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Women's Longitudinal Smoking Patterns from Preconception through Child's Kindergarten Entry: Profiles of Biological Mothers of a 2001 U.S. Birth Cohort

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Abstract

Objectives—To identify longitudinal patterns of women's smoking during the pre-conception, perinatal, and early parenting period and describe risk factors distinguishing the different profiles.

Methods—We conducted longitudinal latent class analysis (LLCA) of maternal smoking status over a six to seven year period in a sample of 8,650 biological mothers of the Early Childhood Longitudinal Study – Birth Cohort (ECLS-B), nationally representative of U.S. births in 2001.

Results—Five latent classes were identified: pregnancy-inspired quitters (4.3%), delayed initiators (5.1%), persistent smokers (8.5%), temporary quitters (10.4%), and nonsmokers (71.7%). These classes were distinguished by age, race/ethnicity, education, poverty status, marital status, parity, drinking behavior, and depression. For example, when compared to those with college degrees, those with less than high school degree are at least five times as likely to be in the delayed initiators, temporary quitters, or persistent smoker classes (versus the nonsmoker class).

Conclusions—Heterogeneous longitudinal smoking patterns indicate the need for both prevention messages and cessation treatment continuing past parturition, tailored to fit individual profiles in order to achieve reduced health consequences for both mothers and children.

Keywords

Smoking trajectories; Pregnancy; ECLS-B; Longitudinal latent class analysis

Introduction

The harmful effects of maternal smoking on mothers' [1] and children's health (as a result of childhood as well as prenatal exposure) are well documented [2–8]. Moreover, a growing body of research points to intergenerational transmission of smoking [9, 10].

Although declines in tobacco use during pregnancy are consistently observed, and qualitative research shows that many women who smoke develop aversive physical responses during pregnancy or postpartum [11, 12], maternal smoking is likely to rebound post-delivery [13–17] with long-term implications for women's health. National longitudinal studies examining 1980s samples indicated postpartum (one to three years later) smoking prevalence (27–30%) close to preconception rates (29–32%) [18, 19]. Reflecting the overall decline in population smoking rates since the 1980s, National Survey on Drug Use or Health (NSDUH) 2002–2007 cross-sectional estimates of first trimester smoking prevalence were 21.8%, declining to 14.4% and 13.9% during the second and third trimesters, respectively, but rebounding to 20.4% within three months post-delivery [13]. This pattern as illustrated by NSDUH data is consistent with longitudinal Pregnancy Risk Assessment Monitoring System (PRAMS) estimates. Across 16 states in 2001, the smoking prevalence in the three months prior to pregnancy was 22.2%, with postpartum prevalence (collected at two to six months postpartum) estimated to be 17.9% [20].

In an early 1990s adult British cohort, Munafo et al. [21] modeled maternal smoking status from preconception to 33 months post-delivery (seven time points), distinguishing nonsmokers from committed smokers, women who quit during pregnancy, and several groups of women who quit but relapsed postpartum. Adversity in terms of living conditions, income and education predicted consistent smoking and early relapse behaviors. Baseline depression status predicted smoking patterns compared to nonsmokers [21]. While in the US the prevalence of depression is lower for pregnant women than nonpregnant women [22], multiple cross-sectional and short-term follow-up studies also document that mental health comorbidity is associated with greater odds of smoking during pregnancy [23] and postpartum [24–27].

As the Munafo et al. [22] study illustrates, understanding longitudinal patterns of maternal smoking is more useful if clinicians and public health practitioners have tools to identify which women are likely to follow which pathway. We know that, in addition to maternal psychopathology, adverse health behaviors, family circumstances, and sociodemographic characteristics are important inputs to patterns of maternal tobacco use that create prenatal and childhood exposures. Maternal alcohol use [24, 25], single parenthood [15, 24, 26], and parity [14, 15, 26, 28, 29] are risk factors for smoking during pregnancy as well as postpartum. About half of pregnant women live beneath the federal poverty line or near to it [30], exacerbating the socioeconomic disadvantages that are persistently related to women's perinatal smoking behavior [21, 26, 31, 32]. Risks associated with lower family incomes [20, 24, 26, 33, 34] may reflect financial stress [30, 35] undermining successful cessation [36]. However, education may play an even more important role in women's perinatal smoking behavior [15, 18, 25, 27, 28, 37–39] than poverty [19, 26]. Finally, younger maternal age, particularly under age 25, is an important correlate of perinatal smoking

behavior. Younger mothers' smoking quantity [40] and rates are greater preconception [41], during pregnancy [28, 33, 35, 42] and postpartum [20, 33]. Still, transitions to parenthood among younger women have been associated with smoking cessation [15, 19] and lower odds of adopting smoking [29, 43]. It is possible that lower levels of nicotine addiction are relevant to spontaneous cessation among younger women in early pregnancy [34]. Further, qualitative research has documented the concerns of younger mothers regarding their responsibilities of role modeling and ensuring infant health [11, 44].

Despite this attention to maternal smoking, there are two important gaps in the research literature. First, while a handful of longitudinal studies include measures of preconception smoking [14, 19, 21, 24, 29, 41] and a few assess maternal smoking past a year postpartum [19, 21, 24, 29], none measure maternal smoking through the early parenting period until the child's formal schooling begins. Second, with two exceptions [21, 27], neither cross-sectional profiles [38, 45, 46] nor longitudinal studies [15, 18–20, 24] relying on regression analyses have identified subgroups of adult mothers defined by their longitudinal patterns of smoking behavior, as more recent modeling techniques allow. Thus there has been nearly no examination of differential effect of covariates for subgroups of maternal smokers. Eiden et al. [27] follow a small sample of urban, mostly poor, pregnant women through two months postpartum. The Munafo et al. study [21], which follows mothers approximately three years postpartum, focused on the effect of adversity and depression without controlling for demographics. Increases in pregnancy quit rates over the course of the 1990s [15], as well as variations in the tobacco control efforts in Great Britain compared to the U.S. warrant a similar study using a U.S. nationally representative sample.

The present study

Our first objective was to identify distinct profiles of women's smoking behavior from preconception through the critical period of early childhood exposure to secondhand smoke in the home. We hypothesized that smokers would follow the general trend of declining smoking behavior during pregnancy with the common pattern illustrating relapse postpartum. We also test for potential population heterogeneity, expecting that there would be variations from this common pattern. Our second objective was to investigate the longitudinal association between mothers' characteristics and these distinct profiles. We expected that sociodemographic, psychosocial (depression), and behavioral (alcohol consumption) characteristics would distinguish the longitudinal smoking patterns found in the data. Understanding the early risk factors of different longitudinal patterns of smoking should allow for the most efficient utilization of available resources.

Methods

Sample

Study data come from the Early Childhood Longitudinal Study (ECLS-B), nationally representative of the 2001 U.S. birth cohort. Of the approximately 14,000 births sampled in 2001, 10,700 parent interviews were completed at the baseline, when the children were approximately 9 months of age. (All sample n's and descriptions as presented are rounded to the nearest 50 in compliance with the ECLS-B confidentiality rules [47].) At the baseline

interview, respondents were queried about their behavior for two additional time points: in the three months prior to conception and during the third trimester of their pregnancy. Follow-up surveys were conducted at 2 years (2003–04), 4 years (2005–06, preschool sample), and 5 or 6 years of age (2006–07, samples allowing for staggered entry into kindergarten). ECLS-B interviews were conducted using a computer-assisted program with the sampled child's primary caregiver, most frequently the mother, at each round. Respondents were asked to provide information about the sampled child, themselves, and family characteristics. Use of the ECLS-B data for this research was approved by the authors' institutional IRB.

In order to have self-reported information regarding smoking status before and during pregnancy, we restricted our sample to respondents who identified themselves as the biological mother of the child at the “9-month” interview. Moreover, we limited the sample to biological mothers who were interviewed at least once in the subsequent three waves (n=9,650). Our sample further reduced to 8,650 mothers after excluding those with missing values on the selected covariates. Attrition analyses indicated that the selected and unselected biological mothers were not substantially different on maternal characteristics including smoking behaviors. We applied the baseline weight (W1R0) for parent respondents such that our study sample is representative of the biological mothers of the 2001 birth cohort.

Outcome variable: smoking status

Smoking is measured at six time points as the respondent's smoking status on a usual day. For those respondents at the 9-month baseline interview who reported having ever smoked 100 cigarettes, smoking status for preconception and third trimester were reported retrospectively. For the 9-month time point and subsequent interviews, respondents were asked “Do you smoke cigarettes now?” Smoking status is coded as an indicator variable for each of the six time points.

Psychosocial and behavioral covariates

Maternal depression at baseline is measured by a modified 12-item version of the Center for Epidemiologic Studies Depression Scale (CES-D) [48]. The modified CESD included both pointedly negative symptoms such as how often the respondent felt “depressed” in the past week as well as more indirect symptoms such as how often “your sleep was restless.” Each item was re-coded from zero to three corresponding with responses from “rarely or never (less than 1 day)” to “most or all (5–7 days).” A total score was created for individuals who answered at least nine out of 12 items using the average of all responses and scaling up. A depression indicator was coded 1 indicating “moderate to severe depression” if a total score was at least 10, and zero otherwise (following Paulson et al. [49]).

At the baseline survey, respondents were asked “how many alcoholic drinks did you have in an average week?” at three months prior to conception. Response options were categorical reflecting multiple ranges. Following Brown et al. [50], an indicator variable was coded 1 for reports of drinking *four or more alcoholic beverages in an average week*, and zero for reports of consuming fewer than four drinks per week.

Sociodemographic covariates

Maternal age at baseline was categorized in three age ranges: younger than 25 years old, between 26 and 35 years old (reference category), and age 36 or older. *Race/ethnicity* is coded as a four-category variable for black, Hispanic, Asian-American, or (as reference) white/other; the small proportion of “other” respondents (2.8% of the children’s biological mothers) precluded inclusion in the multivariate models as a separate category and their smoking behavior was most similar to that of white mothers. *Marital status* at baseline is coded as an indicator variable for married or not. A variable representing *parity* marks if this is the first birth for the respondent (reference category), she has one other child, or she has two or more children in addition to the study child.

Household income at baseline was coded in four categories as follows: less than 100% of the U.S. federal poverty threshold; from 100% up to 130% of the poverty threshold; from 130% up to 185% of the poverty threshold; and at least 185% of the poverty threshold (reference category). *Educational attainment* at baseline was coded in four categories representing less than a high school degree, a high school degree or equivalent, some college education, or at least an undergraduate college degree (reference category).

Statistical Analyses

Analyses were conducted using Mplus 6.12 [51]. Because the ECLS-B data used a complex sample design, we took into account the stratum and primary sampling unit (psu) [52]. Following the lead of Munafo [21], we used a person-centered approach method [53], i.e. longitudinal latent class analysis (LLCA) [54, 55], to identify patterns of smoking status over the study period. Rather than assuming all mothers follow the same development patterns over time, LLCA groups individuals who tend to follow similar smoking patterns (i.e. latent classes). This method takes into account all repeated measures in the study period and allows for the uncertainty of an individual belonging to each latent class, that is, each individual is assigned with a probability of being in each of the empirically identified classes (posterior probabilities) and is then assigned to the class with the highest posterior probability (i.e. modal class) for subsequent analyses. The posterior probabilities of being in each class add up to 1. Latent class structure is described by two sets of parameters, i.e. the probabilities of being in each class (i.e. class proportion, which can be related to a variety of background variables) and the item response probabilities for each repeated measure given class membership.

We used several fit indices, theory, and predictive validity to determine the proximal number of classes [56]. Smaller values of the Bayesian Information Criterion (BIC) and Sample Size Adjusted Bayesian Information Criterion (aBIC) indicate a better fitting model [56]. In addition, a significant Lo- Mendel-Rubin likelihood ratio test (LMR) [57] comparing the n-1 class solution against the n-class solution indicates a n-1 class model can be rejected in favor of a n-class model. Li and Hser [58] concluded BIC and LMR performed better in class enumeration in general. In addition, while not normally used as a model selection criteria, entropy (ranges from 0 to 1 indicating a better classification as values approach 1) was obtained [59] as a measure of classification quality. A high entropy indicates that an individual has a high posterior probability of belonging to the modal class.

Following the suggestions by Li and Hser, we determined the number of latent classes with the inclusion of covariates. Given the categorical nature of the latent class variable, a multinomial logistic regression model was run to examine the role of covariates on membership in the smoker classes [60]. We present adjusted odds ratios (with nonsmokers as the reference group) as well as the predicted probabilities for selected profiles. Analyses were conducted using Mplus 6.12 [51]. As Long [60] recommended, another way to interpret multinomial logistic regression is to present the predicted probabilities, by (1) presenting the predicted probabilities at substantively interesting values of predictors, and/or (2) plotting the changes on the predicted probabilities when one independent variable changes while holding all others constant [60]. Other than presenting the odds ratios of the effect sizes, these two methods will be used for the results presentation. Predicted probabilities of individuals belonging to each latent class can be computed in the same fashion as in multinomial logistic regressions with observed nominal outcomes (for details see Long [60]).

Results

The weighted prevalence of smoking behavior among biological mothers of the 2001 U.S. birth cohort is presented in Table 1, with further sample description. Overall 23% of children of the 2001 U.S. birth cohort had mothers who smoked in the three months prior to conception, 11% during their third trimester, and 17–19% at four time points during the early parenting years. The model fit statistics are presented in Table 2. The 5-class solution was selected based on the recommended selection criteria as well as theoretical consideration. Labels were created by the authors to illustrate as closely as possible the observed smoking pattern of each latent class.

The five classes distinguished by smoking behavior over six time points are illustrated in Figure 1 as the proportion of the full sample predicted to belong to each individual class and the probabilities of smoking given class membership. These include (Class 1, *pregnancy-inspired quitters*) 4.3% of the 2001 U.S. birth cohort whose mothers who had a higher probability of smoking (close to 1.0) before preconception but decreased smoking during pregnancy, maintaining a lower probability of smoking (less than 0.1) postpartum; (Class 2, *delayed initiators*) 5.1% of the 2001 U.S. birth cohort whose mothers who had a lower probability of smoking before preconception, during the pregnancy, and at the nine months postpartum but gradually increased smoking as the child aged through the toddler years into kindergarten; (Class 3, *persistent smokers*) 8.5% of the 2001 U.S. birth cohort whose mothers who smoked throughout the observation period; (Class 4, *temporary quitters*) 10.4% of the 2001 U.S. birth cohort whose mothers exhibited a higher probability of smoking preconception and postpartum but a lower probability of smoking during pregnancy; and (Class 5, *nonsmokers*) 71.7% of the 2001 U.S. birth cohort whose mothers presented with a lower probability of smoking throughout the study period.

Table 3 presents the effects of covariates on class membership in odds ratios, with nonsmokers as the reference. As a behavioral risk factor, mother's preconception drinking behavior consistently predicted assignment to one of the smoking classes vs. nonsmokers. Those mothers who reported drinking at least four alcoholic drinks in the average week

before conception (as compared to those who consumed less on average) were three to five times as likely to be classified in a smoking class rather than as a nonsmoker. As a psychological risk factor, moderate to severe depression at baseline distinguished only the persistent smokers from nonsmokers (OR=1.77; 1.30–2.42). Mothers' postpartum depression status did not distinguish the other smoking classes from nonsmokers.

Education status displayed substantial impact on smoking class membership. When compared to those with college degrees, those who had not completed high school are over 20 times as likely to be in the delayed initiators class and over 5 times as likely to be in the temporary quitters class (versus the nonsmoker class). Because the confidence intervals around the point estimates for education as a risk factor are wide, the true effect size could range considerably. Nevertheless, we note the consistently statistically significant association at the conventional 0.05 level. By contrast, reported income less consistently distinguished membership in a smoking class from the nonsmoking class. For any income bracket lower than 185% of the federal poverty threshold, respondents were more likely to be classified as persistent smokers (ORs ranging from 1.85 to 2.82) rather than nonsmokers. However, reported income did not distinguish the other smoking classes from nonsmokers.

Regarding demographic characteristics, mothers younger than age 25 were significantly more likely to be delayed initiators (OR=2.82; 1.79–4.44) or temporary quitters (OR=1.69; 1.24–2.32) than to be nonsmokers, but maternal age did not distinguish other smoking classes from nonsmokers. White mothers consistently were more likely to than nonwhite mothers to be classified in one of the smoking classes compared to the nonsmoker class. The only exception is Asian-American mothers, for whom the odds of being classified as a persistent smoker compared to a nonsmoker were no different than that of white mothers. Married mothers were significantly less likely to be classified as persistent smokers, temporary quitters, or pregnancy-inspired quitters, but were statistically as likely to be classified as delayed initiators as nonsmokers (although the effect is in the same direction as for other smoking classes).

Mothers who already had at least one child before the current birth were less likely than primiparous mothers to be pregnancy-inspired quitters than nonsmokers (ORs ranging from 0.27 to 0.53). Consistent with this risk pattern, multiparous mothers were more likely than primiparous mothers to be persistent smokers (OR=1.80; 1.26–2.57) than nonsmokers.

In Figure 2, we illustrate the distinction between the smoking classes and nonsmokers for two select characteristics. Figure 2(a) illustrates the relationship between increasing years of education and the predicted probability of being classified in each latent class. In Figure 2(b), predicted probability of class membership is distinguished by whether respondents reported drinking at least four drinks in the average week before conception. As with education, the smoking classes each significantly differ in pattern of their alcohol use compared to nonsmokers.

Discussion

Overall, our results are consistent with other sources showing population-level reductions in smoking prevalence during pregnancy following by considerable relapse behavior within the first year postpartum. Our data imply that half of mothers who smoked prior to conception quit during pregnancy. Although consistent with other sources [19, 61], a caveat is that the ECLS-B study did not ask respondents directly whether they quit or tried to quit smoking during pregnancy (or at any other point in time), and thus estimates of smoking during pregnancy may include new smokers (as many as 10% of nonsmokers may initiate smoking during pregnancy or postpartum [62]). Still, the third-trimester overall smoking rates in ECLS-B are consistent with birth certificate data for the 2001 cohort of births [40]. Our extended follow-up period illustrates heterogeneity of smoking patterns over the early parenting years.

In our data, we have identified five classes of mothers by smoking status as compared to the seven trajectories identified by Munafo et al. [21]. The design of the two studies differ not only by culture and cohort, but also in terms of the number and timing of data points and the extent of the early parenting period examined. Our multivariate model adjusted for multiple sociodemographic characteristics known to be associated with smoking status, while Munafo et al. examined four covariates (including education) representing adversity faced by the mother. Despite these differences, the results are not contradictory. The proportions of mothers in each predicted class membership (aggregating the three Munafo et al. 'relapser' classes in comparison to our pregnancy-inspired quitters, and summing our persistent smokers and delayed initiators in comparison to Munafo et al.'s 'persistent smokers') are similar. While changes are generally in the direction that would be expected given ecological smoking trends between 1990 and 2001, these results suggest that tobacco control has made limited inroads to smoking cessation during pregnancy and to smoking prevention and relapse prevention postpartum. Further policy and health care interventions are warranted to address these issues [20].

Consistent with other studies [21, 23, 61], we found that postpartum depression predicts persistent smoking behavior within the first year post parturition. Our study extends the literature by relating postpartum depression to persistent maternal smoking through the child's entry to kindergarten. However, our study was not designed to assess concurrent changes in smoking behavior and depression, which can be more informative about parallel processes and cessation [21, 63]. This is a research question that should be addressed with the four post-parturition waves of ECLS-B data.

Prior research has associated a single alcoholic drink [24] and current drinker status [25] with perinatal smoking. Our finding that a measure of greater quantity and/or frequency of weekly drinking, per Brown et al. [50], is predictive of maternal smoking profiles over a six to seven year period informs efforts to identify mothers at risk for ongoing smoking patterns based on their preconception drinking behavior. Our analyses are also consistent with national data and numerous studies showing that mothers' smoking prevalence is correlated with education [21, 26, 31, 32], income [20, 24, 26, 34], race/ethnicity [14, 20, 62, 64], marital status [24, 26], and parity [14, 26, 28, 29]. Our results extend the literature by

showing that these correlations remain significant for heterogeneous patterns of smoking behavior over time. Further, our results are consistent with research indicating that younger age is a risk factor for perinatal smoking [20, 24, 26, 28, 40, 42]. However, because younger mothers are also more likely to quit during pregnancy [34], investigation of whether the pattern of smoking profiles differs by maternal age is warranted.

In particular, these correlations may be helpful in identifying longer term smoking risks (persistence, relapsing, and initiation) for mothers seeking to get pregnant or already pregnant. Although a small proportion of pregnancy-inspired quitters still expose their fetus and young children to the risks associated with maternal smoking, the great decline in their probability of smoking (from 1.00 to .53) is unique among the smoking classes, begging closer examination. By contrast, persistent smokers do not appear responsive to the standard of care as of 2001 about the risks of smoking at any point during the study period. Fifteen percent of the study population (delayed initiators and temporary quitters) exhibit increases through initiation or relapse in smoking behavior when their child is still quite young and are of particular interest for directed interventions. While nearly all respondents were advised on the risks of smoking and drinking during pregnancy (data not shown), there may be opportunities to improve earlier identification of mothers' risk for a selected smoking profile through the early parenting years with detailed questions, e.g. regarding their level of pre-conception weekly alcohol consumption. Thus, there are opportunities to take advantage of pediatric as well as maternal health care contacts to support temporary quitters at high risk of relapse or delayed initiators [65].

For example, these results could be made accessible to practitioners assessing individual maternal smoking risk profiles. As demonstrated in the results section, we are able to produce a predicted probability of class membership for any combination of covariates. Thus, upon replication and modification, practitioners could be provided with a modeling tool to assess the likelihood of a woman, e.g. at preconception or in the postpartum period, remaining a nonsmoker initiating smoking post-delivery, quitting and stay quit after delivery or quitting temporarily during pregnancy. For example, a mother who is white, unmarried, younger than 26, and moderately to severely depressed, did not complete high school, already has two children at home at the time of the pregnancy, reported a household income less than 100% of the federal poverty level, and consumes at least four alcoholic beverages in the average week has a 78% predicted probability of being a persistent smoker, a 7% predicted probability of being a delayed initiator, and an 11% predicted probability of being a temporary quitter. More importantly, such tool will enable practitioners to identify early on mothers who are most vulnerable to following a high risk smoking profile, and provides a valuable opportunity for tailored early prevention and intervention to support maternal health and reduce the risk of the child's subsequent exposure to environmental tobacco smoke.

Limitations

Our model results should be interpreted with caution because of shifting trends (e.g. the increasing use of cigars since the year 2000 [66], especially flavored cigars for women who are younger, poor, and less educated [67]). Attention to these more recent trends in research

examining women's perinatal smoking behaviors is warranted. Assessment of several personal characteristics at different time points than assessed in our study (e.g., family income should a new mother return to remunerative full time employment) would potentially result in different inferences than our model predicts. The smoking screening question at the 9-month interview excludes historical smoking behavior for biological mothers who reported they had not smoked 100 cigarettes in their entire life; thus, smoking status at the first two time points may be underestimated. While there is evidence of underreporting of smoking when measured during pregnancy [68–70], retrospective reports of smoking behavior such as those in the ECLS-B show a high correlation with urinary cotinine levels measured during pregnancy [71, 72], thus mitigating concerns about recall bias. Further, retrospective reports of peri-conception and pregnancy alcohol consumption, predictive of child outcomes [73], have been found to exceed contemporaneous reports of alcohol consumption during pregnancy, which are perhaps biased by social expectations [74, 75].

Conclusion

Our study identifies five maternal smoking classes, distinguished by individual characteristics, for mothers of the 2001 U.S. birth cohort. Common evidence of maternal smoking relapse following delivery of a child is further elucidated by these data showing the variety of initiation, cessation, and relapse patterns over a six to seven year period during which mothers are likely exposed to frequent maternal and pediatric health care contacts. These heterogeneous longitudinal smoking patterns indicate that both prevention messages and cessation treatment that last past parturition should be tailored to fit individual profiles and to meet individual needs [76].

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Figure 1.
Latent Classes of Mothers in ECLS-B by Smoking Patterns

Figure 2.
Predicted probability of class membership in ECLS-B by education and drinking status

Table 1

Sample Characteristics of Biological Mothers in the 2001 Early Childhood Longitudinal Study-Birth Cohort (ECLS-B)

	Total population ^a	
	N	%
Total	8650	100%
Smoker at 3 months before preconception	2000	23%
Smoker at last 3 months of pregnancy	1000	11%
Smoker at 9 months of the child	1700	19%
Smoker at 2 year of the child' age	1700	19%
Smoker at preschool of the child	1550	19%
Smoker at kindergarten of the child	1150	17%
Age ^b		
25 years old	3,200	36 %
26–35 years old	4,200	50%
36 years old	1,250	14%
Race/ethnicity ^b		
White + Othersc	4,800	63 %
Black	1,400	13%
Hispanic	1,450	21%
Asian	1,000	3%
Poverty status ^b		
<100% poverty threshold	2,100	22 %
100% to <130% poverty threshold	1,000	11%
130% to <185% poverty threshold	1,100	12%
185% poverty threshold	4,450	54%
Total number of children in the household ^b		
One child (study child is the first child)	3,100	40 %
Two children	3,000	34%
Three or more children	2,550	26%
Education attained ^b		
Less than high school	1,500	18 %
High school	2,350	28%
Some college	2,450	29%
College or more	2,350	26%
Marital status ^b		
No	2,900	32 %
Yes	5,750	68%
Drinking status (3 months pre-conception)		
Drank fewer than 4 alcoholic beverages / average week	8,100	93 %

	Total population ^a	
	N	%
Drank 4 or more alcoholic beverages /average week	550	7%
Depression status ^b		
Less than moderate depression	7,050	83 %
Moderate to severe depression	1,600	17%

^aSample sizes rounded to the nearest 50 per the data security requirements of the National Center for Educational Statistics. Proportions are weighted (W1R0).

^bCovariates represent values reported at 9 month postpartum interview unless otherwise noted.

^c2.8% of study children's biological mothers are 'Other' race/ethnicity.

Table 2

Fit statistics informing model selection^a

	BIC	aBIC	LMR Value	LMR P-Value	Entropy
LCA for smoker - 5 classes	21420.05	21108.62	2048.04	0.00	0.92
LCA for smoker - 6 classes	21454.20	21069.68	1952.60	0.12	0.91
LCA for smoker - 4 classes	21467.42	21229.08	2413.36	0.00	0.93
LCA for smoker - 3 classes	21832.15	21666.91	3329.36	0.00	0.91
LCA for smoker - 2 classes	22998.09	22905.94	25711.4	0.00	0.97
LCA for smoker - 1 class	180507.08	180386.33	–	–	–

^a All models (sorted by BIC) accounting for sample design (strata, PSU) and adjusted for race/ethnicity, poverty status, age, parity, education, marital status, depression, and alcohol use. We selected the 5-class solution, for which the BIC was lowest and the LMR value indicated significantly better classification than a 4-class model (whereas a 6-class model was not a significant improvement).

Table 3

Maternal smoking class membership adjusting for sociodemographic and behavioral characteristics: ECLS-B (2001 U.S. birth cohort)^a

	Pregnancy-Inspired Quitters (Class 1 – 3.5%)	Delayed Initiators (Class 2 – 4.6%)	Persistent Smokers (Class 3 – 9.2%)	Temporary Quitters (Class 4 – 10.4%)
	AOR [95% C.I.]	AOR [95% C.I.]	AOR [95% C.I.]	AOR [95% C.I.]
Race/ethnicity (<i>ref: white/other</i>)				
Black	0.06 *** [0.02, 0.24]	0.68 [0.42, 1.10]	0.08 *** [0.04, 0.16]	0.35 *** [0.23, 0.52]
Hispanic	0.40 ** [0.21, 0.75]	0.26 *** [0.12, 0.54]	0.02 *** [0.01, 0.07]	0.19 *** [0.10, 0.38]
Asian	0.21 *** [0.10, 0.42]	0.20 ** [0.06, 0.67]	0.00 [0.00, 0.00]	0.37 *** [0.23, 0.61]
Poverty status (<i>ref: 185% threshold</i>)				
<100% poverty threshold	0.81 [0.46, 1.46]	1.89 ** [1.19, 3.01]	2.62 *** [1.56, 4.42]	0.72 [0.49, 1.05]
100% to <130% threshold	1.17 [0.60, 2.26]	1.43 [0.76, 2.69]	2.96 *** [1.71, 5.12]	0.90 [0.52, 1.57]
130% to <185% threshold	1.30 [0.76, 2.20]	1.64 [0.92, 2.94]	1.85 * [1.08, 3.17]	0.96 [0.60, 1.55]
Age (<i>ref: 26–35 years old</i>)				
25 years old	1.47 [0.84, 2.57]	2.82 *** [1.79, 4.44]	1.04 [0.71, 1.53]	1.69 ** [1.24, 2.32]
36 years old	1.19 [0.58, 2.46]	0.98 [0.51, 1.89]	0.91 [0.58, 1.43]	0.60 [0.31, 1.19]
Total number of children (<i>ref: 1st child</i>)				
Two children	0.53 ** [0.34, 0.83]	1.28 [0.92, 1.77]	1.47 [1.06, 2.04]	1.14 [0.85, 1.55]
Three or more children	0.27 ** [0.11, 0.69]	1.70 [0.98, 2.95]	1.80 ** [1.26, 2.57]	1.16 [0.78, 1.73]
Education attained (<i>ref: college+</i>)				
Less than high school	1.19 [0.57, 2.50]	21.26 *** [5.15, 87.69]	43.99 *** [6.66, 290.49]	5.22 *** [2.67, 10.23]
High school	2.01 * [1.12, 3.62]	16.01 *** [4.72, 54.32]	23.22 *** [4.65, 115.82]	5.32 *** [3.20, 8.84]
Some college	2.46 *** [1.72, 3.53]	12.42 *** [3.53, 43.77]	10.12 ** [2.12, 48.35]	3.12 *** [1.84, 5.29]
Married	0.56 ** [0.37, 0.84]	0.67 [0.44, 1.02]	0.38 *** [0.27, 0.55]	0.37 *** [0.26, 0.51]
Moderate to Severe depression	1.17 [0.76, 1.83]	1.05 [0.70, 1.59]	1.77 *** [1.30, 2.42]	1.19 [0.92, 1.55]
4+ alcoholic beverages/week	4.22 *** [2.58, 6.91]	2.81 ** [1.48, 5.36]	5.42 *** [3.21, 9.16]	3.72 *** [2.38, 5.83]

^aReference class: Nonsmokers (Class 5 – 71.7%). AOR=adjusted odd ratios. CI=confidence interval.

* p<.05,

** p<.01,

*** p<.001.