Sokol, Delaney-Black, & Nordstrom, 2003; Strandberg-Larsen, Gronboek, Andersen, Andersen, & Olsen, 2009). Alcohol use during pregnancy is common; approximately 15% of pregnant women in the U.S. report any alcohol use and almost 3% report binge drinking (Popova, Lange, Probst, Parunashvili, & Rehm, 2017).

Almost all U.S. states have enacted one or more policies targeting alcohol use during pregnancy (Roberts, Thomas, Treffers, & Drabble, 2017). The number of states with at least one such policy has increased over time, from one in 1974 to 43 in 2013 (Roberts et al., 2017). Scholars have categorized these policies into “supportive” and “punitive” (Chavkin, Wise, & Elman, 1998; Gomez, 1997). Supportive policies do not use threat of sanctions or coercion and include: warning signs; priority treatment for pregnant women or women with children; reporting requirements, when that reporting is to the health department for public health data gathering or for treatment referral purposes; and prohibitions against criminal prosecution. Punitive policies use coercion to compel behavior change and include: civil commitment; Child Protective Services (CPS) reporting requirements; and defining alcohol use during pregnancy as child abuse/neglect (Drabble, Thomas, O’Connor, & Roberts, 2014; Thomas, Rickert, & Cannon, 2006). Through the 1980s, states tended to have only punitive or only supportive policies (Roberts et al., 2017). In the 1990s, having a mix of punitive and supportive policies became the norm, with punitive policies added to supportive ones (Roberts et al., 2017). In 2013, 25 states had a punitive environment, 15 states a supportive environment, 3 states a mixed environment, and 8 states had no policies related to alcohol use during pregnancy.

A limited body of research has examined effects of policies targeting alcohol use during pregnancy. A few studies have examined impacts of a federal law mandating that beverages containing alcohol have warning labels about the effects of alcohol use during pregnancy (Greenfield, Graves, & Kaskutas, 1999; Hankin et al., 1993). One recent study examining impacts of state policies requiring warning signs about effects of alcohol use during pregnancy suggests warning signs may be associated with reduced alcohol use during pregnancy, but this study only examined effects through 2010 (Cil, 2017). To date, there has been no comprehensive research examining effects of other individual state-level policies that target women’s alcohol use during pregnancy or effects of punitive, supportive, or mixed policy environments on alcohol use during pregnancy. Understanding effects of state-level policies targeting alcohol use during pregnancy is important because such policies have been shown to increase adverse birth outcomes and to decrease prenatal care utilization (Subbaraman et al., 2018). Policies targeting alcohol use during pregnancy also continue to

be debated and enacted in individual states (Drabble et al., 2014; Roberts et al., 2017), components of these policies have recently begun to be included in federal legislation (CFF, 2012), and advocates are challenging some of these policies in court (“Eloise Anderson, et al v. Tamara M. Loertscher,” 2017).

In this study, we examine associations between a range of state-level policies, as well as the overall policy environment, and drinking among a national sample of pregnant women. Although typically not stated explicitly (except related to warning signs), the intent of policies targeting alcohol use during pregnancy can be assumed to be to decrease alcohol consumption during pregnancy. Thus, we would expect states with each individual policy, as well as states with only supportive, only punitive, or mixed punitive and supportive policies, would have lower alcohol use during pregnancy than states with no policy. Prohibitions against criminal prosecution could plausibly be associated with more alcohol use during pregnancy as this policy could be interpreted as the state tacitly giving permission for pregnant women to drink. Also, punitive policies could lead women to avoid prenatal care and substance use disorder treatment out of fear of punishment (Roberts & Pies, 2011), which could translate into more drinking during pregnancy in states with punitive policies.

Methods

Data sources

This study uses 1985–2016 data from the Behavioral Risk Factor Surveillance System (BRFSS) for alcohol outcomes and individual-level controls, NIAAA’s Alcohol Policy Information System (APIS) (NIAAA, 2016) and original legal research for alcohol and pregnancy policies, and secondary sources for state-level controls.

BRFSS is an annual telephone survey in the U.S. that tracks health status and health behaviors of adults to provide national and state-level estimates (CDC). BRFSS has been conducted annually since 1984, with pregnancy status assessed since 1985. During the 1980s, between 15 and 40 states participated each year. Beginning in 1992, 49 or more states participated each year. The CDC has used BRFSS data for national estimates of drinking during pregnancy since 1991 (CDC, 2009, 2012). BRFSS data are also often used in policy evaluations (McGeary, 2013; Naimi et al., 2014). BRFSS has included questions about alcohol use since the first survey, although alcohol data were not collected during even years in the 1990s. Participation rates were more than 70% in 1993, and have been closer to 50% through the 2000s (Galea & Tracy, 2007). In this study, we restricted our analyses to participants who reported that they were currently pregnant.

Alcohol and pregnancy policy statutory, regulatory, and effective date data were obtained from APIS and from original legal research using both Westlaw and HeinOnline, two online legal databases. The process for obtaining and coding these data has been described in detail elsewhere (Roberts et al., 2017). Briefly, it involved 1) identifying and gathering relevant statutes and regulations; 2) identifying effective dates for each; 3) coding policies, including ensuring inter-rater reliability; and 4) checking with states and secondary sources to ensure accuracy of data gathering and coding.

Data for state-level controls were obtained from secondary sources, including the U.S. census, the U.S. Centers for Disease Control and Prevention, APIS, the National Highway Traffic Safety Administration, National Beverage Control Association, published research (Kerr, Williams, & Greenfield, 2015), and original legal research.

Measures

Alcohol consumption data for pregnant women come from BRFSS and are measured at the individual level for the past 30 days. Alcohol outcomes were selected based on the official recommendation in the U.S. of abstinence from alcohol use during pregnancy, and literature finding increased risks of poor outcomes associated with binge and higher volume drinking (Alvik, Torgersen, Aalen, & Lindemann, 2011; Meyer-Leu, Lemola, Daepfen, Deriaz, & Gerber, 2011; O'Leary & Bower, 2012; O'Leary, Nassar, Kurinczuk, & Bower, 2009; O'Leary et al., 2010; Sayal et al., 2009; Strandberg-Larsen et al., 2009; Strandberg-Larsen et al., 2008).

Outcomes include: 1) *Any alcohol* (dichotomous, one or more drinks); 2) *Any binge drinking* [dichotomous, five or more (four or more beginning in 2006) drinks on an occasion]; 3) *Heavy drinking* (based on frequency, quantity, and binge drinking frequency, using indexing (Armor & Polich, 1982; Stahre, Naimi, Brewer, & Holt, 2006) and modeled as a dichotomous outcome of 16+ in the past month, or roughly four or more drinks per week, a level at which there is well documented harm (O'Leary & Bower, 2012), for the sample overall.

Although questions about alcohol consumption were asked consistently, there were some changes in wording over time. Our modeling approach (fixed effects for year) controls for measurement changes.

Individual-level controls include age (18–24, 25–29, 30–34, 35–39, 40–45, missing), race (White, Black, Hispanic, Asian/Pacific Islander, Native American/Alaska Native, Mixed race/other/missing), marital status (married, divorced/widowed/separated, single, member of unmarried couple, missing), education (less than high school, high school graduate, some college, college graduate, missing), income (in 2013 \$: ≤27,000, >27,000-≤49,000, >49,000 - ≤88,000, >88,000, missing), tobacco (no, yes, missing), and physical activity (no, yes, missing).

State-level statutes and regulations relating to alcohol and pregnancy are the main independent variables. These include: Mandatory Warning Signs, Priority Treatment for Pregnant Women, Priority Treatment for Pregnant Women and Women with Children, Reporting Requirements for Data and Treatment Purposes, Prohibitions on Criminal Prosecution, Civil Commitment, Reporting Requirements for CPS Purposes, and Child Abuse/Neglect. These policies have been described in detail elsewhere (Roberts et al., 2017). Priority treatment for pregnant women and Priority treatment for pregnant women and women with children are considered separately because lack of childcare availability has been noted as a barrier to substance use disorder treatment for pregnant women (Terplan, Garrett, & Hartmann, 2009). Each policy is dichotomous, coded as 0 if it was not in effect for that state that year and 1 if it was in effect for that state that year.

Briefly, the first alcohol and pregnancy policies – Reporting Requirements for CPS and Child Abuse/Neglect – went into effect in Massachusetts in 1974. [See Table 1.] Mandatory Warning Signs went into effect in Washington D.C. in 1985, followed by Reporting Requirements for Data and Treatment Purposes in Kansas in 1986. Priority Treatment policies for Pregnant Women first went into effect in California and for Pregnant Women and Women with Children in Florida and Washington in 1989. Prohibitions on Criminal Prosecution first went into effect in Kentucky, Missouri, and Virginia in 1992 and Civil Commitment first went into effect in South Dakota and Wisconsin in 1998. Each policy was still in effect in at least four states in 2016. In 2016, Priority Treatment for Pregnant Women and Women with Children was the least common and Reporting for Treatment and Data Purposes the most common. The decades in which the policies were in effect for each state are included in Table 1.

We created a separate variable characterizing policy environments for each state and year as *supportive only* (one or more of Mandatory Warning Signs, Priority Treatment, Reporting for Data and Treatment Purposes, and Prohibitions on Criminal Prosecution and no punitive policies), *punitive only* (one or more of Civil Commitment, Reporting for CPS Purposes, and Child Abuse/Neglect and no supportive policies), *mixed supportive and punitive* (one or more supportive and one or more punitive policies), and *no policy*.

State-level controls include state- and year-specific poverty (continuous), per capita cigarette sales (continuous, as a proxy for effective tobacco policies), and two general population alcohol policies on which data are available for our entire study time period: Blood Alcohol Concentration laws (neither a .10 or .08 law, .10 law, .08 law), and indicators for states with retail monopolies on wine or spirits (dichotomous).

Statistical analysis

To examine associations between state-level policy variables and individual-level alcohol-related outcomes, we used sample-weighted logistic regression in models that adjusted for individual- and state-level controls and included fixed effects for state and for year. Consistent with prior research examining effects of state-level policies on individual behavior with BRFSS data, standard errors were adjusted to reflect clustering by state (Friedman, Schpero, & Busch, 2016; McGeary, 2013). Fixed effects variables for state account for other characteristics of the state that might impact outcomes. Fixed effects for year account for changes in BRFSS questions over time, for changes in BRFSS sampling strategy over time, and changes in federal policy related to alcohol use during pregnancy that have occurred over time.

We first estimated models for the associations between alcohol and pregnancy policy environment (no policy, punitive, supportive, mixed) for each outcome [Model 1]. We then estimated models that included each policy in a separate model [Models 2] and finally estimated models that included all policies [Model 3] for each outcome. Our logistic regression equations testing the effects of our policy variables on alcohol use outcomes take the following general form:

$$ALC_{ist} = \beta_0 + \beta POLICY_{st} + X_{ist} + X_{st} + \alpha_s + \alpha_t + \varepsilon_{ist}$$

where i indexes individual; s indexes state; and t indexes years; ALC represents either any drinking, any binge drinking, or any heavy drinking; X_{ist} represents the vector of individual-level controls (i.e., for an individual in a given state and year); X_{st} represents the vector of time varying state-level controls; α_s represents state fixed effects (i.e., vector of state indicators); and α_t represents year fixed effects (i.e., vector of year indicators). $\beta POLICY_{st}$ in Model 1 represents our policy environment variable; in Model 2 this is each individual policy, and in Model 3 this is the vector of all policies entered simultaneously. Model coefficients are expressed as odds ratios, and analyses were conducted in Stata, version 15 (StataCorp, 2017). For associations significant at a $p < 0.05$ level, we used the post-estimation margins command to generate predicted probabilities of the outcome when the policy was versus was not in effect.

Results

Sample description

Among the 57,955 pregnant women in the BRFSS analytic sample, 57,194 answered questions about past 30 day alcohol use. The majority were under 30 (54%), White (70%), married (72%), current non-smokers (89%), and physically active (66%), and had at least some college education (62%). Respondents represented all regions in the U.S., and the majority of the sample participated in the 2000s and 2010s (77%). At the time of study participation, many respondents were living in states when supportive policies such as Reporting Requirements for Data and Treatment Purposes (47%) and Mandatory Warning Signs (41%) were in effect, and fewer were living in states when Prohibitions on Criminal Prosecution policies (9%) were in effect. Roughly a third of the respondents were living in states when punitive policies such as Child Abuse/Neglect (33%) and Reporting Requirements for CPS Purposes (31%) were in effect; only 7% were living in states when Civil Commitment policies were in effect. [See Table 2] Eleven percent reported any alcohol use, 2% reported binge drinking, and 2% reported heavy drinking. Among those who reported having at least one drink in the past 30 days, the mean number of drinks reported over the past 30 days was 14.3. Of the 1645 participants with valid binge and heavy drinking data, 24% reported binge (but not heavy) drinking, 26% reported heavy (but not binge) drinking, and 50% reported both binge and heavy drinking.

Policy environment associations with past 30 day alcohol use during pregnancy

Both supportive [aOR 1.25, $p=0.005$] and punitive [aOR 1.44, $p=0.019$] environments were associated with higher odds of any alcohol use relative to environments without any policies. The predicted probability of any alcohol use when no policies were in effect was 11.5% [95% CI 10.4, 12.5], 15.2% [95% CI 12.1, 18.4] in punitive policy environments, 13.7% [12.7, 14.7] in supportive environments, and 12.5% [95% CI 11.4, 13.6] in mixed environments. [See Table 3 and Figure 1] Mixed environment was not associated with any alcohol use. In the models predicting binge drinking and predicting heavy drinking, neither

supportive, punitive, nor mixed environments were associated with outcomes in either model. [See Table 3]

Individual-policy associations with past 30 day alcohol use during pregnancy

Of individual supportive policies, Mandatory Warning Signs was associated with lower odds of binge drinking in Model 2 and Model 3 [aOR 0.54, $p=0.005$ and aOR 0.56, $p=0.012$]. The predicted probability of binge drinking when Mandatory Warning Signs was in effect was 1.8% [95% CI 1.43, 2.11] and 3.0% [95% CI 2.3, 3.7] when it was not in effect. [See Table 4 and Figure 2.] Priority Treatment for Pregnant Women and Women with Children was associated with higher odds of any alcohol in both Model 2 and Model 3 [aOR 1.28, $p=0.001$ and aOR 1.25, $p=0.001$]. The predicted probability of any drinking when Priority Treatment for Pregnant Women and Women with Children was in effect was 14.8% [95% CI 13.5, 16.0] and 12.4% when it was not [95% CI 12.3, 12.6]. Prohibitions on Criminal Prosecution was associated with lower odds of heavy drinking in Model 2 [aOR 0.61, $p=0.024$], but not in Model 3. [See Table 4.] Of individual punitive policies, Child Abuse/Neglect was associated with lower odds of binge drinking in Model 3 [aOR 0.69, $p=0.009$] and with heavy drinking in both Model 2 and Model 3 [aOR 0.62, $p=0.015$ and aOR 0.64, $p=0.004$]. The predicted probability of binge drinking when Child Abuse/Neglect was in effect was 1.8% [95% CI 1.4, 2.2] and 2.6% [95% CI 2.4, 2.8] when it was not. The predicted probability of heavy drinking when Child Abuse/Neglect was in effect was 1.8% [95% CI 1.4, 2.1] and 2.6 [95% CI 2.4, 2.8] when it was not.

Discussion

This is the first study to comprehensively examine multiple policies that specifically target alcohol use during pregnancy. We found that both supportive and punitive policy environments are associated with increased odds of any alcohol use during pregnancy, although not with binge or heavy drinking. We also found that few individual alcohol and pregnancy policies are associated with alcohol use during pregnancy, and that those that are are not necessarily associated with less drinking during pregnancy. The three individual alcohol and pregnancy policies that were associated with drinking during pregnancy were: Mandatory Warning Signs, Priority Treatment for Pregnant Women and Women with Children, and Child Abuse/Neglect. Mandatory Warning Signs was associated with lower odds of binge drinking. Priority Treatment for Pregnant Women and Women with Children was associated with higher odds of any drinking. Child Abuse/Neglect was associated with lower odds of binge and heavy drinking.

These findings do not indicate that there is a set of evidence-based policies targeting alcohol use during pregnancy that policy makers should adopt. Combined with published data that indicates that rates of alcohol use during pregnancy have remained relatively steady since the 1990s (CDC, 2009) and that state policies targeting alcohol use during pregnancy lead to increased adverse birth outcomes and decreased prenatal care utilization (Subbaraman et al., 2018), these findings indicate that new policy approaches may be needed in order to meaningfully reduce alcohol use during pregnancy and related public health harms.

There are important factors to consider in relation to the specific policies that were associated with drinking in this sample. First, while the finding of less binge drinking when Mandatory Warning Signs is in effect is consistent with what one would expect, the fact that we did not find Mandatory Warning Signs to be associated with either any alcohol use or with heavy drinking suggests that the messages may not reach female drinkers who do not binge drink. Second, the finding of Priority Treatment associated with more drinking is counter-intuitive. One possibility is that states with such a policy have fewer treatment slots available, which is why they give pregnant women priority. It is also possible that priority treatment could contribute to pregnant women understanding that there might be a benefit to disclosing alcohol use and also to destigmatizing use during pregnancy. Thus, it is possible that in states where priority treatment is in effect, pregnant women may be less likely to underreport their alcohol use. Third, while defining alcohol use during pregnancy as child abuse/neglect appears associated with less drinking, it is also possible that – due to fear of punishment – pregnant women might be less likely to report drinking in response to survey questions when policies defining alcohol use during pregnancy as child abuse/neglect are in effect. Thus, that finding should be interpreted with caution. Even if future research using different methodological approaches were to confirm this finding, the ethics of defining harm to a fetus as child abuse/neglect and possible other public health harms from such a policy need to be weighed against any public health benefit from reductions in drinking among pregnant women.

There may be a concern with endogeneity, i.e., states with more alcohol use during pregnancy or FAS may be more likely to adopt policies. We could not keep state-specific time trends in the analytic models because adding these additional parameters led to model instability. Other methods to handle policy endogeneity, such as differencing, are infeasible in analyses using individual-level data as outcomes as we have here. Differencing would also be inappropriate for BRFSS data due to measurement error inherent in survey data. We were unable to definitively rule out possible effects of endogeneity. There are some factors that suggest endogeneity may be less of a concern for this particular policy topic. In particular, data on alcohol use during pregnancy or FAS in individual states were not readily available (May & Gossage, 2001), available in a timely manner, or necessarily reliable when policies were being enacted. Also, research has also documented that policy-making on substance use and pregnancy has been driven by political concerns, such as positioning on abortion (Murphy & Rosenbaum, 1999; Paltrow, 1999; Roberts et al., 2017), and factors such as the proportion of female legislators in the state (Thomas et al., 2006), and not necessarily influenced by scientific evidence about the prevalence of FAS or alcohol use during pregnancy (Woodruff, 2017).

Limitations

First, there may be differential under-reporting of alcohol use during pregnancy across states and time. If under-reporting is lower in states with supportive policies and higher in states with punitive policies, this could explain why we did not observe effects for some policies or why we observed more drinking when Priority Treatment for Pregnant Women and Women with Children was in effect and less drinking when policies that define alcohol use during pregnancy as child abuse/neglect were in effect. Second, we did not look at FAS or FASD,

but rather at alcohol consumption. Consistent data on FAS and FASD over our time period were not available. Future research should consider conducting similar analyses over a shorter time span in states with consistent FAS surveillance systems or with other indicators of effects of alcohol consumption during pregnancy. Third, we did not examine policy enforcement or women's awareness of policies. If policies are not enforced or women not aware of them (Thomas, Cannon, & French, 2015), this could explain lack of effects. Third, alcohol use during pregnancy is not the only public health outcome of interest related to alcohol and pregnancy policies. Research has already examined the relationship between policies targeting alcohol use during pregnancy and birth outcomes and prenatal care utilization (Subbaraman et al., 2018). Future research is needed to examine the relationship between policies targeting alcohol use during pregnancy and outcomes such as substance use disorder treatment utilization and indicators of harm to children, such as maternal alcohol use related child developmental abnormalities or maternal alcohol use related child maltreatment. Fourth, while BRFSS includes a large sample of pregnant women, binge and heavy drinking are rare outcomes and some policies were only in effect for a small number of states for a small number of years. Thus, it is possible that our study was under-powered to detect effects, such as between Civil Commitment and binge or heavy drinking.

Strengths

To our knowledge, we are the first to consider multiple alcohol and pregnancy policies across the U.S. and the overall state-level policy environment. We also used a large, national sample that asked substantially consistent questions regarding alcohol use and used similar methodology over forty years. Our policy dataset is the first comprehensive dataset of 40 years of state-level alcohol and pregnancy policies. These policy data are based on a rigorous coding process that used consistent decision rules to guide policy classification and effective dates coding (Roberts et al., 2017).

Conclusion

Most policies targeting alcohol use during pregnancy do not appear to be associated with lower levels of alcohol consumption during pregnancy. More research is needed to examine what, if any, public health benefits alcohol and pregnancy policies have.

Implications for policy

The lack of consistent lower levels of alcohol consumption during pregnancy associated with policies targeting alcohol use during pregnancy, combined with other recent research that finds adverse birth and health care utilization outcomes due to these policies (Subbaraman et al., 2018), indicates that new policy approaches to alcohol use during pregnancy may be needed.

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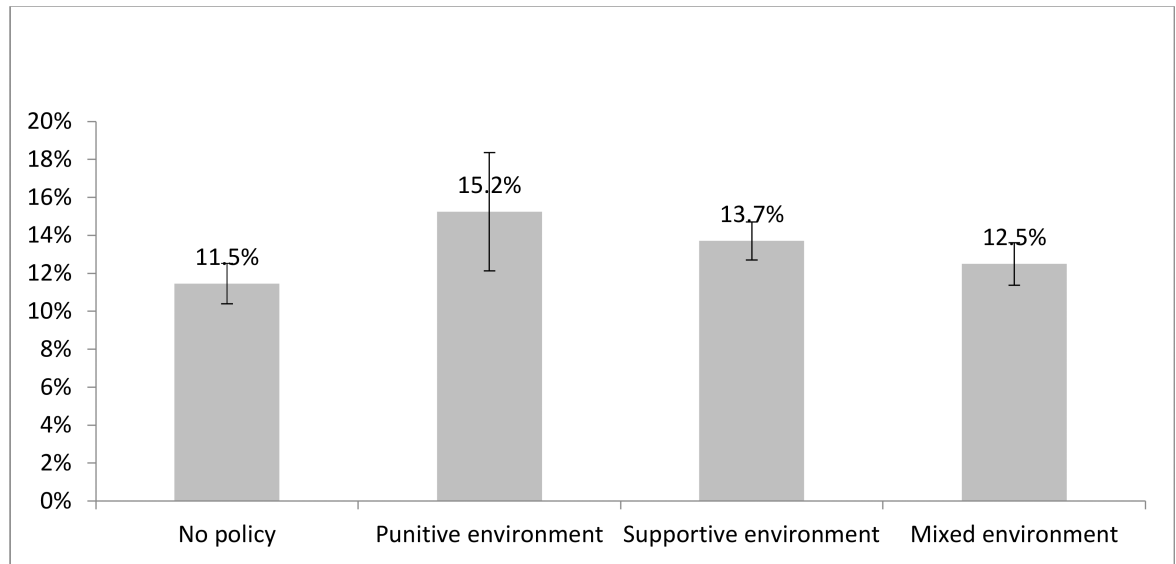


Figure 1.
Adjusted probabilities and 95% CIs of any alcohol by alcohol/pregnancy policy environment

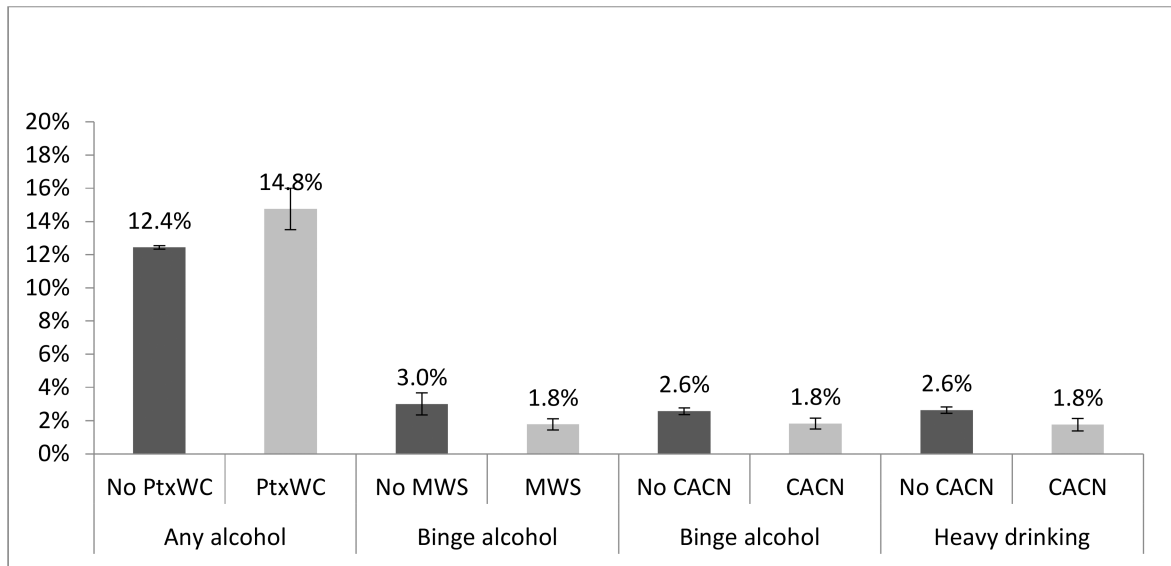


Figure 2. Adjusted probabilities and 95% CIs of alcohol use among pregnant women by alcohol/pregnancy policy for policies with significant associations
 Note: PtWC=Priority Treatment for Pregnant Women and Women with Children; MWS=Mandatory Warning Signs; CACN=Child Abuse/Neglect

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Table 1.

Policies targeting alcohol use during pregnancy in effect by decade and by state

Policy	Year first went into effect	1970s	1980s	1990s	2000s	2010s
Mandatory Warning Signs: <i>Notices warning about harms from alcohol use during pregnancy must be posted in locations where alcoholic beverages are sold</i>	1985		AK, CA, DC, GA, SD	AK, AZ, CA, DC, DE, GA, IL, KY, MN, NE, NH, NJ, NM, NY, OR, SD, TN, WA, WV	AK, AZ, CA, DC, DE, GA, IL, KY, MN, MO, NC, NE, NH, NJ, NM, NY, OR, SD, TN, TX, UT, WA, WV	AK, AZ, CA, DC, DE, GA, IL, KY, MN, MO, NC, NE, NH, NJ, NM, NY, OR, SD, TN, TX, UT, WA, WV
Priority Treatment for Pregnant Women: <i>Mandatory priority access to substance abuse treatment for pregnant women who abuse alcohol</i>	1989		CA	AZ, CA, GA, KS, LA, MD, WI	AK, AR, AZ, CA, CO, GA, KS, LA, MD, OK, UT, WI	AK, AR, AZ, CA, CO, GA, KS, KY, LA, MD, OK, TX, UT, WI
Priority Treatment for Pregnant Women and Women with Children: <i>Mandatory priority access to substance abuse Treatment for pregnant women and women with children who abuse alcohol</i>	1989		FL, WA	DC, FL, IL, MO, WA	DC, FL, IL, MO, TX, WA, WY	DC, FL, IL, MO, WA
Reporting Requirements for Treatment & Data: <i>Mandatory or discretionary reporting of alcohol use during pregnancy for purposes of Treatment referral or data collection</i>	1986		IL, KS, MN, NJ, OR	AK, CA, CO, FL, IA, IL, KS, KY, LA, ME, MI, MN, MO, NI, NY, OK, OR, TX, WI	AK, CA, CO, DE, FL, IA, IL, IN, KS, KY, LA, ME, MI, MN, MO, ND, NH, NJ, NY, OH, OK, OR, PA, SC, SD, TX, WA, WI, WV	AK, CA, CO, DE, FL, IL, IN, KS, KY, ME, MI, MN, MO, ND, NJ, NY, NY, OH, OK, OR, PA, SC, SD, TX, WA, WI, WV
Prohibitions on Criminal Prosecution: <i>Prohibit use of medical tests (such as prenatal screening or toxicology) as evidence in criminal prosecution</i>	1992			FL, KS, KY, MO, NV, VA	KS, KY, LA, MO, NV, VA	CO, KS, KY, LA, MO, NV, VA
Civil Commitment: <i>Mandatory involuntary commitment of pregnant women to Treatment or protective custody to protect fetus from prenatal exposure to alcohol</i>	1998			SD, WI	MN, ND, OK, SD, WI	MN, ND, OK, SD, WI
Reporting Requirements for CPS Purposes: <i>Mandated or discretionary reporting of alcohol use during pregnancy for purposes of child abuse/neglect investigation</i>	1974	MA	MA, MN, UT	AZ, CA, FL, KY, MA, MI, MN, RI, SD, UT, VA, WI	AK, AZ, CA, FL, IN, KY, LA, MA, ME, MI, MN, OK, PA, RI, SD, UT, VA, WI	AK, AR, AZ, CA, DC, FL, IN, KY, LA, MA, MD, ME, MI, MN, OK, PA, RI, SD, UT, VA, WI
Child Abuse/Neglect: <i>Legal significance of alcohol use during pregnancy and, in some cases, defines alcohol use during pregnancy as child abuse/neglect</i>	1974	MA	IL, IN, MA, NV, UT	FL, IL, IN, KY, MA, NV, RI, SC, SD, TX, UT, VA, WI	AL, AZ, CO, FL, IL, IN, KY, LA, MA, ME, ND, NV, OK, RI, SC, SD, TX, UT, VA, WI	AL, AZ, CO, FL, GA, IL, IN, KY, LA, MA, ME, ND, NV, OK, RI, SC, SD, TX, UT, VA, WI

Bold indicates states that had the policy go into effect during that decade; grey background are supportive; white background are punitive

Table 2.

Sample characteristics for pregnant women in the 1985–2016 pooled BRFSS data with alcohol consumption data (n=57,194), unweighted

	n	%
Age		
18–24	13,866	24.2
25–29	17,200	30.1
30–34	16,032	28.0
35–39	7,783	13.6
40–45	2,130	3.7
Missing	183	0.3
Race/Ethnicity		
White	40,080	70.1
Black	5,369	9.4
Hispanic (any race)	6,779	11.9
Asian/Pacific Islander	1,817	3.2
Native American/Alaska Native	1,200	2.1
Mixed race/Other/Missing	1,949	3.4
Marital Status		
Married	40,879	71.5
Divorced/widowed/separated	3,563	6.2
Single	9,206	16.1
Member of an unmarried couple	3,447	6.0
Missing	99	0.2
Education Level		
Less than high school	5,312	9.3
High school graduate	14,694	25.7
Some college	15,216	26.6
College graduate	21,919	38.3
Missing	53	0.1
Income Quartile (2013 adjusted)		
<=27,000	12,629	22.1
>27,000–<=49,000	12,009	21.0
>49,000–<=88,000	13,260	23.2
>88,000	13,056	22.8
Missing	6,240	10.9
Current Tobacco Use		
No	50,589	88.5
Yes	6,452	11.3
Missing	153	0.3

	n	%
Current Physical Activity		
No	14,104	24.7
Yes	37,820	66.1
Missing	5,270	9.2
U.S. Census Region Represented		
Northeast	10,140	17.7
Midwest	14,144	24.7
South	17,551	30.7
West	15,359	26.9
Decade Represented		
1980s	3,203	5.6
1990s	10,254	17.9
2000s	25,824	45.2
2010s	17,913	31.3
Policy Exposure		
Supportive		
Mandatory Warning Signs	23,638	41.3
Priority Treatment for Pregnant Women	11,632	20.3
Priority Treatment for Pregnant Women & Women with Children	5,808	10.2
Reporting Requirements for Data and Treatment Purposes	26,991	47.2
Prohibitions on Criminal Prosecution	5,234	9.2
Punitive		
Civil Commitment	3,851	6.7
Reporting Requirements for CPS Purposes	17,929	31.4
Child Abuse/Neglect	18,632	32.6
Any drinking	6,342	11.1
Binge drinking	1,266	2.2
Heavy drinking	1,251	2.2

Table 3.

Association between state alcohol and pregnancy policy environment and alcohol use during pregnancy, Models 1

<i>Any alcohol use</i>			
	OR	95% CI	p
No policy	ref		
Punitive environment	1.44	[1.06, 1.96]	0.019
Supportive environment	1.25	[1.07, 1.47]	0.005
Mixed policy environment	1.11	[0.90, 1.38]	0.320
<i>Binge alcohol</i>			
	OR	95% CI	p
No policy	ref		
Punitive environment	0.85	[0.47, 1.56]	0.604
Supportive environment	0.91	[0.63, 1.32]	0.627
Mixed policy environment	0.92	[0.61, 1.38]	0.682
<i>Heavy drinking</i>			
	OR	95% CI	p
No policy	ref		
Punitive environment	0.60	[0.32, 1.13]	0.114
Supportive environment	0.87	[0.53, 1.42]	0.576
Mixed policy environment	0.75	[0.45, 1.24]	0.269

Models include individual-level controls (age, race, marital status, education, income, tobacco use, and physical activity) and state-level controls (% poverty, BAC laws, alcohol control state, and tobacco consumption) and fixed effects for state and year. All models were weighted and SEs were adjusted for clustering at the state level.

Table 4.

Association between state policies targeting alcohol use during pregnancy and alcohol use during pregnancy

	Models 2			Model 3		
	aOR	95% CI	p	aOR	95% CI	P
<i>Any alcohol use</i>						
Mandatory Warning Signs	0.94	[0.77, 1.15]	0.544	0.95	[0.76, 1.19]	0.651
Priority Treatment for Pregnant Women	0.84	[0.64, 1.11]	0.222	0.91	[0.69, 1.19]	0.474
Priority Treatment for Pregnant Women & Women with Children	1.28	[1.11, 1.46]	<0.001	1.25	[1.10, 1.41]	<0.001
Reporting Requirements for Treatment & Data	0.95	[0.80, 1.14]	0.600	0.98	[0.82, 1.18]	0.880
Prohibitions on Criminal Prosecution	0.79	[0.57, 1.09]	0.148	0.75	[0.56, 1.01]	0.061
Civil Commitment	0.82	[0.64, 1.04]	0.109	0.84	[0.68, 1.05]	0.132
Reporting Requirements for CPS purposes	0.86	[0.71, 1.05]	0.140	0.93	[0.78, 1.11]	0.411
Child Abuse/Neglect	1.02	[0.83, 1.23]	0.918	1.05	[0.86, 1.28]	0.656
<i>Binge alcohol</i>						
	aOR	95% CI	p	aOR	95% CI	P
Mandatory Warning Signs	0.54	[0.35, 0.83]	0.005	0.56	[0.36, 0.88]	0.012
Priority Treatment for Pregnant Women	0.89	[0.51, 1.55]	0.688	0.89	[0.58, 1.38]	0.610
Priority Treatment for Pregnant Women & Women with Children	0.66	[0.32, 1.39]	0.278	0.77	[0.48, 1.25]	0.293
Reporting Requirements for Treatment & Data	0.96	[0.74, 1.25]	0.770	0.97	[0.74, 1.27]	0.813
Prohibitions on Criminal Prosecution	0.85	[0.49, 1.48]	0.572	1.07	[0.64, 1.78]	0.806
Civil Commitment	1.55	[0.82, 2.92]	0.178	1.56	[0.90, 2.70]	0.111
Reporting Requirements for CPS purposes	1.33	[0.96, 1.85]	0.089	1.24	[0.95, 1.62]	0.117
Child Abuse/Neglect	0.71	[0.49, 1.04]	0.080	0.69	[0.52, 0.91]	0.009
<i>Heavy drinking</i>						
	aOR	95% CI	p	aOR	95% CI	P
Mandatory Warning Signs	0.72	[0.40, 1.30]	0.277	0.73	[0.42, 1.28]	0.276
Priority Treatment for Pregnant Women	1.03	[0.65, 1.62]	0.911	0.95	[0.61, 1.47]	0.819
Priority Treatment for Pregnant Women & Women with Children	0.57	[0.32, 1.03]	0.062	0.65	[0.41, 1.04]	0.074
Reporting Requirements for Treatment & Data	0.83	[0.64, 1.07]	0.150	0.87	[0.70, 1.08]	0.218
Prohibitions on Criminal Prosecution	0.61	[0.40, 0.94]	0.024	0.79	[0.49, 1.27]	0.338
Civil Commitment	1.90	[0.87, 4.11]	0.105	1.99	[0.82, 4.83]	0.126
Reporting Requirements for CPS purposes	1.05	[0.67, 1.64]	0.826	1.06	[0.73, 1.54]	0.766
Child Abuse/Neglect	0.62	[0.43, 0.91]	0.015	0.64	[0.47, 0.87]	0.004

Model 2s examine each policy separately and include individual-level controls (age, race, marital status, education, income, tobacco use, and physical activity) and state-level controls (% poverty, BAC laws, alcohol control state, and tobacco consumption) and fixed effects for state and year. Model 3 includes all alcohol policies with covariates included in Model 1s. All Models were weighted and SEs were adjusted for clustering at the state-level.

Grey background indicates supportive; white background indicates punitive