Centers for Disease Control and Prevention
MMWR Morbidity and Mortality Weekly Report
Early Release / Vol. 59 September 7, 2010

Vital Signs: Current Cigarette Smoking Among Adults Aged ≥18 Years — United States, 2009

ABSTRACT

Background: Cigarette smoking continues to be the leading cause of preventable morbidity and mortality in the United States, causing approximately 443,000 premature deaths annually.

Methods: The 2009 National Health Interview Survey and the 2009 Behavioral Risk Factor Surveillance System were used to estimate national and state adult smoking prevalence, respectively. Cigarette smokers were defined as adults aged ≥18 years who reported having smoked ≥100 cigarettes in their lifetime and now smoke every day or some days.

Results: In 2009, 20.6% of U.S. adults aged ≥18 years were current cigarette smokers. Men (23.5%) were more likely than women (17.9%) to be current smokers. The prevalence of smoking was 31.1% among persons below the federal poverty level. For adults aged ≥25 years, the prevalence of smoking was 28.5% among persons with less than a high school diploma, compared with 5.6% among those with a graduate degree. Regional differences were observed, with the West having the lowest prevalence (16.4%) and higher prevalences being observed in the South (21.8%) and Midwest (23.1%). From 2005 to 2009, the proportion of U.S. adults who were current cigarette smokers did not change (20.9% in 2005 and 20.6% in 2009).

Conclusions: Previous declines in smoking prevalence in the United States have stalled during the past 5 years; the burden of cigarette smoking continues to be high, especially in persons living below the federal poverty level and with low educational attainment. Sustained, adequately funded, comprehensive tobacco control programs could reduce adult smoking.

Implications for Public Health Practice: To further reduce disease and death from cigarette smoking, declines in cigarette smoking among adults must accelerate. The Patient Protection and Affordable Care Act is expected to expand access to evidence-based smoking-cessation services and treatments; this likely will result in additional use of these services and reductions of current smoking and its adverse effects among U.S. adults. Population-based prevention strategies such as tobacco taxes, media campaigns, and smoke-free policies, in concert with clinical cessation interventions, can help adults quit and prevent the uptake of tobacco use, furthering the reduction in the current prevalence of tobacco use in the United States across age groups.

Cigarette smoking continues to be the leading cause of preventable morbidity and mortality in the United States. The negative health consequences of cigarette smoking have been well-documented and include cardiovascular disease, multiple cancers, pulmonary disease, adverse reproductive outcomes, and exacerbation of other chronic health conditions (*1*). Cigarette smoking causes approximately 443,000 premature deaths in the United States annually and $193 billion in direct health-care expenditures and productivity losses because of premature mortality each year.*

Despite significant declines during the past 30 years, cigarette smoking in the United States continues to be widespread; in 2008, one in five U.S. adults (20.6%) were current smokers

* Additional information available at http://www.cdc.gov/tobacco/data_statistics/fact_sheets/fast_facts/index.htm.

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(*2*). Year-to-year decreases in smoking prevalence have been observed only sporadically in recent years. For example, a slight decrease occurred from 2006 to 2007 but not from 2007 to 2008 (*2*). Monitoring tobacco use is essential in the effort to curb the epidemic of tobacco use.[†] To assess progress toward the *Healthy People 2010* objective of reducing the prevalence of cigarette smoking among adults to ≤12% (objective 27-1a),[§] this report provides the most recent national estimates of smoking prevalence among adults aged ≥18 years, based on data from the 2009 National Health Interview Survey (NHIS), and provides state-level estimates based on data from the 2009 Behavioral Risk Factor Surveillance System (BRFSS) survey.

Methods

The 2009 NHIS adult core questionnaire collects national health information on illness and disability. The questionnaire was administered by in-person interview and included a random probability sample of 27,731 noninstitutionalized civilian adults aged ≥18 years; the overall response rate was 65.4%. Of the 27,731, a total of 128 were excluded because of unknown smoking status; thus, the final sample size used in the analyses was 27,603. The BRFSS survey is a state-based, random-digit–dialed telephone survey of the noninstitutionalized civilian adult population and collects information on preventive health practices, health-risk behaviors, and health-care access in the United States. The core questionnaire includes questions on current cigarette smoking; the Council of American Survey and Research Organizations (CASRO) median response rate was 52.5% (from 38.0% in Oregon to 66.9% in Nebraska), and the median cooperation rate was 75.0% (55.5% in California to 88.0% in Kentucky).[¶]

Smoking status was defined identically for both surveillance systems by using two questions, "Have you smoked at least 100 cigarettes in your entire life?" and "Do you now smoke cigarettes every day, some days, or not at all?" Respondents who had smoked at least 100 cigarettes during their lifetime and, at the time of interview, reported smoking every day or some days were classified as current smokers. Smoking status was examined by race/ethnicity, age group, education (among persons aged ≥25 years), poverty status, and region (overall and by sex). Starting in 2007, income-related follow-up questions were added to NHIS to reduce the number of responses with unknown values.[**] For this report, poverty status was defined using 2008 poverty thresholds published by the U.S. Census Bureau in 2009; family income was reported by the family respondent, who might or might not have been the same as the sample adult respondent from whom smoking information was collected.

Data from the 2009 NHIS were adjusted for nonresponse and weighted to provide national estimates of cigarette smoking prevalence; 95% confidence intervals were calculated to account for the survey's multistage probability sample design. Data from the 2009 BRFSS were weighted to adjust for differences in probability of selection and nonresponse, as well as noncoverage (e.g., households lacking landlines), and these sampling weights were used to calculate all estimates. Using NHIS data, the Wald test from logistic regression analysis was used to analyze temporal changes in current smoking prevalence during 2005–2009, overall and by region. For this 5-year trend analysis, results were adjusted for sex, age, and race/ethnicity; a p-value of <0.05 was used to determine statistical significance. NHIS results with relative standard error of ≥30% are not reported.

Results

In 2009, an estimated 20.6% (46.6 million) of U.S. adults were current cigarette smokers; of these, 78.1% (36.4 million) smoked every day, and 21.9% (10.2 million) smoked on some days. Prevalence of current smoking was higher among men (23.5%) than women (17.9%) (Table). Among racial/ethnic groups, Asians had the lowest prevalence (12.0%), and Hispanics had a lower prevalence of smoking (14.5%) than non-Hispanic blacks (21.3%) and non-Hispanic whites (22.1%). Adults reporting multiple races had the highest prevalence (29.5%), followed by American Indians/Alaska Natives (23.2%).

Variations in smoking prevalence in 2009 were observed by education level (Table). Smoking

[†] Additional information available at http://www.who.int/tobacco/mpower/mpower_report_full_2008.pdf.

[§] Additional information available at http://www.healthypeople.gov/document/html/objectives/27-01.htm.

[¶] Based on Council of American Survey and Research Organizations (CASRO) definitions. The response rate is the percentage of persons who completed interviews among all eligible persons, including those who were not successfully contacted. The cooperation rate is the percentage of persons who completed interviews among all eligible persons who were contacted.

[**] Additional information available at ftp://ftp.cdc.gov/pub/health_statistics/nchs/dataset_documentation/nhis/1997/srvydesc.pdf.

TABLE. Percentage of persons aged ≥18 years who were current cigarette smokers,* by selected characteristics — National Health Interview Survey, United States, 2009

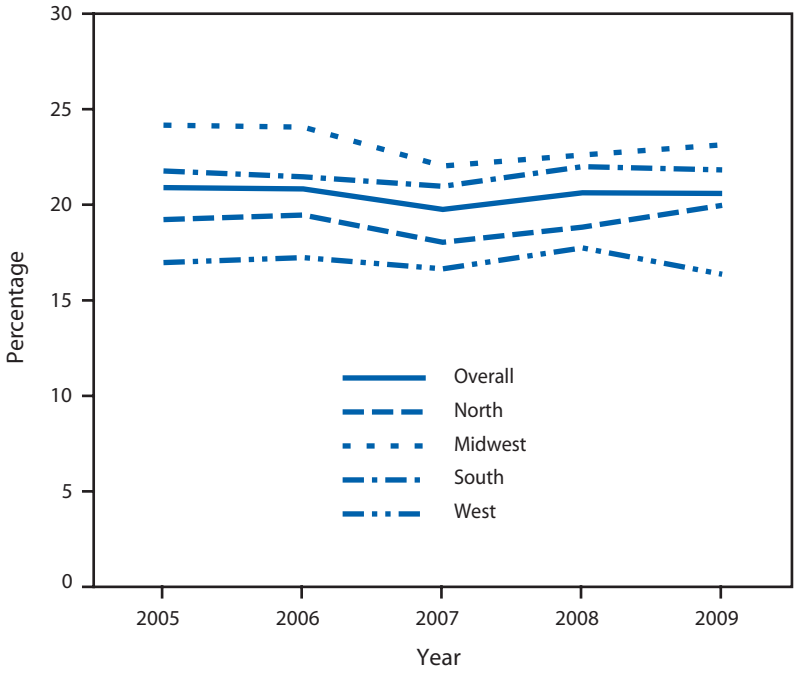
Characteristic	Total (N = 27,603) %	Total (N = 27,603) (95% CI)	Men (n = 12,193) %	Men (n = 12,193) (95% CI†)	Women (n = 15,410) %	Women (n = 15,410) (95% CI)
Age group (yrs)						
18–24	**21.8**	**(19.4–24.2)**	28.0	(24.5–31.5)	15.6	(12.9–18.3)
25–44	**24.0**	**(22.8–25.1)**	26.5	(24.7–28.2)	21.5	(20.1–22.9)
45–64	**21.9**	**(20.7–23.2)**	24.5	(22.8–26.2)	19.5	(17.9–21.1)
≥65	**9.5**	**(8.5–10.5)**	9.5	(8.1–10.9)	9.5	(8.2–10.8)
Race/Ethnicity§						
White, non-Hispanic	**22.1**	**(21.2–23.1)**	24.5	(23.2–25.9)	19.8	(18.8–20.8)
Black, non-Hispanic	**21.3**	**(19.6–22.9)**	23.9	(21.5–26.2)	19.2	(17.1–21.3)
Hispanic	**14.5**	**(13.2–15.8)**	19.0	(16.9–21.1)	9.8	(8.5–11.0)
American Indian/Alaska Native	**23.2**	**(12.9–33.5)**	29.7	(15.4–44.0)	—¶	—
Asian, non-Hispanic**	**12.0**	**(10.0–14.0)**	16.9	(14.0–19.9)	7.5	(4.8–10.3)
Multiple race, non-Hispanic	**29.5**	**(22.9–36.1)**	33.7	(24.4–43.0)	24.8	(16.6–33.0)
Education††						
0–12 yrs (no diploma)	**26.4**	**(24.5–28.3)**	30.5	(27.6–33.5)	22.2	(19.9–24.5)
≤8 yrs	**17.1**	**(14.5–19.6)**	22.2	(18.0–26.4)	11.9	(9.2–14.7)
9–11 yrs	**33.6**	**(30.7–36.5)**	36.5	(32.2–40.9)	30.5	(26.6–34.4)
12 yrs (no diploma)	**28.5**	**(23.2–33.9)**	34.1	(26.0–42.1)	23.3	(17.0–29.6)
GED§§	**49.1**	**(44.5–53.8)**	53.2	(46.6–59.8)	44.7	(38.2–51.2)
High school graduate	**25.1**	**(23.6–26.5)**	29.0	(26.9–31.2)	21.5	(19.8–23.3)
Some college (no degree)	**23.3**	**(21.7–24.9)**	26.1	(23.4–28.8)	21.0	(19.0–22.9)
Associate degree	**19.7**	**(17.9–21.5)**	20.6	(17.5–23.6)	19.1	(16.5–21.6)
Undergraduate degree	**11.1**	**(10.0–12.3)**	12.4	(10.7–14.2)	9.9	(8.3–11.4)
Graduate degree	**5.6**	**(4.6–6.6)**	4.9	(3.6–6.3)	6.3	(4.7–7.9)
Poverty status¶¶						
At or above poverty level	**19.4**	**(18.6–20.2)**	22.2	(21.1–23.3)	16.7	(15.7–17.6)
Below poverty level	**31.1**	**(29.1–32.9)**	34.2	(31.0–37.5)	28.7	(26.5–30.9)
Unspecified	**17.3**	**(15.3–19.3)**	22.3	(18.6–26.1)	13.2	(11.0–15.4)
Region***						
Northeast	**20.0**	**(18.0–22.0)**	23.4	(20.5–26.3)	16.9	(14.8–19.0)
New England	**19.4**	**(15.2–23.6)**	21.5	(14.4–28.6)	17.5	(14.6–20.4)
Mid-Atlantic	**20.2**	**(18.0–22.4)**	24.1	(21.1–27.1)	16.7	(14.1–19.3)
Midwest	**23.1**	**(21.6–24.7)**	25.7	(23.3–28.1)	20.8	(19.2–22.3)
East North Central	**23.8**	**(22.1–25.5)**	26.7	(23.8–29.6)	21.1	(19.5–22.6)
West North Central	**21.8**	**(18.8–24.8)**	23.6	(19.7–27.5)	20.1	(16.5–23.7)
South	**21.8**	**(20.7–22.9)**	24.5	(22.8–26.2)	19.3	(18.1–20.5)
South Atlantic	**20.1**	**(18.7–21.5)**	22.3	(20.1–24.5)	18.0	(16.4–19.6)
East South Central	**25.8**	**(22.7–28.9)**	30.1	(25.0–35.2)	22.3	(20.0–24.6)
West South Central	**22.5**	**(20.5–24.5)**	25.5	(22.6–28.4)	19.8	(17.4–22.2)
West	**16.4**	**(14.9–17.9)**	19.5	(17.6–21.4)	13.3	(11.3–15.2)
Mountain	**18.8**	**(16.0–21.6)**	21.7	(18.1–25.3)	16.0	(13.0–19.0)
Pacific	**15.3**	**(13.6–17.0)**	18.6	(16.4–20.8)	12.1	(9.7–14.5)
Total	**20.6**	**(19.9–21.3)**	**23.5**	**(22.4–24.5)**	**17.9**	**(17.1–18.7)**

* Persons who reported smoking at least 100 cigarettes during their lifetimes and who, at the time of interview, reported smoking every day or some days. Excludes 128 respondents whose smoking status was unknown.
† 95% confidence interval.
§ Excludes 53 respondents of unknown race.
¶ Data not reported because of unstable percentages; relative standard error ≥30%.
** Does not include Native Hawaiians or Other Pacific Islanders.
†† Among persons aged ≥25 years. Excludes 137 persons whose educational level was unknown.
§§ General Educational Development certificate.
¶¶ Family income is reported by the family respondent who might or might not be the same as the sample adult respondent from whom smoking information is collected; 2009 estimates are based on reported family income and 2008 poverty thresholds published by the U.S. Census Bureau.
*** *New England:* Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut. *Mid-Atlantic:* New York, Pennsylvania, and New Jersey. *East North Central:* Wisconsin, Michigan, Illinois, Indiana, and Ohio. *West North Central:* Missouri, North Dakota, South Dakota, Nebraska, Kansas, Minnesota, and Iowa. *South Atlantic:* Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, and Florida. *East South Central:* Kentucky, Tennessee, Mississippi, and Alabama. *West South Central:* Oklahoma, Texas, Arkansas, and Louisiana. *Mountain:* Idaho, Montana, Wyoming, Nevada, Utah, Colorado, Arizona, and New Mexico. *Pacific:* Alaska, Washington, Oregon, California, and Hawaii.

Key Points

- Smoking causes approximately 443,000 premature deaths, accounts for up to 30% of cancer deaths, and is the single most preventable cause of disease and death in the United States.
- Despite the adverse health effects of smoking cigarettes, one in five U.S. adults (46.6 million men and women) currently smoke.
- The prevalence of adult smoking is not decreasing. Effective population-based strategies to encourage cessation (e.g., tobacco taxes, smoke-free policies, and media campaigns) are essential to accelerate the reduction in tobacco use among adults in the United States and prevent smoking initiation in young persons.
- Effective cessation methods should be made available to increase success rates when tobacco users make quit attempts.
- Additional information is available at http://www.cdc.gov/tobacco and http://www.cdc.gov/vitalsigns.

FIGURE 1. Percentage of adults aged ≥18 years who were current smokers,* by geographic region — National Health Interview Survey, United States, 2005–2009



* Persons who reported smoking at least 100 cigarettes during their lifetimes and who, at the time of the survey, reported smoking every day or some days.

prevalence was highest among adults who had obtained a General Education Development certificate (GED) (49.1%) and generally declined with increasing education, being lowest among adults with a graduate degree (5.6%). The prevalence of current smoking was higher among adults living below the federal poverty level (31.1%) than among those at or above this level (19.4%). Smoking prevalence did not vary significantly for adults aged 18–24 years (21.8%), 25–44 years (24.0%), and 45–64 years (21.9%); however, it was lowest for adults aged ≥65 years (9.5%). Regionally, smoking prevalence was higher in the Midwest (23.1%) and South (21.8%), and lowest prevalence for adult current smoking was observed for the West (16.4%).

During 2005–2009, the proportion of U.S. adults who were current cigarette smokers was 20.9% in 2005†† and 20.6% in 2009, with no significant difference (Figure 1). No significant changes in current smoking prevalence for U.S. adults were observed during the 5-year period overall and for each of the four regions: Northeast, Midwest, South, or West ($p \geq 0.05$).

By state, the prevalence of current smoking ranged from 9.8% (Utah) to 25.6% (Kentucky and West Virginia) (Figure 2). States with the highest prevalence of adult current smoking were clustered in the Midwest and Southeast regions.

Conclusions and Comment

The results of these analyses indicate that the national estimates for the prevalence of current cigarette smoking among adults aged ≥18 years did not decline from 2008 (20.6%) (*2*) to 2009, and during the past 5 years (2005–2009) virtually no change has been observed, even by region. In 2009, certain population subgroups (e.g., Hispanic and Asian women, persons with higher levels of education, and older adults) continue to meet the *Healthy People 2010* target of ≤12% prevalence of smoking. Although smoking prevalence was found to be lowest among Asian and Hispanic women, the findings in this report cannot assess specific Asian and Hispanic subgroups. In a previous report, variations in smoking prevalence were observed within specific Asian and Hispanic subgroups and between the sexes within

†† Additional information available at http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5542a1.htm.

these subgroups, suggesting that overall prevalence for Asians and Hispanics do not accurately represent the wide variability across subgroups (*3*).

Differences in understanding the health hazards of smoking and receptivity to antismoking messages might be related to the prevalence variations observed by education level (*4*). For example, persons with higher levels of education might have a better understanding of the health hazards of smoking and might be more receptive to health messaging about the dangers of smoking (*4*). Nonetheless, most population subgroups, particularly those with low education and income levels, will not meet the *Healthy People 2010* target.

Differences also were noted by state and region. In 2009, the lowest prevalence was observed in the West, with lowest prevalence in Utah, followed by California. California traditionally has been cited for its success in tobacco control because of its long-running comprehensive tobacco control program (*5*). California's adult smoking prevalence declined approximately 40% during 1998–2006, and consequently lung cancer incidence in California has been declining four times faster than in the rest of the nation (*5*). Similarly, Maine, New York, and Washington have seen 45%–60% reductions in youth smoking with sustained comprehensive statewide programs (*5*).

Youth smoking is an important indicator to monitor because most adult established smokers (>80%) begin before the age of 18 years.[§§] In 2009, one in five U.S. high school students (19.5%) reported smoking cigarettes in the preceding 30 days (*6*). Moreover, declines in current smoking among high school students have slowed, with an 11% decline from 21.9% in 2003 to 19.5% in 2009 compared with a 40% decline observed from 1997 (36.4%) to 2003 (21.9%) (*7*). The slowing in the decline observed for youth cigarette smoking indicates that cigarette smoking among adults and the associated morbidity and mortality will continue to be important public health issues for the foreseeable future.

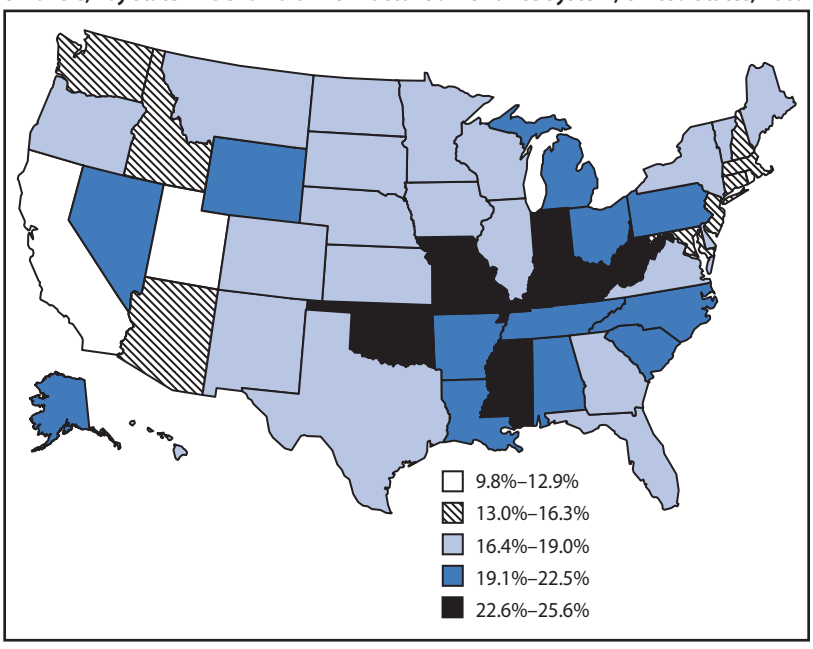
The findings in this report are subject to at least six limitations. First, the estimates of cigarette smoking were self-reported and were not validated by biochemical tests. However, other studies using levels of serum cotinine (a breakdown product of nicotine), yield similar prevalence estimates as those obtained from self-reports (*8*). Second, questionnaires are administered only in English and Spanish; therefore, smoking prevalence for certain racial/ethnic populations might be overestimated or underestimated if English and Spanish are not the primary languages spoken. Third, race/ethnicity was not adjusted for socioeconomic status. Fourth, because NHIS and BRFSS do not include institutionalized populations and persons in the military, the results are not generalizable to these groups. Fifth, BRFSS does not currently include adults without telephone service (1.9%) or with wireless-only service (13.6%).[¶¶] Because adults with wireless-only service are more likely to smoke cigarettes than the rest of the U.S. population and wireless-only service varies by state, state smoking prevalence might be underestimated.[***] Finally, small samples sizes for certain population groups resulted in some imprecise estimates. This might explain why the 2009 prevalence estimate for American Indian/Alaska

[§§] Additional information available at http://www.oas.samhsa.gov/nsduh/2k8nsduh/2k8results.cfm.

[¶¶] Additional information available at http://www.cdc.gov/nchs/data/nhsr/nhsr014.pdf.

[***] Additional information available at http://www.cdc.gov/nchs/nhis.htm.

FIGURE 2. Percentage of persons aged ≥18 years who were current cigarette smokers,* by state — Behavioral Risk Factor Surveillance System, United States, 2009



* Persons who reported smoking at least 100 cigarettes during their lifetimes and who, at the time of the survey, reported smoking every day or some days.

Native women is lower than prevalence estimates from recent years.

The *Healthy People 2010* objective of reducing the overall prevalence of cigarette smoking among U.S. adults to ≤12% (objective 27-1a) will not be met in 2010. However, for some subpopulations and states, this goal has been reached, demonstrating that the national target is achievable. To meet this goal for the entire population in the future, evidence-based strategies focused on populations such as persons with lower education are needed (*5*). Effective strategies including price increases, comprehensive smoke-free policies, and media campaigns to counter pro-tobacco industry influences need to be implemented aggressively in coordination with providing access to affordable and effective cessation treatments and services (*5,9*). If each state sustained comprehensive tobacco control programs for 5 years with CDC-recommended levels of funding, an estimated 5 million fewer persons in the country would smoke, resulting in prevention of premature tobacco-related deaths (*5*).

As this analysis shows, some populations have a higher prevalence of cigarette use; thus, a focus on reducing tobacco-related disparities also is necessary (*5*). The Patient Protection and Affordable Care Act[†††] is expected to expand access to evidence-based smoking-cessation services and treatments. Given the decline in smoking prevalence that was observed after the implementation of a mandated tobacco cessation coverage for the Massachusetts Medicaid program (*10*), expanded access to cessation services and treatments might result in reductions in current smoking and its adverse effects among U.S. adults. For this to occur, health professionals need to better identify, educate, and offer appropriate cessation services to persons who use tobacco.

The enactment of the 2009 Family Smoking Prevention and Tobacco Control Act[§§§] has provided new opportunities for reductions in tobacco use (*7,9*). The Act gives the Food and Drug Administration authority to regulate the manufacturing, marketing, and distribution of tobacco products. Full implementation of comprehensive tobacco control policies and programs at CDC-recommended levels of funding (*5*) would resume progress toward reducing the prevalence of smoking in the population.

[†††] Additional information available at http://www.dol.gov/ebsa/healthreform.

[§§§] Family Smoking Prevention and Tobacco Control Act, Pub. L. 111-31, 123 Stat1776 (2009). Additional information available at http://www.gpo.gov/fdsys/pkg/PLAW-111publ31/content-detail.html.

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Acknowledgments

This report is based, in part, on contributions by P Barnes, MA, and C Schoenborn, MPH, National Center for Health Statistics, CDC.

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Vital Signs: Nonsmokers' Exposure to Secondhand Smoke — United States, 1999–2008

ABSTRACT

Background: Secondhand exposure to tobacco smoke causes heart disease and lung cancer in nonsmoking adults and sudden infant death syndrome, acute respiratory infections, middle ear disease, exacerbated asthma, respiratory symptoms, and decreased lung function in children.

Methods: National Health and Nutrition Examination Survey data from 1999–2008 were analyzed to determine the proportion of the nonsmoking population with serum cotinine (the primary nicotine metabolite) levels ≥0.05 ng/mL, by age, sex, race/ethnicity, household income level, and to determine whether the household included a person who smoked inside the home.

Results: During 2007–2008, approximately 88 million nonsmokers aged ≥3 years in the United States were exposed to secondhand smoke. The prevalence of serum cotinine levels ≥0.05 ng/mL in the nonsmoking population declined significantly from 52.5% (95% CI = 47.1%–57.9%) during 1999–2000 to 40.1% (95% CI = 35.0%–45.3%) during 2007–2008. The decline was significant for each sex, age, race/ethnicity, and income group studied except non-Hispanic whites. The change was greatest from 1999–2000 to 2001–2002. For every period throughout the study, prevalence was highest among males, non-Hispanic blacks, children (aged 3–11 years) and youths (aged 12–19 years), and those in households below the federal poverty level.

Conclusions: Secondhand smoke exposure has declined in the United States, but 88 million nonsmokers aged ≥3 years are still exposed, progress in reducing exposure has slowed, and disparities in exposure persist, with children being among the most exposed. Nearly all nonsmokers who live with someone who smokes inside their home are exposed to secondhand smoke.

Implications for public health practice: The only way to protect nonsmokers fully is to eliminate smoking in indoor spaces. Continued efforts at smoking cessation and comprehensive statewide laws prohibiting smoking in workplaces and public places are needed to ensure that all nonsmokers are protected from this serious health hazard. Health-care providers should educate patients and parents about the dangers of secondhand smoke and follow clinical care guidelines to help smokers quit.

Secondhand exposure to tobacco smoke causes heart disease and lung cancer in nonsmoking adults and sudden infant death syndrome, acute respiratory infections, middle ear disease, exacerbated asthma, respiratory symptoms, and decreased lung function in children (*1*). No risk-free level of secondhand smoke exposure exists (*1*). Levels of secondhand smoke exposure among U.S. nonsmokers have fallen substantially during the past 20 years (*2*). However, millions of nonsmokers remain exposed to secondhand smoke in homes, workplaces, public places, and vehicles (*1*). Using data from the National Health and Nutrition Examination Survey (NHANES) for 1999–2008, this report describes recent trends in secondhand smoke exposure among nonsmokers by analyzing levels of serum cotinine, a metabolite of nicotine that reflects recent exposure.

Methods

NHANES produces data for a nationally representative sample of the noninstitutionalized U.S. civilian population every 2 years. NHANES surveys

include a home interview, physical examination at a mobile examination center where biologic specimens are collected, and laboratory specimen testing, including serum cotinine analysis for participants aged ≥3 years. Response rates exceeded 75% for all 2-year study cycles.* From the 1999–2000, 2001–2002, 2003–2004, 2005–2006, and 2007–2008 NHANES cycles, 30,451 respondents were determined to be nonsmokers (by cotinine level ≤10 ng/mL and self-reported history for persons aged ≥12 years) and were included in the analysis.

Serum cotinine was analyzed using an isotope dilution liquid chromatography tandem mass spectrometry method (*2*). Cotinine concentrations below a level known as the limit of detection (LOD) might be estimated inaccurately. The cotinine LOD initially was 0.05 ng/mL and changed to 0.015 ng/mL after improvements to the method. Cotinine levels below the LOD were reported as LOD / $\sqrt{2}$; this value represents the approximate midpoint of the interval between zero and LOD on a log scale.

Serum cotinine levels >10 ng/mL are associated with active smoking within the past few days (*3*). Therefore, children aged 3–11 years were assumed to be nonsmokers if their serum cotinine concentration was ≤10 ng/mL. Youths aged 12–19 years were considered nonsmokers if their serum cotinine concentration was ≤10 ng/mL and they did not report smoking within the preceding 30 days or use of any nicotine-containing product within the preceding 5 days at their physical examination. Adults aged ≥20 years were considered nonsmokers if their serum cotinine concentration was ≤10 ng/mL and they did not report being a current smoker during their home interview or report use of any nicotine-containing product within the preceding 5 days at their physical examination.

The percentage of the nonsmoking population with serum cotinine levels ≥0.05 ng/mL, the higher LOD, was calculated by survey cycle, sex, race/ethnicity group, age group, household income level, and whether households contained a person who smoked inside the home; 95% confidence intervals (CIs) were calculated using a log transformation for values >98% and the Wald method otherwise. Sample sizes are insufficient to allow separate reporting for race/ethnicity groups other than non-Hispanic whites, non-Hispanic blacks, and Mexican-Americans, but all race/ethnicity groups are included in the reported values for the total population and the values shown by sex, age group, and household income level. For 2007–2008, the most recently completed NHANES cycle, the number of nonsmokers with serum cotinine ≥0.05 ng/mL was calculated by age group using the midpoint population as the denominator, and the distribution of serum cotinine concentrations was examined separately for nonsmokers who lived with and without someone who smoked inside the home.

Two-sided t-tests were used to assess differences between population group percentages within study cycles and differences within population groups across study cycles; $p<0.05$ was considered statistically significant. Data analyses accounted for the complex survey design, differential probability of sample selection, nonresponse, and sample noncoverage.

Results

The overall prevalence of serum cotinine concentrations ≥0.05 ng/mL among the nonsmoking population fell from 52.5% (CI = 47.1%–57.9%) during 1999–2000 to 40.1% (CI = 35.0%–45.3%) during 2007–2008 (Table 1). However, the decline occurred only among the subset of the nonsmoking population that did not live with someone who smoked inside the home. The decline was significant for each sex, age, race/ethnicity, and income group studied except non-Hispanic whites. Prevalence fluctuated from cycle to cycle rather than showing a consistent decline; the greatest decline (10.8% percentage points) occurred from 1999–2000 to 2001–2002.

For every survey cycle, a significantly higher prevalence of cotinine concentrations ≥0.05 ng/mL was observed among males than among females, among non-Hispanic blacks than among non-Hispanic whites and Mexican-Americans, among children aged 3–11 years and youths aged 12–19 years than among adults aged ≥20 years, and among those below the federal poverty level than among those at or above the poverty level.

During 2007–2008, approximately 88 million nonsmokers aged ≥3 years in the United States were exposed to secondhand smoke (CI = 76 million–99 million) (Table 2). Of these, 32 million were aged 3–19 years, reflecting the higher prevalence of exposure among children and youths. Similarly, among nonsmoking adults, the prevalence of exposure

*Additional information available at http://www.cdc.gov/nchs/nhanes/response_rates_cps.htm.

TABLE 1. Percentage of the nonsmoking population aged ≥3 years with serum cotinine levels ≥0.05 ng/mL, by selected characteristics — National Health and Nutrition Examination Survey, United States, 1999–2008

Characteristic	% with serum cotinine ≥0.05 ng/mL (95% CI*)									
	1999–2000		2001–2002		2003–2004		2005–2006		2007–2008	
Total	**52.5**	**(47.1–57.9)**	**41.7**	**(35.5–47.9)**	**47.6**	**(40.3–54.9)**	**39.1**	**(35.6–42.7)**	**40.1**	**(35.0–45.3)**
Sex										
Male	58.5	(52.1–64.9)	45.5	(38.9–52.1)	51.9	(44.3–59.5)	43.0	(39.1–46.9)	43.5	(37.5–49.4)
Female	47.5	(42.5–52.5)	38.6	(32.4–44.7)	44.2	(36.8–51.6)	35.9	(31.6–40.2)	37.4	(32.6–42.2)
Age group (yrs)										
3–11	64.9	(56.0–73.9)	55.7	(47.1–64.2)	64.8	(55.5–74.2)	50.8	(45.4–56.1)	53.6	(46.2–61.0)
12–19	63.1	(56.4–69.7)	46.9	(36.6–57.1)	57.1	(50.3–63.9)	45.4	(38.7–52.1)	46.5	(38.3–54.8)
≥20	48.0	(42.6–53.4)	37.8	(31.7–44.0)	42.4	(35.1–49.8)	35.8	(32.5–39.1)	36.7	(32.0–41.3)
Race/Ethnicity										
White, non-Hispanic	49.6	(42.4–56.7)	36.3	(29.4–43.1)	45.9	(36.6–55.3)	36.6	(32.3–40.8)	40.1	(32.2–48.0)
Black, non-Hispanic	74.2	(70.2–78.2)	71.8	(66.7–77.0)	68.1	(59.7–76.4)	60.2	(53.0–67.3)	55.9	(50.6–61.3)
Mexican-American	44.3	(37.4–51.1)	39.9	(30.1–49.7)	34.0	(25.5–42.5)	33.8	(26.5–41.1)	28.5	(23.1–33.9)
Poverty status										
Below poverty level	71.6	(64.8–78.5)	60.2	(47.1–73.3)	63.6	(55.0–72.2)	62.7	(57.1–68.4)	60.5	(55.0–66.0)
At or above poverty level	48.8	(42.8–54.8)	38.4	(32.9–44.0)	44.8	(37.7–52.0)	35.9	(32.7–39.1)	36.9	(31.3–42.5)
Unspecified	53.5	(48.4–58.6)	44.1	(32.7–55.5)	50.5	(36.4–64.6)	42.0	(29.0–55.0)	39.6	(30.8–48.5)

* Confidence interval.

TABLE 2. Percentage and estimated number of nonsmokers with serum cotinine levels ≥0.05 ng/mL, by age group — National Health and Nutrition Examination Survey, United States, 2007–2008

Age group (yrs)	% with serum cotinine ≥0.05 ng/mL	No. of nonsmokers in population (millions)*	No. of nonsmokers with serum cotinine ≥0.05 ng/mL (millions)	(95% CI†)
≥3	**40.1**	**218**	**88**	**(76–99)**
3–19	50.2	64	32	(28–37)
3–11	53.6	36	19	(17–22)
12–19	46.5	28	13	(11–16)
≥20	36.7	156	57	(50–64)
20–39	42.8	52	22	(20–25)
40–59	35.4	60	21	(18–24)
≥60	31.6	44	14	(11–17)

* Totals do not sum exactly because of rounding.
† Confidence interval.

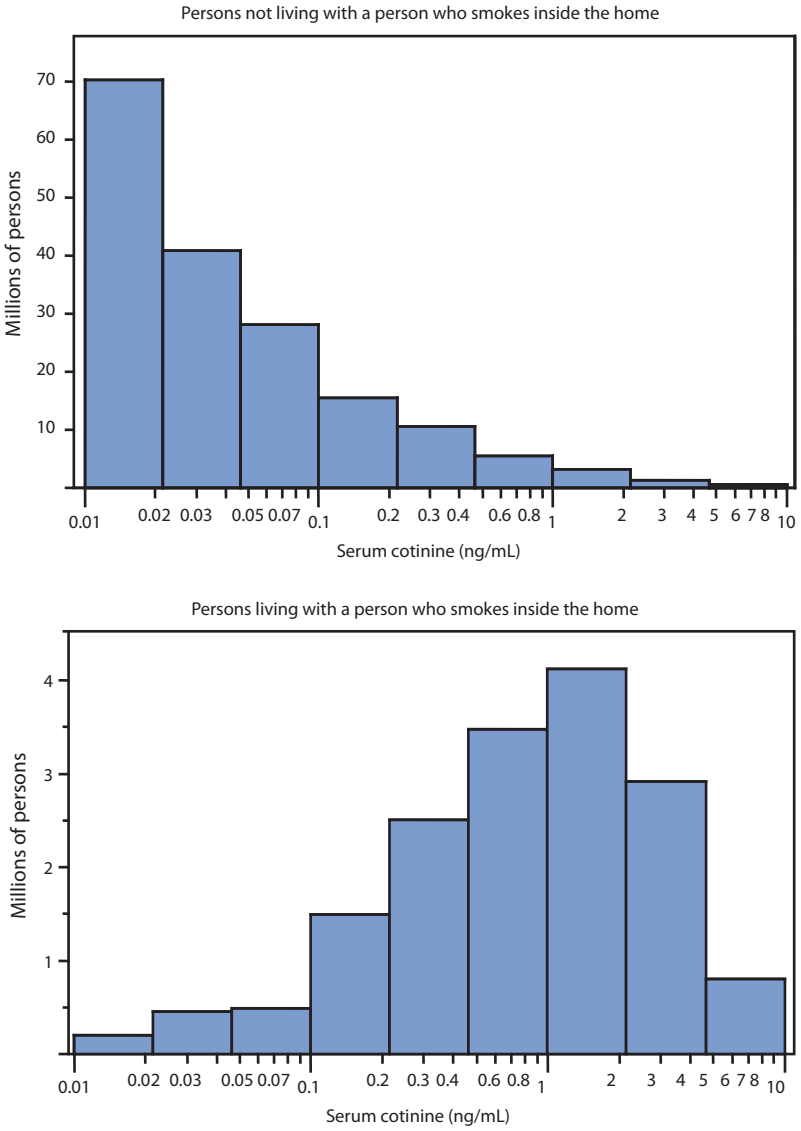
decreased with age so that there were approximately 21–22 million exposed persons in each of the 20–39 year and 40–59 year age groups and approximately 14 million exposed persons in the ≥60 year age group.

Children and nonsmoking youths were more likely than nonsmoking adults to live with someone who smoked inside the home. During 2007–2008, 18.2% (CI = 11.2%–25.3%) of children aged 3–11 years and 17.1% (CI = 12.7%–21.4%) of youths aged 12–19 years lived with someone who smoked inside the home, compared with 5.4% (CI = 3.8%–7.0%) of adults aged ≥20 years. The majority (96.0%; CI = 93.3%–98.6%) of nonsmokers who lived with someone who smoked inside the home had cotinine levels ≥0.05 ng/mL (Figure). Among nonsmoking children and youths living with someone who smoked inside the home, 98.3% (CI = 95.5%–99.3%) had serum cotinine ≥0.05 ng/mL, compared with 39.9% (CI = 34.3%–45.4%) among those not living with someone who smoked inside the home ($p<0.05$). For nonsmoking adults, the corresponding prevalences were 93.4% (CI = 89.2%–97.5%) and 33.4% (CI = 29.1%–37.8%), respectively ($p<0.05$).

Conclusions and Comment

This is the first reported analysis of 2007–2008 cotinine levels among the full U.S. nonsmoking population aged ≥3 years. The results confirm that secondhand smoke exposure in the United States is far less prevalent at 40% than during 1988–1991, when 88% of the nonsmoking population age ≥4 years had serum cotinine levels ≥0.05 ng/mL (*2*). This decline is attributable to a number of factors, including decreased smoking prevalence, increases in

FIGURE. Serum cotinine levels among nonsmoking persons aged ≥3 years — National Health and Nutrition Examination Survey, United States, 2007–2008



the number of local and state laws prohibiting smoking in indoor workplaces and public places, increases in voluntary smoking restrictions in workplaces and homes, and changes in public attitudes regarding social acceptability of smoking near nonsmokers and children (*1*). Although prevalence of exposure has dropped for children and non-Hispanic blacks, groups that traditionally have had higher-than-average exposure levels (*1–4*), disparities remain. Further, this report shows that millions of nonsmokers in the United States remain exposed to secondhand smoke, including nearly all of those who live with someone who smokes inside the home.

Key Points

- Despite progress in protecting nonsmokers from secondhand smoke, approximately 88 million nonsmokers (including 32 million children and youths) in the United States were exposed to secondhand smoke during 2007–2008.
- Children are more likely than nonsmoking adults to live with someone who smokes inside the home and more likely to be exposed to secondhand smoke.
- The vast majority of nonsmokers who live with persons who smoke inside the home are exposed to secondhand smoke.
- Exposure to secondhand smoke causes heart disease and lung cancer in nonsmoking adults and sudden infant death syndrome, acute respiratory infections, middle ear disease, exacerbated asthma, respiratory symptoms, and decreased lung function in children.
- No risk-free level of secondhand smoke exposure exists.
- The only way to protect nonsmokers fully is to eliminate smoking in indoor spaces, including workplaces, public places (e.g., restaurants and bars), and private places (e.g., homes and vehicles) through smoke-free laws and policies and through decreased smoking prevalence.
- Additional information is available at http://www.cdc.gov/vitalsigns.

Workplaces and homes usually are the most important sources of secondhand smoke exposure among adults because these are the settings where they typically spend the most time (*1*). The number of state, local, and voluntary smoke-free policies has greatly increased in recent years and has helped to protect nonsmokers from the toxicants in secondhand smoke. Nonetheless, currently only 24 states and the District of Columbia have comprehensive smoke-free laws covering workplaces, restaurants, and bars[†]; complete statewide bans are needed in the remaining 26 states because only 47% of the national population is covered by comprehensive state or local

[†] Additional information available at http://apps.nccd.cdc.gov/statesystem.

laws.[§] Smoke-free policies have been shown to greatly reduce the probability and amount of exposure to secondhand smoke in workplaces and public places, as well as adverse health events.[¶] Workplace smoking restrictions lead to smoking reductions and cessation among workers.[**] However, smoke-free policies do not eliminate secondhand smoke exposure from all sources. As workplaces and public places increasingly are made smoke-free, private settings such as homes and vehicles are becoming relatively larger sources of overall exposure (*1*).

The home is the major source of secondhand smoke exposure for children (*1*). During 1988–1994, fewer than 1% of children aged 4–16 years living with persons who smoked inside the home had cotinine levels <0.05 ng/mL (*5*). The findings in this report demonstrate that currently approximately 1.7% of nonsmoking children and youths (aged 3–19 years) living with someone who smoked inside the home had cotinine levels <0.05 ng/mL. Thus, among children living with persons who smoked inside the home, the likelihood of exposure has not changed appreciably during the past 20 years. The stall in the decline of adult smoking prevalence and the persistence of smoking in homes likely are impeding progress toward full protection of children and other nonsmokers from secondhand smoke exposure. Based on evidence that providing parents with information about the harms of secondhand smoke reduces children's exposure, the American Academy of Pediatrics and the U.S. Public Health Service recommend that clinicians ask parents about their smoking, advise them about the harms of secondhand smoke, and offer encouragement and help in quitting according to clinical care guidelines (*6,7*).

Previous studies have noted that non-Hispanic black nonsmokers tend to have higher cotinine levels than nonsmokers of other race/ethnicity groups (*1,2*). The reasons for this difference are not known, but some evidence suggests that slower metabolism or clearance of cotinine might result in blacks having higher cotinine levels for a given amount of exposure (*8*). Other possible reasons relate to levels of protection from exposure at home, in vehicles, and in public places or workplaces.

The findings in this report are subject to at least two limitations. First, nonsmoking status was defined based on self-report and cotinine levels. Self-reports might be inaccurate; similarly, any cotinine cutpoint might misclassify some persons. The optimal cotinine cutpoint might vary by race/ethnicity and age group, and is dependent upon background levels of secondhand smoke (*1,8*). This analysis used the 10 ng/mL cutpoint to be consistent with previous analyses (*1–4*). Using self-report and cotinine levels in combination should have minimized misclassification. Second, the sample size was insufficient to allow calculation of trends for all race/ethnicity groups. Smoking prevalence varies widely across and within race/ethnicity groups (*9*) and by region (*10*); secondhand smoke exposure rates are similarly variable (*1*). Also, variability in secondhand smoke exposure across population subgroups might have contributed to the observed fluctuation in prevalence during the study period because NHANES is not designed to have the same regional distribution in every cycle.

Healthy People 2010 objective 27-10 is to reduce the percentage of the nonsmoking population exposed to secondhand smoke (i.e., those with serum cotinine levels ≥0.05 ng/mL) to ≤56%.[††] This target has been met, but disparities in exposure persist. Nonsmokers who live and work in places lacking smoke-free laws or policies continue to be exposed to secondhand smoke (*1*). The only way to protect nonsmokers fully is to eliminate smoking in indoor spaces (*1*).

Several federal government initiatives are currently addressing this issue. For example, in 2010, funds from the American Recovery and Reinvestment Act were made available to all 50 states, the District of Columbia, seven U.S. territories, and 21 communities to address tobacco control. As part of this Communities Putting Prevention to Work Initiative, grantees that do not already have comprehensive smoke-free policies covering workplaces and public places are working toward adopting such policies. The U.S. Department of Housing and Urban Development issued a notice[§§] encouraging public housing authorities to implement no-smoking policies

[§] Additional information available at http://www.no-smoke.org/pdf/SummaryUSPopList.pdf.

[¶] Additional information available at http://www.iom.edu/reports/2009/secondhand-smoke-exposure-and-cardiovascular-effects-making-sense-of-the-evidence.aspx.

[**] Additional information available at http://www.iarc.fr/en/publications/pdfs-online/prev/handbook13/handbook13.pdf.

[††] Additional information available at http://wonder.cdc.gov/data2010.

[§§] Available at http://www.hud.gov/offices/pih/publications/notices/09/pih2009-21.pdf.

in 2009. The U.S. Environmental Protection Agency conducts a national campaign that educates and encourages parents to make their homes smoke-free to protect their children's health.¶¶ Continued efforts to reduce secondhand smoke exposure in all settings are needed to ensure that all nonsmokers are protected from this hazard.

¶¶ Additional information available at http://www.epa.gov/smokefree.

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Acknowledgments

This report is based, in part, on contributions by M Eischen, D Homa, PhD, A MacNeil, MPH, G Promoff, MA, D Shelton, MPH, A Trosclair, MS, Office on Smoking and Health, National Center for Chronic Disease Prevention and Health Promotion, CDC.

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