Published in final edited form as:

Child Care Health Dev. 2014 May ; 40(3): 441–445. doi:10.1111/cch.12058.

Identifying infants at high-risk for second-hand smoke exposure

S. S. Hawkins[★] and L. Berkman[†]

[★]Graduate School of Social Work, Boston College, Chestnut Hill, MA, USA

[†]Harvard Center for Population and Development Studies, Harvard School of Public Health, Cambridge, MA, USA

Abstract

Background—To examine the social determinants of infant smoke exposure and whether these associations vary by mothers' smoking status and number of children in the household.

Methods—There were 135 278 mothers from 28 states who participated in the Pregnancy Risk Assessment Monitoring System from 2000 to 2003.

Results—Overall 9.9% of mothers reported that her infant was in the same room as someone smoking for 1 or more hours per day. Among smoking households, infants with 1 or 2+ siblings were 25% and 59% more likely to be exposed to 1+ hours of second-hand smoke daily, respectively, than infants with no siblings.

Conclusion—Infants only a few months old are being exposed to second-hand smoke, particularly infants whose mother smokes and infants with siblings, indicating the importance of surveillance even for this young age group.

Keywords

infant; second-hand smoke

Introduction

While pregnancy is often a time of positive behaviour change for many women, approximately half of women who quit smoking during pregnancy resume postpartum (Colman & Joyce 2003; Tong *et al.* 2009; Page *et al.* 2012). Children's primary exposure to tobacco smoke occurs in the home, particularly for infants (US Department of Health and Human Services 2006), and estimates suggest that up to one-third of children in the USA live with at least one smoker (Schuster *et al.* 2002; King *et al.* 2009; Hawkins & Berkman 2011a). Children's second-hand smoke exposure is socially patterned, with differences evident across racial/ethnic groups and children from disadvantaged circumstances are more

likely to live in households with smokers (Schuster *et al.* 2002; King *et al.* 2009; Marano *et al.* 2009; Hawkins & Berkman 2011a).

We have shown previously that the age of children appears to influence parental smoking behaviours. Parents of school-age children and adolescents are less likely to have a no smoking policy (Hawkins & Berkman 2011b) and more likely to report that someone smokes inside the home (Hawkins & Berkman 2011a) than parents with a child under age 5. However, little is known whether social and racial/ethnic differences in exposure emerge in children's first year of life. We examined the social determinants of infant smoke exposure and whether these associations varied by mothers' smoking status and number of children in the household.

Methods

The Pregnancy Risk Assessment Monitoring System (PRAMS) is a surveillance system in the USA designed to monitor maternal health behaviours before, during, and after pregnancy. States randomly sample 100–250 mothers per month and mothers complete the questionnaires approximately 4 months post-partum. Additional information on the PRAMS survey methodology has been published elsewhere (Centers for Disease Control and Prevention 2010).

We only included data from 2000 to 2003 because the PRAMS questionnaire no longer asks mothers about the number of children in the household. During these years, 153 912 mothers participated in PRAMS from 28 states. Mothers were excluded if information was missing on infant smoke exposure (10 921), number of children (5682), maternal smoking status (2860), race/ethnicity (534), education (2026), age (21), marital status (91), WIC status (1393), or the sampling stratum had less than five participants (19). Some mothers had more than one exclusion criterion. There were 135 278 mothers included in the analyses.

The Harvard School of Public Health Institutional Review Board reviewed this study and considered it exempt.

The PRAMS questionnaire asked mothers 'about how many hours a day, on average, is your new baby in the same room with someone who is smoking?', which we coded as < versus 1+ hours. Mothers reported the number of babies, children, or teenagers living in her house, apartment, or trailer. We grouped the number of children in the household as: infant with no siblings, infant with 1 sibling, and infant with 2+ siblings. Mothers also reported whether they currently smoked. PRAMS survey data are linked to infants' birth certificates. Each mother reported her race/ethnicity, years of education, age, marital status, and whether she was on the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) during pregnancy.

We conducted analyses using STATA statistical software, version 12.0. SE, and analysis weights were included. We first examined whether infant smoke exposure varied, separately, by maternal smoking and number of children in the household using a Pearson's chi-squared test. We then tested whether the association between infant smoke exposure and number of children in the household varied by maternal smoking. The interaction, evaluated

by an adjusted Wald test, was significant ($F = 5.8$; $P = 0.003$) so analyses were stratified. We conducted mutually adjusted logistic regression models which examined the associations between infant smoke exposure and the following socio-demographic characteristics, separately, by maternal smoking: number of children in the household, maternal race/ ethnicity, education, age, marital status, and WIC status.

Results

Overall 9.9% of mothers reported that her infant was in the same room as someone smoking for 1 or more hours per day, with a mean exposure of 3.3 h (range 1–24 h). However, infant exposure varied by whether the mother currently smoked (6.6% of non-smokers, 24.5% of smokers; $P < 0.001$) and number of children in the household (8.9% of infants with no siblings, 10.1% of infants with 1 sibling, 10.9% of infants with 2+ siblings; $P < 0.001$).

Among households with a mother who currently smoked, infants with one or at least two siblings were 25% and 59% more likely to be exposed to one or more hours of second-hand smoke, respectively, than infants with no siblings (Table 1). Mothers who were Hispanic, Black, or Other race/ethnicity were all less likely to report infant exposure of 1+ hours of secondhand smoke than white mothers. Mothers with at least some college education or were 25 years or older were also less likely to report infant smoke exposure. In contrast, mothers who were not married or on WIC during pregnancy were more likely to report her infant was exposed to 1+ hours of smoke. The mean number of hours of infant smoke exposure also varied by the number of children in the household (among mothers reporting any exposure): 3.8 h with an infant only, 3.7 h with an infant and 1 sibling, and 4.6 h with an infant and 2+ siblings.

Among households with a mother who was a non-smoker, infants with any siblings were approximately 20% more likely to be exposed to 1 or more hours of second-hand smoke daily than infants with no siblings (Table 1). The gradients for maternal race/ethnicity, education, age, marital status, and WIC status were similar to those for households with mothers who currently smoked. The mean number of hours of exposure also varied by the number of children in the household (among mothers reporting any exposure): 2.6 h with an infant only, 2.7 h with an infant and 1 sibling, and 3.4 h with an infant and 2+ siblings.

Discussion

We found that infants whose mother smoked postpartum and infants with siblings were at greater risk of second-hand smoke exposure. Among mothers reporting any infant smoke exposure, regardless of their smoking status, this translated to approximately 3 h daily that infants were exposed to secondhand smoke. Infant smoke exposure was also socially patterned with infants born to white mothers and mothers with low educational attainment, not married, and on WIC during pregnancy more likely to be exposed to second-hand smoke. These findings are consistent with studies including older children (Schuster *et al.* 2002; King *et al.* 2009; Marano *et al.* 2009; Hawkins & Berkman 2011a).

The PRAMS questionnaire has not asked mothers about the number of children in the household since 2003. Our current and previous findings have shown that the presence and

ages of children in the household are important determinants of parental smoking behaviours and household smoking policies (Hawkins & Berkman 2011a, b). Particularly for smokers, having an infant or young child in the household is protective for reducing second-hand smoke exposure and having a home smoking policy. Research has also shown that women with one or more previous live births are more likely to smoke during pregnancy, compared with first time mothers, and they are more likely to continue smoking postpartum (Colman & Joyce 2003; Martin *et al.* 2008). In combination these studies suggest that parents change their smoking habits and home smoking policies as they have more children or as children grow up. Longitudinal studies of families and qualitative research are needed to better understand these decision-making processes and help identify critical periods for when interventions may be most effective.

In this sample 13% of mothers reported smoking during the last 3 months of pregnancy and 19% reported smoking at the time the survey was completed (data not shown), indicating that many mothers are taking up smoking again within the first few months postpartum. Maternal smoking during pregnancy is often under-reported (Gorber *et al.* 2009; Shipton *et al.* 2009), suggesting that mothers' report of infant exposure may also be under-reported. While PRAMS does not collect information on whom in the household smokes or the number of cigarettes smoked, infants are being exposed to other sources of second-hand smoke. Even in households with non-smoking mothers, almost 7% of mothers reported her infant was exposed to one or more hours of smoke daily. Currently, there is limited known about infant exposure at either the state- or population-level. A question on home smoking policies was added to the PRAMS core questionnaire in 2009. Further questions are needed to enquire about the different sources of exposure and whether the exposure is only in the family's home or other locations.

The detrimental health effects of second-hand smoke on infants and children are well-known (US Department of Health and Human Services 2006). Implementing a no smoking policy in the home and only smoking outdoors can help reduce all family members' exposure to second-hand smoke (Best *et al.* 2009). Healthcare professionals need to continue asking parents about their smoking habits and home smoking policies during visits throughout pregnancy and postpartum as well as visits in paediatric clinics (Fiore *et al.* 2008; Best *et al.* 2009). The US Healthy People 2020 target to reduce the proportion of non-smokers exposed to second-hand smoke includes children age 3 years and older (US Department of Health and Human Services 2012). Our findings highlight that infants only a few months old are being exposed to second-hand smoke, particularly infants whose mother smokes and infants with siblings, indicating the importance of surveillance even for this young age group.

Acknowledgments

Funding

S. S. H. is funded by grant from NICHD (R00HD068506). There was no additional funding source for this study. The funder had no role in the study design; in the collection, analysis and interpretation of data; in the writing of the report; and in the decision to submit the paper for publication.

We would like to thank the PRAMS Working Group: Alabama – Albert Woolbright, PhD; Alaska – Kathy Perham-Hester, MS, MPH; Arkansas – Mary McGehee, PhD; Colorado – Alyson Shupe, PhD; Delaware – George Yocher, MS; Florida – Aruna Surendera Babu; Georgia – Carol Hoban, PhD, MS.MPH; Hawaii – Emily Roberson, MPH;

Illinois – Theresa Sandidge, MA; Louisiana – Joan Wightkin, DrPH; Maine – Tom Pat-enaude; Maryland – Diana Cheng, MD; Massachusetts – Haf-satou Diop, MD, MPH; Michigan – Violanda Grigorescu, MD, MSPH; Minnesota – Judy Punyko, PhD, MPH; Mississippi – Marilyn Jones, M.Ed; Missouri – Venkata Garikapaty, MSc, MS, PhD, MPH; Montana – JoAnn Dotson; Nebraska – Brenda Coufal; New Jersey – Lakota Kruse, MD; New Mexico – Eirian Coronado, MA; New York State – Anne Radigan-Garcia; New York City – Candace Mulready-Ward, MPH; North Carolina – Kathleen Jones-Vessey, MS; North Dakota – Sandra Anset; Ohio – Connie Geidenberger, PhD; Oklahoma – Alicia Lincoln, MSW, MSPH; Oregon – Kenneth Rosenberg, MD; Pennsylvania – Tony Norwood; Rhode Island – Sam Viner-Brown, PhD; South Carolina – Mike Smith; South Dakota Tribal – Jennifer Irving, MPH; Texas – Kate Sullivan, PhD; Tennessee – David Law, PhD; Utah – Laurie Baksh; Vermont – Peggy Brozicevic; Virginia – Marilyn Wenner; Washington – Linda Lohdefinck; West Virginia – Melissa Baker, MA; Wisconsin – Katherine Kvale, PhD; Wyoming – Angi Crotsenberg; CDC PRAMS Team, Applied Sciences Branch, Division of Reproductive Health.

References

- Best D. Committee on Environmental Health, Committee on Native American Child Health & Committee on Adolescence. From the American Academy of Pediatrics: technical report – secondhand and prenatal tobacco smoke exposure. *Pediatrics*. 2009; 124:e1017–e1044. [PubMed: 19841110]
- Centers for Disease Control and Prevention. [last accessed 3 May 2010] Pregnancy Risk Assessment Monitoring System (PRAMS). 2010. Available at: <http://www.cdc.gov/prams/>
- Colman GJ, Joyce T. Trends in smoking before, during, and after pregnancy in ten states. *American Journal of Preventive Medicine*. 2003; 24:29–35. [PubMed: 12554021]
- Fiore, MC.; Jaen, CR.; Baker, TB.; Bailey, WC.; Benowitz, NL.; Curry, SJ.; Dorfman, SF.; Froelicher, ES.; Goldstein, MG.; Heaton, CG.; Henderson, PN.; Heyman, RB.; Koh, HK.; Kottke, TE.; Lando, HA.; Mecklenburg, RE.; Mermelstein, RJ.; Mullen, PD.; Orleans, CT.; Robinson, L.; Stitzer, ML.; Tommasello, AC.; Villejo, L.; Wewers, ME. Clinical Practice Guideline. US Department of Health and Human Services. Public Health Service; Rockville, MD, USA: 2008. Treating Tobacco Use and Dependence: 2008 Update.
- Gorber SC, Schofield-Hurwitz S, Hardt J, Levasseur G, Tremblay M. The accuracy of self-reported smoking: a systematic review of the relationship between self-reported and cotinine-assessed smoking status. *Nicotine and Tobacco Research*. 2009; 11:12–24. [PubMed: 19246437]
- Hawkins SS, Berkman L. Increased tobacco exposure in older children and its effect on asthma and ear infections. *Journal of Adolescent Health*. 2011a; 48:647–650. [PubMed: 21575830]
- Hawkins SS, Berkman L. Parental home smoking policies: the protective effect of having a young child in the household. *Preventive Medicine*. 2011b; 53:61–63. [PubMed: 21679724]
- King K, Martynenko M, Bergman MH, Liu YH, Winickoff JP, Weitzman M. Family composition and children's exposure to adult smokers in their homes. *Pediatrics*. 2009; 123:e559–e564. [PubMed: 19336347]
- Marano C, Schober SE, Brody DJ, Zhang C. Secondhand tobacco smoke exposure among children and adolescents: United States, 2003–2006. *Pediatrics*. 2009; 124:1299–1305. [PubMed: 19841116]
- Martin LT, McNamara M, Milot A, Bloch M, Hair EC, Halle T. Correlates of smoking before, during, and after pregnancy. *American Journal of Health Behaviors*. 2008; 32:272–282.
- Page RL, Padilla YC, Hamilton ER. Psychosocial factors associated with patterns of smoking surrounding pregnancy in fragile families. *Maternal and Child Health Journal*. 2012; 16:249–257. [PubMed: 21197563]
- Schuster MA, Franke T, Pham CB. Smoking patterns of household members and visitors in homes with children in the United States. *Archives of Pediatric & Adolescent Medicine*. 2002; 156:1094–1100.
- Shipton D, Tappin DM, Vadeloo T, Crossley JA, Aitken DA, Chalmers J. Reliability of self reported smoking status by pregnant women for estimating smoking prevalence: a retrospective, cross sectional study. *British Medical Journal*. 2009; 339:b4347. [PubMed: 19875845]
- Tong VT, Jones JR, Dietz PM, D'Angelo D, Bombard JM. Trends in smoking before, during, and after pregnancy –Pregnancy Risk Assessment Monitoring System (PRAMS), United States, 31 sites, 2000–2005. *MMWR Surveillance Summary*. 2009; 58:1–29.

- US Department of Health and Human Services. The Health Consequences of Involuntary Exposure to Tobacco Smoke: A Report of the Surgeon General. US Department of Health and Human Services; Atlanta, GA, USA: 2006.
- US Department of Health and Human Services. [last accessed 16 January 2012] Healthy People 2020< Objective Topic Areas. 2012. Available at: <http://healthypeople.gov/2020/topicsobjectives2020/pdfs/HP2020objectives.pdf>

Key messages

- Infants whose mother smoked postpartum and infants with siblings were at greater risk of second-hand smoke exposure.
- Smoke exposure was socially patterned with infants born to white mothers and mothers from disadvantaged circumstances more likely to be exposed to second-hand smoke.
- Infants only a few months old are being exposed to second-hand smoke, indicating the importance of surveillance even for this young age group.

Adjusted odds ratios of the infant exposed to 1+ hours of second-hand smoke by whether the mother currently smoked, 2000–2003 PRAMS surveys ($n = 135\,278$)

Table 1

Infant exposed to 1+ hours of second-hand smoke					
	Overall <i>n</i> (weighted %)	Weighted %	Adjusted OR (95% CI)	Weighted %	Adjusted OR (95% CI)
Number of children in the household					
Infant with no siblings	46 977 (34.5)	21.3	1	6.1	1
Infant with 1 sibling	46 556 (36.0)	24.3	1.25 (1.10, 1.41)	6.8	1.22 (1.11, 1.35)
Infant with 2+ siblings	41 745 (29.5)	28.6	1.59 (1.40, 1.81)	6.9	1.21 (1.08, 1.34)
Maternal race/ethnicity					
White	77 308 (65.7)	25.9	1	7.2	1
Hispanic	16 952 (13.5)	11.9	0.34 (0.26, 0.45)	2.1	0.15 (0.13, 0.19)
Black	23 474 (16.0)	22.8	0.67 (0.58, 0.78)	8.7	0.58 (0.52, 0.64)
Other	17 544 (4.8)	17.7	0.54 (0.42, 0.70)	5.2	0.61 (0.52, 0.73)
Maternal education (years)					
0–11	25 259 (18.2)	28.1	1	9.1	1
12	46 329 (31.9)	25.9	1.00 (0.88, 1.12)	9.3	0.99 (0.87, 1.12)
13–15	30 681 (22.5)	20.3	0.80 (0.68, 0.95)	5.9	0.70 (0.60, 0.81)
16+	33 009 (27.4)	13.4	0.59 (0.45, 0.77)	3.4	0.50 (0.42, 0.59)
Maternal age, grouped (years)					
<17–19	18 804 (11.1)	28.4	1	13.1	1
20–24	35 572 (25.4)	26.3	0.94 (0.82, 1.09)	9.3	0.84 (0.74, 0.95)
25–29	34 781 (27.0)	22.4	0.83 (0.71, 0.98)	5.8	0.69 (0.60, 0.79)
30–34	28 318 (23.5)	20.8	0.79 (0.66, 0.96)	3.9	0.51 (0.43, 0.61)
35+	17 803 (13.1)	21.2	0.82 (0.65, 1.03)	4.2	0.54 (0.45, 0.65)
Marital status					
Married	86 109 (66.7)	22.2	1	5.0	1
Not married	49 169 (33.3)	26.6	1.13 (1.01, 1.27)	10.6	1.55 (1.39, 1.73)
On WIC during pregnancy					
No	72 444 (58.5)	19.6	1	4.8	1

Infant exposed to 1+ hours of second-hand smoke					
		Mother currently smoked (<i>n</i> = 27 924)		Mother was a non-smoker (<i>n</i> = 107 354)	
	Overall <i>n</i> (weighted %)	Weighted %	Adjusted OR (95% CI)	Weighted %	Adjusted OR (95% CI)
Yes	62 834 (41.5)	28.0	1.41 (1.26, 1.57)	9.5	1.47 (1.33, 1.63)

PRAMS, The Pregnancy Risk Assessment Monitoring System; WIC, Women, Infants, and Children.