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Variations by education status in relationships between alcohol/ pregnancy policies and birth outcomes and prenatal care utilization: a legal epidemiology study

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Abstract

Context: Previous research finds that some state policies regarding alcohol use during pregnancy (alcohol/pregnancy policies) increase low birthweight (LBW) and preterm birth (PTB), decrease prenatal care utilization, and have inconclusive relationships with alcohol use during pregnancy.

Objective: This research examines whether effects of eight alcohol/pregnancy policies vary by education status, hypothesizing that health benefits of policies will be concentrated among women with more education and health harms will be concentrated among women with less education.

Methods: This study uses 1972–2015 Vital Statistics data, 1985–2016 Behavioral Risk Factor Surveillance System data, policy data from NIAAA's Alcohol Policy Information System and original legal research, and state-level control variables. Analyses include multivariable logistic regressions with educationXpolicy interaction terms as main predictors.

Results: The impact of alcohol/pregnancy policies varied by education status for PTB and LBW for all policies, for prenatal care use for some policies, and generally did not vary for alcohol use for any policy. Hypotheses were not supported. Five policies had adverse effects on PTB and LBW for high school graduates. Six policies had adverse effects on PTB and LBW for women with more than high school education. In contrast, two policies had beneficial effects on PTB and/or LBW for women with less than high school education. For prenatal care, patterns were generally similar, with adverse effects concentrated among women with more education and beneficial effects among women with less education. Although associations between policies and alcohol use during pregnancy varied by education, there was no clear pattern.

Conclusions: Effects of alcohol/pregnancy policies on birth outcomes and prenatal care use vary by education status, with women with more education typically experiencing health harms and women with less education either not experiencing the harms or experiencing health benefits. New policy approaches that reduce harms related to alcohol use during pregnancy are needed.

Introduction

Recent research categorizes state-level policies targeting alcohol use during pregnancy (alcohol/pregnancy policies) as either supportive or punitive.[1–3] Conceptually, supportive policies offer information, services, and treatment that might prevent or treat use during pregnancy or protect women from prosecution. Punitive policies use threats of punishment or punish use during pregnancy by threatening and carrying out removal of children and involuntary treatment. State-level alcohol pregnancy policy environments have become more punitive over time.[2,3] In 2013, more than 40 states had at least one alcohol/pregnancy policy. [2] Categorizing alcohol/pregnancy policies into supportive versus punitive matters from ethical and legal perspectives, but may be less useful from an effectiveness standpoint, about which there is limited research. One recent study found that Mandatory Warning Sign policies may be associated with improvements in some birth outcomes, such as reductions in very low birthweights.[4] In contrast, our previous research studying the effects of more than 40 years of alcohol/pregnancy policies found that, at best, most policies do not improve birth outcomes or prenatal care use.[5] At worst, some policies (Mandatory Warning Signs and Child Abuse/Neglect) lead to increased adverse birth outcomes and decreased prenatal care use.[5] Further, these relationships vary by race.[6] Our research also found that most policies are not associated with alcohol use during pregnancy,[7] and, to the extent there are relationships, they vary by race/ethnicity.[8] When combined with birth outcomes findings, these findings may be better interpreted as indicators of women's willingness to self-report alcohol use in different policy environments rather than changes in alcohol use. Such results reflect concerns raised in arguments about potential detrimental effects of these policies.[9,10] Findings from qualitative research and smaller quantitative studies support plausibility of these relationships, as they have found that fear of being reported to CPS and losing children is a barrier to prenatal care use for women who use drugs[11,12]; alcohol warning label policies and warning signs may raise awareness that does not translate into behavior[13]; and fear of having already irreversibly harmed a baby is a reason for not making changes in alcohol/drug use after discovering pregnancy and is a barrier to prenatal care.[11,14]

Before discounting current alcohol/pregnancy policy approaches, though, additional research is needed to assess whether such policies benefit subsets of people. If effects are in different directions in socioeconomic status subgroups, overall results could mask differences and lead to erroneous conclusions. Effects could plausibly vary by socioeconomic status subgroups. Recent work emphasizes that 1) population-level interventions that improve health overall do not necessarily reduce and may increase disparities[15]; 2) approaches to population health that rely on individual agency and ability to apply knowledge and information to one's own behaviors, which may be more likely among higher socioeconomic status women, may increase disparities[16–18]; and 3) being involved with CPS is more common among women of lower socioeconomic status[19], and thus could make prenatal care avoidance more common.

Here, we examine whether effects of alcohol/pregnancy policies on low birthweight (LBW), preterm birth (PTB), prenatal care use (PNC), and alcohol use during pregnancy differ by socioeconomic status, measured as women's education status. Based on recent work described above, we expect benefits (i.e. decreased adverse birth outcomes, increased PNC, decreased alcohol during pregnancy) to be greater among women with more education. We expect harms (i.e. increased adverse birth outcomes, decreased PNC, increased alcohol during pregnancy) to be greater among women with less education.

Methods

Data sources

This study uses 1972–2015 Vital Statistics data for birth outcomes (LBW, PTB) and PNC; 1985–2016 Behavioral Risk Factor Surveillance System (BRFSS) data for alcohol use during pregnancy; NIAAA's Alcohol Policy Information System (APIS)[20] and original legal research for alcohol/pregnancy policies; and secondary sources for state-level controls.

Vital Statistics data were obtained from Natality Birth Data (http://www.nber.org/data/vital-statistics-natality-data.html) and requests to the Centers for Disease Control and Prevention for restricted use data from 2005–2015. These data include individual-level data for U.S. births. Between 1972 and 1984, these data include a 50–100% sample of all births. Beginning in 1985, they include 100% of births. LBW and PTB are available throughout the study period, and PNC has been included in all states since 1980 and 43 states from 1972–1979. All singleton births during the study time period among residents of 50 U.S. states and D.C. were included. The dataset includes 155,446,714 births.

BRFSS is an annual telephone survey that tracks health behaviors and health status of U.S. adults. Pregnancy status has been assessed annually since 1985. BRFSS has included questions about alcohol use since 1984, although data about alcohol use were not collected during even years in the 1990s. In 1993, participation rates were more than 70%; in the 2000s, participation rates were closer to 50%. Our analytic sample consists of female BRFSS respondents of reproductive age (18–44) who indicated they were currently pregnant and provided data on drinking (n=57,194 between 1985–2016).

State-level alcohol/pregnancy policy statutory, regulatory, and effective date data were obtained from APIS and original legal research. We have described processes for obtaining and coding these data elsewhere.[2] Briefly, processes 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.

We obtained state-level control data from the U.S. Census, U.S. Centers for Disease Control and Prevention, APIS, published research,[21–23] and original legal research.

Alcohol/pregnancy policy data were merged with individual-level Vital Statistics data based on month and year the woman became pregnant. Alcohol/pregnancy policy data were merged with individual-level BRFSS data based on year the survey was completed.

Measures

Outcomes: Birth outcomes include *Low birthweight* (LBW, dichotomous outcome of born less versus at or more than 2500 grams[24]) and *Preterm birth* [PTB, dichotomous outcome of born before vs. at or after 37 weeks gestation[25]]. We also examined *Prenatal care use* [PNC, any prenatal care, late entry (i.e. after the first trimester), and inadequate care (accounts for timing of entry and number of visits, based on Kotelchuck index[26]]. Alcohol use during pregnancy outcomes refer to use the month before the survey and 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* (frequency, quantity, and binge drinking frequency, using indexing[27,28] and modeled as a dichotomous outcome of 16+ in the past month, roughly four or more drinks per week, a level at which there is well documented harm[29]). Our modeling approach (fixed effects for year) accounts for changes in items/question wording over time.

Alcohol/Pregnancy Policy predictors: State-level alcohol/pregnancy policies are main independent variables. Mandatory Warning Signs, Prohibitions on Criminal Prosecution, Reporting for Data/Treatment Purposes, Priority Treatment for Pregnant Women, and Priority Treatment for Pregnant Women and Women with Children are considered supportive. Child Abuse/Neglect, Civil Commitment, and CPS Reporting Requirements are considered punitive. Policy variables are dichotomous.

Moderators: Education (<high school, high school graduate or equivalent, >high school, other/missing) was chosen as the measure of socioeconomic status because it was included consistently and measured mostly consistently and because more education is a reasonable proxy for individual aptitude to apply knowledge and information to one's own behaviors.

Individual-level controls: Individual-level controls for Vital Statistics analyses include maternal age, race, marital status, education, nativity, and parity. For BRFSS, they include age, race, marital status, education, income, tobacco use, and physical activity.

State-level controls: State-level controls include state- and year-specific unemployment rate, poverty rate, per capita cigarette sales, retail control policies for wine and for spirits, and per capita alcohol consumption. In Vital Statistics analyses, per capita alcohol consumption is used as a proxy for regional drinking culture and other alcohol policies that influence alcohol consumption in general.

Analysis—Multivariable logistic regression models included all policy indicators, fixed effects for state and year, adjusted for individual and state-level control variables, and accounted for clustering of standard errors according to state of residence. Analyses included state and year fixed effects to account for changes in data gathering over time and other events in those states and years. Birth certificate version indicator variables were included in Vital Statistics analyses. State-specific cubic time trends were in Vital Statistics analyses to address concerns with endogeneity. It was infeasible to include state-specific time trends in BRFSS analyses.

To assess for differential effects by education, we examined interactions between education and each policy in separate models; that is, although all models included all policy indicators, only one interaction term was examined at a time. Overall, interactions were considered statistically significant if a Wald Test was p<.05. Group-specific interaction terms were considered statistically significant if both the Wald Test and the education-specific policy interaction term was p<.05. Regression model output and Wald Test results are in an online supplement in Appendix A. The post-estimation margins command was used to obtain predicted values. Statistical significance of differences for subgroups was assessed by whether the main effect of the policy was statistically significant (i.e. for high school graduates, the reference group) and whether predicted marginal differences between when laws were in effect versus not in effect for a subgroup were statistically significant at p<.05. All analyses were performed in Stata v15.1. Two models in Vital Statistics analyses would not converge; one converged when we switched the reference group; this is noted in the table. Descriptions of sensitivity analyses examining whether expanding policies to include those that also cover drugs as well as whether race coding in Vital Statistics data affected findings and their results are in Appendix B.

Results

Supportive policies

Tables Supp1a and Supp1b present logistic regression model output, including Wald-test results and coefficients for interaction terms for supportive policy findings and are electronic supplements. Tables 2a–2c present predicted probabilities for all policy findings and show education-group specific effects.

Birth outcomes—Relationships between each supportive policy and LBW and PTB varied by education [See Table Supp1a]. The variation was mostly due to differences for women with less than high school education compared to high school graduates.

Only one supportive policy (Reporting Requirements for Data and Treatment Purposes) had a benefit; it was associated with lower LBW (0.6% lower) for women with less than high school education [Table 2a]. No other supportive policies had a benefit in terms of birth outcomes for any education subgroup.

All supportive policies had harms; four were associated with higher LBW and PTB for high school graduates, and all five were associated with higher LBW and PTB for women with more than high school education. Increases ranged from 0.3% to 1.0%.

With the exception of the one supportive policy that was associated with lower LBW for women with less than high school education, no supportive policies were associated with birth outcomes for women with less than high school education; and one supportive policy was not associated with LBW for women with high school education.

Prenatal care use—Relationships between each supportive policy and PNC outcomes varied by education, with two exceptions [Table Supp1a]. Differences for women with less than high school education and high school graduates were found for all five policies for at

least one PNC outcome. Differences between women with greater than high school education and high school graduates were found for two policies (Mandatory Warning Signs and Reporting Requirements for Data and Treatment Purposes) for at least one PNC outcome.

Three supportive policies had a benefit for at least one education subgroup; they were associated with increased PNC for at least one outcome [Table 2b]. For women with less than high school education, Reporting Requirements for Data and Treatment Purposes was associated with decreased late PNC and decreased inadequate PNC, and Priority Treatment for Pregnant Women Only was associated with decreased late PNC. For women with more than high school education, Prohibitions on Criminal Prosecution was associated with decreased inadequate PNC. Decreases in inadequate PNC ranged from 1.1% to 3.4%.

Two supportive policies had harms for at least one education subgroup. Mandatory Warning Signs was associated with increased no PNC for all education subgroups and increased late PNC and inadequate PNC for high school graduates and women with greater than high school education (ranging from 0.3% to 13.7%). Reporting Requirements for Data and Treatment Purposes was associated with increased late PNC for women with greater than high school education (1.6%). No other supportive policies were associated with PNC for any education subgroup.

Alcohol consumption during pregnancy—Relationships between supportive policies and alcohol consumption did not vary by education, with one exception [Table Supp1b].

Four supportive policies had a benefit for at least one education subgroup [Table 2c]. Mandatory Warning Signs was associated with decreased binge drinking for women with less than high school education and women with more than high school education. Two policies (Reporting Requirements for Data and Treatment Purposes, Priority Treatment for Pregnant Women and Women with Children) were associated with decreased heavy drinking and one policy (Prohibitions on Criminal Prosecution) was associated with decreased any drinking for high school graduates. Decreases ranged from 0.9% in binge and heavy drinking to 3.6% in any drinking. No other supportive policies were associated with self-reported drinking during pregnancy for any education subgroup.

Punitive policies

Tables Supp1c and Supp1d present logistic regression model output, including Wald-test results and coefficients for interaction terms for punitive policy findings. Tables 2a–2c present predicted probabilities for all policy findings and show education-group specific results.

Birth outcomes—Relationships between each punitive policy and LBW and PTB varied by education [Table Supp1c]. Variation was due primarily to differences between women with less than high school education compared to high school graduates, with one exception.

One punitive policy had a benefit for one education subgroup. For women with less than high school education, LBW and PTB were lower (0.5% and 0.9%) when CPS Reporting Requirements were in effect [Table 2a].

One punitive policy had a health harm. For high school graduates and women with more than high school education, LBW and PTB were higher (ranging from 0.4% to 0.8%) when Child Abuse/Neglect was in effect. No other punitive policies were associated with LBW or PTB for any education subgroup.

Prenatal care use—Most relationships between each punitive policy and PNC varied by education [Table Supp1c]. Variation was due both to differences between women with less than high school education compared to high school graduates and to differences between women with greater than high school education compared to high school graduates.

One punitive policy had a benefit for one education subgroup; Child Abuse/Neglect was associated with decreased late PNC (1.9%) for women with less than high school education [Table 2b]. Two punitive policies had harms for women with more than high school education; Child Abuse/Neglect was associated with increased inadequate PNC, and CPS Reporting Requirements was associated with increased late PNC and inadequate PNC (ranging from 1.4% to 1.9%). No other punitive policies were associated with PNC for any education subgroup.

Alcohol consumption during pregnancy—Relationships between punitive policies and alcohol consumption did not vary by education [Table Supp1d].

One punitive policy had a benefit; Child Abuse/Neglect was associated with decreased binge and heavy drinking for high school graduates and decreased heavy drinking for women with less than high school education (ranging from 0.9% to 1.0%) [Table 2c].

One punitive policy had a health harm; CPS Reporting Requirements was associated with increased binge drinking for women with less than high school education (0.9%). No other punitive policies were associated with self-reported drinking for any education subgroup.

Discussion

This study analyzed more than 40 years of data with more than 150 million births and found that effects of alcohol/pregnancy policies vary by education.

However, general hypotheses regarding directions of differential effects were unsupported. Adverse effects of alcohol/pregnancy policies appear concentrated among those with high school or greater education, while women with less than high school typically do not experience these harms and, in a few cases, appear to experience some benefits. That findings are inconsistent with hypotheses corresponds with findings examining effects of alcohol/pregnancy policies by race, where harms were concentrated among more advantaged (White) and health benefits among less advantaged (Black) women[6].

Although our study does not explore reasons for differences, there are plausible explanations. Exposure to information about policies might vary by education; women with more education might have more resources and, thus, may be in bars, restaurants, and other alcohol venues more often and may have greater exposure to Mandatory Warning Signs. Second, women of different education levels might behave differently when exposed to information about harms of alcohol use or the possibility of having their children removed by the state. Third, we found that both reporting policies – data/treatment and CPS – were associated with improved birth outcomes for women with less education. As more women of lower socioeconomic status receive direct public services, and assuming that services benefit health, women with less education may benefit more from reporting policies.

Among punitive policies, Child Abuse/Neglect and CPS Reporting Requirements had effects in different directions. Child Abuse/Neglect had adverse effects for women with more education, while CPS Reporting Requirements had beneficial effects for women with less education. Regardless of observed beneficial impacts of CPS Reporting Requirements here, other research has documented adverse community-level effects of high levels of CPS involvement[30] and that fear of being reported to CPS leads pregnant women to avoid both treatment[31] and PNC.[11] The opposite effects of Child Abuse/Neglect and CPS Reporting Requirements are worth examining. This could reflect Child Abuse/Neglect focus on legal aspects of child removal and CPS Reporting Requirements plausibly lead to provision of direct, helpful services or priority for other services instead of a focus on child removal. Results for Reporting Requirements for Data/Treatment that mirror those for CPS Reporting Requirements, though, suggest health benefits from reporting to and thus offering services through other agencies that do not have the implied coercion or threat of CPS may be possible.

Although patterns across birth outcomes and PNC are mostly consistent, patterns for alcohol outcomes are mostly not. One explanation is that alcohol outcomes are self-reported – and may reflect women's level of willingness to disclose use. Also, alcohol analyses rely on smaller samples and do not control for state-specific time trends.

These analyses have limitations. First, the large sample size has power to detect small effects. For birth outcomes, small effects matter, but it is unclear how important small effects on prenatal care are from a public health perspective. Second, with the exception of MWS, most policies address both alcohol and drugs.[3] Because of this policy overlap, this study cannot distinguish whether the focus on alcohol or drug use during pregnancy matters for birth outcomes. As confirmed by sensitivity analyses [Appendix A], with the exception of MWS policies, findings can be interpreted as applying to alcohol/pregnancy and to drug/pregnancy policies. Third, our measure of socioeconomic status addresses one domain — education. Other measures, such as income or insurance type, might result in different patterns.

Conclusions

Effects of alcohol/pregnancy policies on birth outcomes vary by education, with women with more education experiencing health harms and women with less experiencing no effect,

and, in a few cases, health benefits. New policy approaches that reduce harms related to alcohol use during pregnancy are needed.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments:

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Implications for Policy and Practice

- State-level alcohol/pregnancy policies that aim to improve outcomes appear to have no effect or some beneficial effects for women with less education and adverse effects for women with more education.

- New policy approaches to alcohol use during pregnancy that do not have adverse health effects are needed.

- Public health professionals should take the lead on identifying and developing policy approaches that reduce harms related to alcohol use during pregnancy.

Table 2a.

Predicted Probability and Average Marginal Effects of Supportive and Punitive Policies on Birth Outcomes, by Education

	Low Birthweight				Preterm Birth			
	No policy	Policy	Average ME	95% CI	No policy	Policy	Average ME	95% CI
Supportive								
MWS								
Less than HS	0.076	0.074	−0.003	−0.005–0.000	0.111	0.110	−0.001	−0.005–0.002
HS Graduate	**0.060**	**0.065**	**0.005**	**0.003–0.007**	**0.094**	**0.099**	**0.005**	**0.002–0.007**
More than HS	**0.048**	**0.053**	**0.005**	**0.003–0.007**	**0.082**	**0.086**	**0.004**	**0.002–0.006**
Other/Missing	**0.070**	**0.075**	**0.005**	**0.002–0.008**	**0.106**	**0.109**	**0.003**	**0.000–0.006**
RR_DTx								
Less than HS	**0.078**	**0.072**	**−0.006**	**−0.009–−0.003**	0.112	0.109	−0.003	−0.008–0.002
HS Graduate	**0.061**	**0.063**	**0.003**	**0.000–0.005**	**0.094**	**0.099**	**0.005**	**0.001–0.009**
More than HS	**0.048**	**0.051**	**0.003**	**0.001–0.005**	**0.081**	**0.087**	**0.006**	**0.002–0.009**
Other/Missing	**0.070**	**0.074**	**0.004**	**0.001–0.007**	**0.105**	**0.111**	**0.006**	**0.001–0.011**
PTxP								
Less than HS	0.076	0.075	0.000	−0.004–0.004	0.110	0.114	0.004	−0.002–0.010
HS Graduate	**0.061**	**0.067**	**0.006**	**0.004–0.008**	**0.094**	**0.102**	**0.008**	**0.004–0.012**
More than HS	**0.048**	**0.055**	**0.007**	**0.004–0.009**	**0.082**	**0.089**	**0.007**	**0.004–0.011**
Other/Missing	**0.070**	**0.078**	**0.008**	**0.004–0.012**	**0.106**	**0.115**	**0.009**	**0.003–0.015**
PTxPWC								
Less than HS	0.076	0.073	−0.002	−0.007–0.002	0.111	0.109	−0.002	−0.007–0.004
HS Graduate	0.061	0.064	0.003	−0.001–0.006	0.095	0.100	0.004	0.000–0.009
More than HS	**0.049**	**0.052**	**0.003**	**0.001–0.005**	**0.083**	**0.088**	**0.005**	**0.002–0.008**
Other/Missing	**0.071**	**0.077**	**0.006**	**0.003–0.008**	**0.106**	**0.115**	**0.008**	**0.003–0.014**
PCP								
Less than HS	0.075	0.080	0.004	−0.001–0.010	0.110	0.116	0.006	0.000–0.012
HS Graduate	**0.061**	**0.068**	**0.007**	**0.002–0.011**	**0.095**	**0.106**	**0.010**	**0.005–0.016**
More than HS	**0.049**	**0.052**	**0.003**	**0.000–0.006**	**0.083**	**0.093**	**0.009**	**0.005–0.014**
Other/Missing	**0.071**	**0.077**	**0.006**	**0.001–0.010**	**0.107**	**0.115**	**0.009**	**0.003–0.014**
Punitive								

	Low Birthweight				Preterm Birth			
	No policy	Policy	Average ME	95% CI	No policy	Policy	Average ME	95% CI
CACN								
Less than HS	0.075	0.075	0.000	−0.003–0.003	0.110	0.112	0.002	−0.002–0.006
HS Graduate	**0.061**	**0.066**	**0.005**	**0.003–0.007**	**0.094**	**0.102**	**0.008**	**0.005–0.012**
More than HS	**0.048**	**0.052**	**0.004**	**0.001–0.006**	**0.082**	**0.090**	**0.008**	**0.004–0.013**
Other/Missing	**0.071**	**0.075**	**0.005**	**0.001–0.008**	**0.105**	**0.114**	**0.009**	**0.004–0.013**
CC								
Less than HS	DNC	DNC	DNC	DNC	0.111	0.107	−0.004	−0.017–0.009
HS Graduate	DNC	DNC	DNC	DNC	0.096	0.098	0.002	−0.008–0.013
More than HS	DNC	DNC	DNC	DNC	0.083	0.088	0.004	−0.006–0.015
Other/Missing	DNC	DNC	DNC	DNC	0.107	0.107	0.000	−0.009–0.009
RR_CPS								
Less than HS	**0.077**	**0.071**	**−0.005**	**−0.009–−0.001**	**0.113**	**0.104**	**−0.009**	**−0.013–−0.004**
HS Graduate	0.061	0.062	0.001	−0.002–0.003	0.096	0.094	−0.002	−0.007–0.002
More than HS	0.049	0.050	0.002	−0.001–0.004	0.084	0.083	−0.001	−0.005–0.004
Other/Missing	0.071	0.073	0.002	−0.001–0.004	0.108	0.105	−0.003	−0.008–0.002

Models display the predicted probability (predictive margins) of outcomes based on models testing the interaction of each policy and maternal education in separate logistic regression models that included fixed effects for state, year and state-specific time trends and adjusted for individual- and state-level covariates, including all other pregnancy-specific alcohol policies. Bold indicates p<.05.

DNC: One model predicting low birthweight did not converge.

MWS=Mandatory Warning Signs; RR_DTx=Reporting Requirements for Data and Treatment Purposes; PTxP=Priority Treatment for Pregnant Women Only; PTxPWC=Priority Treatment for Pregnant Women and Women with Children; PCP=Prohibitions on Criminal Prosecution; CACN=Child Abuse/Neglect; CC=Civil Commitment; RR_CPS=CPS Reporting Requirements

Table 2b.

Predicted Probability and Average Marginal Effects of Supportive and Punitive Policies on Prenatal Care Utilization, by Education

	No Prenatal Care				Late Prenatal Care				Inadequate Prenatal Care			
	No policy	Policy	Average ME	95% CI	No policy	Policy	Average ME	95% CI	No policy	Policy	Average ME	95% CI
Supportive												
MWS												
Less than HS	**0.019**	**0.022**	**0.003**	**0.000–0.006**	0.288	0.281	−0.007	−0.022–0.008	0.202	0.203	0.001	−0.013–0.014
HS Graduate	**0.012**	**0.016**	**0.005**	**0.003–0.006**	**0.215**	**0.246**	**0.031**	**0.021–0.041**	**0.140**	**0.171**	**0.031**	**0.019–0.042**
More than HS	**0.008**	**0.011**	**0.004**	**0.002–0.006**	**0.166**	**0.203**	**0.037**	**0.028–0.045**	**0.104**	**0.137**	**0.033**	**0.024–0.042**
Other/Missing	**0.018**	**0.030**	**0.013**	**0.006–0.019**	**0.217**	**0.261**	**0.044**	**0.025–0.064**	**0.152**	**0.201**	**0.049**	**0.019–0.079**
RR_DTx												
Less than HS	0.021	0.018	−0.002	−0.007–0.003	**0.295**	**0.268**	**−0.027**	**−0.048−−0.007**	**0.215**	**0.180**	**−0.034**	**−0.052−−0.016**
HS Graduate	0.012	0.013	0.001	−0.002–0.004	0.221	0.229	0.008	−0.007–0.024	0.149	0.147	−0.002	−0.016–0.012
More than HS	0.008	0.009	0.001	−0.001–0.003	**0.170**	**0.186**	**0.016**	**0.004–0.029**	0.111	0.116	0.006	−0.006–0.017
Other/Missing	**0.018**	**0.026**	**0.008**	**0.001–0.015**	0.224	0.236	0.012	−0.010–0.033	0.163	0.169	0.006	−0.023–0.035
PTxP												
Less than HS	0.020	0.018	−0.002	−0.006–0.002	**0.290**	**0.265**	**−0.025**	**−0.045−−0.004**	0.205	0.186	−0.019	−0.039−−0.001
HS Graduate	0.013	0.013	0.000	−0.002–0.003	0.222	0.233	0.011	−0.011–0.033	0.147	0.153	0.006	−0.015–0.027
More than HS	0.008	0.008	0.000	−0.002–0.001	0.175	0.188	0.013	−0.003–0.030	0.113	0.118	0.006	−0.009–0.020
Other/Missing	0.019	0.024	0.005	−0.003–0.013	0.225	0.245	0.020	−0.010–0.049	0.161	0.182	0.021	−0.016–0.058
PTxPWC												
Less than HS	0.020	0.019	−0.001	−0.005–0.004	0.287	0.272	−0.014	−0.029–0.000	0.203	0.191	−0.012	−0.030–0.005
HS Graduate	0.013	0.014	0.001	−0.003–0.005	0.224	0.225	0.002	−0.013–0.017	0.148	0.151	0.003	−0.017–0.023
More than HS	0.009	0.008	0.000	−0.003–0.002	0.177	0.177	0.000	−0.021–0.021	0.114	0.116	0.002	−0.021–0.025
Other/Missing	0.020	0.020	0.000	−0.004–0.004	**0.229**	**0.209**	**−0.020**	**−0.032−−0.008**	0.163	0.162	−0.001	−0.029–0.027
PCP												
Less than HS	0.020	0.020	0.001	−0.004–0.005	0.286	0.269	−0.017	−0.038−−0.004	0.203	0.187	−0.015	−0.033−−0.003
HS Graduate	0.013	0.014	0.001	−0.001–0.004	0.224	0.220	−0.005	−0.021−0.012	0.148	0.140	−0.008	−0.019−0.003
More than HS	0.008	0.009	0.000	−0.001–0.002	0.177	0.168	−0.009	−0.023–0.005	**0.114**	**0.104**	**−0.011**	**−0.020− 0.001**
Other/Missing	0.020	0.022	0.003	−0.003–0.008	0.228	0.208	−0.020	−0.045−0.004	0.163	0.161	−0.002	−0.037–0.032
Punitive												

	No Prenatal Care				Late Prenatal Care				Inadequate Prenatal Care			
	No policy	Policy	Average ME	95% CI	No policy	Policy	Average ME	95% CI	No policy	Policy	Average ME	95% CI
CACN												
Less than HS	0.020	0.020	0.000	-0.003–0.003	**0.289**	**0.270**	**-0.019**	**-0.036- -0.002**	0.202	0.201	-0.001	-0.021–0.019
HS Graduate	0.013	0.014	0.001	-0.001–0.003	0.225	0.221	-0.004	-0.014–0.006	0.146	0.155	0.009	-0.001–0.019
More than HS	0.008	0.010	0.002	0.000–0.004	0.175	0.182	0.006	-0.003–0.016	**0.111**	**0.125**	**0.014**	**0.006–0.022**
Other/Missing	0.019	0.023	0.004	-0.001–0.009	0.229	0.220	-0.008	-0.020–0.004	0.161	0.171	0.010	-0.009–0.029
CC												
Less than HS	0.020	0.021	0.001	-0.008–0.009	0.285	0.295	0.009	-0.016–0.035	0.202	0.181	-0.022	-0.083–0.040
HS Graduate	0.013	0.015	0.003	-0.006–0.011	0.223	0.239	0.016	-0.012–0.043	0.148	0.133	-0.015	-0.054–0.024
More than HS	0.008	0.011	0.002	-0.005–0.010	0.176	0.209	0.033	-0.004–0.069	0.114	0.110	-0.004	-0.039–0.031
Other/Missing	0.020	0.027	0.008	-0.008–0.023	0.227	0.250	0.022	-0.007–0.052	0.163	0.145	-0.018	-0.055–0.018
RR_CPS												
Less than HS	0.020	0.020	0.000	-0.006–0.005	0.288	0.273	-0.016	-0.040–0.008	0.202	0.200	-0.002	-0.032–0.028
HS Graduate	0.012	0.015	0.002	-0.002–0.006	0.221	0.235	0.013	-0.008–0.034	0.145	0.163	0.018	-0.001–0.037
More than HS	0.008	0.009	0.001	-0.002–0.003	**0.173**	**0.192**	**0.019**	**0.002–0.036**	**0.110**	**0.130**	**0.019**	**0.003–0.035**
Other/Missing	**0.019**	**0.029**	**0.010**	**0.002–0.017**	0.224	0.245	0.021	-0.006–0.048	0.159	0.186	0.027	-0.001–0.056

Models display the predicted probability (predictive margins) of outcomes based on models testing the interaction of each policy and maternal education in separate logistic regression models that included fixed effects for state, year and state-specific time trends and adjusted for individual- and state-level covariates, including all other pregnancy-specific alcohol policies.

Bold indicates p<.05

MWS=Mandatory Warning Signs; RR_DTx=Reporting Requirements for Data and Treatment Purposes; PTxP=Priority Treatment for Pregnant Women Only; PTxPWC=Priority Treatment for Pregnant Women and Women with Children; PCP=Prohibitions on Criminal Prosecution; CACN=Child Abuse/Neglect; CC=Civil Commitment; RR_CPS=CPS Reporting Requirements

Table 2c.

Predicted Probability and Average Marginal Effects of Supportive and Punitive Policies on Alcohol Use, by Education

	Any Drinking				Binge Drinking				Heavy Drinking			
	No policy	Policy	Average ME	95% CI	No policy	Policy	Average ME	95% CI	No policy	Policy	Average ME	95% CI
Supportive												
MWS												
Less than HS	0.078	0.085	0.007	-0.018-0.032	**0.021**	**0.011**	**-0.009**	**-0.19--0.000**	0.020	0.013	-0.007	-0.020-0.005
HS Graduate	0.103	0.111	0.008	-0.019-0.035	0.028	0.015	-0.012	-0.026-0.002	0.023	0.018	-0.004	-0.021-0.012
More than HS	0.154	0.141	-0.012	-0.034-0.010	**0.035**	**0.022**	**-0.013**	**-0.023--0.003**	0.032	0.024	-0.008	-0.019-0.003
RR_DTx												
Less than HS	0.076	0.085	0.008	-0.014-0.031	0.015	0.016	0.001	-0.007-0.009	0.018	0.016	-0.002	-0.010-0.005
HS Graduate	0.104	0.108	0.004	-0.020-0.028	0.023	0.019	-0.003	-0.014-0.007	**0.024**	**0.016**	**-0.009**	**-0.018--0.000**
More than HS	0.153	0.144	-0.008	-0.030-0.013	0.027	0.029	0.003	-0.008-0.013	0.028	0.028	0.000	-0.010-0.009
PTxP												
Less than HS	0.082	0.077	-0.005	-0.033-0.023	0.016	0.014	-0.002	-0.012-0.007	0.016	0.018	0.002	-0.010-0.013
HS Graduate	0.107	0.101	-0.006	-0.031-0.018	0.022	0.019	-0.003	-0.012-0.005	0.020	0.023	0.002	-0.007-0.012
More than HS	0.150	0.142	-0.008	-0.035-0.019	0.030	0.023	-0.007	-0.021-0.008	0.029	0.025	-0.003	-0.018-0.009
PTxPWC												
Less than HS	0.080	0.097	0.017	-0.010-0.044	0.016	0.014	-0.002	-0.010-0.007	0.018	0.009	-0.008	-0.018-0.001
HS Graduate	**0.104**	**0.130**	**0.027**	**0.008-0.045**	0.022	0.014	-0.007	-0.017-0.002	**0.022**	**0.010**	**-0.012**	**-0.021--0.004**
More than HS	0.147	0.161	0.014	-0.003-0.031	0.029	0.023	-0.006	-0.017-0.006	0.029	0.022	-0.007	-0.018-0.003
PCP												
Less than HS	0.082	0.055	-0.028	-0.059-0.003	0.015	0.015	0.000	-0.112-0.011	0.017	0.011	-0.006	-0.017-0.004
HS Graduate	**0.108**	**0.072**	**-0.036**	**-0.056--0.016**	0.021	0.023	0.002	-0.012-0.016	0.021	0.022	0.002	-0.009-0.013
More than HS	0.150	0.127	-0.022	-0.051-0.007	0.028	0.029	0.000	-0.015-0.016	0.028	0.023	-0.005	-0.015-0.004
Punitive												
CACN												
Less than HS	0.084	0.073	-0.010	-0.037-0.017	0.017	0.012	-0.005	-0.012-0.002	**0.020**	**0.010**	**-0.010**	**-0.018--0.002**
HS Graduate	0.104	0.113	0.009	-0.013-0.032	**0.024**	**0.015**	**-0.009**	**-0.018--0.001**	**0.023**	**0.013**	**-0.010**	**-0.016--0.004**
More than HS	0.147	0.152	0.004	-0.023-0.032	0.030	0.024	-0.007	-0.013-0.000	0.030	0.023	-0.008	-0.017-0.002
CC												

	Any Drinking				Binge Drinking				Heavy Drinking			
	No policy	Policy	Average ME	95% CI	No policy	Policy	Average ME	95% CI	No policy	Policy	Average ME	95% CI
Less than HS	0.082	0.060	−0.022	−0.049–0.006	0.015	0.026	0.011	−0.003–0.025	0.017	0.043	0.027	−0.000–0.054
HS Graduate	0.106	0.089	−0.018	−0.040–0.004	0.021	0.029	0.008	−0.016–0.031	0.020	0.037	0.016	−0.013–0.046
More than HS	0.149	0.121	−0.028	−0.058–0.003	0.028	0.042	0.014	−0.012–0.039	0.028	0.044	0.016	−0.021–0.053
RR_CPS												
Less than HS	0.081	0.081	0.000	−0.024–0.023	**0.013**	**0.022**	**0.009**	**0.000–0.018**	0.014	0.023	0.008	−0.006–0.023
HS Graduate	0.108	0.102	−0.006	−0.024–0.012	0.019	0.025	0.006	−0.004–0.016	0.021	0.020	−0.001	−0.009–0.008
More than HS	0.150	0.144	−0.006	−0.028–0.016	0.028	0.030	0.002	−0.006–0.011	0.028	0.029	0.001	−0.009–0.011

Models display the predicted probability (predictive margins) of outcomes based on models testing the interaction of each policy and educational attainment in separate sample-weighted logistic regression in models that included fixed effects for state and for year and adjusted for individual- and state-level covariates, including all other pregnancy-specific alcohol policies.

ME = (average) marginal effect.

Bold indicates p<.05

MWS=Mandatory Warning Signs; RR_DTx=Reporting Requirements for Data and Treatment Purposes; PTxP=Priority Treatment for Pregnant Women Only; PTxPWC=Priority Treatment for Pregnant Women and Women with Children; PCP=Prohibitions on Criminal Prosecution; CACN=Child Abuse/Neglect; CC=Civil Commitment; RR_CPS=CPS Reporting Requirements