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How have smoking risk factors changed with recent declines in California adolescent smoking?

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ABSTRACT

Aim To compare predictors of smoking initiation in two longitudinal studies in California conducted during periods when adolescent smoking prevalence was increasing (1993–96) and decreasing (1996–99).

Design, setting and participants Cohorts of 12–15-year-old never smokers were identified from the cross-sectional 1993 and 1996 California Tobacco Surveys (large population-based telephone surveys) and followed-up 3 years later (1993–96, $n = 1764$; 1996–99, $n = 2119$).

Measures We compared cohort transition rates to any smoking by follow-up in risk groups defined by known predictors of smoking initiation at baseline. Besides examining predictors individually, risk groups were defined using a multivariate analysis.

Findings Overall, transition to any smoking by follow-up occurred in $38.3 \pm 4.0\%$ ($\% \pm 95\%$ confidence interval) of never smokers in the 1993–96 cohort and $31.1 \pm 2.6\%$ in the 1996–99 cohort. For most predictors, the transition rate for adolescents with the characteristic was the same or only slightly lower in the 1996–99 cohort compared to the 1993–96 cohort, but the transition rate in those without the characteristic was generally much lower, thus increasing the power of the predictor. The multivariate analysis confirmed that compared to the 1993–96 cohort, transition occurred much less often in the 1996–99 cohort for adolescents at low rather than at medium or high risk of future smoking.

Conclusions The turnaround in California adolescent smoking in the mid-1990s, when smoking began to decline, appears to come primarily from adolescents already at low risk of future smoking (as defined by a variety of predictors), who transitioned to smoking at much lower rates than previously.

KEYWORDS: Adolescents, prevention, smoking.

INTRODUCTION

In the United States, 80–90% of smokers first experiment with cigarettes at 16 years of age or younger [1]. Initiation of smoking during early adolescence appears to lead to higher levels of adult dependence [2–5]. In turn, higher dependence coupled with longer smoking duration increases smokers' risks for health sequelae from increased levels of toxin exposure [2]. Nationally, both adolescent initiation of regular smoking and smoking prevalence showed a steady decline from the early 1970s

until the mid- to late 1980s when the decline halted and showed signs of reversing in the later part of the decade [6]. Beginning in the early 1990s, smoking prevalence among adolescents began to climb at an alarming rate, but it has declined somewhat since mid-decade peaks [6]. These trends occurred in California as well [7].

Many investigators have explored predictors of adolescent smoking and, by using longitudinal studies, have identified a number of personal, familial and environmental factors that are associated with increased smoking initiation [1,8]. Groups with increased smoking

uptake include adolescents with significant depressive symptoms, those who tend to rebelliousness and those who perform poorly academically [8]. In addition, exposure to smoking among family members and/or friends is associated with increased adolescent smoking initiation [8–11], while parental supportiveness and/or negative attitudes about their child smoking appear to be protective factors [12,13]. Also, there is evidence that tobacco advertising and promotions influence adolescents to smoke [14–17]. Whether the prevalence or predictive power of such factors changes in periods when smoking is increasing or decreasing is unknown.

In this report, two longitudinal cohorts of young California adolescent never smokers were examined: one was observed from 1993 to 1996, when smoking was increasing, and the second was observed from 1996 to 1999, when it was decreasing. These divergent trends provided different environments pertaining to smoking and thus present a unique natural experiment in which to explore how the predictors of adolescent smoking might have changed. The 12–15-year-old never smokers were identified from the large, population-based 1993 and 1996 California Tobacco Surveys. Follow-up surveys allowed us to examine and contrast rates of never smoker transition to any smoking by follow-up in risk groups defined by known predictors of adolescent smoking at baseline.

METHODS

Data sources

Cross-sectional California Tobacco Surveys

The large population-based, random digit-dialed California Tobacco Surveys (CTS) are conducted every 3 years as part of the evaluation of California's tobacco control program [18]. Briefly, screener surveys enumerate residents in randomly selected households. Following adult consent, adolescents (12–17 years) are called back several days later to answer an approximately 30-minute questionnaire covering tobacco-related attitudes and behavior. The detailed methodology for these surveys is described elsewhere [19]. Completed surveys were obtained for 5531 adolescents in 1993 (80.3% response rate), 6252 in 1996 (71.2% response rate) and 6090 in 1999 (75.5% response rate). In this study, we examine only data from never smokers 12–15 years of age.

Follow-up surveys

With additional funding, we sought to re-interview adolescents first interviewed in the 1993 CTS or in the 1996 CTS to establish subsequent smoking behavior.

Households that provided addresses received an advance letter to explain the follow-up surveys. Extensive tracing procedures were used for families no longer at the same telephone number, first using contact information on record, then using on-line directory assistance, the national change-of-address database and national credit-reference services.

Despite extensive tracing, not all the adolescents were located and re-interviewed successfully [20,21]. In 1996, we re-interviewed 1764 12–15-year-old never smokers at baseline in 1993 (65% follow-up rate), and in 1999, we completed interviews with 2119 of 12–15-year-old never smokers at baseline in 1996 (67% follow-up rate).

Measures

Smoking behavior

To identify never smokers, the CTSs ask adolescents: 'Have you ever smoked a cigarette?' and 'Have you ever tried or experimented with cigarette smoking, even a few puffs?'. A negative response to both questions classified an adolescent as a never smoker. Ever experimenters were those who failed to answer 'no' to the above two questions, that were asked both at baseline and follow-up.

A never smoker at baseline was categorized further as a committed never smoker or as someone susceptible to smoking, using a measure based on cognitions (intentions) and self-efficacy, described and validated previously to be highly predictive of future smoking [22–24]. Failing to consider susceptibility, a potential confounding factor that is likely on the causal pathway to smoking, could inflate artificially the effect of other predictors. Adolescents were asked, 'Do you think in the future you might experiment with cigarettes?', 'If one of your best friends were to offer you a cigarette, would you smoke it?' and 'At any time during the next year do you think you will smoke a cigarettes?'. To be considered a committed never smoker, an adolescent had to answer 'no' to the first question and definitely not (rather than probably not, probably yes or definitely yes) to the other two.

Predictors of adolescent smoking

We examined a number of known predictors of adolescent smoking [1,8–17]. Below we name and provide a description of the survey item(s) and how they were coded for analysis.

School performance. 'How do you do in school? Would you say . . . Much better than average, better than average, average, or below average?' Respondents with 'average' or 'below average' school performance were contrasted

to those with 'better' or 'much better than average' performance.

Significant depressive symptoms. A series of six items was asked to assess whether an adolescent might be suffering from depression. 'During the past 12 months, how often have you: Felt too tired to do things? Had trouble going to sleep or staying asleep? Felt unhappy, sad, or depressed? Felt hopeless about the future? Felt nervous or tense? Worried too much about things?'. Responses to the questions were: often, sometimes or never. Following previous research [25], responses to these items were combined into a scale and a cut-point was used to classify adolescents as having significant depressive symptoms [26].

Rebelliousness. Six questions were answered 'yes' or 'no': 'I get a kick out of doing things every now and then that are a little risky or dangerous', 'My family looks for things to nag me about', 'I have a lot of arguments with my family', 'If anyone upsets me I usually try to get revenge' and 'I don't mind lying to keep my friends out of trouble with the authorities'. The number of 'yes' responses were summed; 0–1, 2–3 and 4 or more classified the adolescent into groups of low, moderate or high rebelliousness.

Smokers in family. 'Do any of your parents, step-parents or guardians now smoke cigarettes?' and 'Do your older brothers or sisters smoke cigarettes?'. An answer of 'yes' to either question classified the adolescent as exposed to smokers in the family.

Parents supportive. 'If you had a serious problem, is there someone you could talk to or go to for help?'. Those answering 'yes' were then asked, 'Who is this?'. Adolescents could give more than one response, and if either a father or mother was mentioned, the adolescent was considered to have supportive parents.

Parent disapproval of adolescent smoking. Adolescents agreed or disagreed with the statement: 'When I am older my parents won't mind if I smoke'. Another question asked: 'If you lit up a cigarette tomorrow in front of your parents, how do you think they would react? Would they, tell you to stop, and be very upset, tell you to stop but not be too upset, not tell you to stop, but would disapprove, or have no reaction?'. Adolescents who disagreed with the statement and gave the first response to the question were contrasted to all others.

Parent desire that adolescent not smoke. 'Have your parents ever expressed a desire for you not to smoke?' If the answer was 'yes', a follow-up question asked: 'How often have your parents expressed a desire for you not to smoke? Would you say . . . often, sometimes, rarely, or

never?'. Those answering 'often' were contrasted to all others.

Attend religious services. 'How often do you attend religious services? Would you say . . . Often, sometimes, rarely, or never?' Again, those answering 'often' were contrasted with all others.

Peer antismoking norms. 'Do you think people your age care about staying off cigarettes?' and 'How do you think your best friends would feel about you smoking on a daily basis? Would they . . . approve, disapprove, or not care?' Respondents who answered 'no' to the first question or 'approve' or 'not care' to the second question were considered to lack strong peer norms against smoking.

Smoking among friends. 'Of your best friends who are male, how many of them smoke?' and 'Of your best friends who are female, how many of them smoke?' If respondents gave a number other than zero in response to either question, they were considered exposed to smokers among their peers.

Safety of smoking. 'Do you believe it is safe to smoke for only a year or two?', 'Do you believe there is any harm in having an occasional cigarette?' and 'If I started to smoke regularly, I could stop smoking anytime I wanted'. If respondents did not answer 'no' to the first question, 'yes' to the second and 'disagree' with the third, they were considered *unconvinced* of the dangers of smoking.

Sees benefit to smoking. 'Smoking can help people when they are bored', 'Cigarette smoking helps people relax', 'Cigarette smoking helps reduce stress', 'Smoking helps people feel more comfortable at parties and in other social situations' and 'Smoking helps people keep their weight down'. A response of 'yes' to any of the questions classified an adolescent as perceiving a benefit to smoking.

Has favorite cigarette advertisement. 'What is the name of the cigarette brand of your favorite cigarette advertisement?' Adolescents who named a brand were contrasted to those who did not.

Has or willing to use a tobacco promotional item. In the past 12 months, have you ever: 'Exchanged coupons for an item with a tobacco brand name or logo on it?', 'Received as a gift or for free, any item with a tobacco brand name or logo on it?' or 'Purchased any item with a tobacco brand name or logo on it?' and 'Do you think you would ever use a tobacco industry promotional item such as a tee shirt?' Those answering 'yes' to the second question, together with those who had an item, were contrasted to all others.

Sample weighting

Person-level survey weights were developed for the cross-sectional CTS, so that estimates are representative of the California adolescent population. First, base weights were computed that account for household selection probability. These were then adjusted to account for differential non-response in the baseline sample, using the latest available population census totals [19].

For each longitudinal sample, the final weights from the baseline surveys for those successfully followed were further adjusted to account for loss to follow-up [20,21]. Examination of unweighted data indicated that some minorities (Hispanics and African Americans) were slightly under-represented (compared to Census totals) in the cross-sectional samples and were less likely to be re-interviewed. Also less likely to be followed were those with average or below average school performance, smokers in the family, less supportive parents and smokers among best friends.

Statistical analyses

A jack-knife procedure [27], as implemented in a special statistical software package for complex survey designs, produced variance estimates [28], and we report weighted percentages and 95% confidence intervals. The prevalence of predictors among 12–15-year-old never smokers in the cross-sectional 1993, 1996 and 1999 CTS was examined to identify any important changes that occurred over the periods when smoking was increasing or decreasing; only results for those that changed by 5% or more are reported.

For each predictor, separate logistic regression analyses within each of the two longitudinal cohorts (1993–96 and 1996–99) were performed, adjusting for demographics (age, sex, race/ethnicity) and susceptibility to smoking and examined the transition from never smok-

ing to any smoking by follow-up as the dependent variable. We present results for significant predictors ($P < 0.05$) in either or both cohorts. Transition rates are also presented for adolescents with and without each characteristic.

Another set of preliminary analyses combined the two cohorts, included an indicator variable for cohort to account for the environment in which the cohort was observed (increased versus decreased smoking) and examined the interaction effect of the cohort variable and each of the predictors in separate analyses that again adjusted for demographics and susceptibility to smoking. A significant interaction ($P < 0.15$) would indicate that the strength of the predictor was different in the two cohorts.

Inspection of these preliminary results led to further analyses aimed at defining risk of transition to any smoking, using multiple predictive factors from the baseline surveys. Again, we combined the data from the two longitudinal cohorts as described above and included any factors identified as significantly predictive of transition to any smoking in either cohort in the analyses described above at the $P < 0.10$ level. The final logistic regression model retained only predictors significant at the $P < 0.05$ level in the combined analysis. Using this model, we computed the probability of transition for each adolescent and used this probability to divide each cohort into risk-group tertiles (low, medium and high). Transition rates were then compared within risk groups between the cohorts.

RESULTS

Table 1 shows the weighted prevalence of known and potential predictors (cross-sectional analysis) of adolescent smoking that changed by $\geq 5\%$ among the 1993,

Table 1 Changes* in the prevalence of predictors of future smoking in 12–15-year-old never smokers across 1993, 1996 and 1999 cross-sectional samples.

	1993 <i>n</i> = 2708 % \pm 95% CI	1996 <i>n</i> = 3157 % \pm 95% CI	1999 <i>n</i> = 3287 % \pm 95% CI	Change 1993–96	Change 1996–99
Personal characteristics					
Is susceptible to smoking	26.7 \pm 2.6	35.3 \pm 1.8	28.9 \pm 1.7	8.6	–6.4
Environmental factors					
Has smokers among friends	27.1 \pm 2.2	40.2 \pm 2.1	30.4 \pm 1.9	13.1	–9.8
Lacks peer antismoking norms	49.0 \pm 2.7	59.6 \pm 1.7	47.0 \pm 2.0	10.6	–12.6
Sees benefit to smoking	55.4 \pm 3.0	53.2 \pm 1.9	47.6 \pm 2.2	–2.2	–5.6
Has favorite cigarette ad	58.9 \pm 2.8	56.9 \pm 2.0	49.5 \pm 1.9	–2.0	–7.4
Has or would use tobacco promotional item	17.0 \pm 2.1	22.6 \pm 1.9	15.4 \pm 1.5	5.6	–7.2

CI = confidence interval. Percentages are weighted percentages. *Only those predictors are included whose prevalence changed by $\geq 5\%$ between 1993 and 1996 and/or 1996–99.

1996 and 1999 cross-sectional samples of 12–15-year-old never smokers. The baseline prevalence estimates were similar when only the adolescents successfully followed-up in the longitudinal samples were examined. (A complete set of results for all predictors considered is available from the authors.)

The percentage of adolescents susceptible to smoking increased from 26.7% in 1993 to 35.3% in 1996, but declined again to 28.9% in 1999. Similar prevalence patterns (increases from 1993 to 1996 followed by declines from 1996 to 1999) were observed for those with smokers among best friends and for those with peers lacking antismoking norms. Percentages of adolescents who had or would use a tobacco promotional item followed the same pattern but to a lesser extent. However, there were small declines from 1993 to 1996 followed by larger declines from 1996 to 1999 in the percentages of adolescents seeing any benefit to smoking and having a favorite cigarette advertisement.

Rates of transition to any smoking by predictor (in longitudinal cohorts)

The overall transition rate to any smoking by follow-up among 12–15-year-old never smokers at baseline in the 1993–96 longitudinal cohort was $38.3 \pm 4.0\%$ ($\pm 95\%$ confidence interval); the comparable rate in the 1996–99 cohort was $31.1 \pm 2.6\%$, a reduction of 19%.

Table 2 presents the results for individual predictors significant in one cohort or the other at $P < 0.05$. These analyses were adjusted for demographics and susceptibility to smoking. For all predictors examined, the percentage of never smokers transitioning to any smoking was higher in the group with the characteristic than in the group without it, even for predictors not significant in either cohort (results available from authors upon request). In the 1993–96 cohort, only rebelliousness and having a favorite cigarette advertisement were significant at the $P < 0.05$ level, although many of the predictors

Table 2 Transition rates from never smoking to any smoking in two longitudinal cohorts of 12–15-year-olds (1993–96 and 1996–99) by predictors significant at $P < 0.05$ in either cohort.

Predictor	1993–96 <i>n</i> = 1764			1996–99 <i>n</i> = 2119			Change in transition rates [‡]
	<i>n</i>	Transition rate % \pm 95%CI	<i>P</i> -value [†]	<i>n</i>	Transition rate % \pm 95%CI	<i>P</i> -value [†]	
Significant depressive symptoms							
No	1587	37.6 \pm 4.6	0.548	1865	28.8 \pm 2.7	<0.001	–8.8
Yes	177	45.2 \pm 11.4		254	46.6 \pm 8.0		1.4
Rebelliousness							
Low	1024	33.2 \pm 5.0	0.037	1204	24.1 \pm 3.3	<0.001	–9.1
Moderate to high	740	45.2 \pm 6.2		915	40.3 \pm 4.6		–4.9
Smokers among friends							
No	1308	36.3 \pm 4.9	0.123	1273	23.4 \pm 2.9	<0.001	–12.9
Yes	456	44.4 \pm 7.5		846	42.5 \pm 4.2		–1.9
Smokers in family							
No	1207	35.7 \pm 4.1	0.093	1461	27.7 \pm 2.9	<0.001	–8.0
Yes	557	43.3 \pm 7.2		658	37.8 \pm 4.8		–5.5
Peer antismoking norms							
Present	985	35.5 \pm 5.0	0.154	957	22.9 \pm 3.2	<0.001	–12.6
Lacking	779	41.8 \pm 5.9		1162	36.9 \pm 3.8		–4.9
Attend religious services							
Often	771	36.2 \pm 5.1	0.528	894	26.5 \pm 3.8	0.001	–9.7
Not often	993	39.8 \pm 5.2		1225	34.4 \pm 3.4		–5.4
Has favorite cigarette advertisement							
No	738	33.5 \pm 5.4	0.029	854	25.1 \pm 3.5	0.008	–8.4
Yes	1026	41.7 \pm 5.1		1265	35.4 \pm 3.5		–6.3
Have or would use tobacco promotional item							
No	1505	36.6 \pm 4.1	0.058	1699	27.3 \pm 2.6	<0.001	–9.3
Yes	259	48.0 \pm 10.1		420	44.6 \pm 7.3		–3.4

CI = Confidence interval. Prevalence (%) is weighted. *N*s are unweighted sample sizes. [†]*P*-values are from logistic regression analyses that included demographics (age, sex, race/ethnicity), susceptibility to smoking, and the individual predictor being evaluated. [‡]Change in transition rate: rate for 1996–99 cohort minus the rate for 1993–96 cohort.

significant in the 1996–99 cohort were marginally significant in the 1993–96 cohort. In the 1996–99 cohort, all predictors shown were highly associated ($P < 0.008$) with transition to any smoking, primarily because the transition rate in the group without a given predictor was much lower (relative to the group with it) in the 1996–99 cohort than in the 1993–96 cohort. For most of the variables (including those not shown), the difference in transition rate between the two cohorts for those with the influence (e.g. moderate to high rebelliousness) was less than half the difference (usually a reduction) in transition for those without it (e.g. low rebelliousness). These differences are highlighted in the right-hand column of Table 2.

Another set of preliminary analyses combined the two cohorts and included an indicator variable for cohort, along with the interaction of this variable and the predictor variable of interest. These analyses also adjusted for demographics and susceptibility to smoking. The interaction term was significant at the $P < 0.15$ level for significant depressive symptoms, smokers among best friends, lack of peer antismoking norms and attendance at religious services, indicating that the strength of these predictors differed between the two cohorts.

The results of the preliminary analyses suggested that we define risk for future smoking multivariately. Table 3 presents results of the final logistic regression model predicting transition to any smoking by follow-up that we used to define the risk groups. This final model included all the significant predictors ($P < 0.05$), demographics, susceptibility to smoking and the cohort indicator variable. The cohort variable was highly significant, indicating that after adjustment for the other factors, adolescent never smokers in the 1996–99 cohort were only about 57% as likely to transition to experimentation than adolescents in the 1993–96 cohort.

Figure 1 shows the transition rates by cohort in the low-, medium- and high-risk groups, as defined by tertiles

of the individual predicted probabilities of transition from the final logistic regression model. Confirming the preliminary analyses, it appears that most of the reduction in transition between the two cohorts occurred among adolescents in the low-risk group. Compared to the 1993–96 cohort, low-risk never smokers in the 1996–99 cohort showed a *significant* reduction in transition of 44%, compared to *non-significant* reductions of 12% for medium-risk and 13% for high-risk never smokers.

DISCUSSION

The ability to observe young adolescents during periods when adolescent smoking was increasing (1993–96) and decreasing (1996–99) allowed us to determine how the prevalence or predictive capacity of known influences on adolescent smoking might have differed in such environments. In general, the cross-sectional analyses showed that the prevalence of the predictors examined was highest in 1996. The longitudinal analyses indicated that the

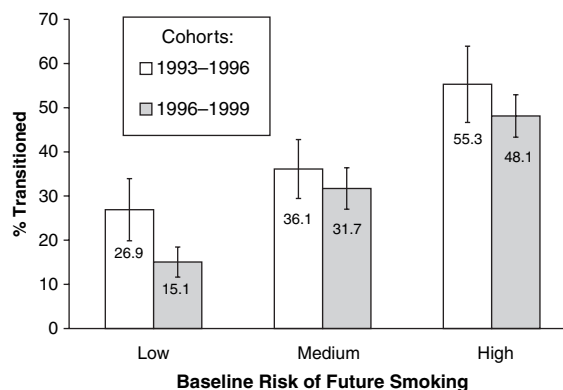


Figure 1 Transition rates to any smoking by follow-up within each cohort (1993–96 and 1996–99) of 12–15-year-old never smokers at low-, medium- and high-risk of future smoking. Only the transition rate for the lowest risk group differed significantly between cohorts

Table 3 Final logistic regression model predictors of transition from never to any smoking, in the combined 1993–96 and 1996–99 longitudinal cohorts of 12–15-year olds.

	Regression coefficient	Adjusted odds ratio*	95% Confidence interval
Cohort indicator (1996–99 versus 1993–96)	–0.556	0.57	(0.44, 0.76)
Significant depressive symptoms (yes versus no)	0.343	1.41	(1.00, 1.98)
Rebelliousness (moderate or high versus low)	0.300	1.35	(1.05, 1.74)
Smokers among friends (yes versus no)	0.344	1.41	(1.14, 1.75)
Smokers in family (yes versus no)	0.243	1.28	(1.04, 1.56)
Peer antismoking norms (lacking versus present)	0.266	1.31	(1.05, 1.62)
Has favorite cigarette advertisement (yes versus no)	0.236	1.27	(1.05, 1.53)
Has or would use tobacco promotional item (yes versus no)	0.321	1.38	(1.01, 1.89)

*Adjusted for demographics (age, sex, race/ethnicity), susceptibility to smoking, and all other predictors. Final model included only significant ($P < 0.05$) predictors.

likelihood of smoking by follow-up for the 12–15-year-old adolescent never smokers with a predictive factor at baseline was either the same or only slightly lower in the 1996–99 cohort compared to the 1993–96 cohort. However, transition in those *without* the predictor generally declined markedly, making the predictive power of the factor stronger in the 1996–99 cohort. A multivariate analysis confirmed that the decline in transition to any smoking between cohorts occurred *primarily* among adolescents at lowest risk of future smoking, although small non-significant declines were present in the medium- and high-risk groups.

The higher prevalence of predictors in 1996, together with continued high transition rates for never smokers in groups with the characteristic, should have led to increased adolescent smoking prevalence in subsequent years. However, the much lower transition rates among young adolescents without the characteristic, generally still a larger percentage of the group of young never smokers, probably helped to offset this effect, producing the drop in prevalence rates observed in California and perhaps nationally [6,29]. Because the CTS are only conducted every 3 years, it is not possible to know exactly when adolescent smoking prevalence or the prevalence of predictors peaked in California. Prevalence for adolescents 12–17 years of age was level between 1990 and 1993, increased markedly in 1996, and dropped again to slightly below 1990 levels by 1999 [29]. Data from a smaller annual survey conducted by the California Department of Health Services suggest that the peak for this age group was in 1995, with most of the decline occurring between 1998 and 1999 [30].

Receptivity to tobacco industry advertising and promotions has been linked to smoking initiation [14–17,31–33]. This variable includes nomination of a favorite advertisement and possession or willingness to use a tobacco promotional item. In the first half of the 1990s, about two-thirds of young California adolescents nominated a favorite cigarette advertisement; the majority picked Camel, with Marlboro capturing most of the remainder [34]. However, by 1999, the proportion who named a favorite advertisement declined to about one-half. Further, the percentage of young adolescents who had or would be willing to use a tobacco promotional item increased from about 30% in 1993 to 40% in 1996, before declining again to about 25% in 1999 [34].

The increase in adolescent smoking created an urgency to intensify national public health efforts aimed at stemming and reversing this trend. For instance, the 1993 federal Synar Amendment linked demonstrated increased enforcement of state laws prohibiting the sale of tobacco to minors to disbursement of federal drug-prevention program entitlement funds [35]. Also,

beginning in 1998, the Master Settlement Agreement (MSA) restricted tobacco industry advertising and promotional practices demonstrated to appeal to youth [36]. While beyond the period of our data analysis, the MSA also established the American Legacy Foundation, which launched its hard-hitting ‘Truth’ media counter-advertising campaign in early 2000 [37]. The MSA was also associated with an average \$0.70/pack increase in cigarette prices by 1999, and as youth appear to be price-sensitive, this also can be considered a prevention measure [38]. Many states enacted excise tax increases in the mid-1990s [39]. Prevention efforts also became a focus of many non-governmental agencies (e.g. Tobacco-Free Kids).

Even before these national prevention efforts were under way, California had established a comprehensive tobacco control program after voters approved Proposition 99 in 1988. This initiative raised the excise tax on cigarettes by \$0.25/pack and dedicated a portion of the new revenue to tobacco control [18]. From the beginning, California’s tobacco control program had its own anti-tobacco media campaign. Special legislation was enacted to comply with the Synar Amendment. Smoking was banned in indoor work-places, including schools grounds for everyone (students, staff and visitors) in 1995, and the voters approved a further \$0.50/pack excise tax increase that took effect on 1 January 1999. The decline in California adolescent smoking in the late 1990s may reflect these efforts. However, our data do not allow us to differentiate which national or state programs might have been responsible.

While cross-sectional surveys are useful for tracking trends in smoking behavior, they cannot characterize completely which adolescents have refrained from smoking experimentation. The longitudinal data allowed us to explore various known predictors of adolescent smoking and, as expected, many were predictive of future experimentation in the cohort analyses. However, these data also have limitations. There was a differential loss to follow-up of some higher-risk adolescents. To some extent, survey weights can compensate for loss to follow-up, but a penalty is paid from increased variance, which limits our ability to demonstrate statistical significance. Another potential limitation is that as antismoking norms become more pervasive in society, respondents may be more reluctant to admit to ever experimenting. This potential limitation cannot be overcome; while it would be ideal to verify reported smoking status, biochemical validation is not feasible in adolescents who smoke infrequently [40]. Finally, because of its comprehensive tobacco control program, the California experience is unique; less marked changes in prevalence in the rest of the nation may or may not be associated with the same changing patterns of predictors.

Just because some adolescent never smokers are at low risk of smoking does not mean that they will not begin to smoke in the future. In the interim, they may acquire various exposures to influences promoting smoking, such as new friends who smoke. In more recent years, adolescents may be delaying first experimentation until their late teens or early twenties, as occurred in some successful school prevention programs of the 1980s [41]. Recently, the tobacco industry has focused considerable promotional activity on young adults [42–44], and upturns in college student smoking have been observed [45]. Our cohorts of 12–15-year-olds were observed again at follow-up as 15–18-year-olds, and it is possible that initiation could still occur after age 18 years. These issues can be addressed by monitoring life-time smoking rates and smoking prevalence among young adults.

In the mid-1980s through the mid-1990s, a significant majority of 12th graders (65–70%) and around half of 8th graders reported life-time use (any smoking) of cigarettes [6]. Because of these high levels, much prevention effort has focused on discouraging experimenters from becoming frequent smokers and encouraging frequent smokers to quit before they become long-term dependent adult smokers. However, for some people dependence may commence after only a few cigarettes are smoked [46], and a recent review indicates that the results of a variety of different programs designed to encourage adolescent smokers to quit have been disappointing [47]. Thus, preventing young adolescents from even beginning to experiment is critically important. It is encouraging that our results suggest that prevention efforts may be keeping young adolescents at lowest risk of smoking from smoking a first cigarette.

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