Mass media campaigns can be an effective public health strategy to prevent youth smoking.\textsuperscript{1–3} Antismoking television campaigns have emphasized diverse themes to discourage smoking, including highlighting short- and long-term health consequences, deglamorizing its social appeal through humorous and unflattering portrayals, and countering misperceptions that smoking is widespread among teens. A more recent theme, first used by California in the 1990s, focuses on exposing deceptive tobacco industry marketing practices and denials of tobacco’s health and addictive effects. In 1998, the Florida Department of Health launched a tobacco prevention program that featured a mass media campaign known as “truth” that countered industry influences with hard-hitting television advertisements that deglamorized smoking and portrayed youth confronting the tobacco industry. After 2 years, the prevalence of any past 30-day smoking among middle and high school students dropped by 40% and 18%, respectively.\textsuperscript{4} In a longitudinal study, Sly et al.\textsuperscript{5} linked exposure to the Florida “truth” campaign to declines in youth smoking prevalence.

As a result of the Master Settlement Agreement between tobacco companies and 46 states, the American Legacy Foundation (Legacy) initiated the national “truth” campaign in February 2000. From 2000 to 2002, annual funding for the campaign averaged $100 million per year. A national media purchase was employed by the campaign, as opposed to a randomized exposure design, for 2 primary reasons. First, Legacy could not ethically assign some media markets to low or zero exposure, given the documented successes of the Florida “truth” campaign. Second, a national media purchase was roughly 40% cheaper than a market-to-market purchase, which would have been necessary to randomize exposure. Although the “truth” campaign builds upon the experiences of Florida and other state campaigns, no similar large-scale national antismoking effort has occurred since the period of the Fairness Doctrine from 1967 to 1970, when TV networks were required to maintain a balance between anti- and prosmoking ads. The “truth” campaign ads are designed to avoid overt and directive messages that tell teens not to smoke and instead use graphic images depicting stark facts about death and disease caused by tobacco and exposures of manipulative marketing practices. For example, an early commercial, “Body Bags,” showed youths piling 1200 body bags outside a major tobacco company’s headquarters to highlight the daily death toll from tobacco use.

This is the first study to evaluate the behavioral outcomes of the campaign. Previous studies have shown that the campaign influenced campaign-related attitudes toward tobacco use and the tobacco industry and that negative attitudes about the tobacco industry are correlated with reduced risk of smoking.\textsuperscript{6–9} The current study assessed whether there was a dose–response relationship between the level of exposure to the campaign and youth smoking prevalence during the first 2 years of the campaign.

**Objectives.** In early 2000, the American Legacy Foundation launched the national “truth” campaign, the first national antismoking campaign to discourage tobacco use among youths. We studied the impact of the campaign on national smoking rates among US youths (students in grades 8, 10, and 12).

**Methods.** We used data from the Monitoring the Future survey in a pre/post quasi-experimental design to relate trends in youth smoking prevalence to varied doses of the “truth” campaign in a national sample of approximately 50000 students in grades 8, 10, and 12, surveyed each spring from 1997 through 2002.

**Results.** Findings indicate that the campaign accounted for a significant portion of the recent decline in youth smoking prevalence. We found that smoking prevalence among all students declined from 25.3% to 18.0% between 1999 and 2002 and that the campaign accounted for approximately 22% of this decline.

**Conclusions.** This study showed that the campaign was associated with substantial declines in youth smoking and has accelerated recent declines in youth smoking prevalence. (Am J Public Health. 2005;95:425–431. doi:10.2105/AJPH.2004.049692)
We grouped the 210 media markets into 1 of 5 levels of exposure, on the basis of the range in total GRPs (647 to 22,389) that accumulated in each market from campaign launch in February 2000 until the second quarter of 2002 (Figure 1). The lowest-exposure group received an average of 3867 GRPs over this 2-year period, whereas the highest-exposure group received an average of 20,367 GRPs. Market-level variation in GRPs is primarily due to the availability of television stations on which “truth” campaign advertisements aired (e.g., FOX, UPN, WB). Markets with fewer stations received lower GRPs, whereas markets with more stations received higher GRPs.

A student’s exposure was defined as the cumulative number of “truth” campaign GRPs that were delivered in a school’s media market from the beginning of the campaign to the time of each spring survey in 2000, 2001, and 2002. Consistent with our pre/post evaluation design, we included students surveyed from 1997 to 1999 to serve as a historical unexposed (GRP=0) comparison group. To account for the possibility that markets that received relatively high doses of the campaign might experience diminishing returns to additional GRPs, we included a quadratic term for cumulative GRPs in our models.

Potential Confounders

Following a socioecological model that recognizes multiple levels of influence on health behaviors (e.g., intrapersonal, interpersonal, community, media, policy, economic factors), we controlled for a wide array of potential confounding influences described in the following sections.

Individual Level. Our multivariable models included individual-level data from the MTF such as grade, race/ethnicity, gender, parental education, and weekly income. We created indicator variables for grade, race/ethnicity (African American, Hispanic, Asian, other race, with White as the reference), gender, and parental education for mother and father separately (high school graduate, at least some college, with less than high school diploma as the reference category). To account for missing data on race and parental education, we included indicator variables for those with unspecified race and father’s and mother’s education in the MTF survey. We also included a measure of students’ weekly income, based on 2 MTF survey questions that assess how much money students earn during an average week from a job and from other sources such as allowances. To adjust for inflation, we used the 2002 consumer price index to express our measure of income in 2002 dollars.

Media Market Level. In light of the source of variation in the media market dose of the “truth” campaign, there might be factors that determined both the dose of the “truth” campaign and the level of smoking at the media market level. For example, low-exposure markets tended to be more rural, White, and less educated and have lower incomes—all factors associated with smoking—than markets with high campaign exposure. Failing to control for these factors could lead to a spurious negative correlation between campaign exposure and smoking prevalence. We implemented 2 approaches to statistically model possible correlations between preexisting media market smoking rates and the subsequent campaign dose. We first treated each of the 210 media markets as fixed effects in a logistic regression model that included indicator variables for 209 of 210 media markets (with 1 market as a reference). The fixed-effects approach was equivalent to controlling for average market-level smoking rates, effectively making each market its own control group. Our second approach included direct media market–level measures of potential confounders—2002 data on the median household income, percentage of the population who were college graduates, and population size.

State Level. To account for potential state-level influences, we collected data on inflation-adjusted cigarette prices and investments in tobacco control programs corresponding to the 1997–2002 MTF and the location of a student’s school. Previous research has shown that cigarette prices and state tobacco control programs influence youth smoking prevalence. Our measure of tobacco control investments is based on state per capita tobacco control program funding derived from Centers for Disease Control and Prevention State Highlight reports and supplemented by data from state programs.
Analytic Approach

Descriptive Statistics. We began by examining the overall change in the prevalence of youth smoking from 1997 to 2002 overall and by grade. We also compared the annual rate of change for the period leading up to the campaign (1997–1999) and during the campaign (2000–2002) as a simple indication of whether declines in youth smoking prevalence appeared to accelerate after campaign launch.

Multivariable Logistic Regression. To more precisely isolate the association between current youth smoking prevalence and “truth” campaign exposure, we used population average logistic regression models to estimate current youth smoking prevalence as a function of individual-, media market-, and state-level influences (noted earlier). We also included a linear time variable, taking values from 0 to 6 for the MTF years from 1997 to 2002, to control for the national downward trend in the prevalence of youth smoking that began in 1997 in order to isolate the effects of the campaign from the national trend. Students from the 1997–1999 surveys served as an unexposed comparison group.

We estimated all regressions by combining the cross-sectional 1997–2002 MTF surveys to relate the odds that an individual smoked to his or her media market dose of the campaign, measured at the time of the survey. Cumulative campaign GRPs were scaled such that the estimated odds ratios indicated the odds of smoking, given an increase of 10,000 GRPs. All models were estimated separately for 8th, 10th, and 12th grades and all grades combined. All analyses were estimated with sampling weights that corrected for nonresponse and sample design. Standard errors were adjusted for clustering at the school level (schools were the primary sampling unit) using Stata’s (version 8.0; Stata Corp, College Station, Tex) SVYLOGIT command. We esti-

<table>
<thead>
<tr>
<th>Grade</th>
<th>Prevalence of Current Smoking, %</th>
<th>Average Annual Percentage Change (95% Confidence Interval)</th>
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</thead>
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<tr>
<td>All</td>
<td>28.0</td>
<td>18.0</td>
</tr>
<tr>
<td>8th</td>
<td>19.4</td>
<td>10.7</td>
</tr>
<tr>
<td>10th</td>
<td>29.8</td>
<td>17.7</td>
</tr>
<tr>
<td>12th</td>
<td>36.5</td>
<td>26.7</td>
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RESEARCH AND PRACTICE

The MTF data showed a large decline in current youth smoking prevalence overall and for each grade between 1997 and 2002 (Table 1). Among all grades combined, current smoking prevalence decreased by 36% from 1997 to 2002. Eighth-grade students exhibited the largest percentage decline during this period at 45%, whereas 12th-grade students showed the smallest decline at 27%. The descriptive MTF data also indicated that the decline in current smoking prevalence accelerated after the launch of the campaign between 2000 and 2002 (Table 1). The annual percentage decline for all grades was 3.2% before the campaign launch (1997–1999) compared with 6.8% after the campaign launch (2000–2002). T tests, based on the observed differences in ratios and a Taylor series approximation of the standard errors of these differences, showed that the post—“truth” campaign annual declines were significantly greater than the pre—“truth” campaign annual declines overall and by grade (P<.001). As shown later, the accelerated decline likely occurred in the latter 2 years of the campaign as a lagged effect.

Results of the logistic regression for all grades indicated that there was a statistically significant dose–response relationship between “truth” campaign exposure and current youth smoking prevalence (odds ratio [OR]=0.78; 95% confidence interval [CI]=0.63, 0.97; P<.05) (Table 2). The odds ratio for the quadratic GRPs provides evidence that the effect diminished at higher levels of exposure (OR=1.11; 95% CI=1.00, 1.25; P<.07). Figure 2 illustrates the overall relationship between youth smoking prevalence and “truth” campaign exposure between 2000 and 2002. As shown, the effect of the campaign continued to increase through 10,000 GRPs and then began to attenuate as markets experienced higher average cumulative doses of the campaign but the odds ratio remained below 1. This suggested that the campaign could have a larger overall impact if it were feasible to redistribute GRPs from the highest-exposure markets to those with relatively low exposure.

Results calculated from the data presented in Table 2 indicate that between 1999 and 2002, the prevalence of smoking among students in all grades combined would have declined by only 5.7 percentage points to 19.6% (95% CI=18.6%, 20.6%) instead of the actual decline of 7.3 percentage points to 18.0% had the campaign not existed. Therefore, roughly 22% (95% CI=8.2%, 35.6%) of the total decline in youth smoking prevalence between 1999 and 2002 is attributable to the campaign.

In addition, as hypothesized, there was no statistically significant relationship between overall youth smoking prevalence and the campaign after only a few months of the campaign in 2000, but the effect was statistically significant in 2001 (OR=0.66; 95% CI=0.45, 0.98; P<.05) and 2002 (OR=0.63; 95% CI=0.45, 0.88; P<.01) (Table 2). To further illustrate the increasing effects of the campaign over time, we calculated the odds of smoking, based on the estimated odds ratios from Table 2, at varied levels of cumulative campaign exposure during each of the postlaunch cumulative periods (Figure 2). These results suggested that the relationship between overall youth smoking prevalence and the campaign strengthened over time and, as expected, the campaign showed little effect in 2000.

Separate regressions by grade show the largest effects for 8th-grade students (OR=0.61; P<.05), followed by statistically nonsignificant effects for 12th- (OR=0.79; P=.198) and 10th- (OR=0.98; P=.884) grade students, respectively (Table 2). We also estimated a set of regressions excluding the quadratic GRP term (GRP²) (results available on request). In this set, the effect was marginally statistically significant for 12th-grade students (OR=0.879; P<.07) but statistically nonsignificant overall and for 8th- and 10th-grade students.

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DISCUSSION

The “truth” campaign was associated with significant declines in youth smoking prevalence; thus, its approach to appeal to youths with hard-hitting ads that show at-risk youths rejecting tobacco and that reveal deceptive tobacco industry manipulation campaigns. More significant, this result was confirmed in multivariable analyses that controlled for confounding influences and indicated a dose–response relationship between “truth” campaign exposure and current youth smoking prevalence. To address concerns over the environmental nature of the “truth” campaign exposure measure, we performed sensitivity analyses that showed internally consistent and intuitive results—no effect in the early months of the campaign, diminishing returns, and no statistically significant association between the campaign and drinking among youths (described later). We found that by 2002, smoking rates overall were 1.5 percentage points lower than they would have been in the absence of the campaign, which translates to roughly 300,000 fewer youth smokers based on 2002 US census population statistics. To put our findings in perspective, research indicated that youth smoking prevalence declined by about 1 percentage point per year between 1967 and 1970 during the period of the Fairness Doctrine. It is important to note that these results may also reflect residual impacts from previous research by reaching generalized conclusions about the effects of antismoking campaigns for youths across the United States and by implementing a pre/post quasi-experimental design that controlled for potential threats to validity, such as secular trends in smoking prevalence, the influence of cigarette prices, state tobacco control programs, and other factors.

Descriptive statistics show that smoking rates declined faster after the launch of the campaign. More significant, this result was confirmed in multivariable analyses that controlled for confounding influences and indicated a dose–response relationship between “truth” campaign exposure and current youth smoking prevalence. To address concerns over the environmental nature of the “truth” campaign exposure measure, we performed sensitivity analyses that showed internally consistent and intuitive results—no effect in the early months of the campaign, diminishing returns, and no statistically significant association between the campaign and drinking among youths (described later). We found that by 2002, smoking rates overall were 1.5 percentage points lower than they would have been in the absence of the campaign, which translates to roughly 300,000 fewer youth smokers based on 2002 US census population statistics. To put our findings in perspective, research indicated that youth smoking prevalence declined by about 1 percentage point per year between 1967 and 1970 during the period of the Fairness Doctrine. It is important to note that these results may also reflect residual impacts from previous research by reaching generalized conclusions about the effects of antismoking campaigns for youths across the United States and by implementing a pre/post quasi-experimental design that controlled for potential threats to validity, such as secular trends in smoking prevalence, the influence of cigarette prices, state tobacco control programs, and other factors.

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the 1964 Smoking and Health: Report of the Advisory Committee to the Surgeon General of the Public Health Service and federal government policies requiring health warnings on all cigarette packages and in all cigarette advertising.

Our findings provide some evidence that the campaign may have the largest impact among 8th-grade students, which is consistent with evidence from Florida that indicates the Florida “truth” campaign led to declines in smoking rates and that smoking rates declined by 50% among middle school students (grades 6 through 8) and by 35% among high school students (grades 9 through 12) from 1998 to 2002.

Our analyses are not without their limitations. Our measures of youth smoking prevalence are self-reported and may be subject to social desirability bias so that youths are less likely to report smoking in areas with high exposure to the campaign than in areas with lower exposure. This would lead to an overstatement of the campaign’s effects. However, previous studies have found that underreporting of smoking by youths is minimal. Our results also rely on repeated cross-sectional surveys, not repeated measures on the same students, which weakens the strength of our causal inference. However, we included youths surveyed before 2000, so students in the 1997–1999 surveys served as an unexposed control group.

Finally, it is possible that the estimated campaign effects may have been due to other unmeasured youth-focused prevention activities (e.g., in-school substance abuse–prevention programs, the national antidrug campaign by the Office of National Drug Control Policy) that were correlated by chance with the “truth” campaign exposure. To assess this possibility, we used data from the 2000 and 2002 National Youth Tobacco Surveys to examine the correlation between the “truth” campaign exposure and exposure to tobacco use prevention education in schools. In addition, if there was a spurious correlation between “truth” campaign exposure and other prevention activities, we would also have expected to find a correlation between the “truth” campaign and other risk behaviors such as underage drinking. We addressed this potential problem by estimating a series of models identical to those presented in Table 2, using indicator variables for any drinking in the past 30 days (OR=0.981; P=.848) nor any relationship between “truth” campaign exposure and any binge drinking within the past 2 weeks (OR=0.857; P=.189), suggesting that “truth” campaign exposure is not spuriously correlated with other prevention efforts. Our results further suggest that the measured “truth” campaign effects on smoking prevalence are not the result of other efforts such as in-school tobacco use prevention education programs and prevention activities aimed at other risk behaviors such as underage drinking.

Although exposure to multistrategy tobacco use prevention education programs in schools has been linked to lower smoking prevalence among middle school students, we found no statistically significant differences in reported exposure to tobacco use prevention education programs in schools and exposure to the “truth” campaign. We tested this relationship by comparing self-reported recall of tobacco use prevention education programs in schools from the National Youth Tobacco Surveys by grouping students into the same 5 levels of “truth” campaign exposure illustrated in Figure 1.

In addition, we did not find any evidence of a relationship between “truth” campaign exposure and any drinking in the past 30 days (OR=0.981; P=.848) nor any relationship between “truth” campaign exposure and any binge drinking within the past 2 weeks (OR=0.857; P=.189), suggesting that “truth” campaign exposure is not spuriously correlated with other prevention efforts. Our results further suggest that the measured “truth” campaign effects on smoking prevalence are not the result of other efforts such as in-school tobacco use prevention education programs and prevention activities aimed at other risk behaviors such as underage drinking.

Under the Master Settlement Agreement, the tobacco industry was obligated to fund Legacy’s Public Education Fund for 5 years (through 2003) and is obligated thereafter in any year in which the tobacco companies participating in the Master Settlement Agreement achieve a combined 99.05% market share of US tobacco sales. The continuation of Legacy’s efforts, including the “truth” campaign, is presently in question because of these terms. Our findings are consistent with those of other studies that demonstrate that effective antismoking campaigns are critical for public health and that their elimination will likely erase gains that have been made to date in reducing youth smoking prevalence.
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Contributors
M.C. Farrelly contributed to the analytic methodology and conceptual approach, directed all data analyses, and prepared the article. K.C. Davis contributed to the analytic methodology and conceptual approach, conducted all data analyses, and participated in preparing the article. M.I. Haviland participated in the final draft preparation. P. Messeri contributed to the analytic methodology and conceptual approach and participated in the data analysis and final draft preparation. C.G. Healton contributed to the analytic methodology and conceptual approach and participated in the draft and final article preparation.

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Human Participant Protection
The University of Michigan institutional review board approved the MTF study and the consent information provided to the respondents. No protocol approval was needed for the analysis of the MTF data.

References