

Trends in Smoking During Pregnancy in Wisconsin, 2011-2016

Renee T. Sullender, BA; Patrick L. Remington, MD, MPH

ABSTRACT

Background: Smoking during pregnancy remains a significant public health concern with widespread social, economic, and health effects.

Objective: To describe the epidemiology of maternal smoking in Wisconsin over time and by county, age, race/ethnicity, education, and other characteristics.

Methods: Cigarette smoking during pregnancy in 2011-2016 was evaluated using Wisconsin Interactive Statistics on Health data.

Results: Maternal smoking rates declined from 14.4% in 2011 to 11.4% in 2016. Rates are highest among women aged 20-24 and those with less education. American Indians had the highest rates of smoking during pregnancy at all education levels.

Conclusion: Despite continued declines in the rates of smoking during pregnancy in Wisconsin, disparities exist for American Indians, young, and less-educated women. Physicians should continue to encourage cessation throughout pregnancy and support evidence-based community programs and policies.

In 2016, one in 14 women (7.2%) who gave birth in the United States smoked during pregnancy.³ Women aged 20-24 had the highest prevalence of smoking at 10.7%. By race, American Indian/Alaskan Natives had the highest smoking prevalence at 16.7%, compared to 10.5% for whites, 6.0% for blacks, 1.8% for Hispanics, and 0.6% for Asians. There were significant differences by state, with a high of 25.1% in West Virginia and a low of 1.6% in California.

The purpose of this study was to describe current trends in smoking rates among different populations of pregnant women in Wisconsin in order to better target tobacco cessation interventions.

BACKGROUND

Smoking during pregnancy can have vast implications for mothers and children, including preterm delivery, low birth weight, sudden infant death syndrome, and preterm-related deaths.¹ There is no safe smoking threshold, and women should be encouraged to stop smoking before becoming pregnant. However, many women face barriers to smoking cessation before or during pregnancy. Those who continue to smoke are more likely to be low income, have partners who smoke, have higher degrees of addiction, and have multiple prior pregnancies.²

• • •

Author Affiliations: University of Wisconsin School of Medicine and Public Health, Madison, Wis (Sullender, Remington).

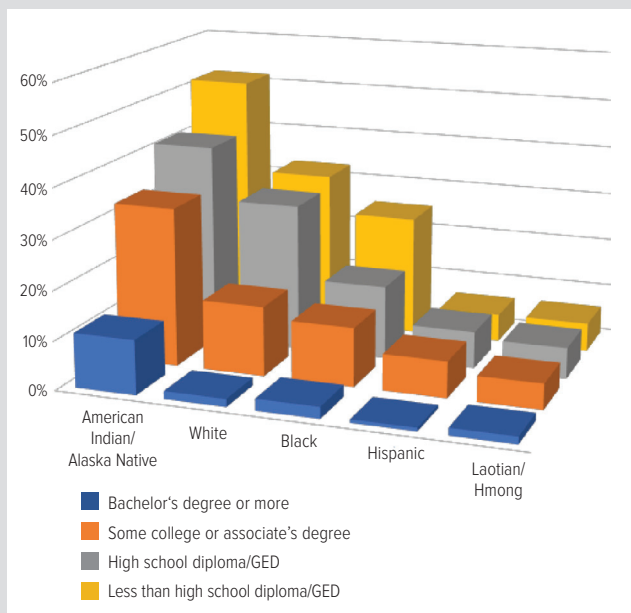
Corresponding Author: Patrick L. Remington, MD, MPH, 610 Walnut St, Rm 1007, Madison, WI 53726; phone 608.263.1745; email plreming@wisc.edu.

METHODS

Data on smoking during pregnancy in Wisconsin were obtained from Wisconsin Interactive Statistics on Health, 2011-2016. Trends by age and race/ethnicity were further assessed for 2001-2016. Smoking data are self-reported by mothers on birth certificates in response to questions about cigarette use. The data were analyzed by county, age, race/ethnicity, education, marital status, number of previous pregnancies, maternal body mass index (BMI), trimester during which prenatal care was initiated, medical payment type, infant birthweight, and breastfeeding status. We restricted the analysis by education to women 25 years of age and older, since younger women may not have completed their full education.

We used the following formula to estimate the 95% confidence limits (CL): $95\% \text{ CL} = 1.96 * (\text{rate}/\sqrt{n})$, where n = births with maternal smoking during pregnancy in 2011-2016.⁴ Rates

Figure. Smoking During Pregnancy by Race/Ethnicity and Education, 2011-2016



Abbreviations: GED, general education diploma.

were considered significantly different if their 95% CL did not overlap.

RESULTS

There were 402,252 births in Wisconsin from 2011 to 2016, of which 52,631 mothers smoked during pregnancy (13.1%). The smoking rate has declined over time, from 15.8% in 2001 to 14.4% in 2011 and 11.4% in 2016.

Smoking during pregnancy varies by a number of demographic characteristics depicted in Table 1. Women aged 20-24 years were the most likely to smoke, followed by those aged 18-19 and 25-29, respectively. American Indians/Alaska natives (American Indians) had a 38.6% smoking prevalence—2.8 times higher than the rate among whites (13.8%). Women with some high school but no diploma or general education diploma (GED) had the highest smoking rates. Compared to women with a doctorate/professional degree, they were 73 times more likely to smoke (29.3% vs 0.4%). When controlling for age, this increased to an 83 times difference (33.2% vs 0.4%).

Analysis by race/ethnicity suggests that American Indians had the highest rates of smoking during pregnancy in all educational categories and Hispanics and Laotian/Hmong had the lowest (Figure). Of American Indians with less than a high school diploma/GED, 51.6% smoked during pregnancy, compared to 41.2% of those with a diploma/GED, 32.7% with some college/associate degree, and 11.2% with at least a bachelor's degree. Among mothers without a high school degree, 32.5% of whites, 24.7% of blacks, 5.8% of Laotian/Hmong, and 5.7% of Hispanics smoked during pregnancy. Among those with at least a bachelor's

Table 1. Smoking During Pregnancy by Characteristics, 2011-2016

Maternal Characteristics	Total No. Births	% Smoke During Pregnancy (95% CL)
All births	402,252	13.1 (13.0 - 13.3)
Age		
< 15 years	229	5.2 (2.3 - 8.2)
15 - 17 years	5,461	11.5 (10.6 - 12.4)
18 - 19 years	16,109	19.8 (19.1 - 20.5)
20 - 24 years	80,386	20.9 (20.6 - 21.2)
25 - 29 years	127,091	13.5 (13.3 - 13.7)
30 - 34 years	117,303	9.0 (8.8 - 9.2)
35 - 39 years	46,506	8.3 (8.0 - 8.6)
40 - 44 years	8,627	8.2 (7.6 - 8.8)
45+ years	535	4.9 (3.0 - 6.7)
Race/ethnicity		
White	292,845	13.8 (13.6 - 13.9)
Black	38,349	15.5 (15.1 - 15.9)
American Indians/Alaska natives	4,423	38.6 (36.7 - 40.4)
Hispanic	38,982	6.2 (6.0 - 6.5)
Laotian or Hmong	9,297	5.2 (4.7 - 5.7)
Education (restricted to women aged 25 and older)		
8th grade or less	10,980	3.4 (3.0 - 3.7)
9th - 12th grade, no diploma	13,427	33.2 (32.2 - 34.2)
High school graduate or GED	53,023	24.3 (23.9 - 24.7)
Some college credit, no degree	53,722	17.3 (17.0 - 17.7)
Associate degree	39,040	8.3 (8.0 - 8.6)
Bachelor's degree	86,975	1.9 (1.8 - 2.0)
Master's degree	32,291	0.8 (0.7 - 0.9)
Doctorate or professional degree	9,326	0.4 (0.3 - 0.5)
Marital status		
Married	251,958	5.7 (5.6 - 5.8)
Not married	148,153	25.8 (25.5 - 26.1)
Number of previous pregnancies		
0	118,940	10.8 (10.6 - 11.0)
1	113,334	11.6 (11.4 - 11.8)
2	75,115	13.5 (13.2 - 13.8)
3	43,138	15.9 (15.5 - 16.3)
4	23,187	18.4 (17.9 - 19.0)
5 or more	27,822	20.1 (19.6 - 20.7)
Body mass index		
Underweight (<18.50)	10,013	19.4 (18.5 - 20.3)
Normal (18.50 - 24.99)	169,469	11.5 (11.3 - 11.7)
Overweight (25.00 - 29.99)	103,640	12.7 (12.5 - 12.9)
Obese (≥ 30.00)	112,188	15.4 (15.2 - 15.7)
Trimester prenatal care initiated		
1 - 3 months (1st trimester)	304,972	11.7 (11.6 - 11.9)
4 - 6 months (2nd trimester)	66,151	17.4 (17.1 - 17.8)
7 - 9 months (3rd trimester)	14,562	19.3 (18.6 - 20.0)
No prenatal care	2,504	31.5 (29.2 - 33.7)
Principal source of payment		
Medicaid/BadgerCare	151,429	24.3 (24.0 - 24.5)
Private	224,230	5.8 (5.7 - 5.9)
Self-pay	11,391	7.0 (6.5 - 7.5)
Other	10,701	15.5 (14.8 - 16.3)
Infant Birthweight		
Under 1,000 grams	2,579	19.4 (17.7 - 21.1)
1,000 - 1,499 grams	2,661	17.7 (16.1 - 19.3)
1,500 - 2,499 grams	23,864	22.4 (21.8 - 23.0)
2,500 - 3,999 grams	333,687	13.1 (13.0 - 13.3)
4,000+ grams	39,339	6.9 (6.6 - 7.2)
Infant Breastfed		
Yes	299,450	9.9 (9.8 - 10.0)
No	77,433	25.4 (25.0 - 25.7)

Abbreviation: GED, general education diploma.

The total per category may not sum to the total number of births due to other and missing data.

Table 2. Smoking During Pregnancy by Wisconsin County, 2011-2016

County	Rank	No. Smoke	% Smoke (95% CL)	County	Rank	No. Smoke	% Smoke (95% CL)
Wisconsin	N/A	52,631	13.1 (13.0-13.3)	Marathon	28	1,422	14.8 (14.0-15.5)
Adams	65	219	27.8 (24.1-31.4)	Marinette	61	565	26.0 (23.8-28.1)
Ashland	68	319	30.0 (26.7-33.2)	Marquette	57	205	22.7 (19.6-25.8)
Barron	47	598	19.6 (18.0-21.2)	Menominee	71	185	33.3 (28.5-38.1)
Bayfield	62	195	26.1 (22.4-29.8)	Milwaukee	12	9,437	11.3 (11.1-11.6)
Brown	15	2,577	12.7 (12.2-13.2)	Monroe	40	666	18.1 (16.7-19.5)
Buffalo	31	130	14.9 (12.3-17.4)	Oconto	50	438	20.6 (18.7-22.5)
Burnett	66	230	29.1 (25.3-32.8)	Oneida	55	397	22.1 (19.9-24.3)
Calumet	6	296	9.2 (8.2-10.3)	Outagamie	13	1,574	11.5 (10.9-12.0)
Chippewa	39	748	17.4 (16.1-18.6)	Ozaukee	2	316	6.5 (5.8-7.2)
Clark	7	339	9.9 (8.8-10.9)	Pepin	5	44	9.2 (6.5-11.9)
Columbia	34	594	16.5 (15.2-17.8)	Pierce	11	264	11.3 (9.9-12.6)
Crawford	44	182	18.7 (16.0-21.4)	Polk	49	502	19.9 (18.1-21.6)
Dane	3	2,579	7.1 (6.8-7.3)	Portage	20	543	13.2 (12.0-14.3)
Dodge	42	899	18.2 (17.0-19.4)	Price	53	139	21.3 (17.8-24.9)
Door	33	204	16.0 (13.8-18.2)	Racine	19	1,867	13.0 (12.4-13.6)
Douglas	51	540	20.8 (19.1-22.6)	Richland	32	169	15.9 (13.5-18.3)
Dunn	41	496	18.1 (16.5-19.7)	Rock	38	2,006	17.3 (16.5-18.0)
Eau Claire	30	1,066	14.8 (14.0-15.7)	Rusk	54	190	22.1 (18.9-25.2)
Florence	67	36	29.3 (19.7-38.8)	St. Croix	69	560	8.9 (8.2-9.7)
Fond Du Lac	35	1,082	16.6 (15.7-17.6)	Sauk	45	772	16.8 (15.6-18.0)
Forest	72	221	33.9 (29.5-38.4)	Sawyer	26	307	31.1 (27.6-34.6)
Grant	16	419	12.7 (11.5-13.9)	Shawano	4	493	19.3 (17.6-21.0)
Green	27	333	14.6 (13.0-16.2)	Sheboygan	37	1,066	14.0 (13.5-15.2)
Green Lake	43	221	18.3 (15.9-20.7)	Taylor	23	191	14.0 (12.0-16.0)
Iowa	18	209	13.0 (11.2-14.7)	Trempealeau	24	339	14.1 (12.6-15.6)
Iron	64	46	26.9 (19.1-34.7)	Vernon	10	260	10.3 (9.0-11.5)
Jackson	59	344	23.1 (20.6-25.5)	Vilas	70	338	32.2 (28.8-35.7)
Jefferson	25	752	14.3 (13.3-15.3)	Walworth	14	765	12.4 (11.6-13.3)
Juneau	60	403	24.5 (22.1-26.9)	Washburn	56	198	22.4 (19.3-25.6)
Kenosha	22	1,591	13.7 (13.0-14.3)	Washington	8	804	10.0 (9.3-10.7)
Kewaunee	17	153	12.8 (10.8-14.8)	Waukesha	1	1,428	6.2 (5.9-6.6)
La Crosse	21	982	13.2 (12.4-14.0)	Waupaca	52	646	21.1 (19.5-22.7)
Lafayette	9	128	10.1 (8.3-11.8)	Waushara	46	263	19.4 (17.1-21.8)
Langlade	63	308	26.4 (23.4-29.3)	Winnebago	29	1,668	14.8 (14.1-15.5)
Lincoln	58	368	23.0 (20.7-25.4)	Wood	48	976	19.8 (18.6-21.0)
Manitowoc	36	819	16.8 (15.6-17.9)				

degree, smoking rates were 7 times higher for American Indians than white women (11.2% vs 1.6%).

Trends by race/ethnicity were assessed from 2001 to 2016. Smoking during pregnancy by whites (16.5% in 2001, 15.2% in 2011, 11.4% in 2016) and blacks (19.1% in 2001, 16.4% in 2011, 13.0% in 2016) decreased over time. Smoking by American Indians (37.7% in 2001, 40.7% in 2011, 36.1% in 2016) and Hispanics (5.7% in 2001, 6.5% in 2011, 6.0% in 2016) largely stagnated. Smoking by Laotian/Hmong has fluctuated, from 2.5% in 2001 to a high of 7.1% in 2011, before decreasing to 4.5% in 2016.

All age groups have experienced a decline in smoking from 2001 to 2016; young women, in particular, have had substantial declines since 2011. For ages 15-17 years, smoking declined from 13.9% in 2011 to 8.5% in 2016. The rate declined from 24.8% in 2011 to 15.3% in 2016 among women aged 18-19 and from 23.5% to 16.6%, respectively, among women aged 20-24 years.

There is a nearly linear positive relationship between the number of previous pregnancies and whether or not women smoke, with a coefficient of determination $r^2=0.982$. Almost a fifth of underweight mothers (BMI < 18.5) smoked during pregnancy. Of low birthweight babies (<2,500 grams), 21.7% were born to mothers who smoked while pregnant. Women who delayed or received no prenatal care had higher rates of smoking than those who sought earlier care. Nearly a quarter of women covered by Medicaid/Badgercare smoked during pregnancy, compared to 5.8% with private insurance.

Smoking rates during pregnancy were ranked by county using 2011-2016 data and ranged from 6.2% in Waukesha County to 33.9% in Forest County (Table 2).

DISCUSSION

Vast differences remain in maternal smoking across the state. In 2016, Wisconsin had a higher percentage of smoking during pregnancy (11.4%) than the United States (7.2%).³ Although the overall prevalence of smoking during pregnancy has decreased in Wisconsin, data suggest this can be attributed largely to decreases among white and black women, while rates among American Indians, Hispanic, and Laotian/Hmong women have remained stagnant. American Indians have a much higher rate than other

groups and have had no real decline since the early 2000s, potentially reflecting socioeconomic and cultural aspects influencing health behaviors.

Our finding that 11.4% of Wisconsin women smoke during pregnancy is commensurate with the 11.3% rate reported by the Centers for Disease Control and Prevention (CDC), which uses data from the National Vital Statistics System.³ Wisconsin American Indians had a higher smoking prevalence in 2016 than American Indian natives nationwide (36.1% vs 16.7%). This is true for the other racial/ethnic groups in Wisconsin as well. For example, in 2016, the prevalence of smoking in black women in Wisconsin was double that of US black women (13.0% vs 6.0%) and more than triple for Wisconsin Hispanics compared to US Hispanics (6.0% vs 1.8%). These findings are largely consistent with trends from a previous report examining Wisconsin data.⁵

Strengths of our study include that we controlled for confounders of age and education to better understand the effects of

both education and race/ethnicity on our outcome. This report provides the most up-to-date detailed information on maternal smoking in Wisconsin.

A limitation of this study is that the birth certificate asks about cigarettes smoked but does not specify type. The CDC uses this data to evaluate tobacco use during pregnancy and employs the terms “cigarette smoking” and “tobacco use” interchangeably.³ However, data may not reflect other forms of tobacco use during pregnancy (eg, chewing tobacco) and may not reliably capture the use of electronic cigarettes (e-cigarettes), depending on a woman’s interpretation of the question. The dramatic decrease in maternal smoking in younger women since 2011 may, in part, reflect increasing use of e-cigarettes.⁶ E-cigarettes contain nicotine, which can lead to addiction and harm fetal brain and lung tissue development.⁷ Fortunately, pregnant women may be more likely to quit e-cigarettes than conventional cigarettes, possibly because traditional cigarette smokers are established smokers as opposed to more experimental e-cigarette users.⁸

Policy and clinical changes should be considered. The predominance of higher smoking rates in counties in northern Wisconsin and those with tribal lands may reflect both economic and social differences. The Wisconsin Native American Tobacco Network promotes prevention and cessation of commercial tobacco abuse while honoring the cultural heritage of traditional tobacco.⁹ Nuanced understanding of why pregnant Native American women have difficulty quitting is needed to tailor culturally appropriate initiatives. Communities may use the data from Table 2 to better understand how they compare to other counties. As education plays a protective role in smoking, we should focus resources on less-educated mothers who may live in circumstances that make it more likely to start or less likely to quit smoking. Considering a quarter of women covered by Medicaid smoked during pregnancy, policymakers should consider potential long-term savings associated with cessation.

Clinicians can follow counseling guidelines from the American College of Obstetricians and Gynecologists, which include the 5As of Ask, Advise, Assess, Assist, and Arrange,¹⁰ and should be aware of other free resources for patients. First Breath is a statewide program that helps pregnant women, new mothers, and their families quit smoking. In 2017, 84% of First Breath participants abstained, quit, or cut back on tobacco use during pregnancy.¹¹ Another free resource is the Wisconsin Tobacco Quit Line (800-QUIT-NOW), which utilizes a Quit Coach and other materials to help people stop smoking.

CONCLUSION

Despite continued declines in maternal smoking rates during pregnancy in Wisconsin, disparities exist for American Indians, young, and less-educated women. Physicians should continue to encourage cessation throughout pregnancy and support evidence-based community programs and policies. Reducing maternal

smoking will require the joint efforts of public health and clinicians statewide to engage with community partners and develop interventions.

Acknowledgements: The authors would like to thank Angela Rohan, PhD, with the Centers for Disease Control and Prevention at the Wisconsin Department of Health Services for her advice.

Funding/Support: None declared.

Financial Disclosures: None declared.

REFERENCES

1. Dietz PM, England LJ, Shapiro-Mendoza CK, Tong VT, Farr SL, Callaghan WM. Infant morbidity and mortality attributable to prenatal smoking in the U.S. *Am J Prev Med.* 2010;39(1):45-52. doi:10.1016/j.amepre.2010.03.009
2. Schneider S, Huy C, Schütz J, Diehl K. Smoking cessation during pregnancy: a systematic literature review. *Drug Alcohol Rev.* 2010;29(1):81-90. doi:10.1111/j.1465-3362.2009.00098.x
3. Drake P, Driscoll AK, Mathews TJ. *Cigarette Smoking During Pregnancy: United States, 2016.* NCHS Data Brief. 2018;(305):1-8. Accessed October 3, 2018. <https://www.cdc.gov/nchs/data/databriefs/db305.pdf>
4. Dever GEA. *Community Health Analysis: Global Awareness At the Local Level.* 2nd ed. Aspen Publishers, Inc; 1991.
5. Palmersheim KA. *Smoking During Pregnancy in Wisconsin: An Update on Trends and Patterns, 1990-2013.* University of Wisconsin-Milwaukee Center for Urban Initiatives and Research; 2016.
6. U.S. Department of Health and Human Services. *E-Cigarette Use Among Youth and Young Adults: A Report of the Surgeon General.* US Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion; 2016.
7. Centers for Disease Control and Prevention. E-cigarettes and pregnancy. Updated February 25, 2019. Accessed October 19, 2018. <https://www.cdc.gov/reproductivehealth/maternalinfanthealth/tobaccousepregnancy/e-cigarettes-pregnancy.htm>
8. Kurti AN, Redner R, Bunn JY, et al. Examining the relationship between pregnancy and quitting use of tobacco products in a U.S. national sample of women of reproductive age. *Prev Med.* 2018;117:52-60. doi:10.1016/j.ypmed.2018.08.019
9. Great Lakes Inter-Tribal Council Inc. Wisconsin Native American Tobacco Network (WNATN). Accessed October 3, 2019. <http://www.glitc.org/programs/wnatn/>
10. Committee on Underserved Women; Committee on Obstetric Practice. Committee opinion no. 721: smoking cessation during pregnancy. *Obstet Gynecol.* 2017;130(4):e200-e204. doi:10.1097/AOG.0000000000002353
11. Wisconsin Women’s Health Foundation. *Wisconsin Women’s Health Foundation 2017 Annual Report.* Published 2018. Accessed October 19, 2018. <https://www.wwhf.org/wp-content/uploads/2018/09/2017-annual-report-FINAL.pdf>

advancing the art & science of medicine in the midwest

WMJ

WMJ (ISSN 1098-1861) is published through a collaboration between The Medical College of Wisconsin and The University of Wisconsin School of Medicine and Public Health. The mission of *WMJ* is to provide an opportunity to publish original research, case reports, review articles, and essays about current medical and public health issues.

© 2020 Board of Regents of the University of Wisconsin System and The Medical College of Wisconsin, Inc.

Visit www.wmjonline.org to learn more.