Michigan PRAMS Delivery

Maternal Adverse Childhood Experiences and Late Pregnancy Smoking

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Traumatic events experienced during childhood may have lingering negative effects throughout life. Adverse Childhood Experiences (ACEs) describe a person's experiences of abuse, neglect or trauma during early life. Individuals experiencing ACEs are more likely to engage in risky health behaviors, develop chronic health conditions and die at a younger age.[1]

Maternal ACEs are of special interest since they could impact the health of both mothers and babies. Mothers who have had many adverse childhood experiences are more likely to have infants born at low birthweight (<2,500g)[2] and have an increased risk of experiencing postpartum depression.[3] In addition, maternal adverse childhood experiences are associated with a greater risk of smoking during pregnancy,[4, 5] which also leads to impaired infant development.[6] A greater understanding of the relationship between maternal ACEs and mothers' behaviors is necessary in order to focus and improve provider discussions during prenatal care. The Michigan Pregnancy Risk Assessment Monitoring System (MI PRAMS) collected information in 2016 and 2017 regarding new mothers' behaviors and experiences, including ACEs and smoking. This issue examines the prevalence of ACEs among Michigan mothers and their relationship with smoking during late pregnancy.

KEY POINTS

- Nearly one half (48.6%) of all Michigan mothers self-report at least one **adverse childhood experience**.
- One in fifteen new Michigan mothers self-report experiencing **four or more ACEs** during childhood.
- One in nine new Michigan mothers report **smoking cigarettes** during the last three months of pregnancy.
- Without accounting for other potential contributing factors, mothers who had experienced ACEs were **more likely** to report smoking during late pregnancy than mothers reporting no ACEs.
- After adjusting for other potential contributing factors, when compared to mothers with no ACEs the adjusted odds (aOR) of smoking during late pregnancy were **significantly higher** for mothers reporting even one ACE (aOR: 1.58) and greater still for mothers reporting 2-3 (aOR: 1.87) or 4+ (aOR: 2.46) ACEs.

METHODS

We used data from MI PRAMS birth years 2016-2017 in this analysis. The average weighted response rate across these years was 55.5%. We aggregated survey responses from these two years into a single data set; approximately 3,695 respondents representing 217,729 mothers of live births were used to generate population proportions. To account for the complex survey design, we calculated point estimates and 95% confidence intervals using SAS version 9.4. We performed significance tests at the p<0.05 level and ran frequencies and associations within the SAS Survey Procedures suite using the codes proc surveyfreq and proc surveylogistic. We used a logit link function in order to model the dichotomous outcome of smoking during late pregnancy.

VARIABLES

Adverse Childhood Experiences were measured as a seven-item scale, used by the 2011 California Maternal and Infant Health Assessment[7] and adapted in part from the 2011-2012 National Survey of Children's Health.[8] Participants were asked about seven adversities from birth through age 13, as seen in Figure 1a.

The dependent variable of smoking during late pregnancy was measured as a binary outcome. Mothers who had smoked any cigarettes in the two years before completing the survey were asked about their frequency of smoking during the last three months of pregnancy, as seen in Figure 1b. If a mother confirmed using any cigarettes during the last three months of pregnancy, they were coded as smokers for the purpose of this analysis.

To broadly capture financial need we constructed a composite "federal services eligibility" variable from several sources. If the birth certificate indicated a mom received WIC food assistance during pregnancy or if Medicaid paid for delivery then she was considered eligible. Additionally, if a mother's reported household income was at or below 195% of the federal poverty level then she was likely eligible for Medicaid and was also considered eligible.

Figure 1a. PRAMS Question 75, ACEs (2016-2017)

75. Some of these things might happen to people during childhood. Childhood experiences may be important. Please tell us if any of these things ever happened to you from the time you were born through age 13.

	No	Yes
a. Most of the time, I had an adult who believed in me and who I could count on to help me	❑	❑
b. A parent or guardian I lived with got divorced or separated	❑	❑
c. We had to move because of problems paying the rent or mortgage	❑	❑
d. Someone in my family or I went hungry because we could not afford enough food	❑	❑
e. A parent or guardian got in trouble with the law or went to jail	❑	❑
f. A parent or guardian I lived with had a serious drinking or drug problem	❑	❑
g. I was in foster care (removed from my home by the court or child welfare agency)	❑	❑

Figure 1b. PRAMS Question 28, Smoking during the last 3 months of pregnancy (2016-2017)

28. In the *last 3 months* of your pregnancy, how many cigarettes did you smoke on an average day? A pack has 20 cigarettes.

- ❑ 41 cigarettes or more
- ❑ 21 to 40 cigarettes
- ❑ 11 to 20 cigarettes
- ❑ 6 to 10 cigarettes
- ❑ 1 to 5 cigarettes
- ❑ Less than 1 cigarette
- ❑ I didn't smoke then

Michigan Pregnancy Risk Assessment Monitoring System, MI PRAMS, is a population-based public health surveillance project of the Michigan Department of Health and Human Services and the Centers for Disease Control and Prevention (CDC). Since 1987, Michigan PRAMS has provided data not available from other sources on maternal attitudes and experiences before, during and after pregnancy. The data is used to identify groups of women and infants at high risk for health problems, monitor changes in health status and measure progress towards goals in improving the health of Michigan's mothers and babies.

ADVERSE CHILDHOOD EXPERIENCES

Nearly one half of all Michigan mothers who had live births between 2016 and 2017 reported experiencing at least one ACE occurring from the time they were born through age 13 (Table 1; 48.6%, 95% CI: 46.4%-50.7%). In addition, 1 out of every 15 new mothers reported experiencing four or more ACEs when they were a child (6.7%, 95% CI: 5.6%-7.8%). Table 1 shows the prevalence of ACEs among Michigan mothers delivering a live-born infant during 2016 and 2017. Table 2 shows that parental divorce or separation (33.8%, 95% CI: 31.8%-35.9%) and problematic parental substance use (17.2%, 95% CI: 15.5%-18.9%) were the most common ACEs.

Table 1. Prevalence of ACEs*

Number of ACEs	Weighted Percent	95% Confidence Interval
0 ACEs	51.4	(49.3-53.6)
1 ACE	24.2	(22.4-26.0)
2-3 ACEs	17.7	(16.0-19.3)
4+ ACEs	6.7	(5.6-7.8)

Table 2. Prevalence of ACEs Items*

ACE Item	Weighted Percent	95% Confidence Interval
A parent or guardian I lived with got divorced or separated	33.8	(31.8-35.9)
A parent or guardian I lived with had a serious drinking or drug problem	17.2	(15.5-18.9)
We had to move because of problems paying the rent or mortgage	13.7	(12.2-15.2)
A parent or guardian got in trouble with the law or went to jail	13.1	(11.7-14.6)
Someone in my family or I went hungry because we could not afford enough food	8.1	(6.9-9.3)
Most of the time, I did not have an adult who believed in me and who I could count on to help me	7.7	(6.6-8.8)
I was in foster care (removed from my home by the court or child welfare agency)	4.4	(3.5-5.2)

*MI PRAMS 2016-2017 Question # 75: Some of these things might happen to people during childhood. Childhood experiences may be important. Please tell us if any of these things ever happened to you from the time you were born through age 13.

The prevalence of reporting any ACEs varied by maternal demographics with 57.4% of non-Hispanic black women reported one or more ACEs (CI: 54.9%-60.0%) compared to 46.6% of non-Hispanic white women (CI: 43.8%-49.4%). ACE prevalence differed by those eligible for federal services (57.5%, CI: 54.8%-60.2%) and those not eligible (34.7%, CI: 31.4%-45.2%), as well as unmarried (65.2%, CI: 62.2%-68.3%) and married (37.9%, CI: 34.2%-40.6%) mothers.

ASSOCIATION BETWEEN ACEs & SMOKING DURING PREGNANCY

In 2016 and 2017, 11.1% of mothers in Michigan smoked during the last three months of pregnancy. Of mothers who reported experiencing 4 or more ACEs, 28.7% smoked during late pregnancy (CI: 20.8-36.6), compared to 18.3% of those reporting 2-3 ACEs (CI: 14.0-22.6), 12.7% of those reporting one ACE (CI: 9.7-15.7), and 5.6% of those reporting no ACEs (CI: 4.2-7.0). In an unadjusted model of association, women with 4 or more ACEs had 6.8 greater odds (Odds Ratio [OR] CI: 4.3-10.8, $p<0.0001$) of smoking during late pregnancy than women with no ACEs. We observed statistically significant elevated unadjusted odds for mothers reporting one ACE (OR: 2.5, CI: 1.7-3.6, $p<0.0001$) and 2-3 ACEs (OR: 3.8, CI: 2.6-5.6, $p<0.0001$).

In order to further investigate the association between number of adverse childhood experiences and smoking during late pregnancy, we employed a logistic regression model comparing the likelihood of smoking during pregnancy among those who experienced 1, 2-3, and 4 or more ACEs.

Potential confounders considered for the logistic regression model were maternal age, race/ethnicity, maternal education, marital status, eligibility for federal services, experience of domestic abuse before or during pregnancy, and cumulative number of life stressors. Among these, experience of domestic abuse was not a significant confounder and was removed from the model. Because there are possible relationships between some confounders (i.e. age and income, age and education) we tested the remaining potential model variables for multicollinearity. No variables

were found to be significantly correlated. Finally, the model was tested for 14 interaction terms, of which three were found to be significant: maternal race/ethnicity by federal services eligibility, maternal age by federal services eligibility, and marital status by federal services eligibility. These terms were included in the final model.

Table 3 shows the results from our logistic regression analysis. Compared to ORs seen in the unadjusted model, the magnitudes of association are diminished after controlling for confounding factors - yet remain significant. Compared to mothers reporting no ACEs, mothers with any one ACE were more likely to have reported smoking during the last three months of pregnancy (adjusted Odds Ratio [aOR]: 1.58, CI: 1.04-2.39). Furthermore, the likelihood of reporting smoking during the last three months of pregnancy was further increased for mothers reporting 2-3 ACEs (aOR: 1.87, CI: 1.18-2.89) and those reporting 4 or more ACEs (aOR: 2.46, CI: 1.44-4.22) compared to mothers reporting no ACEs. In summary, mothers reporting one or more ACEs were significantly more likely to smoke during late pregnancy than mothers reporting no ACEs, and the magnitude of effect increased with quantity of maternal ACEs.

Table 3. Association Between Smoking During Pregnancy and ACEs, MI PRAMS 2016-2017

Number of ACEs	Odds Ratio	95% Confidence Interval
0 ACEs	1.0	Reference
1 ACE	1.58	(1.04-2.39)
2-3 ACEs	1.87	(1.18-2.89)
4+ ACEs	2.46	(1.44-4.22)

STRENGTHS & LIMITATIONS

MI PRAMS mixed-mode data collection methodology provides a population representative view of the effects of ACEs on smoking in new mothers in Michigan. MI PRAMS uses a stratified random sampling to account for differing population densities and sub-group response rates. Consistent yearly unweighted response rates ranging between 50-60% ensure a robust weighted dataset. A consistent methodology incorporating best survey practices allows for comparisons over time and aggregation of data across years. The variables included in this model have low rates of item missingness. Finally, to further minimize response bias, MI PRAMS provides a high level of confidentiality which may encourage mothers to share sensitive information.

As with all population-based cross-sectional surveys, MI PRAMS data may be affected by recall and social desirability biases. The MI PRAMS ACEs scale is not a comprehensive list of stressful or traumatic events that occur during childhood. The significant results of this analysis may reflect the need for an expanded ACEs scale in order to further display the impact of ACEs on maternal behaviors.

CONCLUSIONS & FUTURE DIRECTIONS

Because nearly all pregnant women receive prenatal care, health care providers have a unique opportunity to address ACEs and reduce their impact on the health of mother and infant. Health care providers should consider administering ACEs screenings and making appropriate referrals for counseling and health behavior modification programs based on national guidelines. This is particularly important for women who have endured multiple ACEs, given their increased risk of late pregnancy smoking and potentially reduced access to healthcare before and after pregnancy.

The results of this analysis demonstrate the lingering impact of maternal childhood trauma on the wellbeing of mothers and their infants. Further analysis of MI PRAMS ACEs data along with other maternal behaviors and infant outcomes will help establish a more robust base of information on the impact of maternal ACEs.

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