



Alcohol Use Trajectories Before and After Pregnancy Among Adolescent and Young Adult Mothers

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Background: Moderate to heavy alcohol use during pregnancy (≥ 3 drinks/occasion) is linked to a range of adverse offspring outcomes. Prior studies suggest that adolescent and young adult mothers may be particularly vulnerable to these risky drinking behaviors during and after pregnancy. This study used latent class growth analysis (LCGA) to examine changes in risky drinking from prepregnancy to postpregnancy and identified prepregnancy predictors representing cognitive and social factors to inform prevention.

Methods: Participants included 432 adolescent and young adult mothers (aged 13 to 24; 78% Black) assessed annually since childhood in the Pittsburgh Girls Study. Participants prospectively reported frequency of risky drinking (≥ 3 drinks/occasion) in the year of pregnancy and 2 years before and after pregnancy, as well as social-cognitive risk factors for drinking (alcohol expectancies, drinking motives, caregiver, and peer alcohol use).

Results: Approximately 11% of young mothers in this community-based sample engaged in risky drinking at least once a month during the year of pregnancy, with greater frequency observed for young adult (vs. adolescent) mothers. LCGA revealed 4 risky drinking trajectories across the perinatal period, including 3 relatively stable trajectories (low, moderate, and high frequency) and 1 distinct trajectory (“postpartum initiators”) characterized by increased risky drinking post-childbirth. Peer alcohol use during and after pregnancy distinguished higher risk from lower risk trajectories, controlling for age, race, and age of drinking onset. Exposure to caregiver alcohol use and prepregnancy coping motives for drinking also elevated risk, but only for mothers who became pregnant in early adulthood (vs. adolescence).

Conclusions: Adolescent and young adult mothers show heterogeneous risky drinking trajectories from prepregnancy to postpregnancy. Pregnant women in the transitional age of early adulthood who report exposure to caregiver alcohol use, more friends who drink, and coping motives for drinking may have elevated risk for moderate-heavy drinking during the perinatal period and may benefit from targeted intervention.

Key Words: Alcohol, Pregnancy, Young Mothers, Adolescence, Early Adulthood, Growth Trajectories.

ADOLESCENCE AND EARLY adulthood are transitional periods of development characterized by increased alcohol use and risky sexual behaviors that can lead to pregnancy (Patrick and Schulenberg, 2014; Salas-Wright et al., 2015). Despite the frequent co-occurrence of drinking and sexual behaviors during adolescence and early adulthood (Cavazos-Rehg et al., 2011), few studies have investigated longitudinal changes in alcohol use from

pregnancy to the postpartum period among young mothers, a unique group of women who likely show different trajectories of drinking than same-aged peers.

The U.S. Department of Health and Human Services currently recommends that pregnant women should not drink alcohol (USDHHS, 2015), emphasizing that “no safe level of alcohol use during pregnancy has been established” (CDC, 2018). Indeed, alcohol use during pregnancy and early motherhood can have long-term implications for offspring outcomes, including behavioral and neurodevelopmental impairments, though effects likely differ based on the frequency, quantity, and timing of alcohol use (Gupta et al., 2016). Although there is active ongoing research on the effects of infrequent and low-level drinking on offspring outcomes, a substantial body of evidence shows that “moderate to heavy alcohol use” during pregnancy (typically quantified as ≥ 3 drinks/occasion) significantly heightens risk for fetal alcohol spectrum disorders and adverse birth outcomes (Meyer-Leu et al., 2011). Most women decrease drinking during pregnancy, but at least 1 in 9 pregnant women continue to consume alcohol (Denny, 2019). Furthermore, longitudinal studies suggest that adolescents may be more likely

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than women of other age-groups to rapidly resume drinking during the first year postpartum (Bottorff et al., 2014; De Genna et al., 2017). Identifying subgroups of young mothers who engage in risky drinking during and after pregnancy and understanding what psychosocial factors influence these trajectories is an important public health priority.

Trajectories of Alcohol Use Before and After Pregnancy

Existing studies suggest that on average, adolescent mothers reduce or stop drinking during pregnancy, and then resume drinking in the first year postpartum (Chapman and Wu, 2013; Tung et al., 2019). However, adolescent mothers also vary widely in prepregnancy levels of drinking and the extent to which they change their use during and after pregnancy (Chang et al., 2011; De Genna et al., 2007; Skagerström et al., 2011). For example, one study of 305 pregnant adolescents examined changes in drinking frequency and found significant between-person differences in its slope after pregnancy, which was predicted by greater retrospectively reported history of prepregnancy drinking (Spears et al., 2010). Similarly, in a study of 240 adolescent mothers, latent class growth models from 1 to 10 years postpartum yielded 4 classes distinguished by frequency of postpartum drinking (low-frequency drinkers, early decliners, late decliners, and increasers); younger age at first drink and older age at first birth were associated with higher frequency drinking trajectories after pregnancy (Oxford et al., 2003). Together, these results highlight the importance of elucidating individual differences in drinking patterns for adolescent and young adult mothers. However, because these studies did not differentiate frequency of low-level drinking from moderate–heavy drinking, the implications of these perinatal trajectories are unclear. Prior blood alcohol concentration studies suggest using a 3-drink threshold to represent “binge drinking” for adolescent females (ages 13 to 17; Donovan, 2009), and pregnancy studies similarly have linked “moderate to heavy drinking” during pregnancy (defined as “3+ drinks/occasion”) to serious adverse fetal outcomes (Meyer-Leu et al., 2011). Building on these studies, the present study will focus on characterizing changes in the frequency of “risky drinking” (3+ drinks/occasion) from prepregnancy to postpregnancy in a sample of pregnant adolescent and young adult women.

Predictors of Risky Drinking During and After Pregnancy

To date, almost all studies investigating predictors of perinatal alcohol use have recruited participants when they are already pregnant and, thus, have relied on retrospective reporting of prepregnancy risk factors. In addition to increasing vulnerability to recall bias, this approach limits the types of risk factors that can be investigated. Predictors of drinking during adolescence can differ from later adulthood (Windle, 2016). For example, among adult women, predictors of prenatal drinking include factors such as being

unmarried, having only 1 child, and a history of alcohol use problems (Skagerström et al., 2011; Tran et al., 2015). These risk factors may not generalize to pregnant women in adolescence/early adulthood, a transitional developmental period characterized by normative patterns of alcohol use initiation and increased binge drinking. Importantly, risk factors traditionally linked to alcohol use problems in *adolescence*, such as social context, alcohol expectancies, and drinking motives (Leung et al., 2014; Patrick and Schulenberg, 2014), are ideally assessed using prospective studies, beginning prior to pregnancy.

In this study, we draw from social learning models of alcohol use (Bandura, 1969; Cooper et al., 1988; Maisto et al., 1999) to examine several *pregnancy* predictors of risky drinking during and after pregnancy: exposure to drinking in the social environment (caregivers, peers), early alcohol expectancies, and motives for drinking. Although a large body of evidence supports the predictive influence of these factors on normative trajectories of alcohol use during adolescence (Alati et al., 2014; Patrick and Schulenberg, 2014; Patton et al., 2018), almost no studies have characterized these factors specifically for pregnant adolescents transitioning to motherhood. Frequent exposure to caregiver alcohol use, particularly during *early* adolescence (Chartier et al., 2010), is associated with early initiation of drinking and binge drinking (Alati et al., 2014). These effects may be particularly salient during the transition to early motherhood, when a history of growing up with frequent caregiver alcohol use may influence a new mother’s decisions to engage in risky drinking through social learning (modeling) and positive expectancies about alcohol effects (Brown et al., 1999; Cranford et al., 2010). Thus, prior exposure to frequent caregiver alcohol use may increase vulnerability to risky postpartum drinking, a hypothesis that will be tested.

Beyond these early risk factors, peer relationships also represent a primary social context for risky drinking during adolescence (Leung et al., 2014; McCann et al., 2019). However, few studies have investigated how peer drinking before, during, and after pregnancy influences trajectories of perinatal alcohol use for adolescent mothers. Existing studies support the important role of peer socialization on perinatal drinking: Substance use patterns of best friends significantly predicted drinking during pregnancy for adolescent mothers, even after controlling for (retrospectively reported) prepregnancy drinking (Lohr et al., 1992). Similarly, pregnant adolescents with substance-using boyfriends were more likely to resume drinking postpartum (Spears et al., 2010). These studies suggest that exposure to peer drinking may play a critical role in shaping risky drinking patterns during and after pregnancy. However, because no studies have examined these factors prospectively starting *before* pregnancy, it is unclear how the timing of peer drinking exposure influences *changes* in risky drinking from prepregnancy to postpregnancy.

Finally, among women who are already drinking before pregnancy, drinking motives may play an important role in

drinking trajectories across time (Cooper et al., 2016). The 2 drinking motives most strongly linked with risky drinking patterns are drinking to enhance positive emotions (“enhancement motives”) and dampen negative emotions (“coping motives”) (Cooper et al., 2016; Kuntsche et al., 2005), with enhancement motives endorsed more frequently during adolescence (Kuntsche and Cooper, 2010). However, adolescent and young adult mothers may experience unique stressors compared to same-aged peers. Indeed, for some women, the transition to motherhood is characterized by increased vulnerability to negative emotions and increased responsibilities as part of the social role transition into parenthood (Rutherford and Mayes, 2019). These experiences may be particularly challenging for young mothers who often have more limited resources (Torres et al., 2017). Thus, young women who drink to cope with negative emotions prior to pregnancy may be particularly vulnerable to risky drinking during and after pregnancy, although no study to our knowledge has examined prepregnancy drinking motives as a predictor of risky drinking during and after pregnancy.

The Present Study

Understanding individual differences in trajectories of risky drinking during and after pregnancy and identifying factors that predict these trajectories is important for informing prevention of alcohol-related problems for adolescent and young adult mothers. Although many studies have investigated predictors of alcohol use initiation and risky drinking in adolescence and early adulthood more generally, few studies have examined whether these factors predict risky drinking trajectories for adolescent/young adult mothers, who may show unique changes in drinking patterns compared to their peers across this age range. Drawing from a longitudinal sample of adolescent/young adult mothers (aged 13 to 24 years old) assessed annually since childhood, we examined latent trajectories of risky alcohol use across prepregnancy, prenatal, and postpartum periods, and then characterized these trajectory groups with prepregnancy factors previously linked to risky drinking. Whereas prior studies of pregnant adolescents have largely relied on retrospective data, we used a prospective study design to examine predictors collected *prior* to pregnancy, such as alcohol-related cognitions (e.g., alcohol expectancies) and social environment factors (e.g., caretaker and peer alcohol use).

Based on prior studies (Chapman and Wu, 2013; De Genna et al., 2017), we hypothesized that several distinct patterns of perinatal risky drinking would emerge, including “stable low” and “stable high” trajectories, a “decreasing” trajectory, and a “rebound” trajectory (decrease during pregnancy that then increases after birth). Given that this is the first study of adolescent/young adult mothers to prospectively model trajectories of risky drinking from *pregnancy* to postpregnancy, we note the exploratory nature of these hypotheses. We hypothesized that women who engaged in

frequent risky drinking during and after pregnancy would be characterized by greater exposure to caretaker alcohol use and more positive expectancies about alcohol effects in early adolescence; report more friends who drink alcohol before, during, and after pregnancy; and report a greater prepregnancy tendency to use alcohol to cope with negative emotions. Given the unique age-expected changes in alcohol use during adolescence and early adulthood (Chassin et al., 2002), we examined these predictive associations while adjusting for the linear and quadratic effects of age on drinking and explored whether risk factors for high-risk trajectories differ based on age at pregnancy.

MATERIALS AND METHODS

Participants and Procedures

The present study included a subsample of 432 adolescent and young adult pregnant women (ages 13 to 23 at pregnancy) drawn from the Pittsburgh Girls Study (PGS; Hipwell et al., 2002; Keenan et al., 2010). The PGS is a longitudinal study of 2,450 girls (52% Black, 41% White, 7% multiracial/other) initially recruited in childhood (ages 5 to 8) in 1999 to 2000 based on a stratified, random sampling of 103,238 households that oversampled from low-income neighborhoods in Pittsburgh, PA (USA). Over the past 18 years, participants have been assessed annually with high retention (range: 97.2% in wave 2 to 85.6% in wave 18), and 791 total participants have delivered a live birth. To assess alcohol use before, during, and after pregnancy, data from the 2 years before pregnancy (T-2 and T-1), year of pregnancy (T0), and the 2 years following childbirth (T + 1 and T + 2) were identified. Participants were included in analyses if they completed an assessment *while pregnant* ($N = 109$ excluded) and at least 1 assessment *before and after pregnancy* ($N = 250$ excluded), resulting in a final sample of $N = 432$. We included data from first births only. Compared to participants who delivered a live birth but had insufficient data, the 432 participants included were slightly younger (mean childbirth age = 19.33 vs. 20.83; $t = -8.91$, $p < 0.01$) but did not differ on age of alcohol initiation or any other demographics. Compared to PGS participants who did not deliver a child, the 432 participants included in this study were more likely to identify as minority race (84.0% vs. 54.2%; $\chi^2 = 82.25$, $p < 0.001$) and have a history of using public assistance (24.2% vs. 18.2% at PGS wave 1; $\chi^2 = 6.94$, $p = 0.008$); groups did not differ on age of alcohol initiation ($t = 0.43$, $p = 0.67$).

All study procedures were approved by the university’s Institutional Review Board. Caregivers (94% female) provided written consent, and participants provided verbal assent prior to age 18, after which participants provided their own written informed consent.

Measures

Risky Alcohol Use. Frequency and quantity of alcohol use in the past year were self-reported in the Nicotine, Alcohol and Drug Use questionnaire (NADU; adapted from Pandina et al., 1984). To generate a “frequency of risky drinking” variable, participants reported their frequency of drinking in the past year on a 6-point scale: 0 (none), 1 (less than 5 times), 2 (more than 5 times but less than once a month), 3 (about once a month), 4 (about once a week), and 5 (a couple times a week or more). Next, participants reported their typical quantity of drinks on a 5-point scale: 0 (none), 1 (less than 1 drink), 2 (1 to 2 drinks), 3 (3 to 5 drinks), and 4 (6 or more drinks). Prior blood alcohol concentration studies suggest using a 3-

drink threshold to represent “binge drinking” for adolescents (Donovan, 2009), consistent with the 3-drink threshold of “moderate to heavy drinking” linked to adverse fetal outcomes in pregnancy studies (Meyer-Leu et al., 2011). Thus, we used a “ ≥ 3 drinks” threshold by dichotomizing the quantity variable to indicate presence or absence of “risky drinking.” We combined the frequency and dichotomous quantity data to generate the final “frequency of risky drinking” variable for each time point. Thus, frequency of risky drinking (≥ 3 drinks/occasion) in the past year ranged from 0 (none) to 5 (a couple times a week or more) and was analyzed as an ordinal variable at each time point.

Alcohol Expectancies. The Drug, Alcohol, and Tobacco Expectancy Questionnaire (adapted from Hornik et al., 2002) assessed positive and negative expectancies about the effects of alcohol in early adolescence (ages 11 to 12). Four items assess positive expectancies (e.g., “I would have a good time with friends,” “I would be more relaxed”), and 4 items assess negative expectancies (e.g., “It would upset my parents,” “I would lose control of myself”). Items were rated on a 5-point scale ranging from 0 (very unlikely) to 4 (very likely); positive and negative items were summed separately, with higher scores indicating either stronger positive or negative expectancies about alcohol. We used average scores across ages 11 to 12 for positive expectancies (McDonald’s $\omega = 0.90$ to 0.91 , GLB = 0.89 to 0.93) and negative expectancies ($\omega = 0.50$ to 0.60 , GLB = 0.58 to 0.65) because these were the years of available data prior to the earliest pregnancy (age 13).

Drinking Motives. The Drinking Motives Questionnaire (Cooper, 1994) assessed prepregnancy reasons for drinking for participants who endorsed recurring alcohol use ($\geq 5 \times$ /year) during the 2 years before pregnancy (T-1 and T-2) ($N = 145$). Four items assessed coping motives ($\omega = 0.89$ to 0.90 , GLB = 0.91 to 0.93 ; e.g., “drinking to forget problems,” “drinking when depressed/anxious”), and 5 items assessed enhancement motives ($\omega = 0.72$ to 0.79 , GLB = 0.77 to 0.83 ; e.g., “drinking because it is fun”; “drinking because I like the feeling”). Items were rated on a 3-point scale: 0 (never), 1 (some of the time), and 2 (most of the time). Items were summed to form coping and enhancement subscales, and T-1 and T-2 scores were averaged to represent prepregnancy coping and enhancement motivations for drinking. Coping motives were stable from T-2 to T-1 (2.35 vs. 2.56 ; $t = -0.61$, $p = 0.54$), whereas enhancement motives were slightly higher at T-2 (4.81 vs. 4.23 ; $t = 2.11$, $p = 0.04$).

Caregiver Alcohol Use. The Alcohol Use Disorders Identification Test (AUDIT; Saunders et al., 1993) assessed caregiver’s self-reported alcohol use when the girls were in early adolescence (ages 11 to 12). The AUDIT is a widely used measure with 10 self-report items assessing the frequency/intensity of drinking, alcohol dependence, and alcohol-related impairments. Higher scores indicate greater problems with alcohol, with scores of 8 or more indicating harmful levels of drinking. Because the youngest pregnant participant in this sample was 13 years old, we used average caregiver AUDIT scores when the girls were aged 11 ($\omega = 0.85$, GLB = 0.91) and 12 ($\omega = 0.81$, GLB = 0.86) to represent caregiver alcohol use in early adolescence.

Peer Alcohol Use. Participants reported the number of friends in the past year who used alcohol as part of the Peer Delinquency Scale (Loeber et al., 1998) using a 4-point scale ranging from 0 (none) to 3 (all of them). We examined peer alcohol use at 3 time points: before pregnancy (T-1 and T-2), year of pregnancy (T0), and after childbirth (T + 1 and T + 2).

Covariates. Demographic variables and potential confounding factors were evaluated as covariates by examining their correlations

with risky drinking. *Race* data were collected from caregivers as part of the original longitudinal study. *Age at pregnancy assessment (T0)* was calculated as the number of years between the participant’s date of birth and T0 date of assessment. Due to the annual assessment schedule, some participants completed T0 assessments earlier in pregnancy than others; thus, we covaried month of pregnancy at T0 by using an estimated date of conception (based on a 40-week pregnancy). *Age of alcohol initiation* was the age in which respondents first reported any alcohol consumption on the NADU (described above). *History of conduct problems* was measured by the Child Symptom Inventory (CSI), a standardized behavioral rating scale of DSM-IV oppositional defiant disorder (ODD) and conduct disorder (CD) symptoms that has shown concurrent validity and sensitivity/specificity of symptom scores to clinician diagnoses (Gadow and Sprafkin, 1994). From ages 8 to 13, parents and teacher separately rated symptoms of ODD and CD on a 4-point scale (0 = never; 3 = all the time). We combined parent and teacher reports by selecting the higher reported severity for each item; items were summed into a total ODD/CD severity score. We used average ODD/CD severity from ages 8 to 13 to represent history of childhood conduct problems.

Data Analysis Plan

To model trajectories of risky drinking from prepregnancy to postpregnancy, latent class growth analysis (LCGA) was conducted in Mplus 6.12. Frequency of risky drinking was modeled as an ordered categorical (ordinal) variable across the 5 time points while allowing for linear and nonlinear (quadratic, cubic) patterns of change. To identify the best-fitting number of classes (from 1 to 6), we used goodness-of-fit indices (lower values indicate better fit) including the Akaike information criterion (AIC) and sample-adjusted Bayesian information criterion (BIC), as well as the Lo–Mendell–Rubin (LMR) likelihood ratio test (comparing k class with $k-1$ class models; Lo, Mendell, & Rubin, 2001). Posterior probabilities assign each individual fractionally to all classes, rather than forcing a 0/1 classification (Muthén, 2004). This is important because it is unlikely that participants have 100% probability of membership in a single class. After selecting the fitted latent class model, we conducted post hoc probing of each class to evaluate whether the probability (odds ratio; OR) of engaging in risky drinking “at least once a month or more” significantly changed year to year from 2 years prepregnancy to 2 years postpregnancy.

Predictive Models. Next, to examine predictors of trajectory class, we used 2 sets of fractional multinomial logit models (fmlogit; Buis, 2017) in Stata 15.1. Fractional multinomial logit models are an extension of the multinomial logit model and allow for joint estimation of the probability of each class while accounting for their fractional nature. Thus, we modeled predictions of the probability of membership in each class while simultaneously accounting for the fractional probability of membership in other classes. In Model 1 ($N = 432$), early adolescent expectancies about alcohol effects, caregiver alcohol use, and peer alcohol use (before, during, and after pregnancy) were entered as predictors of the probability of membership in each class. Next, in the subset of mothers ($N = 145$) who drank alcohol (5 + times/year) before pregnancy (Model 2), prepregnancy coping and enhancement motivations for drinking were modeled as predictors of each trajectory class. All models adjusted for linear and quadratic effects of (T0) age on drinking trajectory. Finally, to explore whether predictive effects differed by age, secondary analyses tested interactions between age and each independent variable. To probe significant interactions, we used regions of significance analyses to identify the specific ages in which predictor variables differentiated trajectory class membership (Preacher et al., 2006).

Rates of missing data ranged from 0% to 3.9% for each covariate and predictor variable, with 88% of the sample having complete data on all variables. To minimize parameter biases associated with missing data and increase power, we employed multiple imputation by chained equation (MICE) using 50 iterations (White et al., 2011). MICE employs an iterative regression technique that treats each variable as an outcome variable and then imputes any missing values based on the remaining variables in the model. MICE has several advantages to other missing data methods (e.g., mean imputation, listwise deletion) including generating more accurate standard errors by incorporating a random element to account for uncertainty in the imputations.

RESULTS

Descriptive Statistics

During the year before pregnancy (T-1), 16% of the sample ($N = 61$) reported drinking 3 or more drinks/occasion at least once a month (10% reporting once a week or more). Approximately 11% ($N = 45$) engaged in risky drinking (≥ 3 drinks/occasion) at least once a month during the year of pregnancy (T0), which increased to 18% the year after childbirth (T + 1). Correlations among study variables appear in Table 1. Frequency of risky drinking during pregnancy (T0) showed low to moderate correlations with risky drinking before (T-1, T-2) and after pregnancy (T + 1, T + 2), supporting the need to examine patterns of change over time. For potential covariates, minority race, age at T0, and age of alcohol initiation (but not childhood conduct problems) were correlated with risky drinking before, during, or after pregnancy and thus were included in subsequent predictive models.

Trajectories of Alcohol Use From Pre- to Postpregnancy

Goodness-of-fit comparisons for unconditional LCGA models (classes ranging from 1 to 6) are shown in Table 2. Overall, fit indices supported the 4-class model as the best fit. Because the LMR test comparing the 4-class to 3-class solution was not significant, we examined the distribution of classes for these solutions. Both the 4-class and 3-class models produced a “low-risk” and “postpartum initiating” class; however, whereas the 3-class model grouped the rest of participants into a large “moderate risky drinking” class, the 4-class model distinguished between a “moderate risk” and a smaller “high-risk drinking” class. Given the conceptual significance of differentiating between these 2 groups, we followed the fit indices and used the 4-class solution in subsequent analyses. In general, entropy was modest for all solutions, indicating some imprecision in the classification of individuals into their “most likely class.” Thus, primary models focused on predicting participants’ posterior probability of membership in all classes rather than forcing each individual into a categorical “most likely class” variable (Muthén, 2004).

Table 3 summarizes frequency of risky drinking from 2 years pre-pregnancy to 2 years postpregnancy for each

trajectory class. Approximately half of the sample were members of class 1 (49%; “low-risk”), characterized by a near-zero probability of risky drinking that remained stable in pregnancy and postpartum (post hoc comparisons between adjacent time points: ORs = 0.86 to 0.87, p 's > 0.10) (Fig. 1). Members of class 2 (21%; “postpartum initiation”) had similarly near-zero rates of risky drinking pre-pregnancy, but some increased probability of initiating risky drinking during pregnancy (OR = 7.19, $p = 0.011$) that then substantially increased during the first year postpartum (OR = 8.30, $p = 0.007$). In contrast, class 3 (24%; “moderate-risk”) was characterized by a marginal increase in risky drinking during the 2 years leading up to pregnancy (OR = 1.66, $p = 0.062$) that then stabilized during pregnancy and postpartum (ORs = 0.56 to 0.64, p 's > 0.10). Finally, a minority (6%) of participants followed a “high-risk” drinking trajectory (class 4), with 75% of this class engaging in risky drinking at least once a month and 58% once a week or more during pregnancy (Table 3). Post hoc comparisons indicated no changes in risky drinking from pre-pregnancy to postpregnancy for this high-risk class (ORs = 0.86 to 1.21, p 's > 0.10).

Predicting Alcohol Trajectory Class Membership

Demographic Differences. Table 3 summarizes the demographic characteristics of each trajectory class. There were no significant differences in trajectory class by race (Chi-square = 4.07, $p = 0.255$). One-way ANOVAs revealed that the 4 trajectory classes differed significantly on age of alcohol initiation ($F = 14.60$, $p < 0.001$) and age at childbirth ($F = 19.33$, $p < 0.001$): The moderate and higher risk trajectories were characterized by earlier age of alcohol initiation combined with later age at childbirth. Relative to other groups, the *high-risk* group had the greatest proportion of women who were at or above the legal drinking age (21 years) during pregnancy (60% vs. range from 11% to 34%), and most of this class was employed during and after pregnancy. In contrast, the *postpartum initiation* group had the greatest proportion of women in the “pre-legal drinking age range” of 18 to 20 years old during pregnancy (72%). Regarding contextual factors, similar proportions of women in the *low-risk* (63%) and *postpartum initiation* (66%) groups lived with their caregivers during pregnancy; however, by first year postpartum, only half of these women in the *postpartum initiation* group lived with caregivers, whereas most of the *low-risk* group living with caregivers continued to do so postpartum.

Alcohol Expectancies and Social Factors. Results from the first fractional logistic regression (Model 1; $N = 432$) appear in Table 4, in which the probability of membership in each trajectory class was compared to the *low-risk* class. Positive and negative alcohol expectancies and caregiver alcohol use during early adolescence did not have a main effect on risky drinking trajectory from pre-pregnancy to

Table 1. Spearman's Correlations (rho) Between Observed Study Variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Minority race																
	M (SD) or %															
	84.0%															
2. Age at T0 (preg)	18.96 (2.03)	-0.11*														
3. Age of first drink	15.81 (3.55)	0.11*	<0.01													
4. Child conduct problems	10.77 (5.46)	0.07	-0.18**	-0.24**												
5. Positive expectancies	2.87 (3.07)	0.05	-0.07	0.08	0.04											
6. Negative expectancies	5.19 (2.46)	-0.02	<0.01	-0.17**	0.06	-0.05										
7. Coping motives	2.20 (2.21)	-0.02	-0.06	-0.08	-0.08	0.03	-0.07									
8. Enhancement motives	4.17 (1.92)	-0.07	-0.12	-0.24**	0.17*	0.12	0.08	0.27**								
9. Caregiver AUDIT	2.45 (2.91)	0.02	-0.10*	-0.07	0.08	<0.01	<0.01	0.17*								
10. Peer alcohol before preg	1.54 (0.94)	-0.04	0.27**	-0.33**	0.04	-0.03	0.05	-0.02	0.24**	0.02						
11. Peer alcohol during preg	1.70 (1.06)	-0.03	0.25**	-0.23**	0.04	-0.04	0.09	0.20*	0.25**	<0.01	0.52**					
12. Peer alcohol after preg	1.63 (0.95)	-0.01	-0.17**	-0.19**	>0.01	0.16**	<0.01	-0.01	0.13	-0.01	0.17**	0.19**				
13. T-2 risky drinking	0.55 (1.27)	-0.11*	0.29**	-0.25**	0.02	0.01	0.04	0.10	0.22*	0.04	0.37**	0.30**	0.05			
14. T-1 risky drinking	0.79 (1.53)	-0.08	0.24**	-0.22**	0.03	0.02	0.09	0.25**	0.41**	<0.01	0.48**	0.37**	0.04	0.50**		
15. T0 risky drinking	0.57 (1.31)	-0.07	0.24**	-0.22**	0.01	0.08	0.04	0.19*	0.02	0.02	0.28**	0.33**	0.12*	0.36**	0.43**	
16. T + 1 risky drinking	0.87 (1.51)	0.02	0.26**	-0.23**	0.04	0.03	-0.01	0.04	-0.05	-0.05	0.19**	0.28**	0.19**	0.25**	0.33**	0.37**
17. T + 2 risky drinking	0.99 (1.55)	-0.07	0.24**	-0.17**	0.10	0.07	-0.01	0.05	0.03	0.04	0.33**	0.27**	0.20**	0.26**	0.36**	0.50**

* $p < .05$. *** $p < .01$. T-2 = 2 years before pregnancy; T-1 = 1 year before pregnancy; T0 = during pregnancy; T + 1 = 1 year after childbirth; T + 2 = 2 years after childbirth. Risky drinking variables were measured on an ordinal frequency scale ranging from 0 to 5: 0 = never; 1 = less than 5x/year; 2 = more than 5x/year but less than 1x/month; 3 = about once a month; 4 = about once a week; and 5 = a couple times a week or more.

postpregnancy. However, secondary follow-up analyses that explored moderation by age (presented in text here) revealed that caregiver alcohol use interacted with pregnancy age

($B = 0.04$, $SE = 0.02$, $p = 0.024$) to distinguish the *postpartum initiation* and *low-risk* groups. Regions of significance analyses revealed that a higher caregiver AUDIT score was associated with increased probability of membership in the postpartum initiation group, but only for women who were at least 22 years of age at pregnancy.

Table 2. Fit indices for latent class growth analysis (LCGA) models with 1 to 6 classes

Number of classes	AIC	Sample-adjusted BIC	LMR test	Entropy
1	3870.428	3877.588	—	—
2	3607.635	3619.269	<0.0001	0.747
3	3587.125	3603.235	0.0381	0.623
4	3573.993	3594.577	0.1914	0.659
5	3571.277 ^a	3596.337	0.2717	0.700
6	3572.756	3602.291	n/a ^b	0.732

AIC, Akaike information criterion; BIC, Bayesian information criterion; LMR, Lo-Mendell-Rubin likelihood ratio test.

Bold indicates best-fitting model.

^aAlthough the AIC value for the 5-class model was slightly lower than the 4-class model, this change in AIC was nominal and does not suggest a significant improvement in fit.

^bLMR test results were unavailable for the 6-class solution due to a small $N = 3$ in one category preventing model convergence.

Perceived peer alcohol use significantly differentiated trajectory classes. Reporting more friends who drank alcohol postpregnancy increased probability of membership in the *postpartum initiation* trajectory relative to the *low-risk* trajectory. Perceived peer drinking before, during, and after pregnancy each independently increased probability of membership in the *moderate-* and *high-risk* trajectory classes relative to the *low-risk* class. Compared to the *moderate-risk* class, the *high-risk* class had marginally more friends who drank prepregnancy ($B = 0.58$, $SE = 0.32$, $p = 0.074$) and significantly more friends who drank during pregnancy ($B = 0.46$, $SE = 0.23$, $p = 0.001$), although postpregnancy peer drinking did not differ ($p > 0.10$). These effects persisted even after adjusting for linear and quadratic effects of age,

Table 3. Frequency of Risky Drinking (3 + Drinks) and Demographic Characteristics by Trajectory Class

	C1: Low risk $N = 214$ (49%) % of C1	C2: Postpartum initiation $N = 78$ (21%) % of C2	C3: Moderate risk $N = 99$ (24%) % of C3	C4: High risk $N = 24$ (6%) % of C4
Risky drinking frequency				
T-2 (before pregnancy)				
"1×/month or more"	1.9%	0%	17.4%	78.3%
"1×/week or more"	0.9%	0%	10.9%	69.6%
T-1 (before pregnancy)				
"1×/month or more"	1.4%	0%	43.4%	90.5%
"1×/week or more"	1.0%	0%	25.6%	71.4%
T0 (during pregnancy)				
"1×/month or more"	0%	1.3%	27.3%	75.0%
"1×/week or more"	0%	0%	16.2%	58.3%
T + 1 (after pregnancy)				
"1×/month or more"	0%	34.3%	32.9%	83.3%
"1×/week or more"	0%	17.1%	17.6%	55.6%
T + 2 (after pregnancy)				
"1×/month or more"	0%	46.2%	22.5%	90.9%
"1×/week or more"	0%	21.5%	10.0%	68.2%
Demographic variables	M (SD) or % of C1	M (SD) or % of C2	M (SD) or % of C3	M (SD) or % of C4
Minority race (Black or multiracial)	80.5%	80.8%	73.7%	66.7%
Age at first drink	16.81 (3.65)	15.46 (3.60)	14.39 (2.74)	13.96 (2.56)
Age at childbirth	18.78 (2.03)	19.50 (1.53)	20.04 (1.93)	21.27 (1.79)
Age-group at pregnancy (T0)				
Teenager (13 to 17)	34.1%	14.8%	14.9%	5.0%
Prelegal adult (18 to 20)	54.3%	72.2%	50.7%	25.0%
Legal drinking age (≥ 21)	11.6%	13.0%	34.3%	60.0%
Living with caregiver				
T0 (pregnancy)	63.3%	66.1%	56.6%	43.5%
T + 1 (after pregnancy)	47.9%	34.3%	40.5%	33.3%
Living with intimate partner				
T0 (pregnancy)	15.8%	19.3%	18.4%	21.7%
T + 1 (after pregnancy)	16.1%	14.9%	10.7%	11.1%
Employed full- or part-time				
T0 (pregnancy)	38.1%	40.0%	41.7%	65.2%
T + 1 (after pregnancy)	41.2%	67.1%	58.8%	72.2%
Receiving WIC assistance				
T0 (pregnancy)	32.7%	40.4%	40.3%	17.6%
T + 1 (after pregnancy)	69.8%	67.9%	73.2%	66.7%

T + 1, 1 year after childbirth; T + 2, 2 years after childbirth; T0, during pregnancy; T-1, 1 year before pregnancy; T-2, 2 years before pregnancy; WIC, Women, Infants and Children federal assistance supplemental nutrition program for low-income families.

DISCUSSION

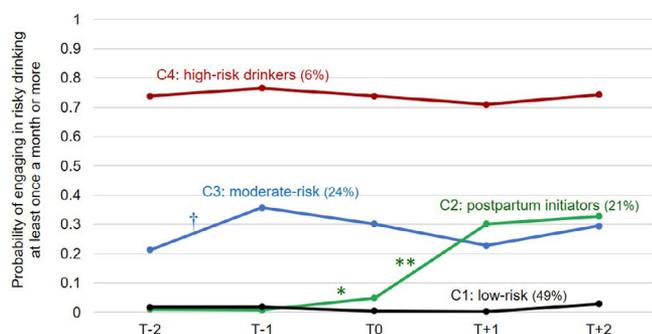


Fig. 1. Probability of engaging in risky drinking (3 or more drinks per occasion) before, during, and after pregnancy for each trajectory class. Participants ranged from ages 13 to 23 during pregnancy (T0) and 13-24 at childbirth: T-2 = 2 years before pregnancy; T-1 = 1 year before pregnancy; T0 = during pregnancy (ages 13 to 23); T + 1 = 1 year after childbirth; T + 2 = 2 years after childbirth. Post hoc analyses compared the probability of risky drinking between adjacent time points; significant (* $p < 0.05$; ** $p < 0.01$) and marginally significant ($\dagger p < 0.10$) are marked.

age of alcohol initiation, and other demographic variables, and they were not moderated by age.

Drinking motives. Model 2 in Table 4 displays the fractional logistic regression results for the subset of mothers ($N = 145$) who endorsed recurring alcohol use before pregnancy. Adjusting for the linear and quadratic effects of age, age of alcohol initiation, and race, neither coping nor enhancement motives had a main effect on trajectory membership. Instead, age at pregnancy interacted with coping motives to predict membership in the *moderate-risk* ($B = 0.21$, $SE = 0.07$, $p = 0.004$) and *high-risk* trajectories ($B = 0.23$, $SE = 0.08$, $p = 0.006$). Regions of significance analyses revealed that a prepregnancy tendency to drink to cope with negative emotions predicted greater probability of membership in the *moderate-* and *high-risk* trajectories (vs. *low-risk* group), but only if women were 19 years or older at pregnancy.

In a longitudinal sample of adolescent and young adult mothers prospectively assessed since childhood, we used person-centered latent growth analyses to identify distinct trajectories of risky alcohol use from prepregnancy to postpregnancy. We capitalized on data that were prospectively collected *prior* to conception to improve on existing studies that relied on retrospective reporting. Four latent trajectories of risky peripartum drinking emerged, including 3 relatively stable trajectories ranging in severity (“low-risk,” “moderate-risk,” and “high-risk”) and 1 additional group characterized by increases in risky drinking during the postpartum period (“postpartum initiators”). Our study had several unique strengths: First, we focused on mothers in adolescence and early adulthood, an understudied group with elevated risk for alcohol-related problems during and after pregnancy. Second, we identified *pregnancy* cognitive (alcohol expectancy, motives) and social environmental predictors (caregiver/peer alcohol use) of perinatal alcohol use trajectories to inform preventative interventions. Our predictive models revealed that perceiving a greater number of friends who drink alcohol during and after pregnancy were key risk factors that differentiated higher from lower risk alcohol use trajectories in young pregnant women. Furthermore, for young adult mothers specifically, prepregnancy exposure to caregiver alcohol use and a preexisting tendency to drink to cope with negative emotions increased probability for higher risk trajectories, whereas these associations were not observed for the younger adolescent mothers.

The 4 identified trajectory patterns were partially consistent with hypotheses; almost half of individuals maintained low to no risky drinking from pre- to postpregnancy (“*low-risk*”), about a quarter engaged in a moderate frequency of risky drinking throughout this period (“*moderate-risk*”), and a small group exhibited more frequent and recurring risky drinking that persisted from pre- to postpregnancy (“*high-risk*”). Interestingly, we additionally detected a sizeable group (21%) that rarely/never engaged in risky drinking

Table 4. Fractional logistic regressions predicting the probability of membership in each perinatal risky drinking trajectory class

	Class 2 (postpartum initiation)				Class 3 (moderate risk)				Class 4 (high risk)			
	<i>B</i>	<i>SE</i>	<i>p</i>	95% CI	<i>B</i>	<i>SE</i>	<i>p</i>	95% CI	<i>B</i>	<i>SE</i>	<i>p</i>	95% CI
Model 1 ($N = 432$)												
Caregiver AUDIT score	0.01	0.03	0.760	-0.05, 0.08	0.03	0.02	0.814	-0.06, 0.08	0.02	0.07	0.806	-0.11, 0.15
Positive alcohol expectancies	0.01	0.03	0.690	-0.05, 0.07	-0.15	0.03	0.203	-0.03, 0.13	0.10	0.07	0.157	-0.04, 0.24
Negative alcohol expectancies	-0.03	0.04	0.427	-0.10, 0.04	0.01	0.04	0.726	-0.10, 0.07	0.01	0.08	0.857	-0.14, 0.17
Peer alcohol before pregnancy	-0.11	0.13	0.374	-0.36, 0.14	0.05	0.04	<0.001	0.28, 0.83	1.13	0.35	0.001	0.45, 1.82
Peer alcohol during pregnancy	0.15	0.10	0.137	-0.05, 0.35	-0.02	0.04	<0.001	0.21, 0.70	0.91	0.27	0.001	0.39, 1.44
Peer alcohol after pregnancy	0.34	0.10	0.001	0.14, 0.53	0.55	0.14	0.021	0.05, 0.57	0.45	0.21	0.029	0.05, 0.86
Model 2 ($N = 145$)												
Coping motivations	-0.07	0.11	0.500	-0.28, 0.14	0.07	0.09	0.454	-0.11, 0.24	0.16	0.12	0.197	-0.08, 0.40
Enhancement motivations	-0.20	0.10	0.057	-0.40, 0.01	0.06	0.10	0.567	-0.14, 0.25	0.23	0.15	0.130	-0.07, 0.53

Reference group = Class 1 (*low risk*). Model 1 includes the full sample, whereas Model 2 focuses on the subset of mothers who were already drinking (at least 5 times a year) before pregnancy. Models covaried for minority race, age of alcohol initiation, linear and quadratic effects of age at T0, and the month of pregnancy at T0. Significant effects ($p < 0.05$) are bolded.

prepregnancy but began regular risky drinking during the postpartum period (“*postpartum initiators*”). Given that adolescence and the transition to early adulthood is a developmental period characterized by normative increases in alcohol initiation and risky use (Chartier et al., 2010), this additional group may represent a risky trajectory unique to mothers in adolescence and early adulthood.

When examining predictors of trajectory membership, the major differentiating factor between trajectories was perceived peer alcohol use. Reporting more friends who drank alcohol before, during, and after pregnancy significantly differentiated the high-/moderate-risk groups from the low-risk group, even after accounting for linear and quadratic effects of age on risky drinking and age of alcohol initiation. Perceiving more peer alcohol use specifically during pregnancy also uniquely differentiated high-risk drinkers from moderate-risk drinkers. Similarly, whereas both the *low-risk* and *postpartum initiators* engaged in little to no risky drinking prepregnancy, the *postpartum-initiator* group significantly increased frequency of risky drinking during the first year after childbirth and was differentiated from the low-risk group by postpartum reporting of peer drinking. These results are consistent with prior studies of (nonpregnant) adolescents that have found peer drinking behaviors to prospectively predict initiation of drinking during adolescence (Trucco et al., 2011). Thus, having friends who drink alcohol during and after pregnancy may be associated with adolescent and young adult mothers’ drinking patterns through risk pathways, such as peer reinforcement and modeling of risky alcohol use (McCann et al., 2019).

Adjusting for peer drinking, neither caregiver alcohol use nor early alcohol expectancies directly differentiated between trajectory groups when examining the full sample, highlighting the potentially unique role of peer relationships in peripartum drinking patterns for these young mothers. However, secondary analyses testing for interactions and regions of significance by age revealed that prior exposure to caregiver alcohol use significantly increased risk for the *postpartum initiation* (vs. *low-risk*) trajectory for young adult mothers (≥ 22 years), whereas these effects were not observed for mothers 21 years or younger during pregnancy. The specificity of these associations to young adult (vs. adolescent) mothers may be related to the legal drinking age (21 years) in the United States. Prior exposure to parental alcohol use may have modeled acceptable caregiving behaviors (Brown et al., 1999) and contributed to increased vulnerability to risky drinking after childbirth, but these effects may depend on age-related access to alcohol during the peripartum period.

Similarly, when examining prepregnancy drinking motives among the subsample of women who reported recurring alcohol use before pregnancy, neither enhancement motives (drinking to increase positive emotions) nor coping motives (drinking to reduce negative emotions) had an overall main effect on trajectory membership. Instead, effects were moderated by age, such that women with preexisting tendencies to

drink to cope with negative emotions were more likely to follow a moderate- or high-risk trajectory of risky drinking across the perinatal period, but only if they were 19 years or older at pregnancy. Compared to same-aged peers, women who become pregnant during the transition to early adulthood may experience unique stressors including sudden changes in financial instability and increased responsibilities as a parent (Rutherford and Mayes, 2019). Our findings suggest that young adult women with a history of using alcohol to cope with negative emotions may be particularly vulnerable to engaging in risky perinatal drinking. These effects may not be as evident for high school-aged mothers (≤ 18 years), who are more likely to be living with caregivers (i.e., grandparents of the new infant) and may experience more child-care and financial support. Follow-up studies are needed to directly test these hypotheses to identify potential mediators underlying the pattern of age-specific vulnerabilities that emerged in the present study.

Overall, our results suggest that many of the same risk factors traditionally implicated in risky drinking in the general adolescent/young adult population, such as peer and parental alcohol use (Chassin et al., 2002), can be generalized and integrated into preventative care for adolescent and young adult mothers. However, interventions may need to be tailored to the adolescent/young adult pregnancy context to address unique factors experienced by young women transitioning to motherhood (Bottorff et al., 2014), including unique contextual changes related to age of pregnancy. Importantly, extant prenatal alcohol use screenings typically focus exclusively on symptoms of alcohol use disorders (Chang et al., 1999; Floyd et al., 2009). Few screeners focus on identifying developmentally sensitive *precursors* for the development of risky drinking patterns during the prenatal/postpartum periods, an important step to initiating preventative interventions. Existing interventions that aim to reduce problem drinking during pregnancy often emphasize psychoeducation about the risks of alcohol use (Floyd et al., 2009), reflecting the tendency of public health interventions to focus on increasing knowledge. Our results suggest that for pregnant adolescent and young adult women, a critical step to reducing risky trajectories of perinatal drinking is to directly screen and shift the peer drinking context during adolescence and early adulthood (NIAAA, 2012). In addition, our findings suggest that risk factors for adolescent mothers may differ from risk factors for young adult mothers, potentially due to differences in access to alcohol- or pregnancy-related changes in social-economic context. Future studies are needed to examine how these factors influence risky peripartum drinking for young mothers transitioning from adolescence to early adulthood.

These findings should be interpreted in the context of study limitations. First, although this study employed a longitudinal framework, the directionality of effects for measures obtained within the same year remains unclear. For example, research on peer drinking and adolescent alcohol use suggests that in addition to peer socialization effects, peer

selection effects account for significant variability in risky drinking outcomes (Mercken et al., 2009). Similarly, perception of peer drinking may differ from actual rates of peer drinking, which may have unique associations with risky drinking outcomes (Iannotti and Bush, 1992; Simons-Morton et al., 2018). Thus, studies that measure each of these factors across multiple time points during the perinatal period are needed to tease apart the complex dynamics underlying the association between peer drinking and risky perinatal drinking. Second, consistent with other community-based studies, the average rates of risky drinking in our sample were low, which may have limited the ability to test some hypotheses. Although several moderate–higher risk groups emerged in our LCGA, including a small group (6%) with high risk for risky drinking, future studies that recruit from clinical samples are needed to further differentiate between higher risk groups of perinatal drinkers. Third, because this study drew pregnancy data from a larger longitudinal study structured by annual assessments, the timing of the T0 assessment during pregnancy varied across participants. Our analyses covaried for the month of pregnancy at T0; however, future studies are needed that measure risky alcohol use across multiple time points throughout pregnancy to increase precision regarding timing effects. Finally, findings are based on a predominantly minority race sample of adolescent and young adult mothers from low-income, urban neighborhoods and may not generalize to other groups.

In conclusion, the present findings highlight significant heterogeneity in trajectories of alcohol use change from prepregnancy to postpregnancy for adolescent and young adult mothers. Despite elevated risk associated with the normative increases of risky drinking during this developmental period, most of the young mothers in our sample did not drink alcohol during pregnancy, whereas a small subgroup of women reported regularly engaging in moderate–heavy drinking during pregnancy and/or the first 2 years postpartum. Adolescent and young adult women who perceive more friends drinking may have the greatest risk for engaging in risky drinking during and after pregnancy. Prior exposure to caregiver alcohol use and a preexisting tendency to drink to cope with negative emotions may also increase risk for postpartum drinking, although effects were specific to women in early adulthood (vs. adolescents). Our results support a need to develop preventative interventions that directly address the unique developmental needs and precursors of perinatal drinking among pregnant adolescent and young adult women as they transition to early motherhood.

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CONFLICTS OF INTEREST

None of the authors have any conflicts of interest to declare.

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