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Social integration and maternal smoking: A longitudinal analysis of a national birth cohort

Elizabeth A Mumford, Ph.D. and Weiwei Liu, Ph.D.

Public Health Research, NORC at the University of Chicago

Abstract

Objectives—Social support and engagement are related to smoking behavior in general populations, but it is unknown whether these **measures of social integration** as experienced by recent mothers are related to longitudinal maternal smoking patterns. The purpose of this study is, first, to describe longitudinal patterns of maternal smoking before, during, and after pregnancy through the early childhood parenting years, as well as variation in these patterns; and second, to examine these patterns in relation to social integration, emotional, behavioral, and sociodemographic factors.

Methods—Among 9,050 mothers of the Early Childhood Longitudinal Study-Birth Cohort (a nationally representative probability sample of children born in 2001), we estimated trajectories of maternal smoking with general growth mixture model (GGMM), and examined how baseline predictors are associated with these patterns over a 5 to 6 year period beginning three months prior to pregnancy.

Results—A 5-class solution identified trajectories of nonsmokers (70.5%), temporary quitters (9.4%), pregnancy-inspired quitters (3.3%), delayed initiators (5.1%), and persistent smokers (11.7%). Modifiable risk factors included postpartum alcohol consumption and behavioral cues from co-resident smokers, while breastfeeding beyond six months and social engagement through religious service attendance were protective characteristics.

Conclusions—Prevention of and treatment for maternal perinatal and postpartum smoking is best informed by mothers' emotional, behavioral and sociodemographic characteristics. Religious service attendance, but not measures of social support or social engagement, is a protective factor for maternal smoking trajectories.

Keywords

maternal smoking patterns; social support; social engagement; community involvement; social connectedness; GGMM

Corresponding author: Elizabeth A. Mumford, Public Health Research, NORC at the University of Chicago, 4350 East-West Highway, 8th Floor, Bethesda MD 20814, mumford-elizabeth@norc.org, TEL 301-634-9534.

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The authors declare that they have no conflict of interest.

Introduction

In addition to overall risks to women's health from smoking, women's smoking during pregnancy as well as close maternal-child contact postpartum introduces health risks to children. However, the experience of pregnancy, accompanied by changes in nicotine metabolism, and the transition to parenting may disrupt women's smoking patterns. Postpartum, there is a disturbing tendency for smoking mothers to assume no further risks to their child's health (Constantine, Slater, Carroll, & Antin, 2014). While there has been some success in achieving late pregnancy smoking cessation, only a few (unsuccessful) efforts have targeted postpartum women to prevent relapse (Chamberlain et al., 2013). Investigating early modifiable risk factors of longitudinal smoking patterns from preconception through the early parenting period broadens the intervention window to engage clinicians across specialties, allowing for a life course perspective in supporting screening and treatment follow through to reduce smoking among women.

Despite the value to prevention and cessation intervention research, variation in smoking trajectories among pregnant women and recent mothers has rarely been investigated. The few studies exploring these patterns (Eiden et al., 2013; Mumford, Hair, Yu, & Liu, 2013; Munafo, Heron, & Araya, 2008) focused solely on individual characteristics to describe smoking trajectories, leaving important questions unanswered regarding the social context in which trajectories of maternal smoking behavior develop. Theory suggests social interaction and relationships — both informal (e.g. family, friends, and neighbors) and formal (e.g. organizational involvement) — affect individual health (Kim & Kawachi, 2006). The nature and measurement of 'social context' in empirical studies have varied widely and been categorized in multiple schema. Cohen et al. (2007) refers to social integration, distinguishing participation in social groups from the informational, instrumental, and emotional support garnered through social interactions. Drawing on Link and Phelan (1995), Berkman et al. (2000) connect social integration to health outcomes through explication of upstream economic and cultural forces (the macro-social context) that shape downstream micro-level psychosocial processes. These micro-level dynamics affect health through multiple pathways including social support, social engagement, and person-to-person contact. For example, social engagement may be characterized by neighborhood organizational participation as well as informally getting together with friends and neighbors.

Consistent with this theoretical framework, the impact of measures of social integration on smoking behavior has received some empirical support. A handful of studies have examined the relationship between social integration and women's prenatal smoking. Specifically, social support provided to women who were pregnant has been found to be associated with nonsmoking during pregnancy as well as smoking cessation during pregnancy (e.g., Gillum & Sullins, 2008; Schaffer & Lia-Hoagberg, 1997). Further research has examined social engagement as measured through participation in religious services indicating that, controlling for other sociodemographic characteristics, the protective effect of religious participation extends to women who are pregnant. For example, religious service attendance was negatively associated with prenatal smoking (e.g., Jesse & Reed, 2004). Further, women

who were smokers were more likely to quit smoking during pregnancy if they reported religious service attendance (Gillum & Sullins, 2008).

Several important gaps have been identified: First, with the exception of Gillum and Sullins' (2008) study which included the preconception period, these studies focused solely on prenatal smoking, leaving the relationship between measures of social integration and post-childbirth maternal smoking behavior unexamined. Second, these studies have left out potentially important components of social engagement identified in other population-based research, such as community organizational participation and informal interaction with friends and neighbors. Social engagement may engender positive and/or negative social comparisons, influences, or cognitive interactions, and thus influence individual health behavior and choice (Berkman et al., 2000). Further, studies of social support and engagement associated with prenatal maternal smoking have failed to consider these relationships in the context of an array of emotional, behavioral, and sociodemographic characteristics. While studies of maternal employment have yielded mixed results (Gilman, Breslau, Subramanian, Hitsman, & Koenen, 2008; Havens, Simmons, Shannon, & Hansen, 2009), perinatal smoking is consistently associated with lower levels of education and income, being single, white race/ethnicity, maternal depression, alcohol use, limited or no breastfeeding (e.g., Holtrop et al., 2010; Munafo et al., 2008; Page, Padilla, & Hamilton, 2012), and co-residence with a smoker (Homish, Eiden, Leonard, & Kozlowski, 2012). However, little is known about the combined effects of social integration, emotional, behavioral, and sociodemographic factors.

Addressing these gaps, we investigated measures of social integration as potential protective factors in influencing longitudinal maternal smoking patterns. Using data from a large nationally representative sample, we examined the direct relationship between women's social support and social engagement and their longitudinal smoking trajectories from pre-conception through prenatal and postpartum periods with follow up extending five to six years after childbirth. Based on prior research regarding current smoking by women who are pregnant, we hypothesized that measures of social integration would differentially distinguish longitudinal trajectories of smoking from a pattern of consistent non-smoking, with implications for smoking cessation treatment programs and guidelines for women during this transitional life course phase.

Methods

Data Source and Study Sample

The Early Childhood Longitudinal Study (ECLS-B), nationally representative of the 2001 U.S. birth cohort, provides data on 10,700 children and their parents collected when the child was approximately 9 months (baseline), 2 years, 4 years, and 5–6 years of age (kindergarten). At baseline, parent respondents were queried about their behavior in the three months prior to conception and during the third trimester of the pregnancy, adding two retrospective time points to the four-wave prospective design. A sample of 9,050 (approximately 85% of the original sample; all numbers rounded to the nearest 50 in compliance with the ECLS-B confidentiality rules) adult biological mothers with valid information on at least one of the six smoking measures and all the exogenous variables

were included in the analysis (Table 1). Use of the ECLS-B data for this research was approved by the authors' institutional IRB.

Measures

Dependent variable—Among those screened as having ever smoked 100 cigarettes, smoking at pre-conception (“In the 3 months before you got pregnant, how many cigarettes or packs did you smoke on an average day?”) and during the third trimester of pregnancy (“In the last 3 months of your pregnancy, how many cigarettes or packs did you smoke on an average day?”) were retrospectively assessed at baseline. All respondents were queried about current smoking status at baseline and the three subsequent interviews (“Do you smoke cigarettes now?”). Indicators of smoking status at each time point were coded 1 for smoking and 0 for not smoking.

Measures of Social Integration—The ECLS-B study assessed *social support* from people who were not living with the respondent. From a list of 13 possible personal relationships, respondents were directed to mark all potential sources of support regarding four scenarios: feeling depressed or confused about a problem; needing to borrow money for an emergency; needing help in the middle of the night for an emergency; and seeking advice about child care. We coded these 13 potential support sources into three categorical sources of support: *family* (excludes co-residents); *friends* (including coworkers, church members, and/or an ex-spouse); and *professional* (e.g. clergy, health/social workers, emergency services, childcare providers). Following Cabrera et al. (2006), three (family, friends, and professional sources) separate 3-point ordinal composite support variables were created.

Social engagement was represented by baseline measures of *social connectedness* (frequency with which the respondent mother got together to socialize with friends or neighbors following the birth of the child; 5-point scale); *community service* (whether or not they participate in any activity, e.g. school, sports, neighborhood, or church volunteerism); and *religious service attendance* (frequency in the past year; 5-point scale).

Emotional and Behavioral Covariates—Based on the literature regarding associations of women's emotional state and behavioral choices with their smoking behavior, we included an indicator of moderate or severe *postpartum depression* (marked by score of 10 or more on a modified version of the Center for Epidemiologic Studies Depression Scale). We also examined an indicator of *postpartum alcohol consumption* and a three-category ordinal measure of the duration of *breastfeeding*. Women who reside with another smoker are also known to be a greater risk of smoking themselves, building on behavioral studies following smoking cues (Veilleux & Skinner, 2015) and the theorized stimulation of desire (Hofmann & Van Dillen, 2012), and thus we include an indicator of their co-residence with one or more *additional smokers*. These measures were captured at the baseline survey.

Sociodemographic Covariates—Finally, we included in the models common sociodemographic covariates of smoking behavior measured at baseline: *age*; *education*; *married/cohabitating*; *employment status*; *race/ethnicity*; and *household income*.

Analytic Strategy

We used general growth mixture modeling (GGMM) (Muthén, 2004) to empirically identify developmental trajectories of maternal smoking status. GGMM uses a categorical latent class variable in combination with continuous growth factors to explore population heterogeneity in the change process of the outcome of interest, i.e., whether the study population consists of two or more discrete classes of individuals with varying growth trajectories (Muthén, 2004).

In order to determine the functional form for individual change in our categorical smoking outcome (Masyn, Petras, & Liu, 2013), we first estimated a series of growth models with fixed or random intercept, linear and nonlinear slopes using Mplus version 7.1. The origin of time was set at the baseline interview in order to accommodate inclusion of covariates measured at baseline. Thus, the methods support the association of baseline covariates with subsequent smoking measures (Biesanz, Deeb-Sossa, Papadakis, Bollen, & Curran, 2004). Heterogeneity in maternal smoking trajectories was then explored by estimating models with increasing numbers of classes. The final model selection applying a random intercept and a random slope was based on substantive reasoning as well as standard criteria such as the Bayesian Information Criterion (BIC) and the Lo-Mendell-Rubin (LMR) likelihood ratio chi-square test. Once the best fitting GGMM model was selected, we modeled the association of individual and social characteristics with class membership, via categorical logistic regression (Long & Cheng, 2004). Given the strong associations of individual level covariates found in past studies, we chose a multi-step approach. In the first step, we separately estimated the effect of (a) measures of social integration to detect their role in the absence of other characteristics, (b) measures of emotional and behavioral measures hypothesized to predict smoking trajectories, and (c) known sociodemographic correlates of smoking behavior. In the second step, we estimated a model inclusive of social integration, emotional, behavioral, and sociodemographic characteristics to test the relative impact of these measures in a fully adjusted model.

We accounted for missing data on smoking measures over time through full information maximum likelihood (FIML) estimation (Arbuckle, 1996; Schafer & Graham, 2002). In the sample of approximately 9,050 mothers, 60% had valid information on all six smoking measures and 20% on five of the six measures. Complex sampling design was accounted for by computing robust standard errors using a sandwich estimator. Results were weighted to represent the 2001 birth cohort (weights provided by the National Center for Education Statistics).

Results

Description of maternal smoking

A quarter of the sample smoked during the 3 months prior to conception (Table 1). Smoking prevalence reduced significantly during pregnancy, but following childbirth, the smoking rate returned to pre-pregnancy levels, reaching an apex at the postpartum baseline and declining slightly over the next four years.

Variation in maternal smoking trajectories

A 5-class solution best represented the heterogeneity of the longitudinal smoking trajectories (LL= -11898.51 (15), BIC=23933.64; see Table 2 for fit indices).

A “*nonsmokers*” class comprised 70.5% of the sample; members in this class had a near zero probability of smoking over the six time periods (Figure 1). In contrast, a class of “*persistent smokers*” (11.7% of the sample) had a near 100% chance of smoking over the six time periods with a slight reduction to an 80% probability in the 3rd trimester of pregnancy. A “*temporary quitters*” class (9.4%) started with a high likelihood of smoking, but exhibited significant reduction during pregnancy. While temporary quitters also displayed an apparent increase in smoking following the child delivery, their smoking rate never returned to the preconception level and their smoking propensity continued to decrease throughout early parenthood. Two additional classes were identified: “*pregnancy-inspired quitters*” (3.3% of the sample) who returned to smoking briefly after delivery at a very low probability of 0.1 but quit after the postpartum period, and “*delayed initiators*” (5.1%), who initiated and exhibited an increasing likelihood of smoking while parenting their young children.

Unadjusted role of measures of social integration

Social connectedness, religious service attendance, and the support of family and friends all had significant impact on being assigned into one of the four smoking trajectories versus the nonsmokers class, with different levels of strength (Table 3 Panel A; LL= -11474.938 (75), BIC=23632.990). For example, getting together with friends and neighbors with moderate frequency reduced the likelihood of following a persistent smoking trajectory by nearly half (AOR=0.67 for getting together less than once a month; AOR=0.65 for once or twice a month). Attending religious services had a protective effect from assignment to any of the four smoking trajectories, with a higher frequency of religious service attendance reducing the likelihood of following persistent smoker (AORs range from 0.11 to 0.58) and temporary quitter trajectories (AOR ranges from 0.20 to 0.60). For pregnancy-inspired quitters and delayed initiators, the protective effect appeared only for more frequent religious service attendance (weekly; AORs= 0.36, 0.58 respectively). Family support was protective against recent mothers initiating smoking following the birth of the child (AOR=0.56 for one form; AOR=0.49 for 2+ forms of support). Having friends’ support was protective from following either the persistent smoking trajectory (AOR=0.74 for one form of support; AOR=0.66 for 2+ forms) or the temporary quitter trajectory (AOR=0.43 for 2+ forms of support).

Unadjusted role of emotional, behavioral and sociodemographic characteristics

Emotional and Behavioral Covariates—Moderate to severe postpartum depression, maternal drinking behavior, duration of breastfeeding, and living with at least one other smoker were all predictors of being classified in a smoking trajectory vs. the nonsmoking class (Table 3 Panel B; LL= -10881.309 (35), BIC= 22081.404). The effect of living with another smoker was consistently strong across the trajectories, predicting a two to eight-fold increase in the likelihood of being classified in a maternal smoking trajectory (AORs range from 2.23 to 8.83). Women faced an increased likelihood of following the persistent smoking trajectory based on postpartum depression (AOR=2.52) and any postpartum drinking (AOR=1.88). However, whereas postpartum depression also predicted an increased

likelihood of mothers initiating smoking following childbirth (AOR=1.62), postpartum drinking was associated with the pregnancy-inspired quitting trajectory (AOR=2.56). Consistently, breastfeeding for any length of time showed a protective effect on classification in a smoking trajectory, compared to women who did not breastfeed (AORs range from 0.13 to 0.63).

Sociodemographics—Women ages 18–25 at childbirth were more likely to be classified as temporary quitters, delayed initiators, or pregnancy-inspired quitters than nonsmokers (AORs range from 2.06 to 2.64), with reference to women ages 26 or older (Table 3 Panel C; LL= −10775.547 (71), BIC= 22197.776). Having at least completed high school (through attaining some college or graduate education) showed a protective effect from following a persistent smoking trajectory (AORs range from .03 to .45), whereas only having some college/graduate education showed a protective effect from following the temporary quitters (AOR=.27) or delayed initiator (AOR=.04) trajectories. Consistent with the education effect, reporting a household income of at least 130% of the federal poverty line showed a protective effect from following a persistent smoking trajectory (AORs .30 to .62), and the highest income category was additionally associated with a reduced likelihood of being classified in the delayed initiator trajectory (AOR=.41). The protective effect of marriage or living with a partner extended to a reduced likelihood of following the temporary quitters (AOR=.55) and of being classified as a pregnancy-inspired quitter (AOR=.43), relative to the likelihood of following the nonsmoking trajectory. All race/ethnicity categories compared to being white were associated with a reduced likelihood of following some if not all the smoking trajectories.

Full model of social integration, emotional, behavioral, and sociodemographic measures

With all covariates entered into the final model (LL= −10029.340 (151), BIC= 21434.017), reported attendance at religious services remained a robust protective factor from following a persistent smoking trajectory (Table 4). Attending religious services once or twice in the past year reduced the likelihood of following the persistent smoking trajectory by 30% (AOR=0.70), with increasing effect size given higher frequency of service attendance (AORs ranged from 0.18 to 0.70). In addition, weekly service attendance significantly reduced the chance of following the temporary quitter (AOR=0.39) and pregnancy-inspired quitter (AOR=0.45) trajectories, compared to following a non-smoker trajectory.

In the fully adjusted model, breastfeeding for more than 6 months remained a significant protective effect on the three initiating/continuing smoking trajectories, with the effect on the persistent smoking class being the strongest (AORs ranged from 0.31 to 0.54). By contrast, breastfeeding for six months or less did not exhibit the protective effect found in prior analyses. However, the broader predictive value of any postpartum drinking was revealed in the fully adjusted model. Controlling for other characteristics, postpartum drinking was a risk factor for the three initiating/continuing smoking trajectories of (AORs range from 1.95 to 2.13). Co-residence with other smoking household members remained a robust predictor of persistent smoking and the resumption of smoking postpartum. The array of emotional and behavioral covariates no longer distinguished the pregnancy-inspired quitting trajectory from the nonsmoking trajectory. Effects of the sociodemographics

characteristics were largely the same in this model adjusting for behavioral, emotional, and social integration characteristics.

Discussion

In this study, we found that mothers of a nationally representative birth cohort were likely to follow one of five distinct trajectories of smoking behavior. Consistent with Mumford et al. (2013), in addition to nonsmokers, we found patterns of persistent smoking; temporary cessation limited to pregnancy; the encouraging pattern of women who quit smoking at pregnancy and remained smokefree through at least the child's entry to kindergarten; and, less promising, a group of women who initiated smoking following childbirth, as others have reported (Webb, Culhane, Mathew, Bloch, & Goldenberg, 2011). We found some evidence that women's social support and social engagement are associated with longitudinal patterns of maternal smoking behavior, with implications for the design of longitudinal epidemiological studies as well as interventions administered before, during, and after pregnancy. A perception of low social support from friends and low engagement in community service activities appears to be of particular relevance for distinguishing the risk of perinatal women and recent mothers following a persistent smoking trajectory. Regular participation in religious activities appears to be an even stronger protective factor. It may be that these social factors represent the social connections that Link and Phalen (2009) identify as essential for the transmission of healthy beliefs averting persistent smoking behavior. However, as Link and Phalen further note, the expansion of human control over health outcomes leads to health disparities by sociodemographic measures of race/ethnicity and socioeconomic status. Accordingly, in this study we find that the emotional, behavioral, and sociodemographic factors known to predict maternal smoking show particularly strong effects. While this finding stands in contrast to the identified role of social support and engagement in general population smoking behavior, the relative differences may be attributed to measurement and analytic differences, life course position, or even cross-national cultural differences.

Our study is consistent with prior findings that weekly religious service attendance protects against maternal smoking during pregnancy in the first year postpartum (Page et al., 2012) and further distinguishes the strength of this significant association for women following persistent smoking, pregnancy-inspired quitting, and temporary quitting trajectories throughout the early parenting years. Although we theorized religious service attendance as a proxy of social engagement, there are multiple potential mechanisms. The protective effect of religious service attendance may also or alternatively be a result of healthy norms or expanded social networks (Gillum, 2005) or, as Nonnemaker and colleagues (2015) posit, social control or social support. However, to the extent that norms in a religious community reflect those in the mainstream culture (which in the U.S. tends to censure smoking by women who are pregnant or caring for children), the religious norms *per se* have less impact (Cochran, Beeghley, & Bock, 1988). This would suggest, for the purposes of prevention and cessation interventions, that support and engagement may be the dominant mechanisms through which public participation in religious communities affects maternal smoking behavior. Additionally, research investigating social influence or self-esteem as potential

mechanisms may be constructive inputs to faith-based smoking prevention designs (Berkman et al., 2000).

This is the first study to examine social engagement in terms of community service in association with maternal smoking. In our study, the community service activities of perinatal women and mothers of young children in the U.S. were not significantly associated with their smoking behavior. This stands in contrast to general population cross-sectional research in Sweden (Lindstrom, Moghaddassi, Bolin, Lindgren, & Merlo, 2003). Further research may elucidate the inevitable time constraints imposed by pregnancy and early parenting and therefore reveal little variation in community service participation regardless of smoking behavior; other potential explanations for our null findings may be the more generous employment leave benefits that extend into parenting elementary school children in Sweden which would provide more discretionary time, cultural differences in volunteering in the U.S., and/or the narrower definition of community service in ECLS-B data.

Adjusting only for other measures of social integration, our results are consistent with past research (Elsenbruch et al., 2007; Mann, McKeown, Bacon, Vesselinov, & Bush, 2007) in finding an inverse association between informal social support (from non-co-resident family, coworkers, church members, and/or an ex-spouse) and maternal smoking during pregnancy. In addition to examining informal social support, our study was designed to examine professional sources of support, including clergy, health/social workers, emergency services, and childcare providers. Also in line with prior research, support from professionals does not appear to be of comparable protective value to that received from family and friends. Health professionals may be most constructive by motivating women to identify individuals in their personal networks who could provide (emotional, instrumental, informational, other) forms of support to encourage nonsmoking (Schaffer & Lia-Hoagberg, 1997).

By controlling for a broad range of emotional, behavioral, and sociodemographic characteristics, this study expands the literature in assessing the relative strength of social integration measures' impact on maternal smoking. The results, adjusted for factors known to have a strong impact on women's postpartum smoking — including, for example, women's alcohol consumption and smoking by other household members — challenge findings of the role of social support. One reason may be that the ECLS-B measure of social support excludes persons who were co-residents of the respondent. For some women, ample support may be available at home, as in a recent study of the protective effect of partner support associated with maternal nonsmoking (Capponi et al., 2014). Moreover, the nature of the social relationship — i.e., intimate partners, family members, or friends — from which positive or negative support is derived may not be as important as the form or the content of support (Koshy, Mackenzie, Tappin, & Bauld, 2010). However, importantly, even should social support be insufficient to prevent maternal smoking directly, the effect of social support among maternal smokers may be beneficial for birth outcomes (Elsenbruch et al., 2007).

Also for consideration is the extent to which measures we consider in this study to be sociodemographic factors may be proxies for broader social constructs, i.e. the upstream economic and cultural forces that Berkman et al. (2000) label consisting of inequality,

discrimination, labor market structure, and other macro factors. However, as Glass and McAtee (2006) note, the influence of these constructs cannot be directly tested and we are left with moving downstream to look at non-material risk regulators (e.g. emotional/behavioral cues like smoking in the household, or psychosocial protective factors such as social support, connection, and participation in other community activities). To the extent that individual sociodemographics in this study of women's smoking behavior are proxies of or shaped by upstream social capital regulators (e.g., public policies, environmental factors), our findings do not negate the importance of broad social constructs but, rather, identify downstream individual characteristics and resources as the measurable representations of increased population-based risk for smoking (Link & Phelan, 2009).

Limitations of this study include potential exaggeration of weekly religious service attendance in self-reports to a live interviewer (Cox, Jones, & Navarro-Rivera, 2014). Also, limited variation in the measure of social connectedness may mask effects of that form of social engagement. Two of the six smoking time points are collected retrospectively which may introduce recall bias; however there is some evidence that measurement of maternal prenatal smoking collected post-delivery is a reliable approach in comparison to potential antenatal underreporting (Dietz et al., 2011). Additionally, research focusing on the mother's intimate partner suggests that the partner's own smoking status and commitment to supporting cessation, rather than broader measures of support, are key factors (Homish et al., 2012; Koshy et al., 2010; Schaffer & Lia-Hoagberg, 1997). Further, as noted above there is some variation in the definitions and operationalization of the ECLS-B measures of social integration used in this study compared to other studies of social factors, which could account for different results. Finally, there are numerous independent factors (e.g., individual resilience to stress, hereditary risk for smoking, among others) that are risks for tobacco use. The current study does not rule out potential interplay between other covariates and social factors, and additional research to examine these complexities may benefit prevention and treatment design.

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Significance

There is some evidence that social support and engagement are protective from cigarette smoking. However, this study shows that for most of the four heterogeneous patterns of women's smoking behavior before, during, and years after a pregnancy (in comparison to the non-smoking pattern), postpartum drinking, breastfeeding, and depression; behavioral cues from co-resident smokers; religious service attendance; and several sociodemographic characteristics are the key risk and protective factors.

Figure 1.
Conditional 5-class solution for maternal smoking, ECLS-B

Table 1

Weighted distribution of maternal smoking and sample covariates (ECLS-B, N=9,050)

Maternal smoking		Emotional and Behavioral Covariates ^b	
<i>3 months before pregnancy</i>	24.2	Postpartum depression	
<i>Last 3 months of pregnancy</i>	11.3	<i>Moderately/severely depressed</i>	16.5
<i>9 months post- partum</i>	20.0	Postpartum drinking	
<i>2 years post- partum</i>	19.3	<i>Any drinking</i>	36.5
<i>Child in Preschool</i>	18.6	Breastfeeding duration	
<i>Child in Kindergarten</i>	17.1	<i>Never breastfed^a</i>	30.6
Sociodemographics		<i>Breastfed < 6 months</i>	42.6
Maternal Age Group (at birth of child)		<i>Breastfed >6 months</i>	26.8
<i>18–25</i>	36.0	Other household members smoking	
<i>26–35^a</i>	50.4	<i>One other smoker in household</i>	25.5
<i>36+</i>	13.6	Measures of Social Integration^c	
Race		Social Engagement	
<i>White^a</i>	60.0	Community Service Activities	26.7
<i>Black</i>	13.7	Religious Service Attendance	
<i>Hispanic</i>	20.4	<i>Once or twice</i>	16.9
<i>Asian and Others</i>	5.9	<i>Several times a year</i>	19.2
Marital Status		<i>Once or twice a month</i>	14.5
<i>Married or cohabitating</i>	82.0	<i>Nearly every week or more</i>	27.9
<i>Other relationship status^a</i>	18.0	Social Connectedness (Friends & Neighbors)	
Education		<i>Less than once a month</i>	19.0
<i>Less than high school^a</i>	16.4	<i>Once or twice a month</i>	35.9
<i>High school degree</i>	28.8	<i>Once a week</i>	23.0
<i>Some college</i>	29.2	<i>Several times a week</i>	11.1
<i>College or Graduate School</i>	25.6	Sources of Social Support	
Employment		Family Members	
<i>Not employed^a</i>	46.7	<i>1 type of support</i>	8.6
<i>Part time employed</i>	20.5	<i>2 + types of support</i>	89.5
<i>Full time employed</i>	32.9	Friends	
Household income		<i>1 type of support</i>	27.7
<i>Lower than poverty line^a</i>	22.5	<i>2 + types of support</i>	19.0
<i>100–130% poverty line</i>	11.4	Professional Support	
<i>130–185% poverty line</i>	12.3	<i>1 type of support</i>	32.3
<i>Above 185% poverty line</i>	53.9	<i>2 + types of support</i>	5.9

^aDenotes reference category for multivariate models in Tables 2 and 3.

^bThe reference categories for 'postpartum depression' is "no/low depression"; for 'postpartum drinking' is "no drinking"; and for 'other household members smoking' is "no other smokers in household".

^cThe reference categories for 'community service activities' is "no participation"; for both 'religious service attendance' and 'social connectedness' is "never"; and for 'sources of social support' is "none."

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Table 2

Determining the number of classes in GGMM (ECLS-B, N=9,050)

Model	LL	# of parameters	BIC ^a	LMR-LRT ^b P-value	Entropy
1 class model	-22814.637	3	45656.60	NA	NA
2 class model	-12655.151	6	25364.95	<0.001	0.961
3 class model	-12106.975	9	24295.92	<0.001	0.901
4 class model	-11934.711	12	23978.72	<0.001	0.898
5 class model	-11898.51	15	23933.64	1.000	0.875
6 class model	-11861.711	18	23887.37	<0.001	0.917
7 class model	-11857.284	21	23905.84	0.2397	0.888

^aBayesian Information Criterion;

^bLo-Mendell-Rubin likelihood ratio chi-square test; NA: non-applicable. The 4, 5, and 6-class solutions were considered to be candidate models. When comparing the 5-class model to the 4-class model, a meaningful and substantively interesting class emerged. However, the pattern of the additional smoker class that emerged in the 6-class solution was not visually distinctive and over 90% of the members in this additional class were in the non-smokers class in the 5-class model. Thus, we determined the best fit to be the 5-class solution.

Table 3

Predictors of maternal smoking trajectories (ECLS-B, N=9,050)

	Persistent smokers	Temporary quitters	Delayed initiators	Pregnancy-inspired quitters
	AOR ^b	AOR	AOR	AOR
Social Engagement ^a				
Community Service Activities	—	—	—	—
Religious Service Attendance: <i>Once or twice/ year</i>	0.58 ^{**}	—	—	—
<i>Several times/ year</i>	0.28 ^{**}	0.60 ^{**}	—	—
<i>Once or twice/month</i>	0.28 ^{**}	0.46 ^{**}	—	—
<i>Nearly weekly or more</i>	0.11 ^{**}	0.20 ^{**}	0.58 [*]	0.36 [*]
Social Connectedness <i><once/ month</i>	0.67 ^{**}	—	—	—
<i>Once or twice/month</i>	0.65 ^{**}	—	—	—
<i>Once/week</i>	—	—	—	—
<i>Several times/ week</i>	—	—	—	—
A. Social Integration				
Sources of Social Support ^a				
Family members	—	fixed	0.56 ^{**}	—
<i>1 type of support</i>	—	fixed	0.49 [*]	—
<i>2+ types of support</i>	—	—	—	—
Friends	0.74 [*]	—	—	—
<i>1 type of support</i>	—	—	—	—
<i>2+ types of support</i>	0.66 [*]	0.43 [*]	—	—
Professionals	—	—	—	—
<i>1 type of support</i>	—	—	—	—
<i>2+types of support</i>	—	—	—	—
B. Emotional & Behavioral				
<i>Breastfed 6 months</i>	0.43 ^{**}	—	0.55 ^{**}	0.63 [*]
<i>Breastfed >6 months</i>	0.13 ^{**}	0.28 ^{**}	0.29 ^{**}	0.29 ^{**}
Any postpartum drinking	1.88 ^{**}	—	—	2.56 ^{**}
1+ additional smoker in household	8.83 ^{**}	6.75 ^{**}	2.23 ^{**}	6.15 ^{**}

	Persistent smokers	Temporary quitters	Delayed initiators	Pregnancy-inspired quitters
	11.7%	9.4%	5.1%	3.3%
	AOR ^b	AOR	AOR	AOR
Moderate/Severe Postpartum Depression	2.52**	—	1.62**	—
Age Group				
18–25	—	2.06**	2.64**	2.41**
36+	—	—	—	—
Education				
High school degree	0.45**	—	—	—
Some college	0.20**	—	—	—
College/graduate school	0.03**	0.27**	0.04**	—
Married/Cohabiting	—	0.55**	—	0.43**
Employment	—	—	—	—
Part-time	—	—	—	—
Full-time	—	—	—	—
Race/Ethnicity				
Black	0.13**	0.39**	—	—
Hispanic	0.03**	0.30**	0.41*	0.47*
Asian and Others	0.52**	0.57**	0.41*	0.59*
Household Income				
100–1300% poverty line	—	—	—	—
130–185% poverty line	0.62*	—	—	—
Above 185% poverty line	0.30**	—	0.41**	—

^a See Table 1 footnote for reference categories.

^b Adjusted Odds Ratio within each panel.

* p-value <0.05

** p-value <0.01

Table 4

Full model of social integration, emotional, behavioral, and sociodemographic measures (ECLS-B, N=9,050)^a

	Persistent smokers	Temporary quitters	Delayed initiators	Pregnancy-inspired quitters
	AOR ^b	AOR	AOR	AOR
Religious Service Attendance				
1–2 times/year	0.70* (0.50, 0.97)	—	—	—
Several times a year	0.40** (0.25, 0.63)	—	—	—
1–2 times/month	0.43** (0.28, 0.67)	—	—	—
Nearly every week +	0.18** (0.11, 0.31)	0.39** (0.25, 0.63)	—	0.45* (0.23, 0.89)
Breastfeeding Duration				
>6 months	0.31** (0.19, 0.52)	0.52** (0.31, 0.88)	0.54* (0.30, 0.96)	—
Postpartum Drinking				
Any postpartum drinking	2.13** (1.53, 2.98)	2.09** (1.52, 2.89)	1.95** (1.23, 3.08)	—
Household Smokers				
1+ additional smoker	6.08** (4.43, 8.36)	6.89** (4.61, 10.30)	1.96** (1.33, 2.89)	—
Postpartum Depression				
Moderate/severe	1.93** (1.36, 2.74)	—	—	—
Age Group				
18–25	—	1.58* (1.10, 2.28)	2.46** (1.64, 3.68)	2.31** (1.07, 4.99)
Education				
High school degree	0.56** (0.39, 0.81)	—	—	—
Some college	0.33** (0.21, 0.50)	—	—	—
College/graduate school	0.06** (0.02, 0.14)	—	0.06** (0.02, 0.25)	—
Marital Status				
Married/cohabitating	0.52** (0.36, 0.75)	0.40** (0.24, 0.65)	—	0.38** (0.20, 0.75)

	Persistent smokers	Temporary quitters	Delayed initiators	Pregnancy- inspired quitters
	11.7%	9.4%	5.1%	3.3%
	AOR ^b	AOR	AOR	AOR
Race/ Ethnicity				
Black	0.14 ^{**} (0.07, 0.30)	0.46 ^{**} (0.29, 0.73)	—	0.02 [*] (0.00, 0.75)
Hispanic	0.05 ^{**} (0.03, 0.09)	0.34 [*] (0.15, 0.80)	0.27 ^{**} (0.13, 0.55)	—
Asian and Others	0.47 ^{**} (0.31, 0.72)	0.54 ^{**} (0.34, 0.85)	0.44 [*] (0.19, 1.01)	0.55 [*] (0.31, 0.98)
Household Income	0.41 ^{**} (0.24, 0.69)	1.65 ^{**} (1.08, 2.53)	0.45 ^{**} (0.27, 0.75)	—

^aResults adjusted for community service activities, social connectedness, social support, and employment status, none of which were significant in the full model.

^bAdjusted Odds Ratio.

* p-value <0.05

** p-value <0.01