

# Trends in Adult Cigarette Smoking in California Compared With the Rest of the United States, 1978–1994

## ABSTRACT

**Objectives.** This study compared trends in adult cigarette smoking prevalence in California and the remainder of the United States between 1978 and 1994.

**Methods.** We used data from National Health Interview Surveys and Behavioral Risk Factor Surveillance System surveys to compare trends in smoking prevalence among persons 18 years and older.

**Results.** In both California and the remainder of the United States, the estimated annual rate of decline in adult smoking prevalence accelerated significantly from 1985 to 1990: to  $-1.22$  percentage points per year (95% confidence interval [CI] =  $-1.51, -0.93$ ) in California and to  $-0.93$  percentage points per year (95% CI =  $-1.13, -0.73$ ) in the remainder of the nation. The rate of decline slowed significantly from 1990 to 1994: to  $-0.39$  percentage points per year (95% CI =  $-0.76, -0.03$ ) in California and to  $-0.05$  percentage points per year (95% CI =  $-0.34, 0.24$ ) in the remainder of the United States.

**Conclusions.** The presence of an aggressive tobacco control intervention has supported a significant decline in adult smoking prevalence in California from 1985 to 1990 and a slower but still significant decline from 1990 to 1994, a period in which there was no significant decline in the remainder of the nation. To restore nationwide progress in reducing smoking prevalence, other states should consider similar interventions. (*Am J Public Health*. 2000;90:372–379)

Michael Siegel, MD, MPH, Paul D. Mowery, MA, Terry P. Pechacek, PhD, Warren J. Strauss, ScM, Michael W. Schooley, MPH, Robert K. Merritt, MA, Thomas E. Novotny, MD, MPH, Gary A. Giovino, MS, PhD, and Michael P. Eriksen, ScD

Although the prevalence of adult smoking in the United States declined steadily from 1965 to 1990 (from 42.4% to 25.5%), there was no further significant decline from 1990 to 1994.<sup>1–5</sup> Hence, the nation probably will not achieve its year 2000 goal of reducing adult smoking prevalence to 15%.<sup>6</sup> Data from California, however, suggest that the prevalence of adult smoking in that state continued to decline from 1990 to 1994 and may approach 15% by the year 2000 if present trends continue.<sup>7</sup>

California was the first state to implement a comprehensive tobacco control program funded by an increase in the state cigarette excise tax (Proposition 99).<sup>8</sup> This program, implemented in 1989, is considered a model for the nation.<sup>9,10</sup> Because of the uniqueness of the California Tobacco Control Program and the size of the California population (between 1980 and 1994, 10% to 12% of the nation's adult population resided in California<sup>11,12</sup>), comparing trends in smoking behavior in California with those in the remainder of the United States is both technically feasible and important. Massachusetts, Arizona, and more recently Oregon and Maine have followed the California model of funding statewide tobacco control programs by increasing state excise taxes. Comparing smoking prevalence trends in California with those in the United States as a whole may help to identify the social, environmental, and political factors that influence cigarette smoking, to determine how California's intervention can best be applied in other states, and to monitor national progress toward the year 2000 objective.

To compare trends in adult cigarette smoking in California with those in the remainder of the United States, we examined data on current smoking among adults (persons 18 years and older) from several

national surveys conducted periodically from 1978 through 1994. For each survey, respondents who lived in California were identified so that we could make separate estimates for California and for the remainder of the United States. In evaluating smoking prevalence trends, we considered the role of race/ethnicity, education level, tobacco control interventions, and tobacco industry responses to these interventions.

## Methods

### Selection of Data Sources

We identified all national and state systems for surveillance of tobacco use conducted between 1978 and 1994 that allowed estimation of the prevalence of adult cigarette smoking in California. Although prior reports

Michael Siegel is with the Social and Behavioral Sciences Department, Boston University School of Public Health, Boston, Mass. Paul D. Mowery is with the Research Triangle Institute, Atlanta, Ga. Terry P. Pechacek, Michael W. Schooley, and Michael P. Eriksen are with the Office on Smoking and Health and Robert K. Merritt is with the Division of Reproductive Health, National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention, Atlanta, Ga. Warren J. Strauss is with the Battelle Memorial Institute, Atlanta, Ga, and Columbus, Ohio. Thomas E. Novotny is with the Office of Global Health, Centers for Disease Control and Prevention, Washington, DC. Gary A. Giovino is with the Roswell Park Cancer Institute, Buffalo, NY.

Requests for reprints should be sent to Michael Siegel, MD, MPH, Social and Behavioral Sciences Department, Boston University School of Public Health, 715 Albany St, TW2, Boston, MA 02118 (e-mail: mbsiegel@bu.edu).

This article was accepted November 15, 1999.

TABLE 1—Sample Sizes for the National and California Surveys, Persons Aged 18 Years and Older, 1978–1994

Year	National Health Interview Survey <sup>a</sup>			California Behavioral Risk Factor Surveillance System Survey, <sup>a</sup> n	Other Referenced Surveys		
	California only, n	US, Excluding California, n	National Sample in California, %		Current Population Survey, Tobacco Supplement, California Only, n	California Tobacco Survey, n	California Adult Tobacco Survey, n
1978	1190	10 333	10.3	...	...	...	...
1979	2610	21 358	10.9	...	...	...	...
1980	1137	9 205	11.0	...	...	...	...
1981	...	...	...	...	...	...	...
1982	...	...	...	...	...	...	...
1983	2349	20 037	10.5	...	...	...	...
1984	...	...	...	1081	...	...	...
1985	3506	29 449	10.6	1369	4 076	...	...
1986	...	...	...	1577	...	...	...
1987	4872	37 831	11.4	1784	...	...	...
1988	4979	38 831	11.4	2444	...	...	...
1989	...	...	...	2381	4 498	...	...
1990	4835	35 831	11.9	2687	...	26 815	...
1991	5310	37 844	12.3	2988	...	...	...
1992	1389	9 989	12.2	3959	...	11 905	...
1993	2649	18 211	12.7	3692	16 712 <sup>b</sup>	30 716	...
1994	2357	17 210	12.0	3939	...	...	4170

<sup>a</sup>Sample sizes include only those respondents with valid responses to questions on cigarette smoking.

<sup>b</sup>Combined data from 3 monthly surveys conducted in 1992 and 1993.

of smoking prevalence in California used 1974 as the initial year of analysis,<sup>7,13–15</sup> we selected 1978 as the initial year for our analysis because it was the first year that the National Health Interview Survey (NHIS) tobacco supplements included 18- and 19-year-olds and collected information on the ethnicity of respondents. The inability to adjust estimates to reflect differences in the proportion of persons of various racial/ethnic groups or to reflect age differences in the sample populations before 1978 could significantly alter the estimates for these early years. Because these data points serve as anchors for the entire analysis, it is important to estimate them accurately.

We identified 5 surveys: the NHIS (1978–1980, 1983, 1985, 1987, 1988, and 1990–1994), the Behavioral Risk Factor Surveillance System (BRFSS) surveys (1984–1994), the Current Population Surveys (CPS) (1985, 1989, and 1992/1993), the California Tobacco Survey (CTS) (1990, 1992, and 1993), and the California Adult Tobacco Surveys (CATS) (1994). Because of potential differences in methodology between surveys, we selected for trend analyses only the 2 surveys conducted periodically during the time of interest (NHIS and BRFSS). Data from the CPS were not included because these surveys assessed smoking status for only 3 time points, and data from the CTS and CATS were not included in trend analyses because they were conducted only after 1990. However, we compared the data from

the latter 3 surveys with the findings of our trend analyses.

#### Description of Data Sources

**NHIS.** The NHIS is a household survey of a stratified, multistage, probability sample of the civilian, noninstitutionalized US population.<sup>16–22</sup> Supplements to the NHIS included questions on tobacco use in 1978–1980, 1983, 1985, 1987, 1988, and 1990–1994 and were administered to all adult respondents (18 years and older).

Although the NHIS was designed to produce national estimates, we were able to produce estimates for California by stratifying the sample on the basis of primary sampling units, which are metropolitan areas or groups of counties that serve as the basis for household sampling. Unique characteristics of the California NHIS sample enabled us to derive state-specific estimates.<sup>23,24</sup> Approximately 12% of NHIS respondents lived in California, and this proportion was relatively stable between 1978 and 1994 (Table 1). All primary sampling units that included California respondents were completely within the state's boundaries. Approximately 90% of California residents lived in areas that were part of a primary sampling unit.

The National Center for Health Statistics (NCHS) provided information that allowed us to classify NHIS respondents as California or non-California residents. In accordance with the NCHS protocol, the specific identity of

primary sampling units was not revealed; we were only given information on whether a unit was in California or not. We adjusted post-stratification weights from the NHIS to match the California and US populations by age, sex, and race/ethnicity for each survey year. Population controls were derived from the annual demographic files of the CPS.<sup>25</sup> Rates of response to the NHIS supplements varied from 79.5% to 87.8%.

**BRFSS.** The BRFSS is a system of state surveillance of behavioral risk factors among adults.<sup>26</sup> Data are collected through random-digit-dial telephone interviews by means of a multistage cluster sampling method. California has participated in the BRFSS since 1984. Rates of response to the annual surveys between 1984 and 1994 varied from 77% to 84%.

**CPS.** The CPS is a national survey of the US civilian household population 15 years and older.<sup>27</sup> Interviews are conducted in person, but proxy respondents are permitted. We used data only from self-respondents, however, because analyses based on proxy respondents have been shown to significantly underestimate smoking prevalence.<sup>28</sup> Questions on tobacco use were included in special supplements to the monthly CPS in September 1985, September 1989, September 1992, January 1993, and May 1993. We combined data from the 3 1992 and 1993 monthly supplements to estimate smoking prevalence in 1993. The overall rate of response to the CPS supplements in 1993 was 87.9%.

*CTS.* The CTS was a computer-assisted, random-digit-dial telephone survey conducted by the University of California, San Diego, and Westat, Inc in 1990, 1992, and 1993.<sup>29</sup> Rates of response to the adult component of the survey ranged from 71.3% in 1992 to 99.4% in 1993.

*CATS.* The CATS is an ongoing, monthly, computer-assisted telephone survey conducted by the California Department of Health Services and initiated in 1994. The methodology is similar to that used in the BRFSS.

Sample sizes for each of the above surveys are shown in Table 1.

### Measurement of Smoking Prevalence

We defined current smokers as respondents who answered yes to the following questions: "Have you smoked at least 100 cigarettes in your entire life?" and "Do you smoke cigarettes now?" These questions were asked in all 5 surveys. In certain years, some of the surveys asked an additional question to assess smoking status. Starting in 1992, the California BRFSS survey added the question "Have you smoked any cigarettes in the past 30 days?" To maintain continuity in assessing smoking status in the BRFSS over time, we classified as former smokers those respondents who reported that they did not currently smoke but had smoked 1 or more cigarettes in the past 30 days. In 1987, NHIS respondents were asked "How old were you when you first started smoking cigarettes fairly regularly?" Those who had never smoked regularly were not asked whether they currently smoked and were not classified as current smokers. The 1985 and 1989 CPS supplements included the question "How old were you when you first started smoking cigarettes fairly regularly?" Again, respondents who reported that they had never smoked regularly were not classified as current smokers, even if they indicated that they currently smoked.

Before 1992, all estimates of current smoking prevalence from the NHIS and CPS included only respondents who indicated that they currently smoked. Starting in 1992, the NHIS replaced the question "Do you smoke cigarettes now?" with the question "Do you now smoke cigarettes every day, some days, or not at all?" For the 1992–1994 NHIS, we defined current smokers as those who had ever smoked 100 cigarettes and who currently smoked every day or some days. This change in definition increased the NHIS prevalence estimates for 1992 by approximately 1 percentage point.<sup>3</sup> The 1992 and 1993 CPS questions were identical to the 1992–1994 NHIS questions. The California BRFSS retained the pre-1992 NHIS definition of current smokers until 1996.

### Measurement of Quit Ratio

We defined the quit ratio for a given year as the percentage of ever smokers (current smokers plus former smokers) who were former smokers.<sup>30</sup> Former smokers were defined as persons who had smoked 100 cigarettes in their lifetime but were not current smokers. Ever smokers were defined as persons who had smoked 100 cigarettes in their lifetime, regardless of their current smoking status. Only data from the NHIS were used to estimate quit ratios.

### Statistical Analyses

We weighted study data before computing point estimates of smoking prevalence and quit ratios. Survey weights were used to adjust for probability of subject selection, nonresponse, and the age, sex, and race distribution of the California or US (excluding California) population. We used the California BRFSS and California CPS weights provided on the data tapes for each year and adjusted the supplied NHIS weights to make the sample distributions accurately reflect the age, sex, and race/ethnicity distributions of California (or the remainder of the nation). We used SUDAAN software<sup>31</sup> to compute standard errors of point estimates.

To identify time trends, we created separate regression models for the NHIS and the BRFSS surveys, using all available data points. Using NHIS data, we assessed several potential models (linear, logistic, exponential, and polynomial [second-order and third-order]) of the trend in national smoking prevalence. Because the trend in smoking prevalence may not have been linear over the entire time period, we allowed the slope of the regression curves to vary for up to 3 different time periods within the overall period 1978 to 1994. For the linear models, we chose points of intersection of the regression line segments at 1985 and 1990 on the basis of visual inspection of the scatter plots, which suggested a different rate of change in smoking prevalence for the periods 1978 to 1985, 1985 to 1990, and 1990 to 1994. For the nonlinear models, we examined models with 0, 1, or 2 inflection points for each. We selected the best-fit model for the United States (excluding California) by using the  $R^2$  coefficient as the criterion for goodness of fit.<sup>32</sup> Once the best-fit model was selected, we used a similar type of model to estimate smoking prevalence trends for the California NHIS and California BRFSS surveys.

To assess differences in the slopes of trend line segments between California and the remainder of the United States, we ran a single model that included all NHIS data

points and contained a dummy variable that indicated whether the point represented an estimate for the United States (excluding California) or for California. For all other models, we estimated separate regression lines for the California and US (excluding California) data.

We plotted data from the CPS, CTS, and CATS to assess the degree to which these data were consistent with findings from the NHIS and the BRFSS surveys. These data points were not included in the regression analyses.

To take into account variations in the precision with which point estimates of adult smoking prevalence were derived, we used weighted least squares regression models that gave more weight to observations with smaller variances.

## Results

### Model Selection

Of the models tested (linear, quadratic, 2-segment piecewise linear, 3-segment piecewise linear, and cubic), the 3-segment piecewise linear regression model with points of intersection of the regression line segments at 1985 and 1990 produced the best overall fit of the data ( $R^2 = 0.98$  for the United States [excluding California];  $R^2 = 0.99$  for California). This model, which produced separate estimates of the trend in adult smoking prevalence for 3 time periods (1978–1985, 1985–1990, and 1990–1994), was used in all subsequent analyses.

### Adult Smoking Prevalence

According to our analysis of NHIS data, adult smoking prevalence decreased more rapidly from 1985 to 1990 than from 1978 to 1985 in both California and the remainder of the nation (Table 2, Figure 1). The increase in the rate of decline in smoking prevalence between these 2 periods was 0.62 percentage points per year (95% confidence interval [CI] = -1.27, -0.03) in California and 0.43 percentage points per year (95% CI = -0.70, -0.16) in the remainder of the United States.

Adult smoking prevalence decreased less rapidly from 1990 to 1994 than from 1985 to 1990 for both California and the remainder of the United States. In California, the rate of decline in smoking prevalence from 1990 to 1994 was 0.39 percentage points per year (significantly different from 0), whereas in the remainder of the United States it was only 0.05 percentage points per year (not significantly different from 0) (Table 2).

**TABLE 2—Estimated Rate of Change<sup>a</sup> (95% Confidence Interval) in Smoking Prevalence and Quit Ratio, by Period: California and the Remainder of the United States, 1978–1994, National Health Interview Survey**

	1978–1985	1985–1990 <sup>b</sup>	1990–1994 <sup>b</sup>
Smoking prevalence (adults aged 18+ years)			
California	–0.60 (–0.79, –0.40)	–1.22* (–1.51, –0.93)	–0.39* (–0.76, –0.03)
United States <sup>b</sup>	–0.50 (–0.67, –0.33)	–0.93* (–1.13, –0.73)	–0.05* (–0.34, +0.24)
Smoking prevalence (adults aged 25+ years)			
California	–0.61 (–0.83, –0.39)	–1.11* (–1.37, –0.84)	–0.61 (–0.99, –0.23)
United States <sup>b</sup>	–0.43 (–0.63, –0.24)	–0.88* (–1.10, –0.66)	–0.20* (–0.52, +0.12)
Quit ratio (adults aged 18+ years)			
California	+0.73 (+0.22, +1.24)	+1.36 (+0.74, +1.97)	+0.18 (–0.80, +1.15)
United States <sup>b</sup>	+0.73 (+0.40, +1.05)	+1.04 (+0.62, +1.46)	+0.15 (–0.47, +0.77)

<sup>a</sup>Estimated annual change in smoking prevalence or quit ratio (ratio of former smokers to former plus current smokers) in percentage points.

<sup>b</sup>Excluding California.

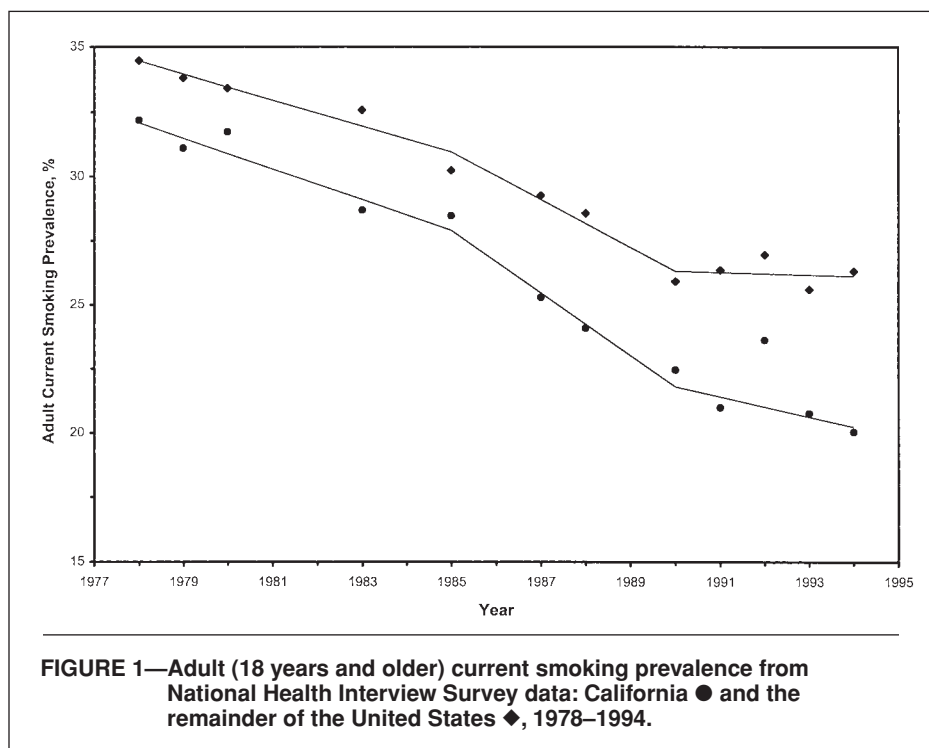
\*Significant difference ( $P < .05$ ) between the estimated rate of change for that period and that for the previous period.

Between 1978 and 1994, adult smoking prevalence was approximately 2 to 5 percentage points lower in California than in the remainder of the United States (Figure 1). The estimated rate of decline in smoking prevalence in California was not significantly different from that of the rest of the United States during any of the 3 time periods (Table 2).

Restricting the analysis to NHIS survey respondents 25 years and older had little effect, except that the slowing of the rate of decline in smoking prevalence during the early 1990s was less pronounced (Table 2); for those years, the rate of decline in smoking prevalence among adults 25 years and older was 0.61 percentage points per year in California and 0.20 percentage points per year in the remainder of the United States. Thus, smoking prevalence among these adults declined 3 times faster in California than in the rest of the nation during 1990 to 1994.

The trends in smoking prevalence in California described above were observed among both men and women and persisted when we restricted our analysis to non-Hispanic White adults (data not shown).

Trends in adult current smoking prevalence in California that were estimated from BRFSS survey data were similar to those estimated from NHIS data (Figure 2). The BRFSS estimates tended to be about 2 percentage points lower than the NHIS estimates for any given year, but these differences were consistent, and the overall trends were remarkably similar. Smoking prevalence estimates from the CPS, CTS, and CATS were consistent with the NHIS and BRFSS survey trend patterns (Figure 2). The smoking prevalence estimates from the CPS and CATS tended to be closer to the BRFSS survey estimates, which is understandable given that the CPS, CATS, and



**FIGURE 1—Adult (18 years and older) current smoking prevalence from National Health Interview Survey data: California ● and the remainder of the United States ◆, 1978–1994.**

BRFSS are all telephone surveys, while the NHIS uses face-to-face interviews.

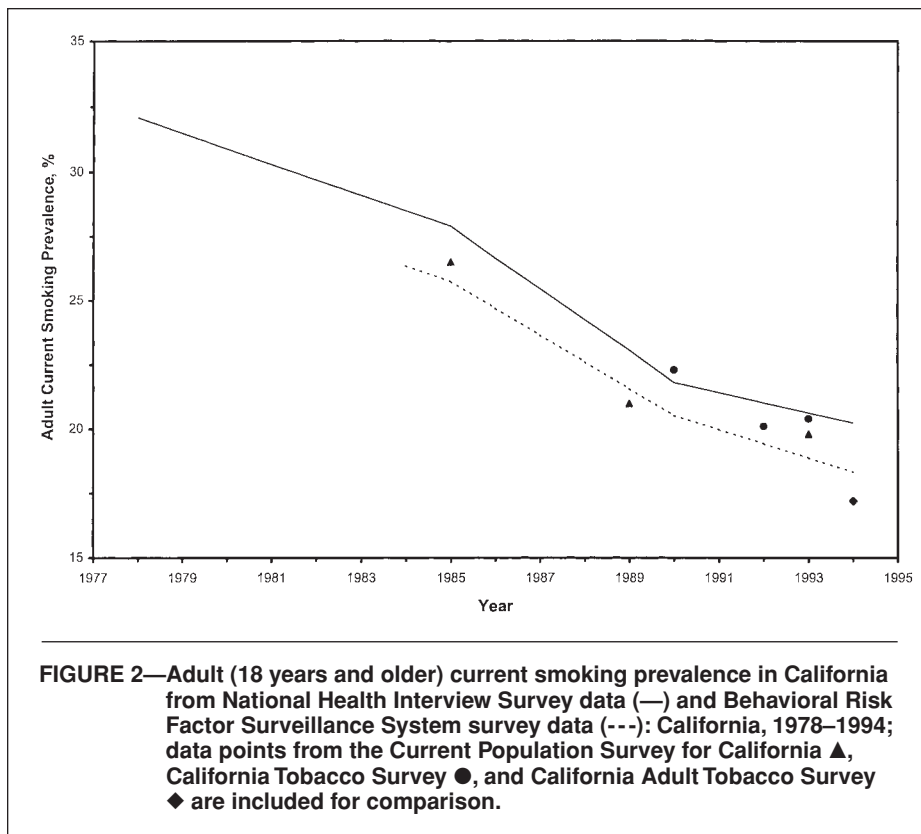
#### Adult Quit Ratio

Trends in the adult quit ratio were opposite to those for smoking prevalence (Figure 3). In both California and the rest of the United States, the rate of increase in the quit ratio accelerated during 1985 to 1990, but these changes were not significant (Table 2). The rate of increase in the quit ratio decreased during 1990 to 1994; neither California nor the remainder of the nation demonstrated a significant change in the quit ratio during 1990 to 1994 compared with 1985 to 1990.

#### Discussion

In both California and the rest of the United States, the prevalence of adult smoking decreased more rapidly from 1985 to 1990 than from 1978 to 1985. After this period of accelerated decline in smoking prevalence, the rate of decline slowed significantly during the early 1990s in both California and the remainder of the United States. However, whereas adult smoking prevalence in the nation as a whole was essentially stable from 1990 to 1994, the prevalence in California continued to decline significantly.

This last observation—that adult smoking prevalence in California continued to decline during the early 1990s, while smok-



ing prevalence in the rest of the nation was stable—cannot be explained by changes in the age, sex, or race/ethnicity distribution of the California or US populations. Restricting our analysis to older adults (25 years and older), men, women, or non-Hispanic White adults did not appreciably affect the results. Our observation also cannot be explained by differences in educational attainment, because the percentages of Californians who graduated from high school and from college have not increased faster than the corresponding proportions for the United States (excluding California) from 1978 to 1995 (Centers for Disease Control and Prevention, Office on Smoking and Health, unpublished data from the US Bureau of the Census, Current Population Reports, 1997).

One possible explanation for the different rates of decrease in recent smoking prevalence for California and the remainder of the nation is the continued presence of California's tobacco control program (Proposition 99). Proposition 99 was associated with an acceleration in the rate of decline of per capita cigarette consumption in California<sup>7,29,33–45</sup> and produced a 10% to 13% long-term reduction in cigarette consumption.<sup>44</sup> Both short-term effects of the cigarette tax increase and long-term effects due to the tax increase or other programs funded by Proposition 99 have been demonstrated,<sup>38,42</sup> and evidence exists that the antismoking media

campaign specifically resulted in reduced cigarette consumption.<sup>7,41–44</sup>

The slowed rate of decline in smoking prevalence from 1990 to 1994 in California may be a result of increased smoking initiation among youths. From 1990 to 1994, smoking prevalence declined 0.61 percentage points per year among Californians 25 years and older and 0.39 percentage points per year among all adults (Table 2). Because adults 25 years and older made up about 85% of our sample, the decline in smoking prevalence among all adults during the early 1990s could be attributed entirely to the older age group.

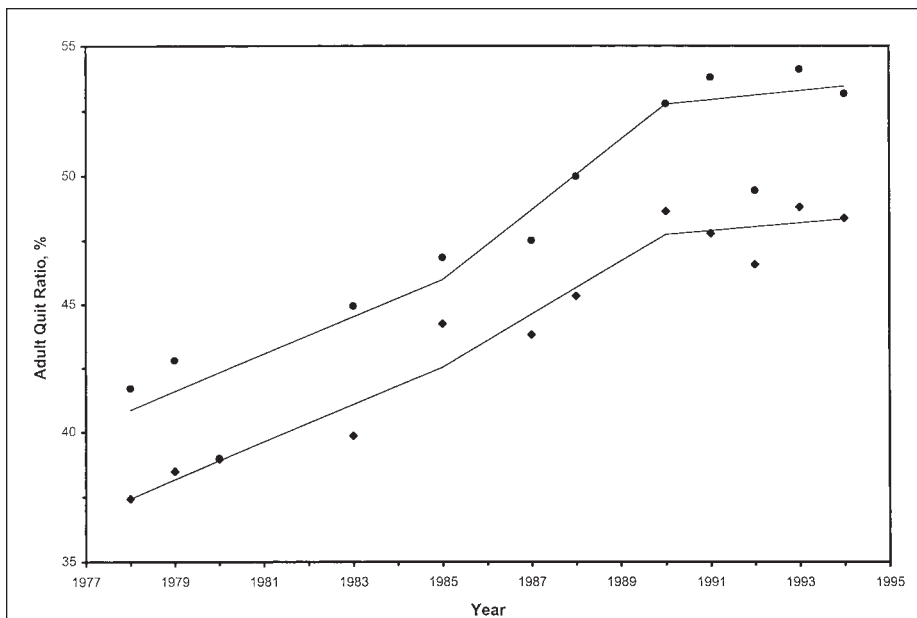
Similarly, for the United States (excluding California), the decline in smoking prevalence from 1990 to 1994 among persons 25 years and older (0.20 percentage points per year) was greater than that among all adults (persons 18 years and older) (0.05 percentage points per year) (Table 2). Again, this difference may be due to increased smoking prevalence among the younger adults. Previously reported data show an increase in smoking prevalence among 18- to 24-year-olds from 1990 (24.5%) to 1994 (27.5%),<sup>1–5</sup> an increase in smoking initiation rates among 12- to 17-year-olds from 1985 to 1989,<sup>46</sup> and a leveling, during the latter half of the 1980s, of a previous decline in smoking prevalence among 14- to 18-year-olds.<sup>47</sup>

Changes in the marketing, pricing, and product differentiation of cigarettes may help

explain the slowing in the rate of decline in smoking prevalence in both California and the remainder of the United States during the first half of the 1990s.<sup>48–51</sup> In the nation, the pattern of cigarette advertising has shifted from traditional print advertising to promotional activities.<sup>50,51</sup> In California, expenditures for cigarette promotions, especially for advertisements targeting youth and women, have increased.<sup>15,38,43,52–55</sup> The frequency of print and outdoor advertisements targeting youth and women more than tripled after the passage of Proposition 99.<sup>14,54,55</sup> From 1990 through 1993, the tobacco industry outspent the Proposition 99-funded media campaign by 10 to 1 through magazine, newspaper, and outdoor advertising alone.<sup>52</sup>

Changes in cigarette product differentiation and pricing occurred during the late 1980s and early 1990s.<sup>49</sup> Nationwide, the market share of discount and generic brands increased from 11% in 1988 to over 40% by the second quarter of 1993.<sup>48,49,56</sup> In California, the percentage of smokers buying generic brands increased by 70% from 1990 to 1992.<sup>57</sup> In 1993, major cigarette producers dropped prices of premium brands to retain market share.<sup>49</sup>

In addition to these nationwide factors, some unique factors may help explain the slowing in the rate of decline in smoking prevalence in California after the tobacco control program was introduced. First, the tobacco industry responded to Proposition 99 by drastically increasing its political activity and promotion of tobacco in the state.<sup>52–55,58–60</sup> Political expenditures in California increased 10-fold after passage of Proposition 99, making California legislators the recipients of more tobacco industry money per legislator than members of the US Congress.<sup>58</sup> Additionally, the California Tobacco Control Program has been implemented at less than the approved level of funding.<sup>8,10,58,59,61–63</sup> Although Proposition 99 specified that 25% of the revenues generated by the tobacco tax increase should be allocated for tobacco education and prevention programs, Proposition 99 expenditures for tobacco education, prevention, and research declined from \$133 million during the first year of the program (1989) to \$57 million during fiscal year 1995.<sup>64</sup> Not until fiscal year 1996 were Proposition 99 tobacco education and prevention programs fully funded at the 25% level.<sup>61</sup> The tobacco control program has been implemented without the full support of the state legislature, which has repeatedly used the excise tax revenues for other programs.<sup>8,10,52,58–64</sup> For example, in fiscal years 1995 and 1996, the state legislature redirected \$285 million from Proposition 99 tobacco education and prevention programs to medical care.<sup>64</sup>



**FIGURE 3—Adult (18 years and older) quit ratio from National Health Interview Survey data: California ● and the remainder of the United States ◆, 1978–1994.**

Our results are consistent with the findings of Pierce et al., who reported that per capita cigarette consumption in California declined 52% faster during the period 1989 to 1993 than during the period 1983 to 1989, but that the decline in cigarette consumption slowed significantly during more recent years (1994–1996).<sup>45</sup> Pierce et al. found that smoking prevalence showed a similar pattern but did not decline significantly in either California or the remainder of the United States during the period 1994 to 1996.<sup>45</sup> These authors also implicate reduced program funding, increased tobacco industry expenditures for marketing and political activities, and industry pricing strategies as potential explanations for the slowed progress in reducing smoking prevalence in California.<sup>45</sup>

The lack of improvement in quit ratios for both California and the United States from 1990 to 1994 suggests a need for increased attention to smoking cessation. The burden of smoking-related disease will not decline unless smokers stop smoking before the onset of chronic diseases caused by smoking in later life.<sup>65</sup> Comprehensive tobacco control programs should perhaps look more carefully at policy options to support cessation. The availability of nicotine replacement therapy as an over-the-counter smoking cessation aid since 1997 has increased the rate of successful cessation with or without the support of smoking cessation programs.<sup>66</sup> Additional interventions to help addicted smokers should be supported by comprehensive tobacco control programs,

and further research into population-based cessation activities is needed.

The main limitation of this study is that, although it had substantial power to detect significant differences in smoking prevalence trends between time periods within California or the remainder of the United States, it had limited power to detect differences in smoking prevalence trends between California and the United States during any specific time period. Although smoking prevalence in California still declined significantly during the period 1990 to 1994 while smoking prevalence for the remainder of the United States was statistically unchanged during this period, the slopes for California and the remainder of the United States were not significantly different during this period or during any of the 3 time periods in our study. Our failure, due to limited power, to detect significant differences in smoking prevalence trends in California compared with the remainder of the United States should not be interpreted to mean that the trends were the same, or that the California antismoking intervention had no effect. In light of the absence of any significant change in smoking prevalence in the nation as a whole during the period 1990 to 1994, we interpret the significant decline in smoking prevalence during this period in California as evidence suggestive of an effect of the tobacco control intervention.

California may approach the Healthy People 2000 goal of reducing adult smoking prevalence to 15%, but it seems very unlikely

that the nation as a whole will come anywhere close to this goal. An increase in the number of states implementing comprehensive tobacco control programs, funded by cigarette tax revenues or tobacco settlement funds, could restore the trend of declining smoking prevalence. As this type of funding is implemented, however, special attention should be given to sustaining funding for the tobacco education and prevention programs and to minimizing the degree to which the tobacco industry counteracts these public health efforts. □

## Contributors

M. Siegel, P.D. Mowery, T.P. Pechacek, R. K. Merritt, T. E. Novotny, G. A. Giovino, and M. P. Eriksen conceived and designed the study and contributed to the interpretation of the study results and the writing and reviewing of the manuscript. P.D. Mowery, W.J. Strauss, and M. W. Schooley directed and conducted the data analysis and contributed to the review and editing of the manuscript.

## Acknowledgments

The authors wish to thank Shawna Collins of Battelle Statistics and Data Analysis Systems for assistance with data analysis and Joanne Abed of Battelle Centers for Public Health Research and Evaluation for editing the manuscript.

## References

1. National Center for Health Statistics. *Health, United States, 1994*. Hyattsville, Md: National Center for Health Statistics; 1995. DHHS publication PHS 95-1232.
2. Giovino GA, Schooley MW, Zhu B, et al. Surveillance for selected tobacco-use behaviors—United States, 1990–1994. *MMWR Morb Mortal Wkly Rep*. 1994;43(SS-3):1–43.
3. Centers for Disease Control and Prevention. Cigarette smoking among adults—United States, 1992, and changes in the definition of current cigarette smoking. *MMWR Morb Mortal Wkly Rep*. 1994;43:342–346.
4. Centers for Disease Control and Prevention. Cigarette smoking among adults—United States, 1993. *MMWR Morb Mortal Wkly Rep*. 1994;43:925–930.
5. Centers for Disease Control and Prevention. Cigarette smoking among adults—United States, 1994. *MMWR Morb Mortal Wkly Rep*. 1996;45:588–590.
6. National Center for Health Statistics. *Health, United States, 1992 and Healthy People 2000 Review*. Hyattsville, Md: National Center for Health Statistics; 1993. DHHS publication PHS 93-1232.
7. Pierce JP, Evans N, Farkas AJ, et al. *Tobacco Use in California. An Evaluation of the Tobacco Control Program, 1989–1993*. La Jolla: University of California, San Diego, Cancer Prevention and Control Program; 1994.
8. Bal DG, Kizer KW, Felton PG, Mozar HN, Niemeier D. Reducing tobacco consumption

- in California: development of a statewide anti-tobacco use campaign. *JAMA*. 1990;264:1570-1574.
9. Novotny TE. *Structural Evaluation: California's Proposition 99-Funded Tobacco Control Program*. Berkeley: University of California, Berkeley, School of Public Health; 1994.
  10. Novotny TE, Siegel M. California's tobacco control saga. *Health Aff*. 1996;15:58-72.
  11. US Bureau of the Census. *State Population Estimates by Age and Sex: 1980 to 1992*. Washington, DC: US Bureau of the Census; 1993. Current Population Reports, P25-1106.
  12. US Bureau of the Census. *Statistical Abstract of the United States: 1994*. 114th ed. Washington, DC: US Bureau of the Census; 1994.
  13. Burns D, Pierce JP. *Tobacco Use in California 1990-1991*. Sacramento: California Department of Health Services, Los Angeles County Department of Health Services, University of California, San Diego, and Westat Inc; 1992.
  14. *Toward a Tobacco-Free California: A Report on the Activities and Evaluation of California's Tobacco Control Program, April 1992*. Sacramento: California Department of Health Services, California Department of Education; 1992.
  15. *Toward a Tobacco-Free California: Exploring a New Frontier, 1993-1995*. Sacramento, Calif: Tobacco Education Oversight Committee; 1993.
  16. Kovar MG, Poe GS. The National Health Interview Survey design, 1973-84, and procedures, 1975-83. *Vital Health Stat 1*. 1985;No. 18. DHHS publication PHS 85-1320.
  17. National Center for Health Statistics. Current estimates from the National Health Interview Survey, United States, 1985. *Vital Health Stat 10*. 1986;No. 160. DHHS publication PHS 86-1588.
  18. National Center for Health Statistics. Current estimates from the National Health Interview Survey, United States, 1987. *Vital Health Stat 10*. 1988;No. 166. DHHS publication PHS 88-1594.
  19. National Center for Health Statistics. Current estimates from the National Health Interview Survey, United States, 1988. *Vital Health Stat 10*. 1989;No. 173. DHHS publication PHS 89-1501.
  20. National Center for Health Statistics. Current estimates from the National Health Interview Survey, United States, 1990. *Vital Health Stat 10*. 1991;No. 181. DHHS publication PHS 92-1509.
  21. National Center for Health Statistics. Current estimates from the National Health Interview Survey, United States, 1991. *Vital Health Stat 10*. 1993;No. 184. DHHS publication PHS 93-1512.
  22. Massey JT, Moore TF, Parsons VL, Tadros W. Design and estimation for the National Health Interview Survey, 1985-94. *Vital Health Stat 2*. 1989;No.110. DHHS publication (PHS) 89-1384.
  23. National Center for Health Statistics. Small area estimation: an empirical comparison of conventional and synthetic estimators for states. *Vital Health Stat 2*. 1979;No. 82. DHEW publication PHS 80-1356.
  24. National Center for Health Statistics. Synthetic estimation of state health characteristics based on the Health Interview Survey. *Vital Health Stat 2*. 1977;No. 75. DHEW publication PHS 78-1349.
  25. *Current Population Surveys, March 1978-March 1994* [machine-readable data file]. Conducted by the Bureau of the Census for the Bureau of Labor Statistics. Washington, DC: US Bureau of the Census.
  26. Frazier EL, Franks AL, Sanderson LM. Using behavioral risk factor surveillance data. In: *Using Chronic Disease Data: A Handbook for Public Health Practitioners*. Atlanta, Ga: Centers for Disease Control and Prevention; 1992.
  27. Trammel D. *Summary Report: Current Population Survey Tobacco Use Supplements (First Phase)* [unpublished report]. Washington, DC: US Bureau of the Census; 1994.
  28. Gilpin EA, Pierce JP, Cavin SW, et al. Estimates of population smoking prevalence: self versus proxy reports of smoking status. *Am J Public Health*. 1994;84:1576-1579.
  29. Pierce JP, Farkas A, Evans N, et al. *Tobacco Use in California 1992: A Focus on Preventing Uptake in Adolescents*. Sacramento: California Department of Health Services, Cancer Prevention Program, University of California, San Diego, and Westat Inc; 1993.
  30. US Dept of Health and Human Services. *The Health Benefits of Smoking Cessation: A Report of the Surgeon General*. Washington, DC: Centers for Disease Control and Prevention, Office on Smoking and Health; 1990.
  31. Shah BV. *Software for Survey Data Analysis (SUDAAN), Version 5.30*. Research Triangle Park, NC: Research Triangle Institute; 1989.
  32. Neter J, Wasserman W, Kutner MH. *Applied Linear Regression Models*. 2nd ed. Homewood, Ill: Irwin; 1989.
  33. Breslow L, Johnson M. California's Proposition 99 on tobacco, and its impact. *Annu Rev Public Health*. 1993;14:585-604.
  34. Hu T, Bai J, Keeler TE, Barnett PG. *The Impact of a Large Tax Increase on Cigarette Consumption: The Case of California*. Berkeley: Institute of Business and Economic Research, University of California; 1991. Economics working paper 91-174.
  35. Flewelling RL, Kenney K, Elder JP, Pierce J, Johnson M, Bal DG. First-year impact of the 1989 California cigarette tax increase on cigarette consumption. *Am J Public Health*. 1992; 82:867-869.
  36. Hu T, Bai J, Keeler TE, Barnett PG. *The Impact of 1989 California Major Anti-Smoking Legislation on Cigarette Consumption: Three Years Later*. Berkeley: Institute of Business and Economic Research, University of California; 1992. Economics working paper 92-203.
  37. Keeler T, Hu TW, Barnett P, Manning WG. Taxation, regulation, and addiction: a demand function for cigarettes based on time-series evidence. *J Health Econ*. 1993;12:1-18.
  38. Glantz SA. Changes in cigarette consumption, prices, and tobacco industry revenues associated with California's Proposition 99. *Tob Control*. 1993;2:311-314.
  39. Sung HY, Hu TW, Keeler TE. Cigarette taxation and demand: an empirical model. *Contemp Econ Policy*. 1994;12:1-10.
  40. Hu TW, Bai J, Keeler TE, Barnett PG, Sung HY. The impact of California Proposition 99, a major anti-smoking law, on cigarette consumption. *J Public Health Policy*. 1994;15:26-36.
  41. Hu TW, Sung HY, Keeler TE. Reducing cigarette consumption in California: tobacco taxes vs an anti-smoking media campaign. *Am J Public Health*. 1995;85:1218-1222.
  42. Hu TW, Sung HY, Keeler TE. The state anti-smoking campaign and the industry response: the effects of advertising on cigarette consumption in California. *Am Econ Rev*. 1995;85: 85-90.
  43. Elder JP, Edwards CC, Conway TL, Kenney E, Johnson CA, Bennett ED. Independent evaluation of the California tobacco education program. *Public Health Rep*. 1996;111:353-358.
  44. Hu T, Keeler TE, Sung H, Barnett PG. The impact of California anti-smoking legislation on cigarette sales, consumption, and prices. *Tob Control*. 1995;4(suppl):S34-S38.
  45. Pierce JP, Gilpin EA, Emery SL, White MM, Rosbrook B, Berry CC. Has the California Tobacco Control Program reduced smoking? *JAMA*. 1998;280:893-899.
  46. Centers for Disease Control and Prevention. Trends in smoking initiation among adolescents and young adults—United States, 1980-1989. *MMWR Morb Mortal Wkly Rep*. 1995;44: 521-525.
  47. Nelson DE, Giovino GA, Shopland DR, Mowery PD, Mills SL, Eriksen MP. Trends in cigarette smoking among US adolescents, 1974 through 1991. *Am J Public Health*. 1995;85: 34-40.
  48. Maxwell JC Jr. *The Maxwell Consumer Report: Fourth-Quarter and Year-End 1994 Sales Estimates for the Cigarette Industry*. Richmond, Va: Wheat First Butcher Singer; 1995.
  49. Howell C, Congelio F, Yatsko R. Pricing practices for tobacco products, 1980-94. *Monthly Labor Rev*. 1994;117:3-16.
  50. Federal Trade Commission. *Report to Congress for 1995 Pursuant to the Federal Cigarette Labeling and Advertising Act*. Washington, DC: Federal Trade Commission; 1997.
  51. US Dept of Health and Human Services. *Preventing Tobacco Use Among Young People: A Report of the Surgeon General*. Washington, DC: Centers for Disease Control and Prevention, Office on Smoking and Health; 1994.
  52. *Toward a Tobacco-Free California: Mastering the Challenges, 1995-1997*. Sacramento, Calif: Tobacco Education Oversight Committee; 1995.
  53. Johnson CA, Sanford D. Tobacco industry response. In: Elder JP, Kenney E, eds. *Independent Evaluation of Efforts to Prevent and Control Tobacco Use in California: Annual Report*. San Diego, Calif: San Diego State University; 1991.
  54. Johnson CA, Gunning G, Bal DG, Johnson M. Tobacco promotions in California since the 1988 tobacco control legislation: appeals to youth, females, and minorities. Paper presented at: 102nd Annual Convention of the American Psychological Association; August 12, 1994; Los Angeles, Calif.
  55. Johnson CA, Cruz TB, Stoddard J, Gunning G, Hennessey M. *Evaluation of the Tobacco Industry's Response to the California Tobacco Education Program: Final Report to the California Department of Health Services, December 1994*. San Diego, Calif: San Diego State University; 1994.
  56. Siegel M, Nelson DE, Peddicord JP, Merritt RK, Giovino GA, Eriksen MP. The extent of

- cigarette brand and company switching: results from the Adult Use-of-Tobacco Survey. *Am J Prev Med.* 1996;12:14–16.
57. Cavin SW, Pierce JP. Low-cost cigarettes and smoking behavior in California, 1990–1993. *Am J Prev Med.* 1996;12:17–21.
  58. Begay ME, Traynor M, Glantz SA. The tobacco industry, state politics, and tobacco education in California. *Am J Public Health.* 1993;83:1214–1221.
  59. Begay ME, Traynor M, Glantz SA. *The Twilight of Proposition 99: Reauthorization of Tobacco Education Programs and Tobacco Industry Expenditures in 1993.* San Francisco: Institute for Health Policy Studies, School of Medicine, University of California; 1994.
  60. Aguinaga S, Macdonald H, Traynor M, Begay ME, Glantz SA. *Undermining Popular Government: Tobacco Industry Political Expenditures in California, 1993–1994.* San Francisco: Institute for Health Policy Studies, School of Medicine, University of California; 1995.
  61. Sherman R. Shaming Big Tobacco's friends in California. *Tob Control.* 1996;5:189–191.
  62. Skolnick AA. Antitobacco advocates fight “illegal” diversion of tobacco control money. *JAMA.* 1994;271:1387–1390.
  63. Skolnick AA. Judge rules diversion of anti-smoking money illegal, victory for California Tobacco Control Program. *JAMA.* 1995;273:610–611.
  64. Siegel M, Biener L. Evaluating the impact of statewide anti-tobacco campaigns: the Massachusetts and California tobacco control programs. *J Soc Issues.* 1997;53:147–168.
  65. The World Bank. *Curbing the Epidemic: Governments and the Economics of Tobacco Control.* Washington, DC: The World Bank; 1999.
  66. Shiffman S, Gitchell J, Pinney JM, Burton SL, Kemper KE, Lara EA. Public health benefit of over-the-counter nicotine medications. *Tob Control.* 1997;6:306–310.