

# Adult Tobacco Use Levels After Intensive Tobacco Control Measures: New York City, 2002–2003

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Cigarette smoking remains the leading cause of preventable death in the United States. Smoking causes serious illness among an estimated 8.6 million persons, costs \$157 billion annually in medical costs and lost productivity, and kills approximately 440 000 people each year.<sup>1,2</sup> Nationally, adult smoking prevalence has declined rapidly, from 42.4% in 1964, the year the first surgeon general's report on smoking was issued, to 25.5% in 1990.<sup>3</sup> Since 1990, adult smoking prevalence in the United States has declined more slowly, to 21.7% in 2003.<sup>3</sup> From 1993 to 2001, the proportion of New York City adult residents who smoke remained constant, at approximately 22%.<sup>4</sup>

A growing body of evidence documents the effectiveness of public health and clinical interventions in reducing cigarette consumption.<sup>5–15</sup> In 2002, New York City initiated a comprehensive tobacco control program and also began to conduct a large-scale, systematic collection of population-based data on smoking and other health-related behaviors.

## METHODS

### Tobacco Control Program

In 2002, New York City began implementing a comprehensive, 5-component tobacco control strategy. The first component, an increase in the city's cigarette tax (from \$0.08 to \$1.50 per pack), became effective on July 2, 2002. New York State had already increased its tax from \$1.11 to \$1.50 per pack on April 1, 2002. Together, the state and city tax increases raised the cost of a pack of cigarettes by approximately 32%, to a retail price of approximately \$6.85.<sup>16</sup> The second component, enactment of the Smoke-Free Air Act of 2002 (SFAA),<sup>17</sup> became effective on March 30, 2003, and eliminated existing exemptions to make virtually all indoor workplaces, including restaurants and bars, smoke free. Third, nicotine-dependence treatment guidelines were sent to all physicians in the

*Objectives.* We sought to determine the impact of comprehensive tobacco control measures in New York City.

*Methods.* In 2002, New York City implemented a tobacco control strategy of (1) increased cigarette excise taxes; (2) legal action that made virtually all workplaces, including bars and restaurants, smoke free; (3) increased cessation services, including a large-scale free nicotine-patch program; (4) education; and (5) evaluation. The health department also began annual surveys on a broad array of health measures, including smoking.

*Results.* From 2002 to 2003, smoking prevalence among New York City adults decreased by 11% (from 21.6% to 19.2%, approximately 140 000 fewer smokers). Smoking declined among all age groups, race/ethnicities, and education levels; in both genders; among both US-born and foreign-born persons; and in all 5 boroughs. Increased taxation appeared to account for the largest proportion of the decrease; however, between 2002 and 2003 the proportion of cigarettes purchased outside New York City doubled, reducing the effective price increase by a third.

*Conclusions.* Concerted local action can sharply reduce smoking prevalence. However, further progress will require national action, particularly to increase cigarette taxes, reduce cigarette tax evasion, expand education and cessation services, and limit tobacco marketing. (*Am J Public Health.* 2005;95:1016–1023. doi:10.2105/AJPH.2004.058164)

city,<sup>18</sup> and a nicotine-patch distribution program began providing free 6-week courses (coupled with brief telephone counseling) to 34 000 of the city's heavy smokers beginning April 2, 2003.<sup>19</sup> The fourth component, expansion of educational efforts such as publications and advertisements in broadcast and print media, emphasized the health risks of environmental tobacco smoke and the benefits of quitting. There was also extensive media coverage of the debate regarding smoke-free workplace legislation. The fifth component was systematic evaluation, including the surveys reported here.

### Data Collection and Sample

Smoking prevalence data for 1993 through 2001 were obtained through surveys of New York City residents excerpted from the annual New York State Behavioral Risk Factor Surveillance System (BRFSS).<sup>4</sup>

In 2002, the New York City Department of Health and Mental Hygiene (DOHMH) conducted a population-based, random-digit-

dial telephone community health survey of approximately 10 000 adult New York residents, which was repeated in 2003. Trained interviewers collected data through computer-assisted telephone interviews. The Baruch College survey research unit assisted with the survey design, oversaw data collection, and conducted the interviews. Data were collected in 3 waves: 9674 interviews from May through July 2002, 9802 interviews from April through August 2003, and 1222 interviews in November 2003. Ten attempts were made to reach each telephone number. One adult New York City resident (aged 18 years or older) was randomly selected from each participating household. Response rates per wave among contacted households were 64%, 59%, and 64% respectively.

### Community Health Survey Instrument

Community health surveys included questions on sociodemographic characteristics, health status, health care access, use of clinical preventive services, health behaviors,

health conditions, and home and community environment. The community health survey instruments were adapted from the Centers for Disease Control and Prevention's BRFSS<sup>20</sup> and the National Health Interview Survey.<sup>21</sup> An expanded tobacco module included detailed questions on current smoking practices, exposure to environmental tobacco smoke, response to recent increases in local taxation, and smoking cessation.<sup>22</sup> Translation services were available in both years to conduct interviews in languages other than English (9 languages in 2002 and 23 languages in 2003).

As in national BRFSS surveys, current smoking was defined as currently smoking on all or some days and having smoked at least 100 cigarettes in one's lifetime. A quit attempt was defined as stopping smoking for at least 1 day; a successful attempt was defined as cessation for at least 3 months.<sup>23</sup> Smokers were classified as "heavy" if they smoked 11 cigarettes or more per day and "light" if they smoked between 1 and 10 cigarettes per day. If no information on the number of cigarettes smoked was available, values were ascribed on the basis of whether the smoker smoked some or all days (the average number of cigarettes smoked was 4.4 per day for those who smoked some days and 14 per day for those who smoked all days).

Questions on response to the tax increase, the SFAA, and exposure to environmental tobacco smoke were not included in the November 2003 survey. In the 2002 survey, there were a large number of missing answers to the question about place of purchase; in the 2003 surveys, additional response options were added, including Indian reservations, another country, and another person.

### Statistical Analysis

Because of small New York City-specific sample sizes for individual years (range 794–1665 respondents<sup>4</sup>), the BRFSS data were grouped into 3-year datasets (2828 respondents for 1993–1995, 3759 for 1996–1998, and 3271 for 1999–2001). The 2002 community health survey was considered to be the preintervention sample, and the 2 surveys conducted in 2003 were combined and treated as the postintervention sample.

Datasets were weighted to account for unequal selection probabilities and nonresponse. Primary weights were calculated for each respondent and consisted of the inverse of the probability of selection (number of adults in each household divided by number of residential telephone lines). Poststratification weights were used to adjust the sample estimates according to the precise age, race/ethnicity, and gender composition of each sampling stratum (neighborhood for the community health survey dataset, county for earlier datasets). All univariate and bivariate analyses were weighted and age standardized to the 2000 US Census population.

Analyses of education level were restricted to adults aged 25 years and older. To calculate the number of cigarettes consumed from different purchasing locations, each smoker's reported daily cigarette consumption was multiplied by the specified poststratification weight and summarized by the reported locations of purchase.

We used SAS (SAS Institute Inc, Cary, NC) for data management, and SAS-callable SUDAAN (Research Triangle Institute, Research Triangle Park, NC) to obtain appropri-

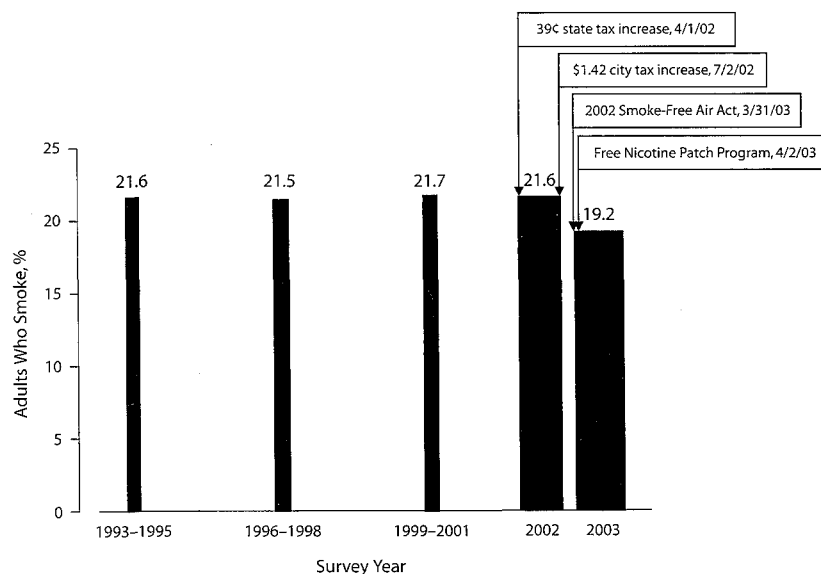
ate standard errors for the point estimates (PROC DESCRIPT). We calculated changes in percentages from rate ratios, which were derived from the odds ratios calculated from age-adjusted logistic regression models.

## RESULTS

### Prevalence

Smoking prevalence among New York City adult residents remained constant (between 21.5% and 21.7%) from 1991 through 2002. From 2002 to 2003, smoking prevalence decreased by 11%, from 21.6% to 19.2% ( $P = .0002$ ), representing approximately 140 000 fewer smokers (Figure 1). Smoking declined among all age groups, race/ethnicities, and educational attainment levels; in both genders; among both US-born and foreign-born persons; and in all 5 boroughs of the city (Table 1, Figure 2).

This decrease was more pronounced among women (a 13.3% decrease, from 19.8% in 2002 to 17.2% in 2003;  $P = .002$ ), particularly Hispanic women (a 20.8% decrease, from 21.0% to 16.6%;  $P = .007$ ) and low-income women (an 18.1% decrease, from



Note. Smoking prevalence among adults decreased by 11%. Width of bars is proportional to sample size. Space between bars is proportional to time interval between surveys.

**FIGURE 1—Smoking prevalence among New York City adults, 1993–2003, with key tobacco control initiatives and dates of implementation.**

TABLE 1—Smoking Prevalence and Decline, by Demographic Characteristics: New York City, 2002–2003

	2002		2003		2002–2003 <sup>a</sup>
	Percentage (95% CI)	Population	Percentage (95% CI)	Population	Percentage Change (95% CI)
Age, y	21.6 (20.5, 22.6)	1 305 000	19.2 (18.4, 20.1)	1 167 000	-11.3 (-17.2, -5.6)
18–24	23.8 (20.7, 27.2)	185 000	19.3 (16.7, 22.1)	147 000	-20.3 (-34.6, -3.9)
25–44	24.3 (22.6, 26.0)	616 000	21.9 (20.6, 23.3)	579 000	-9.4 (-16.8, -0.8)
45–64	23.4 (21.4, 25.6)	390 000	21.2 (19.6, 22.9)	358 000	-11.1 (-20.3, 0.0)
≥65	10.0 (8.4, 11.9)	89 000	9.3 (7.9, 11.0)	87 000	-10.0 (-28.8, +14.2)
Race/ethnicity					
Non-Hispanic White	23.9 (22.2, 25.7)	568 000	21.9 (20.4, 23.4)	498 000	-6.2 (-15.1, +3.0)
Non-Hispanic Black	20.8 (18.8, 22.9)	284 000	18.3 (16.7, 19.9)	252 000	-14.0 (-25.3, -1.6)
Hispanic	21.5 (19.5, 23.5)	327 000	19.0 (17.4, 20.8)	294 000	-13.0 (-4.3, -0.8)
Asian	15.3 (12.0, 19.3)	98 000	13.6 (11.0, 16.7)	90 000	-13.0 (-36.1, +16.4)
Other	22.8 (15.8, 31.7)	29 000	20.2 (15.5, 25.8)	38 000	-13.7 (-44.6, +28.9)
Gender					
Male	23.4 (21.7, 25.1)	675 000	21.6 (20.3, 23.0)	618 000	-10.3 (-18.6, -1.5)
Female	19.8 (18.5, 21.2)	630 000	17.2 (16.2, 18.3)	553 000	-13.3 (-21.1, -4.9)
Borough					
Bronx	25.2 (22.7, 28.0)	234 000	21.3 (19.2, 23.7)	193 000	-15.8 (-27.8, -1.5)
Brooklyn	19.7 (18.1, 21.5)	354 000	18.7 (17.3, 20.2)	336 000	-9.0 (-19.3, +2.4)
Manhattan	21.2 (19.1, 23.3)	270 000	18.4 (16.7, 20.3)	240 000	-13.1 (-24.3, 0.0)
Queens	20.8 (18.7, 23.2)	357 000	18.2 (16.6, 19.9)	318 000	-8.9 (-20.9, +4.7)
Staten Island	27.3 (23.1, 31.9)	90 000	25.7 (21.7, 30.0)	85 000	-12.2 (-31.7, +11.1)
Income, \$					
<25 000	24.1 (22.1, 26.1)	412 000	21.3 (19.8, 23.0)	371 000	-12.6 (-21.9, -2.3)
25 000–49 999	23.5 (21.5, 25.6)	397 000	21.9 (20.0, 23.8)	296 000	-6.2 (-16.9, +6.0)
50 000–74 999	18.5 (15.9, 21.4)	145 000	19.4 (16.7, 22.4)	122 000	+3.2 (-15.2, +24.6)
≥75 000	18.7 (16.2, 21.5)	175 000	15.9 (13.8, 18.3)	144 000	-13.4 (-29.5, +4.0)
Education					
Some high school	24.5 (21.7, 27.5)	188 000	22.9 (20.4, 25.6)	184 000	-10.3 (-23.9, +6.0)
High school graduate	23.9 (21.6, 26.3)	318 000	22.6 (20.8, 24.5)	294 000	-6.2 (-17.8, +6.0)
Some college	24.3 (21.8, 26.9)	277 000	20.2 (18.4, 22.2)	230 000	-16.6 (-27.8, -3.8)
College or more	16.4 (14.9, 18.1)	329 000	15.1 (13.8, 16.5)	311 000	-7.5 (-18.9, +5.7)
Place of birth					
United States	25.9 (24.5, 27.2)	904 000	23.5 (22.3, 24.7)	785 000	-9.2 (-15.6, -2.2)
Puerto Rico/US territories	26.8 (20.6, 34.0)	40 000	19.5 (15.1, 24.8)	38 000	-11.5 (-36.6, +18.5)
Other	15.4 (13.8, 17.0)	357 000	13.5 (12.3, 14.8)	347 000	-9.5 (-21.1, +4.2)
No. of cigarettes smoked daily					
≤10 (light smokers)	13.4 (12.6, 14.3)	815 000	12.9 (12.2, 13.7)	793 000	-7.9 (-15.1, +0.9)
>10 (heavy smokers)	8.0 (7.4, 8.8)	464 000	6.2 (5.7, 6.7)	357 000	-20.6 (-35.1, -17.7)
Smoking frequency					
Every day	14.4 (13.6, 15.4)	878 000	12.9 (12.2, 13.6)	787 000	-10.5 (-17.6, -3.4)
Some days	7.0 (6.4, 7.7)	427 000	6.3 (5.7, 6.8)	385 000	-13.1 (-23.7, -1.9)

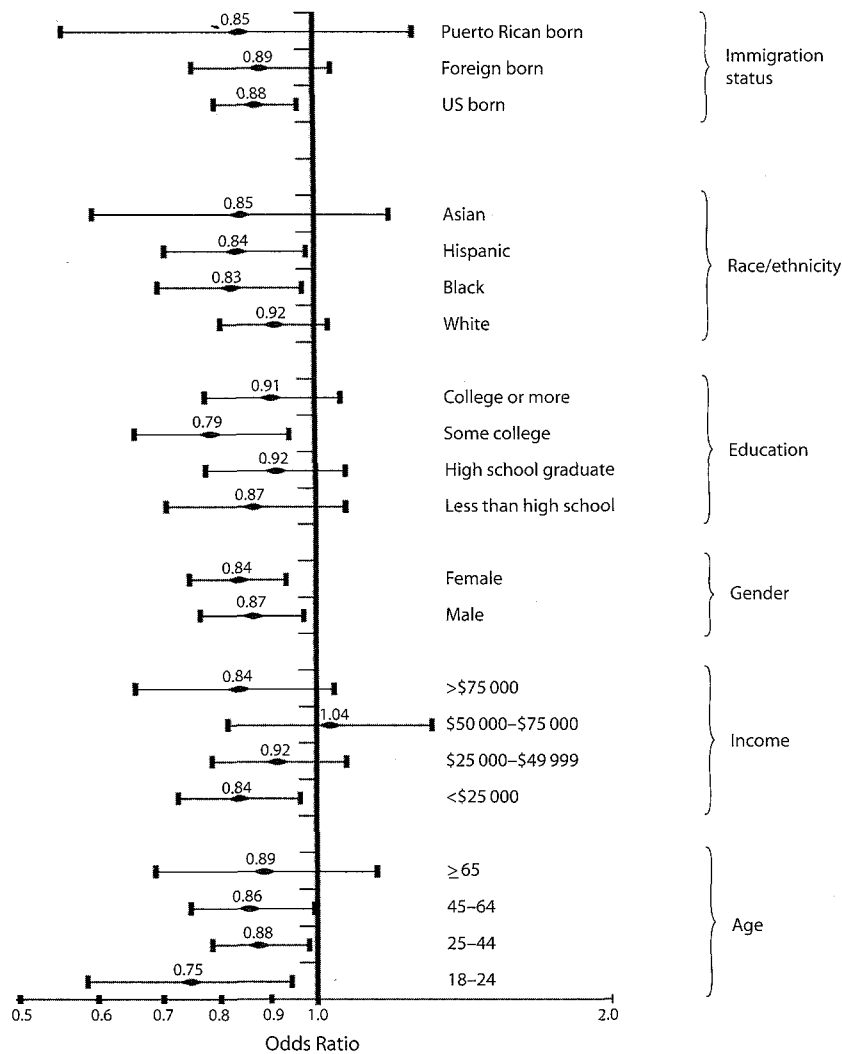
Note. CI = confidence interval. Percentages are age adjusted (except for age). Totals may not add to 100 because of rounding. Data for education were analyzed only for smokers aged 25 years and older.  
<sup>a</sup>Percentage changes were calculated with rate ratios derived from odds ratios from age-adjusted logistic regression models.

21.6% to 17.8%;  $P=.009$ ). Significant decreases in smoking also were found among Black US-born New York residents (a 16.8% decrease, from 29.2% to 24.3%;  $P=.009$ ) and among people with more than a high

school education (a 12.4% decrease, from 19.3% to 16.9%;  $P=.01$ ). Declines were also large among 18- to 24-year-olds (an 18.9% decrease, from 23.8% to 19.3%;  $P=.02$ ) and among people with annual family incomes of

less than \$25 000 (a 12.6% decrease) or \$75 000 or more (a 13.4% decrease).

Among smokers, average consumption declined from 11.2 to 10.6 cigarettes per day. The proportion of heavy smokers (>10 ciga-



Note. Logarithmic scale. All data are age adjusted (except for age).

**FIGURE 2—Odds ratios for smoking in 2003 vs 2002, by sociodemographic group, with 95% confidence intervals.**

rettes per day) declined by 22.5% (from 8.0% to 6.2%,  $P < .0001$ ), which presumably reflects both cessation and reduced consumption. Thus, groups that experienced the largest declines in smoking prevalence were young people, women, people in the lowest and highest income brackets, people with higher educational levels, and heavy smokers.

**Cessation Practices**

In both the 2002 (57.3%) and the 2003 (59.5%) surveys, more than half of New York City adult smokers reported that they had tried to quit at least once during the preced-

ing year. In 2003, former smokers who had quit within the past year were more likely to have low incomes compared with former smokers who had quit more than 1 year previously (43.6% vs 32.0%,  $P = .0001$ ).

**Self-Reported Responses of Smokers to Tobacco Tax Increases and the SFAA**

Nearly half (45.3%) of residents who had smoked during the past year reported that they had reduced the number of cigarettes smoked, thought about quitting, tried to quit, or quit in response to the tax increase (Table 2). Black and Hispanic New York residents were

more likely than White New York residents (50.7% and 49.0% vs 37.2%,  $P < .0001$ ), and low-income New York residents were more likely than high-income New York residents (51.5% vs 38.7%,  $P < .0001$ ), to report an impact of the tax increase on smoking. Similarly, residents with low incomes (<\$25 000 per year) or with less than a high school education were more likely than those with high incomes ( $\geq$ \$75 000 per year) and those with a high school education or higher to report that the tax increase reduced the number of cigarettes they smoked (income: 26% [low] vs 13.0% [high],  $P = .0002$ ; educational attainment: 27.5% [lower] vs 19.3% [higher],  $P = .009$ ).

Among smokers and recent former smokers (those who had smoked in the past year), younger New York residents were more likely than older New York residents to report that the smoke-free legislation had an effect on their smoking (31.9% vs 15.2%,  $P = .002$ ), and Whites were more likely than Blacks to report an effect (26.4% vs 18.7%,  $P = .02$ ). Overall, 21.4% of smokers reported reducing their cigarette consumption because of the SFAA; White New York residents were more likely than Black New York residents to report having reduced the number of cigarettes they smoked in response to the legislation (25.6% vs 16.8%,  $P < .0001$ ).

**Exposure to Environmental Tobacco Smoke**

Almost half (46%) of respondents reported less exposure to environmental tobacco smoke after the passage of smoke-free legislation. High-income, White, and younger people were more likely than low-income, Black, and older people to report that the SFAA reduced their exposure (53.3% vs 41.9%, 50.4% vs 38.3%, and 51.0% vs 32.4%, respectively;  $P < .0001$  for all comparisons).

Among nonsmoking adult New York residents, the proportion reporting environmental tobacco smoke exposure at home decreased by 29.4% (from 8.5% in 2002 to 6.0% in 2003;  $P < .0001$ ), a reduction representing approximately 105 000 fewer nonsmokers exposed. Decreases were particularly large among low-income residents (a 37.6% decrease, from 9.3% to 5.8%;  $P < .0001$ ), non-Hispanic Whites (a 36.9% decrease, from

**TABLE 2—Reaction to Legislation Among New York Residents Who Smoked in 2002–2003**

	Percentage (95% CI)	Population
Response to tax increase		
No impact	52.9 (50.3, 55.5)	733 000
Reduced cigarettes	21.2 (19.0, 23.5)	284 000
Thought about quitting	7.8 (6.6, 9.3)	111 000
Tried to quit	10.6 (9.1, 12.3)	147 000
Quit	5.7 (4.6, 7.1)	75 000
Response to workplace smoking ban		
No impact	69.8 (67.3, 72.3)	865 000
Reduced cigarettes	21.4 (19.2, 23.8)	281 000
Thought about quitting	2.9 (2.1, 3.9)	37 000
Tried to quit	2.0 (1.4, 2.8)	26 000
Quit	2.2 (1.6, 3.0)	28 000

Note. Percentages were age adjusted. Percentages will not add to 100 because of "other" or missing responses.

8.4% to 5.3%;  $P=.003$ ), and Hispanics (a 46.7% decrease, from 10.5% to 5.6%;  $P<.0001$ ).

The proportion of nonsmoking adults exposed to environmental tobacco smoke at work declined by 18.0% (from 8.9% in 2002 to 7.3% in 2003;  $P=.005$ ), a reduction representing approximately 67 000 fewer nonsmokers exposed. Approximately 157 000 fewer nonsmoking New York residents were exposed to environmental tobacco smoke at work or at home.

#### Alternative Sales Channels

Although the New York City tax hike increased tax receipts 10-fold (by more than \$260 million annually),<sup>24</sup> the proportion of cigarettes reportedly purchased outside New York City increased, from 17.4% in 2002 to 32.9% in 2003 ( $P<.0001$ ): a 15% decrease in the number of cigarettes purchased in New York City and an 89% increase in cigarettes purchased elsewhere. Overall, a net 15% decrease in consumption was reported. Of cigarettes reportedly purchased elsewhere in 2003, 29.0% were bought in New York State outside New York City, 21.7% were bought in a different state, 18.1% were bought over the Internet, 12.4% were bought from another person, and 7.8% were bought from an Indian reservation.

In 2003, purchases through alternative sales channels were more common among

heavy smokers than among light smokers (36.3% vs 26.9%,  $P<.002$ ). Internet purchases were more common among Whites (8.4% of all purchases) than among Asians (6.1%), Hispanics (5.3%), or Blacks (1.2%) ( $P=.01$ ). Purchases from another person were much less likely among Whites (1.7%) than among Blacks (9.2%), Asians (7.5%), or Hispanics (5.9%) ( $P=.0001$ ). Because of the increase in nontaxed cigarette purchases, the effective price of a pack of cigarettes, on the basis of our surveys, showed a 20% increase (from \$4.60 to \$5.50) rather than the 32% increase (from \$5.20 to \$6.85) that would have occurred in the absence of any cigarette tax avoidance.<sup>16</sup>

#### DISCUSSION

##### Reduction in Burden

The health risks of smoking have been proven for at least half a century,<sup>25</sup> and the effectiveness of means to reduce smoking are increasingly well documented.<sup>8–12</sup> New York City built on the successes of California, Massachusetts, and other jurisdictions in reducing tobacco use through taxation, education, and cessation services<sup>7,26–29</sup> and new, systematic guidelines for treating tobacco dependence,<sup>11,30</sup> despite substantial controversy,<sup>31–33</sup> by implementing a comprehensive tobacco control program in 2002. During the following year, after a decade during which smoking preva-

lence remained unchanged, there was a large and rapid decline in tobacco use among adults.

This decline corresponded to approximately 140 000 fewer adult smokers. Because roughly one third of smokers die prematurely (by an average of 14 years<sup>1</sup>) from tobacco-related disease,<sup>1</sup> this decline, if sustained, will result in 45 000 fewer premature deaths and approximately 650 000 fewer years of preventable potential life lost in coming decades. Exposure to environmental tobacco smoke, which causes increased morbidity and mortality,<sup>34–38</sup> also decreased significantly.

Reduced prevalence, if maintained, will reduce governmental and patient costs from illness, hospitalization, and death; annually, these costs are approximately \$3400 higher for a smoker than for a nonsmoker<sup>1</sup> and add up to \$500 million annually for 140 000 smokers. The tax increase also resulted in an annual tax gain of more than \$260 million for 2003.<sup>24</sup> Smoke-free workplace legislation was associated with no decline in restaurant and bar employment and business tax receipts.<sup>39</sup>

##### Evidence of Causation

A causal association between stronger tobacco control policies and decline in smoking prevalence is suggested by both temporal and geographic factors. During the 10 years preceding the 2002 program, smoking prevalence did not decline in New York City; within a year of implementation of the new policies, a large, statistically significant decrease occurred.

The Centers for Disease Control and Prevention's BRFSS provides annual county-level data on smoking prevalence. Of the 25 US primary metropolitan statistical areas (as defined by the US Census Bureau) with a population greater than 2 million, data were available for 8 (4 on the East Coast) that did not intensify tobacco control efforts in 2002–2003. Among these 8 metropolitan areas, 6 showed increases of 4%–18%, 1 showed no change, and 1 showed a slight, nonsignificant (7%) decrease in smoking prevalence.<sup>40</sup>

Responses to our survey as well as other research suggest that increased taxation was

the primary reason for the decline in smoking prevalence. Among survey respondents, approximately 59 000 attributed their smoking cessation to the tax increase, 13 000 to the SFAA, and 16 000 to both factors. Furthermore, almost half of smokers reported that they reduced tobacco consumption, thought about quitting, tried to quit, or quit smoking in response to the tax increase—approximately twice the number who reported taking one of these actions in response to the smoke-free legislation. Both the magnitude of the decline and the pattern of the decrease—which was greatest for younger smokers, smokers with lower incomes, and Hispanic smokers—are consistent with published analyses of price impact.<sup>41</sup>

Application of age-specific price elasticities established by other studies<sup>41</sup> to the New York City data on smoking prevalence meant the tax increase would be expected to result in smoking cessation among approximately 45 000 smokers. If data from a review of publications that analyzed the relationship between smoke-free workplace policies and worker smoking<sup>9</sup> were applied to New York City's population, the SFAA would be expected to result in smoking cessation among approximately 18 000 smokers. The free nicotine-patch program accounted for the cessation of approximately 11 000 smokers.<sup>19</sup> Hence, increased taxation appears to have accounted for approximately 33% to 54% of the decline in smoking prevalence, smoke-free workplace legislation to have accounted for 13% to 21% of the decline, and the nicotine-patch program to have accounted for 8% of the decline.

The remaining decline may have been caused by individual or synergistic effects of public education, changing social norms, additional cessation interventions, or greater-than-estimated effects of taxation or smoke-free workplace legislation on smoking initiation or relapse. Higher cigarette prices and decreasing availability of public places to smoke likely assisted smokers who attempted to quit and were undoubtedly important factors in the high cessation rate from the free nicotine-patch program.<sup>19</sup> Public education about the risks of environmental tobacco smoke assisted in the passage and implementation of the

SFAA, contributed to the large increase among New York residents with smoke-free homes, and encouraged smokers to quit for the sake of their own health and the health of those around them. The increase in homes that did not allow smoking appears to have been a welcome, although unexpected, result of publicity related to the legislation; home smoking restrictions are associated with lower rates of current smoking and higher rates of former smoking among youth<sup>42</sup> and with higher quit rates among adults.<sup>43</sup>

Our data suggest that people with lower incomes may have been more heavily affected by the increase in taxation, whereas people with higher incomes may have been more affected by greater awareness of the dangers of environmental tobacco smoke and expansion of smoke-free workplace legislation. Younger New York residents appear to have been disproportionately affected by both price increases and smoke-free workplace legislation. Younger people are more sensitive to tobacco price increases<sup>41</sup> and more likely to be frequent patrons of bars or nightclubs<sup>44</sup>; requiring smoke-free bars may have had greater effects on younger than on older smokers. Because various sociodemographic groups appear to respond differently to individual tobacco control initiatives, multiple and varied interventions would likely be more effective than a single intervention in reducing smoking among a large, diverse population.

The data also suggest a transition to lower levels of smoking among current smokers, as has occurred in California.<sup>45</sup> A reduction in cigarette consumption increases the likelihood of future cessation.<sup>46–49</sup>

### Limitations

Because these surveys were cross-sectional, our ability to conduct longitudinal analyses is limited, and the causality of associations is uncertain. However, the surveys were large, were conducted in multiple languages, and were representative of New York City. All data were self-reported, introducing the danger of a social response bias; however, because the telephone surveys were anonymous, we have no reason to expect a large effect from such a bias.

Respondents' attribution of the impact of various control measures on their smoking behavior may not be accurate; however, respondent opinions from these surveys correlate well with both observed declines and predictions from the published literature,<sup>9,41</sup> and the consistency of decreases in different age, racial/ethnic, gender, and socioeconomic groups strongly suggests that the results reflect actual change. Furthermore, the reliability and validity of smoking-related questions in the BRFSS have been shown to be relatively high,<sup>50,51</sup> as has the validity of other self-reported measures of smoking.<sup>52</sup> In jurisdictions such as California, moreover, decreases in self-reported smoking have been associated with reductions in tobacco-related disease,<sup>7</sup> a finding that strongly suggests that decreases measured by survey data reflect actual decreases.

Other cities surveyed in the BRFSS had smaller sizes than did New York City, and in some instances city and county boundaries are not contiguous. Comparison of changes in smoking prevalence observed in these areas with changes observed in New York City is therefore suggestive but not definitive evidence that New York City's program was the cause of the observed reduction in smoking. It is theoretically possible that social receptivity to increased tobacco taxation indicated a preexisting readiness to change; the decline in smoking, however, occurred only after the described measures were implemented.

### Conclusions

Although tax receipts were significantly higher after the 2002 tax increases, cigarette tax avoidance through increased purchasing of cigarettes outside New York City undermined the potential health benefit of higher taxes by reducing the effective price increase from 32% to 20%. Tax evasion through cross-border and Internet cigarette purchases provides evidence of the need for both a national cigarette tax increase, as has been proposed,<sup>53</sup> and stronger congressional legislation restricting untaxed Internet and cross-border tobacco sales.<sup>54–56</sup>

New York City and other jurisdictions have much further to go in reducing tobacco use, particularly among men. New York City still has more than 1 million smokers, and to-

bacco use remains the leading cause of preventable death. Future local initiatives will include continued expansion of access to cessation treatment and public education specific to different communities (e.g., addressing the gap in knowledge about the health risks of smoking among foreign-born Chinese men<sup>57</sup>). Efforts to restrict tobacco advertising locally appear to be preempted by current federal legislation.<sup>58</sup>

The national *Healthy People 2010* target smoking prevalence among adults is less than 12%.<sup>59</sup> California has achieved a rate of 16% among adults,<sup>60</sup> which suggests that further progress is possible.<sup>61</sup> New York State had the highest state cigarette tax in the nation before the 2002 tax increases,<sup>62</sup> and most workplaces (excluding bars and some restaurants) in New York City had been smoke free since 1995.<sup>63</sup> Other localities can reduce tobacco use and tobacco-related illness by raising taxes, strengthening workplace smoking restrictions, and increasing public education and cessation services. Jurisdictions that currently levy low taxes and have limited smoke-free workplace protections may potentially achieve more rapid progress if similar aggressive, multiple measures are applied.

Success in meeting national targets will depend on federal, state, and local tobacco control policies and adequate funding for tobacco control programs. However, significant national progress is likely to remain stalled until the advent of higher taxes<sup>53</sup>; increased education and cessation services<sup>53</sup>; better control of Internet and other nontaxed cigarette sales<sup>54,64</sup>; restrictions on tobacco company marketing<sup>65–67</sup>; and fewer positive portrayals of smoking to children in movies,<sup>68</sup> music videos,<sup>69</sup> and other media.<sup>70</sup> ■

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#### Contributors

T.R. Frieden was principal investigator, had full access to all of the data in the study, and was responsible for the study design and integrity of the data, as well as the accuracy of the data analysis and interpretation. F. Mostashari, B. Kerker, and N. Miller also were responsible for the study concept and design. M. Frankel was responsible for acquisition of data. F. Mostashari, B. Kerker, N. Miller, and A. Hajat also were responsible for statistical analysis and interpretation of data. T.R. Frieden, F. Mostashari, and B. Kerker were responsible for writing. All authors critically reviewed and revised the article and supervised aspects of the study.

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