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Factors Associated with Alcohol Use, Depression, and Their Co-occurrence during Pregnancy

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Abstract

Background—Alcohol use and depression each adversely affect birth outcomes, but the impact of their co-occurrence among pregnant women is not well understood. In this study, we examined factors associated with alcohol use, depression, and their co-occurrence during pregnancy.

Methods—We analyzed datasets from 2 longitudinal studies conducted nearly 20 years apart in the same outpatient prenatal clinic of an urban women's hospital. Participants included 278 women recruited from 1982 to 1985 for the Maternal Health Practices and Child Development (MHPCD) Study and 209 women recruited from 2000 to 2002 for the Health Outcomes from Prenatal Education (HOPE) Study. Both studies selected women on the basis of their level of alcohol use early in pregnancy. We used multinomial logistic regression models to test multiclassification prediction of alcohol use, depression, and their co-occurrence during pregnancy.

Results—In the second and third trimesters, more MHPCD participants than HOPE participants consumed alcohol (67% vs. 20%), experienced depression (85% vs. 34%), and had co-occurring drinking and depression (56% vs. 10%) ($p < 0.001$ for each). For the MHPCD cohort, smoking predicted alcohol use. There were no significant predictors for depression alone or the co-occurrence. For the HOPE cohort, older age and smoking were predictors of alcohol use; smoking and less education were predictors of depression; and illicit drug use was a predictor of the co-occurrence of alcohol use and depression ($p < 0.05$ for all relationships).

Conclusions—Smoking, older age, lower education, and illicit substance use predicted alcohol and/or probable depression in the second and third trimesters among women who drank in the first trimester.

Keywords

alcohol use; depression; co-occurrence; pregnancy; risk factors

INTRODUCTION

Alcohol use and depression are common conditions that affect the health of pregnant women and lead to adverse outcomes in their offspring. Although most women stop drinking when they recognize that they are pregnant, the prevalence of alcohol use remains high: 12.9% of pregnant women consume some alcohol, and almost 5% engage in binge drinking (Floyd and Sidhu, 2004). The prevalence of depression during pregnancy is also high, ranging from 0.5% to 51% (Bennett et al., 2004). While a number of studies have examined alcohol use alone or depression alone in pregnant women, little is known about the prevalence and risk factors for the co-occurrence of these conditions during pregnancy.

Hanna et al. (1997) found that the co-occurrence of alcohol use and depression in pregnant women was associated with multiple hospitalizations and that the co-occurrence of alcohol use, depression, and smoking was associated with fetal and infant death. In a population-based study in California, Kelly et al. (2002) found that women with both a substance use disorder and a psychiatric disorder were significantly more likely than women with neither disorder to have very low birth weight and premature infants. However, the rates of these adverse outcomes among women with both disorders did not differ from the rates among women with a substance use disorder alone.

To examine factors associated with second and third trimester alcohol use, depression, and their co-occurrence during pregnancy, we analyzed data collected from pregnant women in 2 different longitudinal studies conducted nearly 20 years apart in the same prenatal clinic. For each study, the participants were selected on the basis of their alcohol use in the first trimester of pregnancy. One study was an observational study, and the other was a randomized clinical trial. By using data from both studies, we were able to compare the results and note differences in the study findings.

METHODS

We analyzed data from the Maternal Health Practices and Child Development (MHPCD) Study and the Health Outcomes from Prenatal Education (HOPE) Study. These studies recruited women from the prenatal clinic at Magee-Womens Hospital (MWH) in Pittsburgh, Pennsylvania. Both studies were approved by the institutional review boards of MWH and the University of Pittsburgh, and both obtained written informed consent from study participants.

Study Designs

The MHPCD Study is a longitudinal cohort study designed to assess the relationship between antenatal alcohol exposure and child development at birth, 8 months, 18 months, and 3, 6, 10, 14, 16, and 22 years postpartum (e.g., Day et al., 1985; Day and Robles, 1989; Day et al., 1991a; Day et al., 1991b; Day and Richardson, 1991). Between 1982 and 1985, the study investigators recruited pregnant women during their fourth-month visit to the MWH clinic. This eliminated women with early fetal loss and elective abortions and women who came in late for prenatal care, and it ensured that data were collected at defined times during pregnancy. For the analyses reported here, we used assessment data collected at 4 and 7 months of gestation and at delivery.

The HOPE Study was a randomized clinical trial of a brief intervention to decrease drinking during and after pregnancy. Between 2000 and 2002, the study investigators administered a screening instrument to women during their first or second prenatal visit to the MWH clinic to identify those who drank early in their pregnancy. Women randomized to the intervention arm had a maximum of 5 face-to-face sessions with a trained therapist who focused on

reducing alcohol use during and after pregnancy. After an initial brief intervention session, follow-up intervention sessions took place in the clinic 4 and 8 weeks later, at 32 weeks of gestation, and in the clinic or by telephone at 6 weeks postpartum. Participants completed telephone interviews 4 and 8 weeks after enrollment, at 32 weeks of gestation, and at 6 weeks, 6 months, and 12 months postpartum. For our current analyses, we used data only from pregnancy. Table 1 compares the time points for collecting data about drinking from participants in the 2 studies. For the MHPCD Study, participants were asked at 4 months, at 7 months, and at delivery about their drinking during the first, second, and third trimesters, respectively. For the HOPE Study, participants were asked about their current drinking at 3, 4, 5, and 8 months of gestation. For our current analyses, we used 2 time frames. One combined the baseline and first trimester and the other combined the second and third trimesters.

Study Selection Criteria and Samples

Women were eligible for the MHPCD Study if they were 18 years or older, able to provide a signed informed consent, and in their fourth month of pregnancy. When the study was initiated, the investigators interviewed a sequential sample of 1,360 women who attended the clinic. The refusal rate was 15%. A review of the medical records of women who refused and women who agreed to participate indicated that there were no differences between the groups in terms of age, race/ethnicity, or payment status. All women who reported drinking an average of 3 or more drinks a week during the first trimester and a random sample of women who reported drinking less than this amount or abstaining were selected for follow-up. The follow-up rates for this cohort were high, with 92% of the cohort interviewed at delivery. To make this sample comparable to the HOPE sample, we used only the women who consumed 3 or more drinks a week during the first trimester. This left 278 women from the total sample of 763 for our analyses.

Like the MHPCD Study, the HOPE Study considered women to be eligible if they were 18 years or older and able to provide a signed informed consent. In addition, the HOPE Study required that women be at or before 20 weeks of gestation, have access to a household telephone, and meet one or more of the following criteria: an alcohol intake of 3 drinks or more per week between conception and recognition of pregnancy, an alcohol intake of 1 or more drinks per week after recognition of pregnancy, or at least 1 episode of binge drinking (consuming 4 or more drinks in a single day) between conception and baseline. Of 3,438 women who were approached about the study, 337 were eligible and provided consent. For the current analyses, we used data from the 209 women in this group who had complete baseline information and had no missing data concerning alcohol use and depression for the second or third trimester. Given the underserved population that this sample represents, compliance with follow-up assessments was difficult. When we compared data from the women we included in our current analyses and the women we excluded because of missing data (Table 2), we found the only significant difference was in the proportion who reported illicit drug use (26% vs. 12% respectively; $p < 0.01$).

Study Measures

Baseline Characteristics—In the MHPCD and HOPE Studies, investigators collected socioeconomic data, including the participant's age, race/ethnicity, marital status, parity, education level, living situation, and income. Data on illicit drug use and smoking were collected for each study at each phase. However, to be consistent with our handling of the other independent variables, we used only the baseline data for drug use and smoking. We defined drug use and smoking as dichotomous variables (any use vs. no use). We defined parity as a dichotomous variable representing any births. We counted the number of

pregnancies and subtracted the number of miscarriages or abortions. For any number greater than 0, we considered this a positive value for parity.

Alcohol Use—Both studies used an instrument developed by the MHPCD Project (Day et al., 1989; Robles and Day, 1990). This instrument includes questions about the usual, maximum, and minimum quantities and frequencies of drinking wine, beer, and liquor. The validated instrument (Day et al., 1991a) allows for calculation of quantity, frequency, minimal and maximal intake on drinking days, average daily volume, and frequent heavy (binge) drinking. Alcohol use was defined as a dichotomous variable (any reported drinking vs. no drinking) during the second or third trimester, since the rates for binge or hazardous drinking and the quantity of drinking were minimal.

Depression—The MHPCD Study used the Center for Epidemiologic Studies Depression Scale (CES-D; Radloff, 1977) to measure depression, and the HOPE Study used the Edinburgh Postnatal Depression Scale (EPDS; Cox et al., 1987). These scales were selected because they are less reliant than other scales on somatic symptoms that overlap with symptoms of pregnancy and the postnatal period. Both the CES-D and the EPDS have been validated with the Beck Depression Inventory and with the criteria for depression outlined in the Diagnostic and Statistical Manual of Mental Disorders (Geisser et al., 1997; Harris et al., 1989).

The CES-D is a validated, 20-item scale that assesses the affective component, rather than the somatic component, of depression (Radloff, 1977). Each item is scored on a scale of 0 to 3, with the total score ranging from 0 to 60. Higher scores indicate more symptoms of depression. The threshold for probable depression is 16 or greater (Radloff, 1977). The CES-D has a sensitivity of 82% and a specificity of 73% (Geisser et al., 1997). Internal consistency for this scale is high, with alpha equal to 0.85 in the MHPCD data (Larkby, 1998).

The EPDS is a validated, 10-item instrument (Cox et al., 1987; Murray and Carothers, 1990; Schaper et al., 1994). The scores range from 0 to 30, and the threshold for probable depression ranges from 8.5 to 12.5 (Eberhard-Gran et al., 2001). We used a threshold of 10 or greater for probable clinical depression. The instrument has a sensitivity of 88% (Cox et al., 1996).

For the current analyses, we determined whether each study participant crossed the threshold for probable clinical depression in the study in which she was enrolled. We defined depression as a dichotomous variable (any probable depression vs. no depression) in the second or third trimester.

Co-occurrence of Alcohol Use and Depression—The co-occurrence of alcohol use and depression was defined as drinking any alcohol during the second or third trimester and also meeting the threshold for probable depression, defined as a CES-D score of 16 or greater in MHPCD participants or EPDS of 10 or greater in HOPE participants, during that time period.

Statistical Analyses

We used descriptive statistics to report the frequency of 8 baseline characteristics (age, race/ethnicity, marital status, parity, education, living alone, illicit drug use, and smoking) and the prevalence of 3 outcomes (alcohol use during pregnancy, depression during pregnancy, and co-occurrence of these conditions) in the MHPCD and HOPE samples. We used chi-square and *t* tests to compare the frequencies in the 2 study samples.

We used simple and multinomial logistic regression models for 2 purposes. First, we determined which factors best predicted each of the 3 outcomes in the 2 samples. Second, we determined if the observed differences between the samples across the 3 outcomes remained significant after we controlled for sample characteristics (age, race/ethnicity, marital status, education) and risk factors (parity, living alone, illicit drug use, and smoking). In all of the HOPE models, we also controlled for intervention group status (i.e., being or not being in the intervention group).

The outcome variable was categorical and consisted of four categories: (1) alcohol use only, (2) depression only, (3) both alcohol use and depression (co-occurrence), and (4) neither condition. Multinomial logistic models were used for the analyses. In all models, we used “neither condition” as the reference group. To determine if the models had global significance, we used both the likelihood ratio test and the Wald test.

For all analyses, we used SAS 9.1.3 (SAS Institute Inc., Cary, NC). A p value of <0.05 was considered significant.

RESULTS

Comparison of Characteristics and Outcomes in the Two Samples

Our analyses included 278 women from the MHPCD Study (the earlier study) and 209 women from the HOPE Study (the more recent study). There were no significant differences in the proportions of white and nonwhite women in the 2 study cohorts (Table 3). Each cohort had a slight preponderance of white women. Compared with HOPE participants, MHPCD participants were younger, more likely to be primiparous and married, less likely to live alone, or to have had more than a high school education. Similar proportions of MHPCD and HOPE participants reported illicit drug use at baseline, but a larger proportion of MHPCD participants reported smoking at baseline.

All women in these analyses reported some drinking during the first trimester. It is important to note, however, that there were differences in the level of drinking in the 2 cohorts. For the MHPCD participants, the total average daily volume was 1.56 drinks (standard deviation (SD) 1.87). For the HOPE participants, the total average daily volume was 1.42 drinks (SD 2.71).

As shown in Table 3, there were significant differences in the rates of all 3 outcomes by cohort. During the second or third trimester, a larger proportion of the MHPCD participants consumed alcohol (67% vs. 20%), experienced depression (85% vs. 34%), and had co-occurring drinking and depression (56% vs. 10%) ($p < 0.0001$ for each). These differences remained significant even after we controlled for the covariates.

Logistic Regression Models for Each Sample

Table 4 shows the results of the 6 different regression models that we used to identify the baseline factors that predicted the 3 outcomes (alcohol use, depression, or the co-occurrence of both conditions during the second or third trimester) in the 2 cohorts.

Smoking ($p=0.03$) was the only factor that predicted alcohol use in the MHPCD cohort. In contrast, older age ($p=0.01$) and not being in the intervention group ($p=0.03$) each predicted alcohol use in the HOPE cohort. The MHPCD and HOPE models were globally significant under the likelihood ratio test and the Wald test.

None of the proposed covariates predicted depression in the MHPCD cohort. However, smoking ($p=0.01$), less education ($p=0.01$), and not being in the intervention group ($p=0.04$)

each predicted depression in the HOPE cohort. It is not surprising that the MHPCD model was not globally significant under either the likelihood ratio or Wald test, since 85% of the MHPCD cohort met the threshold for probable depression. In contrast, the HOPE model was highly significant under both tests.

Older age ($p=0.01$) predicted the co-occurrence of alcohol use and depression in the MHPCD cohort, whereas illicit drug use ($p=0.01$) predicted co-occurrence in the HOPE cohort. The MHPCD model approached significance under the likelihood ratio test ($p=0.06$) and Wald test ($p=0.09$). The HOPE model was significant under the likelihood ratio test ($p=0.02$) but only approached significance under the Wald test ($p=0.06$).

Multinomial Logistic Models for Each Sample

Table 5 shows the results of the 2 multinomial logistic models in which we examined each of the cohorts in terms of a 4-level outcome (alcohol use only, depression only, both conditions, or neither condition) and used “neither condition” as the reference group.

For the MHPCD cohort, the overall model was not significant under the likelihood ratio test ($p=0.22$) or the Wald test ($p=0.38$). Therefore, we are unable to comment on the individual predictors for the MHPCD cohort.

For the HOPE cohort, older age ($p=0.03$) and smoking ($p=0.05$) predicted alcohol use. Smoking ($p=0.01$) and less education ($p=0.04$) predicted depression. Illicit drug use ($p=0.01$) and not being in the intervention group ($p=0.02$) were predictors of the co-occurrence of alcohol use and depression. The HOPE model was highly significant under both the likelihood ratio and the Wald tests.

DISCUSSION

Among women with first trimester alcohol use, the factors that predicted alcohol use, depression, and their co-occurrence in the second and third trimesters of pregnancy differed between the two studies. In the MHPCD study, tobacco use predicted alcohol use later in pregnancy, but none of the examined factors predicted either depression or the co-occurrence of alcohol and probable depression. In the HOPE study, by contrast, older maternal age and tobacco use predicted second and third trimester alcohol use among the women, while tobacco use and education predicted depression in the second and third trimesters. Illicit drug use predicted the co-occurrence of alcohol and probable depression in the second and third trimesters.

We found that second- and third-trimester alcohol use, depression, and co-occurring drinking and depression were more common in the MHPCD cohort, even after we adjusted for baseline characteristics. This might be due to the different time periods or to differences in clinic practices at the two time periods. It is more widely recognized today than in 1982 - 1985 that alcohol use during pregnancy contributes to poor birth outcomes. Starting in 1989, all alcoholic beverages had a label warning that drinking during pregnancy increased the risk of birth defects (US Congress: Public Law 100-690). Awareness of the label among pregnant women increased from 29% to 78% between 1989 and 1993 (Hankin et al., 1996). Increased awareness could influence alcohol use during pregnancy and also change the willingness of the women to report accurately on their alcohol use during pregnancy. In addition, some of the differences could be attributable to different data collection methods or different depression measures. For example, if we change the threshold for probably depression in the MHPCD from a cut off of 16 to 25, depression is no longer significantly different between the two studies ($p=.06$). Twenty-five was selected based on previous research indicating that a cut off of 25 signifies severe depression. As Seto et al (2005)

report, scores ranging from 16-24 reflect mild depression and score of 25 or above represents severely depressed. Similarly, Weissman et al (1977) report that a score of 25 is one standard deviation above the average score of their sample of recovered depressed patients. It is difficult to select the most sensitive threshold for probable depression; we chose to use 16. We did test different multinomial models using a CESD score of 16, 22, and 25. The significance of the predictive factors did not change.

There are few reports on the characteristics that predict alcohol use, probable depression and their co-occurrence in the second and third trimester among women who were drinkers in the first trimester. Below, we have compared our results to studies that have reported on variables that are associated with the prevalence of alcohol and depression during pregnancy. In some cases, our findings did not confirm the recent findings of others.

Caetano and colleagues (2006), who used data from the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC), and Perreira and Cortes (2006), who used data from the Fragile Families and Child Wellbeing Study (FFCWS), found that nonwhite women were less likely than white women to drink during pregnancy. Hanna et al. (1994), examined data from the National Maternal and Infant Health Survey and found that black and Asian women drank less than white women. Among women with first-trimester alcohol use, we did not find any significant race/ethnicity-based differences in the prevalence of alcohol use, depression, or their co-occurrence in the second and third trimesters.

Similarly, studies have found that married women are less likely than unmarried women to use alcohol during pregnancy (Caetano et al., 2006; Hanna et al., 1994; Perreira and Cortes, 2006; Meschke et al.2003). We did not find that marital status was a protective factor against alcohol use, depression, or their co-occurrence later in pregnancy. Other reports have also reported that pregnant women with a higher level of education were more likely to abstain from drinking (Caetano et al., 2006; Ebrahim et al., 1998). We did not find education to be a predictor of second and third trimester alcohol use among women who drank in the first trimester. We did, however, find it to be a predictor of depression during the second and third trimester. The differences between our results and those in the literature most likely reflect the differences in the populations studied. The MHPCD and the HOPE studies were of low-income women, while the studies in the literature were general population samples.

Several studies have examined the relationship between smoking and alcohol use among pregnant women. Perreira and Cortes (2006) found that nonsmokers were more likely to abstain from drinking during pregnancy. Ebrahim et al. (1999) found that smokers were less likely to reduce their binge drinking. Perham-Hester and Gessner (1997) found that smoking predicted third-trimester drinking, and Serdula et al. (1991) reported high rates of alcohol use among pregnant women who smoked. In both the MHPCD and HOPE cohorts, we found that women who smoked in the first trimester were more likely to use alcohol in the second and third trimester.

The literature shows conflicting results concerning the influence of age on alcohol use during pregnancy. While some investigators have shown that the prevalence of alcohol use increases with age (Perreira and Cortes, 2006), others have found that alcohol use is more prevalent in younger women (Caetano et al., 2006; Finch et al., 2001). We found that older age was a predictor of alcohol use in the HOPE cohort but not in the MHPCD cohort in the logistic and multinomial models. Older age, however, did predict the co-occurrence of alcohol use and depression in the logistic model for the MHPCD cohort, although this model only approached significance.

Many studies have shown that illicit drug use is correlated with alcohol use. For example, Ebrahim and Gfroerer (2003) reported that more than half of pregnant women who use illicit

drugs also use alcohol. Perham-Hester and Gessner (1997) found that marijuana and cocaine use were significantly associated with third-trimester drinking. Much of the research concerning illicit drug use examines factors that predict alcohol use or depression but not the co-occurrence of these conditions. What we found is that illicit drug use was a predictor of second- and third-trimester alcohol use only among women who also reported experiencing depressive symptoms. This finding was true in the logistic and multinomial models for the HOPE cohort.

Several studies have examined demographic characteristics associated with depression during pregnancy, and the results are mixed. For example, 2 studies reported no individual demographic characteristics predictive of depression (Pajulo et al., 2001; Jesse et al., 2005). This was consistent with our findings for the MHPCD. However, 3 studies reported that lower education was associated with higher levels of depression (Gotlib et al., 1989; Marcus et al., 2003; Zayas et al., 2002). Another study (Marcus et al., 2003), found that depression among pregnant women was associated with marital status, tobacco use, and employment status, while Gotlib et al. (1989) reported that women who were younger, had more children, or were housewives were more likely to be depressed. The findings that lower education and smoking are associated with depression were supported by our analysis of the HOPE data in both the logistic and multinomial models.

Differences between our findings and those presented above may be related to study design and cohort selection. Both the MHPCD and the HOPE studies asked about drinking at defined times during pregnancy. In the NESARC, women were asked about pregnancy and alcohol use over the past 12 months; the pregnancy and alcohol use may not have co-occurred. Women in the FFCWS were interviewed after delivery and were not asked when the alcohol use occurred during their pregnancy. In the Behavioral Risk Factor Surveillance System (BRFSS), the women surveyed were asked only about their alcohol use in the past month, so women who used alcohol before the past month would have been classified as nondrinkers. In addition, the BRFSS alcohol use questions changed between study years, which could have affected the rates that were reported (Ebrahim et al., 1998). It is also possible that the factors that predict use or non-use of alcohol may not be the same as the variables that predict continued use across pregnancy, or depression, or the co-occurrence of alcohol and depression in later pregnancy.

Our study has limitations. First, the samples were not nationally representative and only include women with first-trimester alcohol use, limiting the generalizability of our results. However, unlike the data from nationally representative studies, our data were collected at multiple points during the prenatal period, allowing us to predict second- and third-trimester drinking and depression from first-trimester characteristics. Second, our 2 datasets were derived from the same clinic, allowing us to compare differences over time. Although one of the datasets was from a longitudinal cohort study (the MHPCD Study) and the other was from a randomized controlled trial (the HOPE Study), we controlled for treatment status with the HOPE sample to eliminate the effects that this had on drinking and depression. Other methods of treatment were not assessed, however, and could have contributed to the outcome. The intervention group had lower alcohol use and depression symptoms than the non-intervention group. It may be that since most of the women were already abstinent, they used the brief intervention session to work on topics other than drinking, perhaps leading to their lower depression rates.

The HOPE study design and missing data may have influenced our finding that illicit drug use and intervention group status are associated with co-occurrence of alcohol use and depression. First, illicit drug use was significantly higher in HOPE participants who were included in the analyses than in those who were excluded. The disproportionate numbers

may have changed the analyses of the association between illicit drug use, alcohol use, and depression. Second, the intervention group was less likely to have co-occurrence of alcohol use and depression. The HOPE interventionists were not instructed or trained to specifically address depressive symptoms but it is possible the face-to-face, empathetic, motivational sessions had a benefit beyond changes in alcohol use. This will be an important question for future study.

Finally, the MHPCD and HOPE studies used different measures of depression. While we used a threshold for probable depression, the differences in the measures and thresholds could have influenced our results.

In summary, our study found that tobacco, older age, lower education, and illicit drug use are likely predictors of second- and third-trimester alcohol use, depression, and/or their co-occurrence among women who use alcohol early in their pregnancy. We have also shown that while factors like race/ethnic status, marital status, and education predict who is likely to drink during pregnancy, they do not predict which women will continue to use alcohol and/or have probable depression later in pregnancy. Although these results need replication, they may point the direction for identifying women who are at risk in later pregnancy. With this in mind, healthcare professionals should be especially vigilant for alcohol use and depressive symptoms during the course of prenatal care among women with these risk factors. The professionals may wish to not only assess the risk factors during the first prenatal visit but also at other time points during the course of pregnancy. As more information about risk factors becomes available, they may be able to develop more effective screening tools and interventions to reduce alcohol use and depression during pregnancy. Clearly, women are still using alcohol while pregnant and many are depressed. This study shows that there are potential risk factors that health care professionals can assess. If practitioners identify these risk factors at the prenatal visit, interventions can be targeted for these women to help them with their depression and to help them stop drinking throughout the course of their pregnancy. Ultimately, this improves women's health and reduces their risk for poor birth outcomes.

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Table 1
Time Points for Collecting Alcohol Use Data in the Two Studies*

Study	Month								
	1	2	3	4	5	6	7	8	9
Maternal Health Practices and Child Development (MHPCD) Study				X			X		X
Health Outcomes from Prenatal Education (HOPE) Study			X	X	X			X	

* In the MHPCD Study, participants were asked at 4 months, at 7 months, and at delivery about their drinking during the first, second, and third trimesters, respectively. In the HOPE Study, participants were asked about their current drinking at 3, 4, 5, and 8 months of gestation. We used two time frames for analysis: One combined the baseline and first trimester and the other combined the second and third trimesters.

Table 2
Comparison of HOPE Study Participants Who Were Included in the Analyses and HOPE Study Participants Who Were Excluded Because of Missing Data*

Variable	Included in Current Modeling Sample			Excluded from Current Modeling Sample			P Value
	n	Mean/%	SD	n	Mean/%	SD	
Age	209	23.92	4.53	111	24.93	4.93	0.07
White race	209	53%	0.50	123	57%	0.50	0.45
Married	209	12%	0.33	93	06%	0.25	0.12
Parity	209	67%	0.47	92	67%	0.47	0.99
Years of education	209	12.38	1.66	89	12.46	1.74	0.70
Living alone	209	15%	0.36	93	11%	0.31	0.34
Illicit drug use	209	26%	0.44	126	12%	0.33	<0.01
Smoking	209	42%	0.49	91	45%	0.50	0.58
Intervention group	209	47%	0.50	126	56%	0.50	0.09

* The HOPE Study is the Health Outcomes from Prenatal Education Study. SD indicates standard deviation.

Table 3
Participant Characteristics and Outcomes of the MHPCD Study and the HOPE Study*

Characteristics and Outcomes	MHPCD Study (n = 278)	HOPE Study (n = 209)	P Value
Characteristics			
Age, mean $\pm$ SD	23.0 $\pm$ 3.8	24.0 $\pm$ 4.5	0.01
Race/ethnicity, n (%)			0.89
White	148 (53)	110 (53)	
Nonwhite	130 (47)	99 (47)	
Marital status, n (%)			<0.0001
Unmarried	193 (69)	183 (88)	
Married	85 (31)	26 (12)	
Parity, n (%)			0.0009
Yes	146 (53)	141 (67)	
No	132 (47)	68 (33)	
Education level, n (%)			<0.0001
Less than high school	76 (27)	48 (23)	
High school, GED, or vocational degree	172 (62)	87 (42)	
Some college, associate's degree, or bachelor's degree	30 (11)	74 (35)	
Living alone, n (%)			0.046
Yes	25 (9)	31 (15)	
No	253 (91)	178 (85)	
Illicit drug use at baseline, n (%)			0.09
Yes	54 (19)	54 (26)	
No	224 (81)	155 (74)	
Smoking at baseline, n (%)			<0.0001
Yes	199 (72)	87 (42)	
No	79 (28)	122 (58)	
Outcomes			
Alcohol use during second and third trimester, n (%)	186 (67)	42 (20)	<0.0001
Depression during second and third trimester, n (%)	237 (85)	72 (34)	<0.0001
Co-occurring drinking and depression during second and third trimester, n (%)	157 (56)	21 (10)	<0.0001

* The MHPCD Study is the Maternal Health Practices and Child Development Study; the HOPE Study, performed 20 years later, is the Health Outcomes from Prenatal Education Study. SD indicates standard deviation; GED indicates general educational development.

Table 4
Logistic Regression Models for Outcomes in the MHPCD Study and the HOPE Study*

Outcome	Effect**	MHPCD (N=278)				HOPE (N=209)			
		Odds Ratio	95% CI	p		Odds Ratio	95% CI	p	
Alcohol use	Age	1.04	0.96	1.13	0.36	1.10	1.02	1.19	0.01
	Race/ethnicity	1.39	0.78	2.46	0.26	0.58	0.26	1.34	0.20
	Marital status	0.69	0.37	1.26	0.23	1.96	0.71	5.36	0.19
	Parity	1.60	0.86	2.99	0.14	1.88	0.72	4.93	0.20
	Years of education	1.19	0.95	1.49	0.12	1.04	0.81	1.32	0.78
	Living alone	0.85	0.33	2.16	0.73	1.52	0.52	4.43	0.45
	Illicit drug use	1.72	0.85	3.49	0.13	1.85	0.82	4.16	0.14
	Smoking	1.91	1.06	3.42	0.03	2.10	0.97	4.54	0.06
	Intervention group	--	--	--	--	0.42	0.20	0.91	0.03
	<i>Global likelihood ratio test</i>				0.02				0.003
Depression	<i>Global Wald test</i>				0.03				0.01
	Age	0.96	0.87	1.07	0.66	0.99	0.92	1.07	0.08
	Race/ethnicity	0.90	0.43	1.90	0.50	1.54	0.77	3.07	0.77
	Marital status	0.82	0.38	1.79	0.62	0.56	0.18	1.76	0.22
	Parity	1.54	0.68	3.49	0.30	0.98	0.45	2.11	0.95
	Years of education	1.14	0.86	1.52	0.36	0.75	0.61	0.93	0.01
	Living alone	1.33	0.36	4.93	0.67	1.48	0.62	3.55	0.38
	Illicit drug use	0.61	0.27	1.36	0.23	1.82	0.90	3.69	0.10
	Smoking	1.36	0.63	2.91	0.43	2.31	1.22	4.39	0.01
	Intervention group	--	--	--	--	0.51	0.27	0.96	0.04
Co-occurrence	<i>Global likelihood ratio test</i>				0.85				<0.001
	<i>Global Wald test</i>				0.85				0.001
	Age	1.03	0.95	1.11	0.01	1.05	0.96	1.16	0.34
	Race/ethnicity	1.19	0.69	2.03	0.47	0.67	0.23	1.95	0.27
	Marital status	0.68	0.38	1.21	0.53	1.24	0.29	5.42	0.46
	Parity	1.52	0.85	2.75	0.19	2.80	0.67	11.59	0.77
	Years of education	1.22	0.99	1.51	0.06	0.82	0.59	1.13	0.16

Outcome	Effect**	MHPCD (N=278)				HOPE (N=209)			
		Odds Ratio	95% CI	p		Odds Ratio	95% CI	p	
	Living alone	0.95	0.39	2.32	0.91	1.71	0.47	6.26	0.42
	Illicit drug use	1.39	0.73	2.66	0.31	3.81	1.41	10.34	0.01
	Smoking	1.71	0.97	3.00	0.06	1.84	0.67	5.04	0.24
	Intervention group	--	--	--	--	0.37	0.13	1.05	0.06
	<i>Global likelihood ratio test</i>				0.06				0.02
	<i>Global Wald test</i>				0.09				0.06

* Co-occurrence indicates co-occurrence of alcohol use and depression. The MHPCD Study is the Maternal Health Practices and Child Development Study; the HOPE Study, performed 20 years later, is the Health Outcomes from Prenatal Education Study. CI indicates confidence interval.

** In all models, the reference groups are as follows: whites; unmarried; no parity; not living alone; not using illicit drugs; not smoking; and not in the intervention group

Table 5
Multinomial Models for Outcomes in the MHPCD Study and the HOPE Study*

Outcome (reference group: Neither)	Effect**	MHPCD (N=278)			HOPE (N=209)		
		Odds Ratio	95% CI	p	Odds Ratio	95% CI	p
Alcohol use only	Age	0.92	0.74	1.15	0.47	1.01	1.25
	Race/ethnicity	2.16	0.45	10.43	0.34	0.19	2.06
	Marital status	0.81	0.17	3.80	0.79	0.57	6.90
	Parity	4.48	0.71	28.14	0.11	0.38	4.94
	Years of education	1.08	0.59	1.95	0.81	0.85	1.73
	Living alone	0.96	0.07	13.46	0.98	0.27	7.76
	Illicit drug use	0.64	0.13	3.10	0.58	0.19	2.97
	Smoking	4.05	0.84	19.43	0.08	0.99	8.18
	Intervention group	--	--	--	--	0.17	1.33
							0.16
Depression Only	Age	0.87	0.72	1.07	0.18	0.98	1.08
	Race/ethnicity	1.36	0.32	5.72	0.68	0.85	4.20
	Marital status	0.93	0.23	3.68	0.91	0.37	1.87
	Parity	3.79	0.70	20.60	0.12	0.79	1.85
	Years of education	1.07	0.62	1.83	0.82	0.77	0.99
	Living alone	1.44	0.15	14.28	0.76	1.46	3.89
	Illicit drug use	0.26	0.06	1.14	0.07	1.21	0.53
	Smoking	2.58	0.65	10.24	0.18	2.72	1.31
	Intervention group	--	--	--	--	0.55	0.27
							1.13
Co-occurrence	Age	0.92	0.76	1.12	0.42	0.96	1.19
	Race/ethnicity	1.78	0.44	7.23	0.42	0.78	2.37
	Marital status	0.61	0.16	2.35	0.48	1.22	0.26
	Parity	5.37	1.02	28.21	0.05	2.54	0.58
	Years of education	1.30	0.77	2.20	0.32	0.76	0.54
	Living alone	1.19	0.13	11.25	0.88	2.05	0.52
	Illicit drug use	0.55	0.14	2.16	0.39	3.87	1.35
	Smoking	4.46	1.15	17.28	0.03	2.81	0.98
	Intervention group	--	--	--	--	0.27	0.09
							0.82

Outcome (reference group: Neither)	Effect**	MHPCD (N=278)			HOPE (N=209)		
		Odds Ratio	95% CI	p	Odds Ratio	95% CI	p
Global likelihood ratio test				0.22			<0.001
Global Wald test				0.38			0.002

* Co-occurrence indicates co-occurrence of alcohol use and depression. The MHPCD Study is the Maternal Health Practices and Child Development Study; the HOPE Study, performed 20 years later, is the Health Outcomes from Prenatal Education Study. CI indicates confidence interval.

** In all models, the reference groups are as follows: whites; unmarried; no parity; not living alone; not using illicit drugs; not smoking; and not in the intervention group