Inequities in Workplace Secondhand Smoke Exposure Among Nonsmoking Women of Reproductive Age

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Objectives. We characterized workplace secondhand smoke exposure among nonsmoking women of reproductive age as a proxy for workplace secondhand smoke exposure during pregnancy.

Methods. We included nonsmoking women aged 18 to 44 years employed during the past 12 months who participated in the 2010 National Health Interview Survey. We estimated the prevalence of workplace secondhand smoke exposure and its associations with sociodemographic and workplace characteristics.

Results. Nine percent of women reported workplace secondhand smoke exposure. Prevalence decreased with increasing age, education, and earnings. Workplace secondhand smoke exposure was associated with chemical exposure (prevalence odds ratio [POR] = 3.3; 95% confidence interval [CI] = 2.3, 4.7); being threatened, bullied, or harassed (POR = 3.2; 95% CI = 2.1, 5.1); vapors, gas, dust, or fume exposure (POR = 3.1; 95% CI = 2.3, 4.4); and worrying about unemployment (POR = 3.0; 95% CI = 1.8, 5.2), among other things.

Conclusions. Comprehensive smoke-free laws covering all workers could eliminate inequities in workplace secondhand smoke exposure, including during pregnancy. (*Am J Public Health.* 2015;105:e33–e40. doi:10.2105/AJPH.2014.302380)

An estimated 49% of persons in the United States are covered by smoke-free legislation protecting workers from secondhand smoke in all indoor, private, nonhospitality workplaces (e.g., offices, factories, warehouses), restaurants, and bars.[1] In the absence of smoke-free legislation, employers can implement company-specific smoke-free policies, increasing the number of workers protected from exposure to secondhand smoke.

Despite the existence of smoke-free laws and policies, 1 in 10 nonsmoking US workers continues to report regular exposure to secondhand smoke in the workplace.[2] Secondhand smoke exposure is associated with chronic diseases such as lung cancer, coronary heart disease, and stroke and with adverse reproductive effects, including low birth weight, when mothers are exposed during pregnancy.[3] Two thirds of first-time mothers work at some point during their pregnancy, meaning that a substantial proportion of fetuses could be exposed to secondhand smoke at their mother's workplace.[4]

There are few data available on the prevalence of workplace secondhand smoke among pregnant women in the United States or on the characteristics of pregnant women and their workplaces associated with secondhand smoke exposure. This information would help us identify which pregnant workers remain at risk for secondhand smoke exposure despite the growing number of smoke-free laws and policies in the United States.

From previous studies, we know that not all US workers are equally likely to be exposed to secondhand smoke at work. Workplace secondhand smoke exposure is more common among men than women, decreases with age and educational attainment, and is most prevalent among blue-collar workers and in industries such as mining and construction.[2,5,6] Because of the differences in prevalence of exposure by gender, age, and type of employment, estimates of prevalence from the worker population as a whole (men and women of all ages) are likely not generalizable to women of reproductive age.

We investigated the prevalence of reported workplace secondhand smoke exposure among women of reproductive age as a proxy for the prevalence of exposure during pregnancy and sociodemographic and workplace characteristics associated with workplace secondhand smoke exposure in this population.

METHODS

The National Health Interview Survey (NHIS) is an annual cross-sectional household survey of the health and health behaviors of the civilian, noninstitutionalized population of the United States conducted by the National Center for Health Statistics, Centers for Disease Control and Prevention.[7] NHIS, ongoing since 1957, is administered in person by trained interviewers from the US Census Bureau. Major themes of NHIS include chronic diseases, health limitations, and interactions with the health care system. NHIS includes basic questions on participants' work, including current industry and occupation, work hours, and workplace injuries and poisonings.

In 2010, the National Institute for Occupational Safety and Health sponsored an Occupational Health Supplement, which collected additional information on work, including a more detailed work history and information on work organization, chemical and physical agent exposures, and psychosocial exposures such as job insecurity and workplace bullying.[8] A question on workplace secondhand smoke exposure was also included: "During the past 12 months, were you regularly exposed to tobacco smoke from other people at work twice a week or more?"

Inclusion Criteria

We included women aged 18 to 44 years who participated in the 2010 NHIS Occupational Health Supplement, who reported that they were working for pay within the past 12 months, and who answered either "yes" or "no" to the survey question on workplace secondhand smoke exposure.

We included only current nonsmokers in our analyses. We defined a current nonsmoker

as a woman who reported smoking either fewer than 100 cigarettes in her lifetime or at least 100 cigarettes in her lifetime but was currently not smoking at all. We did not apply any further exclusion criteria.

Variables of Interest

Our outcome of interest was prevalence of workplace secondhand smoke exposure. We calculated this prevalence among all respondents and within strata of sociodemographic and workplace characteristics.

Sociodemographic characteristics of interest were age (18–24, 25–29, 30–34, 35–39, and 40–44 years), race/ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, and other), country of birth (United States and other), region of the country (Midwest, Northeast, South, and West), education (for all women and restricted to women aged 25–44 years; less than high school, high school or equivalent, some college, bachelor's degree, and graduate degree), and perceived health status (excellent, very good, good, and fair or poor).

For questions about work, if respondents were currently working, they answered on the basis of their current job; otherwise, they answered on the basis of their most recently held job within the past 12 months. Trained coders from the US Census Bureau coded industry and occupation using US Census codes on the basis of the 2007 North American Industrial Classification System and the 2010 Standard Occupational Classification system from respondents' descriptions of their type of business and work activities. NHIS grouped these jobs into 21 simple and 79 detailed industry codes and 23 simple and 94 detailed occupation codes.

Questions on current or most recent job characteristics included employer type (private, government, self-employed); employer size (1–9, 10–99, 100–499, ≥ 500); work schedule (day, evening, night, rotating, other); yearly earnings from all jobs ($0–$19 999, $20 000–$44 999, ≥ $45 000); whether employer offers paid sick leave; whether respondent worried about unemployment; ability to combine family and work responsibilities; and regular exposure to vapors, gas, dust, or fumes. All respondents were asked if they had experienced any of the following at any job during the past 12 months: being threatened, bullied, or harassed; handling or coming into skin contact with chemicals twice a week or more; or regularly working outdoors. Women who were currently employed were asked whether they were working multiple jobs, the number of hours they worked per week at all jobs (1–20, 21–40, ≥ 41), and whether their employer offered health insurance.

Statistical Analysis

We calculated prevalence (%) and 95% confidence intervals (CIs) for workplace secondhand smoke exposure. To investigate associations between sociodemographic and work characteristics and secondhand smoke, we used logistic regression to estimate prevalence odds ratios (PORs) and 95% CIs for these associations. We calculated *P* values for linear trend for ordinal variables; for numeric variables, we used the midpoint of each category as the value for the category in the calculation of *P* for trend. We have not reported any results for which the coefficient of variation (CV) exceeded 50% or for which there were fewer than 5 exposed women; for all results with CVs between 30% and 49%, these estimates are potentially unstable.

We created predictive models to identify the characteristics most predictive of workplace secondhand smoke exposure. Variables eligible for inclusion in the model were sociodemographic and work characteristic variables associated with workplace secondhand smoke exposure with a *P* level of less than .05 in bivariate analyses. We used forward selection, entering each variable in turn (beginning from the lowest type 3 Wald *P* value) and removing any with a *P* value of .05 or greater.

We conducted all analyses in SAS version 9.3 (SAS Institute, Cary, NC) and used SAS survey procedures to take into account the complex sampling design of NHIS. Analytic weights are included with the NHIS data set, so when the data are properly weighted in the analysis, the findings are representative of the civilian, noninstitutionalized population of the United States and account for survey nonresponse bias.[7] Because age distributions differ between the general population and pregnant women, we used a previously described method to adjust the NHIS analytic weights using age- and race/ethnicity-specific birth rates so that the data better reflect the age distribution of pregnant women.[9,10]

We calculated single-year age- and race/ethnicity-specific birth rates using data from the National Vital Statistics System (number of births for year 2010 in each age and race/ethnicity stratum)[11] and the US Census (number of women in year 2010 in each age and race/ethnicity stratum).[12] We multiplied NHIS analytic weights by the age- and race/ethnicity-specific birth rates to create the age-adjusted analytic weights we used in the analysis.

RESULTS

We included 4088 nonsmoking women aged 18 to 44 years who were working for pay within the past 12 months; using the birth rate weighting, this represents 2.3 million pregnant women. Nine percent (95% CI = 8%, 10%) of these women reported regular exposure to secondhand smoke at work during the past 12 months, corresponding to an estimated 200 000 nonsmoking working pregnant women exposed.

Prevalence of workplace secondhand smoke exposure decreased with increasing age (*P* = .020) and educational attainment (*P* = .001; Table 1). Higher prevalence of exposure was reported by non-Hispanic Black women (POR = 2.2; 95% CI = 1.4, 3.5; non-Hispanic Black vs non-Hispanic White) and women living in the South (POR = 1.6; 95% CI = 1.1, 2.3; South vs Midwest). When we created a predictive model for the sociodemographic variables, only education and race/ethnicity were retained in the final model.

Workplace characteristics associated with secondhand smoke exposure included working non–day shifts, working outdoors, being paid an hourly wage, and having low earnings (Table 2). Workplace secondhand smoke exposure was strongly associated with the presence of other potential workplace hazards and stressors, including chemical exposures (POR = 3.3; 95% CI = 2.3, 4.7); being threatened, harassed, or bullied at work (POR = 3.2; 95% CI = 2.1, 5.1); exposure to vapors, gas, dust, or fumes (POR = 3.1; 95% CI = 2.3, 4.4); and worrying about unemployment (POR = 3.0; 95% CI = 1.8, 5.2 for strongly agree vs strongly disagree). Variables retained in the predictive

TABLE 1—Prevalence of Workplace Secondhand Smoke Exposure by Sociodemographic Characteristics: National Health Interview Survey, United States, 2010

Characteristic	Unweighted No.	Weighted No.	% Exposed (95% CI)	Weighted No. Exposed	Crude POR (95% CI)	Predictive Model POR (95% CI)[a]	P[b]
Overall	4 088	2 322 049	9 (8.0, 10.0)	204 421			
Age, y							
18–24	856	726 754	10 (8.0, 13.0)	74 912	2.0 (1.2, 3.2)		
25–29	811	678 159	9 (7.0, 11.0)	61 293	1.7 (1.1, 2.8)		
30–34	803	566 940	8 (6.0, 11.0)	46 850	1.6 (1.0, 2.4)		
35–39	819	284 245	6 (4.0, 8.0)	17 788	1.2 (0.7, 1.9)		
40–44	799	65 952	5 (4.0, 7.0)	3 578	1.0 (Ref)		
Race/ethnicity							
Non-Hispanic White	1 945	1 341 369	7 (6.0, 9.0)	95 041	1.0 (Ref)	1.0 (Ref)	
Non-Hispanic Black	795	385 437	14 (10.0, 19.0)	55 422	2.2 (1.4, 3.5)	1.9 (1.2, 3.0)	
Hispanic	1 007	465 412	9 (6.0, 12.0)	42 134	1.3 (0.9, 1.9)	1.1 (0.8, 1.7)	
Other	341	129 832	9 (4.0, 14.0)	11 824	1.3 (0.7, 2.4)	1.5 (0.8, 2.8)	
Country of birth							
United States	3 103	1 920 427	9 (7.0, 10.0)	164 757	1.0 (Ref)		
Other	983	400 257	10 (6.0, 13.0)	39 663	1.2 (0.8, 1.8)		
Missing	2	1 365					
Region							
South	1 533	844 007	11 (9.0, 13.0)	90 805	1.6 (1.1, 2.3)		
Northeast	604	364 078	9 (5.0, 13.0)	31 924	1.3 (0.7, 2.2)		
West	1 072	577 632	8 (5.0, 10.0)	44 431	1.1 (0.7, 1.7)		
Midwest	879	536 333	7 (5.0, 9.0)	37 261	1.0 (Ref)		
Education (all women)							.001
< high school	400	168 382	10 (5.0, 14.0)	16 386	2.4 (1.0, 5.4)	2.2 (0.9, 5.3)	
High school or equivalent	763	424 099	10 (7.0, 13.0)	41 821	2.4 (1.2, 4.7)	2.2 (1.1, 4.4)	
Some college or associate's degree	1 422	845 110	11 (8.0, 14.0)	94 955	2.8 (1.4, 5.4)	2.6 (1.3, 5.0)	
Bachelor's degree	995	613 914	6 (4.0, 8.0)	39 679	1.5 (0.8, 3.0)	1.5 (0.7, 3.1)	
Graduate degree	498	264 583	4 (2.0, 7.0)	11 580	1.0 (Ref)	1.0 (Ref)	
Missing	10	5 962					
Education (women ≥ 25 y)[c]							
< high school	315	109 375	11 (6.0, 17.0)	12 482	2.8 (1.1, 7.0)		
High school or equivalent	573	270 989	10 (7.0, 13.0)	27 699	2.5 (1.2, 5.0)		
Some college or associate's degree	1 017	483 402	10 (7.0, 12.0)	46 837	2.3 (1.2, 4.7)		
Bachelor's degree	832	471 318	7 (4.0, 9.0)	31 279	1.6 (0.7, 3.2)		
Graduate degree	487	255 625	4 (2.0, 7.0)	11 212	1.0 (Ref)		
Missing	8	4 586					
Health status							
Excellent	1 533	924 900	8 (6.0, 10.0)	71 585	1.0 (Ref)		
Very good	1 457	851 299	8 (6.0, 10.0)	70 522	1.1 (0.7, 1.6)		
Good	887	459 921	11 (8.0, 14.0)	51 161	1.5 (1.0, 2.2)		
Fair or poor	210	85 566	13 (6.0, 20.0)	11 153	1.8 (0.9, 3.5)		
Missing	1	362					

Note. CI = confidence interval; POR = prevalence odds ratio.
[a]Variables remaining in model after forward selection of sociodemographic variables at a threshold of $P < .05$.
[b]P value for trend for the predictive model.
[c]Not included in the predictive model.

model were chemical exposures; being threatened, harassed, or bullied; exposure to vapors, gas, dust, or fumes; worrying about unemployment; earnings; and employer size.

We created a combined predictive model including the 12 sociodemographic and workplace variables associated with workplace secondhand smoke exposure at a *P* level of less than .05 in bivariate analyses (Tables 1 and 2). Following forward elimination, only workplace variables remained; these were the same variables retained in the predictive model for workplace characteristics (Table 2).

Prevalence of workplace secondhand smoke in the 5 most common simple industry and occupation groups (on the basis of weighted sample size in our study population) are shown in Table 3; results for all simple and detailed industry and occupation groups with sufficient sample size for analysis are available as a supplement to the online version of this article at http://www.ajph.org. Of the 5 most common industries and occupations, prevalence of workplace secondhand smoke exposure was higher in the accommodation and food services industry (19%; adjusted POR = 2.7; 95% CI = 1.6, 4.7) than in all other industries and in food preparation and serving-related occupations (19%; adjusted POR = 2.1; 95% CI = 1.1, 3.9) than in all other occupations.

Among the detailed industry groups, the accommodation industry had the highest prevalence of workplace secondhand smoke exposure (36%; POR = 6.0; 95% CI = 1.9, 19.3), followed by miscellaneous store retailers (25%; POR = 4.1; 95% CI = 1.1, 15.3; CV = 39%), and nursing and residential care facilities (19%; POR = 2.5; 95% CI = 1.3, 4.9). Among the detailed occupation groups, the highest prevalence of exposure was among law enforcement workers (27%; POR = 4.5; 95% CI = 1.1, 18.8; CV = 42%), food and beverage serving workers (21%; POR = 2.2; 95% CI = 1.0, 4.7), and building cleaning and pest-control workers (19%; POR = 2.1; 95% CI = 1.0, 4.6).

TABLE 2—Prevalence of Workplace Secondhand Smoke Exposure by Work Characteristics: National Health Interview Survey, United States, 2010

Variable	Unweighted No.	Weighted No.	% Exposed (95% CI)	Weighted No. Exposed	Crude POR (95% CI)	Predictive Model POR (95% CI)[a]	*P*[b]
Employer type							
Private company	3 091	1 804 572	10 (8, 11)	172 398	1.0 (Ref)		
Government	759	407 089	7 (4, 9)	26 962	0.7 (0.5, 1.0)		
Self-employed	238	110 389	5 (1, 8)[c]	5061	0.5 (0.2, 1.0)		
Employer size							.22
1–9	916	498 395	6 (4, 9)	31 791	1.0 (Ref)	1.0 (Ref)	
10–99	1 528	921 368	11 (9, 13)	99 683	1.8 (1.0, 3.0)	2.1 (1.2, 3.7)	
100–499	746	427 660	10 (7, 14)	44 824	1.7 (1.0, 3.0)	2.5 (1.4, 4.6)	
≥ 500	741	386 308	6 (4, 8)	23 017	0.9 (0.5, 1.8)	1.2 (0.6, 2.4)	
Missing	157						
Working > 1 job[d]							
Yes	322	195 512	9 (4, 14)	18 215	1.2 (0.6, 2.2)		
No	3 279	1 815 442	8 (7, 9)	145 043	1.0 (Ref)		
Missing	487	311 095					
Regularly work outdoors							
Yes	417	233 063	14 (10, 18)	31 906	1.8 (1.3, 2.5)		
No	3 671	2 088 986	8 (7, 10)	172 515	1.0 (Ref)		
Hours worked/wk[d,e]							
1–20	502	308 334	8 (4, 12)	24 087	1.0 (Ref)		
21–40	2 433	1 346 194	8 (6, 9)	107 107	1.0 (0.6, 1.9)		
≥ 41	649	341 053	9 (6, 13)	31 581	1.2 (0.6, 2.4)		
Missing	504	326 468					
Work schedule							
Day	2 912	1 579 111	7 (6, 8)	113 527	1.0 (Ref)		
Evening	239	153 026	19 (10, 28)	28 759	3.0 (1.6, 5.5)		
Night	176	100 423	16 (9, 23)	16 029	2.5 (1.4, 4.2)		
Rotating	457	305 748	10 (7, 14)	32 065	1.5 (1.0, 2.3)		
Other	300	176 657	8 (4, 12)	14 040	1.1 (0.6, 2.0)		
Missing	4	7 085					

Continued

TABLE 2—*Continued*

Yearly earnings from all jobs, $							.003
0–19 999	1 297	743 611	11 (9, 14)	84 374	2.7 (1.6, 4.9)	2.4 (1.4, 4.2)	
20 000–44 999	1 265	722 828	9 (7, 11)	66 926	2.2 (1.3, 3.8)	2.0 (1.2, 3.6)	
≥ 45 000	757	355 356	4 (2, 6)	15 748	1.0 (Ref)	1.0 (Ref)	
Missing	769	500 254					
Paid by the hour							
Yes	2 690	1 582 123	10 (9, 12)	165 190	2.0 (1.4, 3.0)		
No	1 390	729 019	5 (4, 7)	39 231	1.0 (Ref)		
Missing	8	10 908					
Employer offers paid sick leave							
Yes	2 162	1 192 669	8 (6, 10)	93 660	1.0 (Ref)		
No	1 895	1 106 619	10 (8, 12)	108 418	1.3 (0.9, 1.8)		
Missing	31	22 761					
Employer offers health insurance[d]							
Yes	2 314	1 254 512	8 (7, 10)	102 256	1.0 (Ref)		
No	1 260	729 899	8 (6, 10)	57 406	1.0 (0.7, 1.4)		
Missing	514	337 639					
Harassed, bullied, threatened							
Yes	316	186 515	21 (14, 28)	39 266	3.2 (2.1, 5.1)	2.4 (1.3, 4.2)	
No	3 769	2 130 965	8 (6, 9)	165 155	1.0 (Ref)	1.0 (Ref)	
Missing	3	4 569					
Worried about unemployment							< .001
Strongly agree	516	248 105	16 (10, 22)	40 028	3.0 (1.8, 5.2)	3.1 (1.7, 5.7)	
Agree	813	440 689	9 (6, 12)	39 574	1.5 (0.9, 2.5)	1.5 (0.9, 2.6)	
Disagree	1 599	951 139	9 (7, 11)	83 470	1.5 (0.9, 2.4)	1.5 (0.9, 2.6)	
Strongly disagree	1 152	674 381	6 (4, 8)	41 152	1.0 (Ref)	1.0 (Ref)	
Missing	8	7 735					
Easy to combine work and family responsibilities							
Strongly agree	1 228	719 645	8 (6, 11)	58 983	1.0 (Ref)		
Agree	2 067	1 189 531	8 (7, 10)	101 074	1.0 (0.7, 1.5)		
Disagree	586	304 063	11 (8, 15)	34 159	1.4 (0.9, 2.2)		
Strongly disagree	192	96 528	11 (5, 16)	10 205	1.4 (0.7, 2.5)		
Missing	15	12 283					
Dermal chemical exposures							
Yes	672	379 300	19 (15, 23)	72 327	3.3 (2.3, 4.7)	2.1 (1.4, 3.0)	
No	3 415	1 941 835	7 (6, 8)	132 094	1.0 (Ref)	1.0 (Ref)	
Missing	1	914					
Vapors, dust, gas, or fume exposures							
Yes	580	293 900	20 (15, 24)	57 866	3.1 (2.3, 4.4)	2.4 (1.6, 3.6)	
No	3 500	2 023 821	7 (6, 9)	146 555	1.0 (Ref)	1.0 (Ref)	
Missing	8	4 328					

Note. CI = confidence interval; POR = prevalence odds ratio.
[a]Variables remaining in the model after forward selection of workplace characteristics at threshold $P < .05$.
[b]P for trend for the predictive model.
[c]Coefficient of variation = 39%.
[d]We asked only women who are currently working.
[e]Answered by the designated family respondent; could be either self-report or proxy report.

TABLE 3—Prevalence of Workplace Secondhand Smoke Exposure in the 5 Most Common Industries and Occupations Reported by Study Participants: National Health Interview Survey, United States, 2010

Industry or Occupation	Unweighted No.	Weighted No.	% Exposed (95% CI)	Weighted No. Exposed	Crude POR (95% CI)[a]	Adjusted POR (95% CI)[b]
Industry						
Health care and social assistance	951	536 714	9 (6.0, 11.0)	47 296	1.0 (0.7, 1.4)	0.8 (0.6, 1.0)
Education services	529	311 213	4 (2.0, 6.0)	12 227	0.4 (0.2, 0.7)	0.4 (0.2, 0.7)
Retail trade	447	307 251	10 (6.0, 14.0)	29 992	1.1 (0.7, 1.9)	1.2 (0.6, 2.2)
Accommodation and food services	353	220 920	19 (14.0, 25.0)	42 877	2.9 (1.9, 4.2)	2.7 (1.6, 4.7)
Professional, scientific, and technical services	271	159 413	3 (1.0, 5.0)[c]	4 822	0.3 (0.1, 0.7)	0.5 (0.2, 1.3)
Occupation						
Office and administrative support	756	441 797	6 (4.0, 9.0)	28 328	0.7 (0.4, 1.0)	0.8 (0.4, 1.3)
Sales and related	460	295 295	10 (6.0, 14.0)	29 569	1.2 (0.7, 2.0)	1.3 (0.7, 2.4)
Education, training, and library	398	240 663	2 (1.0, 4.0)[c]	5 666	0.2 (0.1, 0.5)	0.2 (0.1, 0.5)
Health care practitioners and technical	342	182 548	8 (5.0, 12.0)	15 292	0.9 (0.6, 1.5)	1.1 (0.6, 2.0)
Food preparation and serving related	271	173 175	19 (12.0, 26.0)	32 406	2.6 (1.6, 4.3)	2.1 (1.1, 3.9)

Note. CI = confidence interval; POR = prevalence odds ratio.
[a]Odds of exposure compared with all other industries or occupations.
[b]Adjusted for chemical exposure; earnings; employer size; harassment, bullying, or threats; exposure to vapor, gas, dust, or fumes; and worrying about unemployment.
[c]Coefficient of variation ≥ 30% and < 50%.

DISCUSSION

We estimate that 9% of US nonsmoking pregnant women are regularly exposed to secondhand smoke in the workplace; additionally, our results demonstrate that this exposure varies markedly by sociodemographic and workplace characteristics and by industry and occupation. Characteristics that indicate low socioeconomic status and potentially hazardous workplace conditions were strongly associated with exposure, suggesting that women who are already at the highest risk for adverse pregnancy outcomes are those most likely to be exposed to workplace secondhand smoke.

Smoke-free workplace laws and policies are effective public health interventions for protecting workers from secondhand smoke exposure.[13] However, most laws and policies in the United States do not cover outdoor workers or workers in private residences, and many do not cover workers in restaurants, bars, hotels, or casinos, leaving large groups of workers unprotected.[1] Accordingly, we found that women working outdoors were more likely to report secondhand smoke exposure than were indoor workers. A limitation of our analysis was that we had no information about which women worked in private residences. Workers in the accommodation and food services industry (which includes restaurants and bars) had some of the highest reported prevalences of workplace secondhand smoke exposure in our analysis, consistent with workers in these industries being less likely to be protected than were workers in nonhospitality industries.

The marked differences observed by sociodemographic characteristics might reflect that workers with low socioeconomic status are the most likely to work in industries or occupations not covered by smoke-free laws or policies. We used predictive models to identify the strongest predictors of workplace secondhand smoke exposure and found that workplace and not sociodemographic characteristics were the strongest predictors. The presence of a smoke-free workplace law or policy is a strong determinant of exposure. Our finding that variables that indicate low socioeconomic status are associated with exposure highlight characteristics of the women whose workplaces are not subject to these laws and of those for whom exposure to workplace secondhand smoke continues to occur.

We recognize a limitation in the questionnaire related to secondhand smoke exposure: we were unable to determine whether secondhand smoke exposure reported by study participants was intentional. An example of intentional exposure is spending time with smokers on a break, whereas an example of unintentional exposure is a client or customer smoking in the workplace when the worker would rather maintain a smoke-free workplace. Therefore, our estimates of the prevalence of secondhand smoke exposure represent more than what could be prevented by comprehensive smoke-free laws and policies. Policies prohibiting smoking anywhere on the company premises are becoming more common and could help to reduce the prevalence of any secondhand smoke exposure.

We focused our analyses on the potential for fetal harm caused by workplace secondhand smoke exposure, an exposed population that receives little attention in the occupational safety and health literature. Secondhand smoke is an example of a hazardous workplace exposure that affects not only the workers who have direct exposure but their families as well.[14] The workplace is an important source of secondhand smoke for both the mother and baby during pregnancy, particularly if the mother is otherwise avoiding smoking and exposure to secondhand smoke in other venues. A recent study showed that the enactment of smoke-free legislation resulted in a decreased prevalence of preterm birth in

the population, demonstrating that smoke-free laws and policies offer health benefits to a greater number of people than only workers themselves.[15]

We did not identify any previous nationally representative studies evaluating predictors of workplace secondhand smoke exposure specific to US women of reproductive age. However, results of previous studies of all US workers are similar to ours, showing that higher prevalence of exposure to workplace secondhand smoke (either exposure to secondhand smoke or absence of a smoke-free workplace policy) is associated with younger age, non-Hispanic Black race/ethnicity, lower educational attainment, lower income, and working in food service occupations.[2,5,16–18] These similar results are seen in studies conducted decades apart, demonstrating ongoing inequities in workplace secondhand smoke exposure.

Workplace characteristics aside from industry and occupation have been infrequently investigated in association with secondhand smoke exposure; inclusion of these variables was a strength of our study. Smoking can interact with other occupational exposures to increase risk for some diseases; secondhand smoke might have similar interactive effects.[19–21] Our finding that 1 in 5 women exposed to chemicals, vapors, gas, dust, or fumes at work are also exposed to secondhand smoke at work suggests that a substantial proportion of workers are exposed to this increased risk for occupational disease. Psychological stressors such as worrying about unemployment or being threatened, harassed, or bullied at work were also strongly associated with workplace secondhand smoke exposure. Women who worried about losing their jobs or who feel intimidated at work might not be able to talk to their employers about creating a smoke-free environment at work without fear of reprisal. Enactment of state or local smoke-free laws will be the most effective means to protect workers who are unable to advocate their own workplace smoke-free policies.

Estimating the prevalence of workplace secondhand smoke exposure among pregnant women in the United States is a challenge because there are few nationally representative data sets including both a large number of pregnant women and detailed information on workplace exposures. One limitation of our data reweighting was our inability to take into account that some women might change their job, working status, or hours worked during pregnancy, which could affect their potential for exposure to workplace secondhand smoke. A study of US mothers of live-born infants showed that self-reported workplace secondhand smoke exposure decreased by 12% from the 3 months before conception through the third trimester of pregnancy.[22] A second limitation was use of US live birth certificates as the basis for calculating weights; a substantial proportion of pregnancies do not end in live birth, and characteristics of mothers and their occupations might differ between mothers who have live births and those who have other birth outcomes.

Predictors of workplace secondhand smoke exposure identified in our study might not be predictors of exposure in other countries, where women might work in different types of jobs, smoke-free legislation might differ, or a greater or lesser proportion of the general population smokes. The inverse associations that we observed between age and education and secondhand smoke exposure were not seen in a study of workplace secondhand smoke exposure among women aged 15 to 49 years in low- and middle-income countries. The prevalence of workplace secondhand smoke exposure was substantially higher in these countries than in the United States (14%–53%), underscoring the importance of workplace secondhand smoke as a global public health problem.[23]

Our results come from a contemporary population of women living in the United States, where smoke-free laws and policies are inconsistently applied. They suggest that workplace secondhand smoke exposure clusters with risk factors for adverse pregnancy outcomes, such as low educational attainment, low income, and potentially hazardous workplace exposures, meaning that an already vulnerable population of women and fetuses is the most likely to be exposed to secondhand smoke in the workplace. Employer-based smoke-free policies and workplace smoking cessation programs are important interventions that employers can implement in the absence of smoke-free laws in their region. Having comprehensive smoke-free laws covering all US workers, regardless of industry or occupation, would be an effective public health intervention for protecting workers and their families and for eliminating inequities in workplace secondhand smoke exposure. ■

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Contributors

C. Y. Johnson led development of the project, conducted the analyses, and drafted the article. All authors contributed to development of the project, interpretation of results, and revisions to the article.

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