

Factors Associated With Successful Smoking Cessation in the United States, 2000

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Cigarette smoking is the leading cause of preventable death in the United States. Each year, it kills more than 440 000 Americans,¹ and about 8.6 million people in the United States have illnesses attributable to smoking.² In addition, direct medical costs related to smoking total about \$75 billion annually.¹ The adverse health effects of cigarette smoking and the benefits of quitting are well documented and widely known to the general public.^{3–6} Even so, as of 2003, some 45.4 million US adults (21.6%) were current smokers.⁷

In 2003, the Centers for Disease Control and Prevention (CDC) found from self-reports that 41% of current smokers (20.2 million) had tried to quit smoking for 1 or more days within the previous 12 months.⁷ Many smokers who try to quit cite a desire to improve their health as the main reason.^{8,9} Unfortunately, most smokers are not successful in quitting, primarily because they are addicted to nicotine.^{10–14} Motivation and readiness to quit are predictors of successful quitting, but dependence on nicotine has been found to be a stronger predictor.¹³

Numerous studies have addressed factors associated with making a quit attempt or with successful smoking cessation. Past studies have examined such demographic factors as gender, age, marital status, income, and education to assess whether they differed between smokers who tried to quit and those who did not try, as well as between successful and unsuccessful quitters.^{5,12,13,15–17} For example, Derby et al.¹⁸ found that for women, successful smoking cessation was associated with not living with a smoker; for men, it was correlated with increased age. Hymowitz et al.¹⁹ found that being older, male, and having higher income predicted cessation, as did 2 behavioral variables—smoking fewer cigarettes and having previous quit attempts. Hatzianandreu et al.¹⁰ found that greater educational attainment was positively associated with trying to quit and

Objectives. Each year, nearly 2 in 5 cigarette smokers try to quit, but fewer than 10% succeed. Taking a multifaceted approach to examine the predictors of successfully quitting smoking, we identified factors associated with successful quitting so that cessation programs could be tailored to those at highest risk for relapse.

Methods. Using data from the 2000 National Health Interview Survey, we employed multiple regression analysis to compare demographic, behavioral, and environmental characteristics of current smokers who tried unsuccessfully to quit in the previous 12 months with characteristics of those able to quit for at least 7 to 24 months before the survey.

Results. Successful quitters were more likely than those unable to quit to have rules against smoking in their homes, less likely to have switched to light cigarettes for health concerns, and more likely to be aged 35 years or older, married or living with a partner, and non-Hispanic White, and to have at least a college education.

Conclusions. Programs promoting smoking cessation might benefit by involving family or other household members to encourage smoke-free homes. (*Am J Public Health.* 2007;97:1503–1509. doi:10.2105/AJPH.2005.083527)

that people aged 17 to 24 years and those aged 65 or older tried to quit more frequently. In addition, Wilcox et al.²⁰ found that people with higher income and educational levels were more likely to reattempt quitting after a relapse. Similarly, Borland et al.²¹ found that having higher education was a predictor of successfully quitting, but they found that having previous quit attempts was a predictor of relapse to smoking.

The environment in which an addictive behavior such as smoking occurs is a significant factor in determining whether or not that behavior is maintained.²² Several studies found that being in daily contact with other smokers reduced the likelihood of success in quitting.^{23–25} Similarly, Senore et al.²⁶ and Gourlay et al.²⁷ found that the likelihood of success in quitting was lower among smokers who lived with other smokers than among those who did not. Farkas et al.²⁸ found that bans in both the workplace and in the home were significant predictors of successful quitting. Correspondingly, Woodruff et al.²⁹ found a lower prevalence of smoking among workers employed in jobs with smoke-free policies. Other studies have found that bans on smoking in the workplace increase

cessation and promote reduction in cigarette consumption.^{30–32}

With regard to quit-related behaviors and methods of quitting, past studies have been inconsistent. Some found that switching to low-tar cigarettes helped smokers to quit,^{33–35} but a large, prospective, population-based study³⁶ found that this practice was not associated with the number of quit attempts. Giovino et al.³⁵ found that the consumption of low-tar cigarettes was associated with decreased quit rates. From the California Tobacco Survey, Farkas³⁷ found that “fading” in smoking (i.e., reducing consumption) increased the probability of cessation. In the same survey, it was also observed that heavy smokers (those who smoked more than 15 cigarettes a day) were less successful at quitting in the preceding 18 months than light smokers.^{37,38} Cinciripini et al.³⁹ compared 2 cessation methods—gradual reduction in cigarette consumption and “cold turkey”—and found that groups that gradually increased the time interval between cigarettes were more successful at quitting than groups that did not. McGovern and Lando⁴⁰ found that switching brands to reduce nicotine consumption increased the probability of cessation.

Gilpin and Pierce found that people often do not accurately remember past quit attempts other than the most recent one.⁴¹ A cross-sectional study of lung health by Murray et al.⁴² found that the number of quit attempts had a negative impact on smoking abstinence for men but no relationship to abstinence among women. Raw et al.⁴³ reported that it took smokers 3 to 4 quit attempts before they could quit completely. The US Public Health Service (PHS) Clinical Practice Guideline states that both having social support during quit attempts and a longer time before the first cigarette of the day increase the likelihood of quitting, because a shorter time before the first cigarette signals a higher level of addiction.⁴⁴

Most past studies of factors affecting quit attempts and their outcomes have been limited to specific populations or have addressed individual demographic or environmental characteristics. Recognizing the dynamic nature of smoking behavior, Horn,⁴⁵ Prochaska et al.,^{46–48} and DiClemente et al.⁴⁹ found that change in smoking behavior followed a series of stages, with each stage individually influenced by different factors. In addition, a few studies have examined several aspects of smokers' characteristics to determine the predictors of making quit attempts or successful smoking cessation, but almost none of them have taken a holistic approach where smokers' demographic, behavioral, and environmental characteristics and the methods used to quit are examined together.

In this study, using a representative sample of the US population, we identified statistically significant predictors of successful smoking cessation. To do so, we compared the approaches to smoking cessation of people who recently succeeded in quitting with those of current smokers who attempted but failed to quit in the previous year. Identifying predictors for successful quitting will help to target smoking cessation programs and interventions in the United States.

METHODS

Study Population

We used data from the 2000 National Health Interview Survey (NHIS), a large, population-based, cross-sectional survey of

the US civilian noninstitutionalized population that began in 1957. In 2000, data were collected through computer-aided face-to-face interviews conducted at respondents' homes. The NHIS collects a multitude of information on health-related behaviors, such as cigarette smoking, physical activity, and alcohol use, in addition to demographic characteristics. In 2000, approximately 100 620 people from 38 633 sampled households participated in the survey,⁵⁰ including 32 374 adults (aged 18 years and older). Our analysis was limited to adults who answered questions on tobacco.

In 2000, a special cancer control module was added to the NHIS that included in-depth questions on current and former smokers' cessation-related behaviors. In the main part of the survey, questions measured respondents' smoking status (current, former, or never smoker), history of smoking, amount of cigarette use, and among current smokers, whether they had tried to quit during the past year. The cancer control module contained detailed questions on tobacco use and cessation, including age at which smoking started, use of low-tar and low-nicotine cigarettes, quitting methods used among former smokers, whether current smokers had attempted to quit during the past year, and lifetime number of quit attempts. The 2000 NHIS data were therefore used for this study despite the fact that there are more recent NHIS data sets available.

Measures

Dependent variable. We compared recent successful quitters (who had quit 7–24 months earlier and had not relapsed) with current smokers who had a recent failed quit attempt (past 12 months). The successful quitters had responded “yes” to the question, “Have you smoked at least 100 cigarettes in your entire life?”; “not at all” to the question, “Do you *now* smoke cigarettes every day, some days or not at all?”; and “7–24 months” to the question, “How long has it been since you quit smoking cigarettes?” Since smokers who quit 1 to 6 months earlier are at high risk of relapse, we did not include them as recent successful quitters; some studies have shown that about 65% to 75% would relapse within a year.^{42,51,52}

Current smokers who had a recent failed quit attempt answered “yes” to the question, “Have you smoked at least 100 cigarettes in your entire life?”; “every day” or “some days” to the question, “Do you *now* smoke cigarettes every day, some days or not at all?”; and “yes” to the question, “During the *past 12 months*, have you stopped smoking for more than one day *because you were trying to quit smoking?*”

The screening process used to select recent successful quitters and current smokers with a recent failed quit attempt is illustrated in Figure 1.

Independent variables. Demographic characteristics included age, gender, education, marital status, and race/ethnicity. Age was categorized as 18–24, 25–34, 35–44, 45–54, 55–64, or 65 years or older. Educational status was divided into less than high school graduate, high school diploma or GED (general equivalency diploma), some college or associate degree, and college degree or higher. Marital status was dichotomized into (1) married or living with partner and (2) never married or divorced, separated, or widowed. Racial/ethnic categories were non-Hispanic White, non-Hispanic Black, Hispanic, and other.

Behavioral characteristics included age when respondent started smoking regularly, whether respondent ever switched to low-tar or low-nicotine products to reduce health risk, and lifetime quit attempts. The question “How old were you when you *first* started to smoke fairly regularly?” was asked of both former and current smokers. On the basis of the distribution of the age at which respondents first smoked cigarettes regularly, we created 3 categories: younger than 15, 15 to 18, and 19 years and older. For lifetime quit attempts, former smokers were asked, “In your *whole life*, including the last time, how many times did you stop smoking for one day or longer *because you were trying to quit smoking?*” Current smokers were asked, “In your *whole life*, how many times have you stopped smoking for one day or longer *because you were trying to quit smoking?*” On the basis of the distribution of responses to these questions, the number of lifetime quit attempts was categorized as 1, 2, 3 to 5, and 6 or more.

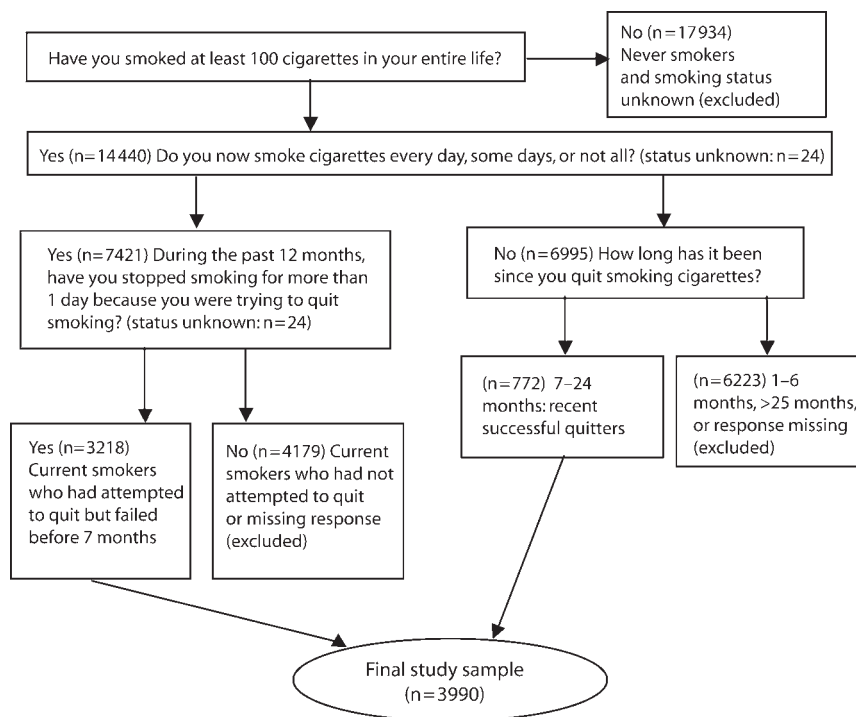


FIGURE 1—Survey screening process used to select recent successful quitters and current smokers with a recent failed quit attempt: National Health Interview Survey, 2000.

For environmental variables, we examined the presence of (1) smoking in the workplace, (2) a no-smoking policy at work, and (3) smoking in the home. Respondents were asked, “As far as you know, has anyone smoked in your work area in the *last week*?” The survey also asked, “Does your employer have an official policy that restricts smoking in any way?” To incorporate respondents who were not currently employed, the variable for those 2 questions was categorized as yes, no, and not employed. For the home environment, the survey asked, “During the *past week*, how many days did *anyone* smoke cigarettes, cigars, or pipes *anywhere inside* your home?” Respondents were grouped into less than 1 day per week/rarely/none and 1–7 days per week.

For quitting methods, the NHIS asked former smokers, “When you stopped smoking completely, which of these methods did you use?” It then listed the following methods: stopping all at once, gradually decreasing the number of cigarettes smoked, following instructions in a pamphlet or book, one-on-one

counseling, stop-smoking clinic or program, nicotine patch, nicotine-containing gum, nicotine nasal spray, nicotine inhaler, medication (Zyban, bupropion, or Wellbutrin), switched to chewing tobacco or snuff, and any other method. For current smokers, the response options were the same but the question was worded, “The *last time* you stopped smoking, which of these methods did you use?” Respondents were asked to select all of the quitting methods they used the last time. On the basis of the sample needed to achieve stable estimates, only 3 methods could be examined in the analysis: stopped all at once, gradually decreased the number of cigarettes smoked, and use of a nicotine patch or gum.

Statistical Analysis

Analyses were performed to identify which demographic, behavioral, and environmental characteristics and which quitting methods were associated with successful cessation. Sampling weights were used to account for the NHIS design and to achieve estimates for the US adult population. Statistical packages

SAS version 8.2 (SAS Institute Inc, Cary, NC) and SUDAAN version 8.0 (Research Triangle Institute, Research Triangle Park, NC) were used for all analyses. We conducted a preliminary descriptive analysis to examine the distributions of demographic, behavioral, environmental, and quitting method variables, and then we carried out a multivariate logistic regression analysis to identify statistically significant factors of successful smoking cessation.

RESULTS

Study Population

For the 2000 NHIS, the overall adult response rate was 72.1%. Among the 32 374 adults who completed the survey, 7421 were current smokers, 6995 former smokers, and 17 657 never smokers (smoking status was unknown for 301). Of the 7421 current smokers, 3218 (43.4%) had attempted to quit for longer than 1 day during the previous 12 months. Among former smokers, 363 reported quitting 7 to 12 months before the survey and 409 had quit 13 to 24 months earlier. The 430 people who had quit 1 to 6 months earlier were not included because, as mentioned earlier, they are at high risk of relapse. Thus, among current and former smokers who had attempted to quit during the previous 12 months ($n=4011$), 363, or 9.1%, sustained their abstinence for at least 7 to 12 months.

The distribution of the study sample by demographic, behavioral, and environmental characteristics, as well as the quitting methods used the last time respondents either successfully quit or attempted but failed to quit, are shown in Table 1.

Among current smokers who had attempted to quit but failed, about two thirds (66%) were aged 44 years or younger, 75% were non-Hispanic White, 60% were married or living with a partner, and 58% had a high school education or less. Seventy percent had attempted to quit smoking at least 3 times, 69% started to smoke regularly at age 18 or younger, and almost two thirds (65%) reported that others at home smoked.

Among recent successful quitters, 60% were aged 35 or younger, 81% were non-Hispanic White, 68% were married or living with a partner, and 48% had only a high school

TABLE 1—Selected Characteristics of US Adults, by Smoking Cessation Status: National Health Interview Survey, 2000

| Characteristic | Attempted but Failed to Quit in Past Year, % | Successfully Quit for 7–24 Months, % |
|--|--|--------------------------------------|
| Demographic | | |
| Age, y | | |
| 18–24 | 19.1 | 16.3 |
| 25–34 | 21.7 | 22.5 |
| 35–44 | 25.4 | 20.7 |
| 45–54 | 18.6 | 15.4 |
| 55–64 | 9.6 | 13.4 |
| ≥ 65 | 5.6 | 11.6 |
| Gender | | |
| Man | 51.3 | 50.0 |
| Woman | 48.7 | 50.0 |
| Race/ethnicity | | |
| Non-Hispanic White | 75.4 | 80.5 |
| Non-Hispanic Black | 12.1 | 7.5 |
| Hispanic | 8.0 | 7.7 |
| Other | 4.5 | 4.3 |
| Marital status | | |
| Married or living with a partner | 60.2 | 67.9 |
| Never married, divorced, separated, or widowed | 39.8 | 32.1 |
| Education | | |
| Less than high school | 20.9 | 18.1 |
| High school graduate or GED | 36.6 | 30.0 |
| Some college or associate degree | 30.7 | 30.2 |
| College graduate or higher | 11.8 | 21.7 |
| Behavioral | | |
| Lifetime quit attempts | | |
| 1 | 14.3 | 37.6 |
| 2 | 15.9 | 16.5 |
| 3–5 | 35.3 | 26.9 |
| ≥ 6 | 34.6 | 19.0 |
| Age first smoked regularly, y | | |
| ≤ 14 | 20.8 | 23.6 |
| 15–18 | 47.7 | 50.3 |
| ≥ 19 | 31.5 | 26.1 |
| Ever switched to low-tar/low-nicotine products | 52.5 | 41.9 |
| Environmental factors | | |
| No-smoking policy at work | 39.9 | 45.2 |
| Others smoke at work | 11.8 | 8.8 |
| Others smoke at home | 65.1 | 15.8 |
| Quitting methods used | | |
| Stopped at once or cold turkey | 72.1 | 75.7 |
| Gradually decreased no. of cigarettes | 10.5 | 8.6 |
| Nicotine patch or gum | 16.2 | 12.4 |

Note. GED = general equivalency diploma. Percentages given for Environmental Factors and Quitting Methods used were those persons who replied “yes” to the question posed.

demographic characteristics were significantly associated with cessation. The odds of successful quitting increased with age. People with a college education or more were 1.83 times as likely to be successful quitters as those with less than a high school education. People who were married or living with a partner and non-Hispanic Whites were also more likely to succeed in quitting.

Regarding smoking-related behaviors, trying numerous times to quit and switching to low-tar or low-nicotine cigarettes for health reasons reduced the likelihood of successful cessation. With respect to environmental factors, people who had a smoke-free home were 10 times as likely to be successful quitters as those who lived in a home where smoking took place. For workers, having a no-smoking policy at work doubled the likelihood of successful cessation. A person's gender, the presence of smokers at work, going “cold turkey,” gradually decreasing the number of cigarettes, and using nicotine replacement therapy did not significantly predict cessation.

DISCUSSION

We used a large population-based sample of US adults to examine multiple factors that might be associated with successful smoking cessation. By contrast, most earlier studies have examined quit attempts among population subgroups (such as pregnant women, working populations, or specific communities),^{18,19,21,53–55} the impact of individual interventions,^{28,36,42} or the influence of specific population or environmental characteristics.^{28,51,55} To better guide smokers who wish to quit, we must understand the underlying dynamics of the quitting process with respect not only to smokers' demographic and behavioral characteristics but also their living and working environments. The significant gap between the proportion of current and former smokers who had tried to quit during the previous year (43%) and those who actually quit for 7 or more months (9%) by itself reflects the reality that intentions alone are not enough.

We found that having a smoke-free home, having a no-smoking policy at work, being aged 35 or older, having a college education or more, being married or living with a

education or less. Almost half (46%) had tried to quit 3 or more times, 74% had started to smoke regularly at age 18 or younger, and 16% reported that others at home smoked.

Multivariate Analysis

The odds ratios (with 95% confidence intervals) for successful cessation are shown by type of characteristic in Table 2. All 4

TABLE 2—Odds Ratios With 95% Confidence Intervals Comparing Those Who Successfully Quit Smoking With Unsuccessful Quitters: National Health Interview Survey, 2000

| Characteristic | Odds Ratio (95% Confidence Interval) | P |
|--|--------------------------------------|-------|
| Demographic | | |
| Age, y | | |
| 18–24 | 1.00 (Reference) | |
| 25–34 | 1.32 (0.92, 1.90) | .137 |
| 35–44 | 1.47 (1.02, 2.12) | .038 |
| 45–54 | 1.80 (1.19, 2.71) | .005 |
| 55–64 | 3.58 (2.30, 5.58) | <.001 |
| ≥ 65 | 5.34 (3.47, 8.22) | <.001 |
| Education | | |
| Less than high school | 1.00 (Reference) | |
| High school graduate or GED | 1.02 (0.73, 1.43) | .889 |
| Some college or associate degree | 1.20 (0.87, 1.66) | .268 |
| College graduate or higher | 1.83 (1.24, 2.69) | .002 |
| Marital status | | |
| Married or living with a partner | 1.00 (Reference) | |
| Never married, divorced, separated, or widowed | 0.73 (0.58, 0.91) | .005 |
| Race/ethnicity | | |
| Non-Hispanic White | 1.00 (Reference) | |
| Non-Hispanic Black | 0.67 (0.47, 0.97) | .032 |
| Hispanic | 0.69 (0.49, 0.96) | .026 |
| Other | 0.74 (0.42, 1.28) | .279 |
| Behavioral | | |
| Lifetime quit attempts | | |
| 1 | 1.00 (Reference) | |
| 2 | 0.43 (0.31, 0.60) | <.001 |
| 3–5 | 0.28 (0.21, 0.37) | <.001 |
| ≥ 6 | 0.19 (0.14, 0.26) | <.001 |
| Ever switched to low-tar/nicotine products | | |
| Yes | 1.00 (Reference) | |
| No | 1.32 (1.04, 1.66) | .021 |
| Environmental | | |
| Others smoking at home | | |
| Yes | 1.00 (Reference) | |
| No | 10.47 (8.15, 13.46) | <.001 |
| No-smoking policy at work | | |
| No | 1.00 (Reference) | |
| Yes | 2.01 (1.20, 3.37) | .008 |

Note. GED = general equivalency diploma. Successful quitters were defined as those who had maintained their quit status for 7 to 24 months. Unsuccessful quitters were defined as those who had tried to quit for 1 day or more during the past year but relapsed before 7 months.

partner, being a non-Hispanic White, having only 1 lifetime attempt to quit, and not switching to low-tar or low-nicotine products for health reasons were significantly associated with cessation. The significant influence of 2 environmental factors (smoke-free home

and no-smoking policy at work) was found in several earlier studies. For example, using US population-based survey data, Farkas et al.²⁸ found that working in a smoke-free workplace and living under a partial or total home smoking ban were positively associ-

ated with successful cessation. In a multivariate study that examined predictors of cessation, Hymowitz et al.¹⁹ identified the absence of other smokers in the household as a significant predictor. Finally, Derby et al.,¹⁸ Borland et al.,²¹ and McMahon and Jason⁵⁶ identified the positive influence of social support on sustained cessation after the implementation of a smoking ban for workers.

Similar to our findings, having higher education,^{21,53,55} being married,¹⁸ and older age¹⁹ have all been identified by others as determinants of successful cessation. Data on the relationship of gender to cessation have been contradictory, with some studies finding men more likely to be successful quitters^{19,55,57} and others^{53,56,58} finding no relationship with gender.

Regarding behavioral characteristics, our finding of a negative correlation between multiple attempts to quit and successful cessation accords well with the findings of Borland et al.²¹ and Murray et al.⁴² The latter group found that male participants who had more quit attempts at baseline were less likely to sustain cessation over 5 years. On the other hand, Hymowitz et al.¹⁹ reported that having more than 1 previous quit attempt was associated with successful cessation. Although Hyland et al.³⁶ found that switching to a low-tar cigarette did not alter the likelihood of successful cessation over a 2-year period, our multivariate analysis found that switching to low-tar or low-nicotine products was negatively associated with successful cessation. Although a few previous studies^{19,52,54} have identified older age of initiation as a significant predictor of successful cessation, we found no relationship between age at which a person started smoking and successful cessation.

Several limitations to the present study need to be noted. First, because the NHIS is a US-based study of civilian, noninstitutionalized people, some groups of interest (e.g., the military, those in extended care facilities, the homeless, people living abroad) were excluded. Second, because we relied on self-reports to determine smoking status, smoking could be underreported through respondents' wish to give a socially desirable response.^{59,60} Recent studies, however, have shown that self-reports and biochemical measurements of serum cotinine concentration (which indicate

exposure to tobacco smoke) provide similar estimates of smoking prevalence in the United States.⁶¹

Third, we did not have information on the number of cigarettes smoked by former smokers. Past studies^{19,53,55,58,62} have found that heavy smokers are less likely than light smokers to succeed in quitting. We also could not examine the number and duration of quitting methods used because the information was unavailable in the data set. The association between the use of quitting methods and cessation outcome may vary depending on the number and duration of methods used. Although our study did not identify a significant impact of nicotine replacement therapy on cessation outcome, clinical trials have found that the use of such therapy and nonnicotine medications such as sustained-release Bupropion double long-term abstinence rates.⁴⁴ Finally, we limited successful quitters to those who quit for 7 to 24 months, but some people will relapse after more than 2 years of quitting,⁴² and thus our analysis probably included some people who did not quit permanently.

This study may have several important implications for policy. The significant impact of a no-smoking policy in the workplace, also shown by several past studies to be related to cessation, indicates that its implementation will help those who intend to quit to succeed. Currently, 7 US states have comprehensive smoke-free policies for most enclosed workplaces and public settings, including bars and restaurants.⁶³ In one prominent success story, 10 years after passing a statewide smoke-free workplace law, California is experiencing a significant decrease in tobacco use among youths, is limiting exposure to environmental tobacco smoke for many of its citizens, and is helping many smokers to quit through its antismoking programs and policies.⁶⁴ The PHS Clinical Practice Guideline⁴⁴ recommends that smokers be counseled to ask for social support from their spouse or partner, friends, and coworkers. The present study suggests that cessation programs need to take a holistic approach. Because smokers' demographic characteristics, smoking-related behaviors, and daily living and working environments significantly affect their ability to quit,

effective programs will need to involve not only smokers who intend to quit but also their family members, friends, and colleagues, and at the same time implementing smoke-free policies that support cessation. ■

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Contributors

C. Lee originated the study, conducted the data analysis, and led the writing. J. Kahende assisted with the interpretation of the findings and the writing and reviewed drafts of the article.

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