

The *Morbidity and Mortality Weekly Report (MMWR)* Series is prepared by the Centers for Disease Control and Prevention (CDC) and is available free of charge in electronic format and on a paid subscription basis or paper copy. To receive an electronic copy on Friday of each week, send an e-mail message to [listserv@listserv.cdc.gov](mailto:listserv@listserv.cdc.gov). The body content should read *SUBscribe mmwr-toc*. Electronic copy also is available from CDC's World-Wide Web server at <http://www.cdc.gov/> or from CDC's file transfer protocol server at <ftp.cdc.gov>. To subscribe for paper copy, contact Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402; telephone (202) 512-1800.

Data in the weekly *MMWR* are provisional, based on weekly reports to CDC by state health departments. The reporting week concludes at close of business on Friday; compiled data on a national basis are officially released to the public on the following Friday. Address inquiries about the *MMWR* Series, including material to be considered for publication, to: Editor, *MMWR* Series, Mailstop C-08, CDC, 1600 Clifton Rd., N.E., Atlanta, GA 30333; telephone (888) 232-3228.

All material in the *MMWR* Series is in the public domain and may be used and reprinted without permission; citation as to source, however, is appreciated.

Acting Director, Centers for Disease Control and Prevention  
Claire V. Broome, M.D.

Acting Deputy Director, Centers for Disease Control and Prevention  
Stephen B. Thacker, M.D., M.Sc.

Acting Director, Epidemiology Program Office  
Barbara R. Holloway, M.P.H.

Editor, *MMWR* Series  
John W. Ward, M.D.

Acting Managing Editor, *MMWR* (weekly)  
Caran R. Wilbanks

Writers-Editors, *MMWR* (weekly)  
David C. Johnson  
Teresa F. Rutledge

Desktop Publishing and Graphics Support  
Morie M. Higgins  
Peter M. Jenkins

☆U.S. Government Printing Office: 1998-633-228/87015 Region IV

9705 204941 MMR  
COLUMBIA HEALTH SCIENCE  
SERIALS/BOOK ACQUISITIONS  
701 WEST 168TH ST  
NEW YORK NY 10032-2704

0001

DEPARTMENT OF  
HEALTH AND HUMAN SERVICES  
Centers for Disease Control  
and Prevention (CDC)  
Atlanta, Georgia 30333

Official Business  
Penalty for Private Use \$300  
Return Service Requested

FIRST-CLASS MAIL  
POSTAGE & FEES PAID  
PHS/CDC  
Permit No. G-284

CDC  
CENTERS FOR DISEASE CONTROL  
AND PREVENTION

AUG - 4 1998

July 31, 1998 / Vol. 47 / No. 29

MMWR

MORBIDITY AND MORTALITY WEEKLY REPORT

- |     |   |
|-----|---|
| 605 | Response to Increases in Cigarette Prices by Race/Ethnicity, Income, and Age Groups — U.S., 1976–1993             |
| 610 | Clinical Sepsis and Death in a Newborn Nursery Associated with Contaminated Parenteral Medications — Brazil, 1996 |
| 613 | Use of Clinical Preventive Services by Adults Aged <65 Years Enrolled in Health-Maintenance Organizations         |
| 627 | Quarterly Immunization Table  |

## Response to Increases in Cigarette Prices by Race/Ethnicity, Income, and Age Groups — United States, 1976–1993

Tobacco use, particularly cigarette smoking, remains the leading cause of preventable illness and death in the United States (1). Studies have shown that increases in the price of cigarettes will decrease the prevalence of smoking and the number of cigarettes smoked both by youth and adults (1,2). However, the potential impact of price increases on minority and lower-income populations is an important consideration (3,4). This report summarizes the analysis of data for 14 years from the National Health Interview Survey (NHIS), which indicates that lower-income, minority, and younger populations would be more likely to reduce or quit smoking in response to a price increase in cigarettes.

Data from the NHIS from 1976 to 1980, 1983, 1985, and 1987 to 1993 were pooled to conduct the analysis. The NHIS was administered to a nationally representative multistage probability sample of the noninstitutionalized civilian population aged ≥18 years. Smoking histories were obtained for these years in supplements to the NHIS; the overall response rate for these supplements was approximately 80%. Before 1992, participants were asked, "Have you smoked at least 100 cigarettes in your entire life?" and "Do you smoke cigarettes now?" In 1992 and 1993, participants were asked, "Do you now smoke cigarettes every day, some days, or not at all?" Current smokers were persons who reported having smoked ≥100 cigarettes during their lifetimes and who currently smoked cigarettes. Current smokers were asked, "On average, how many cigarettes do you smoke per day?" Information on race/ethnicity, income, age, and other demographic factors were obtained from the core of the NHIS questionnaire. Using data reported by the Tobacco Institute (5), the average price of a pack of cigarettes for each state, adjusted for inflation, was merged into the NHIS data by year and state of residence. The 14 cross-sections of the NHIS have 367,106 respondents; of these, 355,246 respondents had complete demographic and price data (approximately 24,000 respondents per year).

Two types of multiple regression models were estimated. A probit (limited dependent variable) model was used with the full sample (n=355,246) to estimate the change in the probability of smoking (one for current smokers and zero for all other respondents) for a change in the inflation-adjusted price (1982–1984 dollars). An ordinary least squares model, restricted to current smokers (n=112,657) with self-reported number of cigarettes smoked per day as the dependent variable, was used to estimate

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES

## Cigarette Prices — Continued

the relation between inflation-adjusted price and quantity of cigarettes consumed. Both models controlled for year, region of the country (Northeast, South, Midwest, and West)\*, age, sex, race/ethnicity, education, marital status, family income, and urbanicity (based on residence in a metropolitan statistical area [MSA] central city, MSA city, or rural area). Separate subpopulation models were estimated by race/ethnicity (Hispanics, non-Hispanic blacks, and non-Hispanic whites), by age group (aged 18–24, 25–39, and ≥40 years), and by income group. Self-reported family incomes from all survey years were inflation-adjusted to 1982–1984 dollars, and the sample median was computed for all respondents reporting family income data. Respondents with incomes equal to or below the median were compared with those above the median income (\$33,106 in 1997 dollars). All subpopulation models included the control variables used in the full models.

For all models, the effect of price is expressed as price elasticities. Price elasticity is a standardized measure indicating the percentage change in the dependent variable (i.e., smoking prevalence or number of cigarettes consumed per day) for a 1% change in the inflation-adjusted price of cigarettes (independent variable) (6). Prevalence price elasticity, using price coefficients from the probit regression models, is the percentage reduction in the prevalence of smoking that would be predicted from a 1% price increase. Consumption price elasticity, using price coefficients from the linear regression models, is the percentage reduction in the average number of cigarettes smoked by persons who continue to smoke after a 1% price increase. Total price elasticity is the sum of smoking prevalence and cigarette consumption price elasticities.

For all respondents, the models estimated a prevalence price elasticity of –0.15 and a consumption price elasticity of –0.10, yielding a total price elasticity estimate of –0.25 (Table 1). Therefore, a 50% price increase could cause a 12.5% reduction in the total U.S. cigarette consumption (i.e., 50% X –0.25 = –12.5%), or approximately 60 billion fewer cigarettes smoked per year. In the age-specific model, younger smokers were more likely than older smokers to quit smoking, and after controlling for income, education, and other nonprice variables, Hispanic smokers and non-Hispanic black smokers were more likely than white smokers to reduce or quit smoking in response to a price increase. This pattern was consistent for all age groups (Figure 1). Among both non-Hispanic blacks and Hispanics, smokers aged 18–24 years were substantially more price-responsive than smokers aged ≥40 years. Lower-income populations also were more likely to reduce or quit smoking than those with higher incomes. The total price elasticity was –0.29 for lower-income persons compared with –0.17 for higher-income persons.

Reported by: MC Farrelly, PhD, JW Bray, MA, Research Triangle Institute, Research Triangle Park, North Carolina. Office on Smoking and Health, National Center for Chronic Disease Prevention and Health Promotion, CDC.

\* Northeast=Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont; Midwest=Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin; South=Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia; and West=Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming. Models including state-specific controls yielded results similar to those obtained with controls for region of the country. Because sample sizes in subpopulation analyses were smaller, region of the country rather than state-specific controls were used in all models.

## Cigarette Prices — Continued

TABLE 1. Prevalence, consumption, and total price elasticities\* using a probit regression model and least squares model to estimate response to increases in cigarette prices†, by selected characteristics — United States, 1976–1993

Characteristic	Probit model			Least squares model			Total elasticity††
	No.	% Smokers	Prevalence elasticity†	No.	Mean no. cigarettes	Consumption elasticity**	
<b>Race/Ethnicity<sup>§§</sup></b>							
White, non-Hispanic	281,482	29.4	–0.04	90,829	21.49	–1.90	–0.14
Black, non-Hispanic	43,141	32.8	–0.31	14,158	14.12	0.50	–0.32
Hispanic	21,926	24.5	–0.76	5,736	14.00	–7.50	–1.89
<b>Age group (yrs)</b>							
18–24	46,884	29.6	–0.29	13,875	16.03	–3.34	–0.58
25–39	119,510	34.2	–0.22	42,177	19.49	–3.15	–0.42
≥40	188,521	26.2	–0.04	56,515	21.28	–0.73	–0.10
<b>Family income<sup>¶¶</sup></b>							
≤Median income	154,602	31.7	–0.16	51,780	19.24	–1.65	–0.29
>Median income	156,940	27.5	–0.03	48,422	20.82	–2.50	–0.17
Income not reported	43,704	26.1	–0.15	12,365	19.64	–0.60	–0.25
<b>Sex</b>							
Male	151,711	32.4	–0.18	54,417	22.17	–1.91	–0.26
Female	203,535	26.8	–0.07	58,150	17.89	–1.87	–0.19
<b>Total</b>	<b>355,246</b>	<b>29.3</b>	<b>–0.12</b>	<b>112,657</b>	<b>19.96</b>	<b>–1.94</b>	<b>–0.25</b>

\* Price elasticity is a ratio of the marginal change (i.e., per unit changes) between two variables and the average change between the same variables (7). This ratio is a standardized measure that indicates the percentage change in the dependent variable (i.e., smoking prevalence or number of cigarettes consumed per day) for a 1% change in the Consumer Price Index (CPI) adjusted price of cigarettes (independent variable).

† Cigarette prices were denominated in constant 1982–1984 dollars for all price elasticity estimates.

‡ Confidence interval.

§ Percentage reduction in prevalence of smoking for each 1% increase in the CPI adjusted price of cigarettes. The numerator (the marginal change) consists of the regression coefficient for price multiplied by the average probability (based on the regression coefficient for price and variance terms) that a person is a smoker. The denominator (the average change) is the ratio of the average number of surveyed persons who smoke (smoking prevalence) to the average sample price.

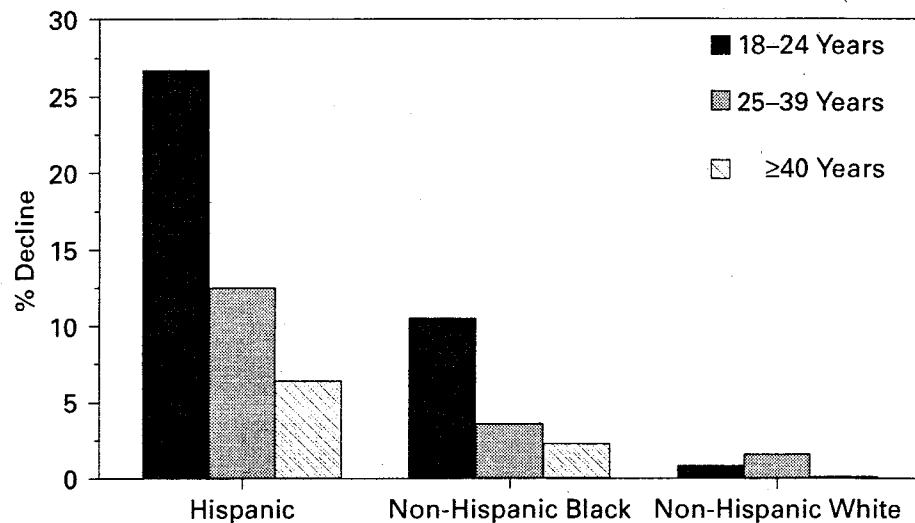
¶ Percentage reduction in the number of cigarettes smoked per day for each 1% increase in the CPI adjusted price of cigarettes. The numerator is the coefficient on price and the denominator is the ratio of the average number of cigarettes consumed per day to the average sample price.

‡‡ Calculated by summing the smoking prevalence and cigarette consumption price elasticities.

§§ Data for racial/ethnic groups other than non-Hispanic whites, non-Hispanic blacks, and Hispanics were too small for meaningful analysis.

¶¶ Family income data were denominated in constant 1982–1984 dollars for all price elasticity estimates.

Cigarette Prices — Continued

**FIGURE 1. Percentage decline in smoking in response to a 10% price increase on cigarettes, by age and racial/ethnic group\* — United States, 1976–1993**

\*Data for racial/ethnic groups other than non-Hispanic whites, non-Hispanic blacks, and Hispanics were too small for meaningful analysis.

**Editorial Note:** The findings in this report indicate that lower-income and minority smokers would be more likely than other smokers to be encouraged to quit in response to a price increase and thus would obtain health benefits attributable to quitting. Other studies also have found that youth, young adults, and lower-income populations are the most price responsive (1,2,7). In this study, smokers with family incomes equal to or below the study sample median were more likely to respond to price increases by quitting than smokers with family incomes above the median (e.g., 10% quitting compared with 3% quitting in response to a 50% price increase). After controlling for income and education, Hispanics and non-Hispanic blacks are substantially more price responsive than other smokers. Data from this model suggest that Hispanic smokers were the most price responsive. Non-Hispanic black smokers would respond to price increases primarily by quitting rather than reducing the number of cigarettes smoked per day.

This study is subject to at least five potential limitations. First, because the analysis is based on pooled cross-sectional surveys, the estimates of price elasticity could underestimate the long-term response to price changes that would be observed from longitudinal surveys. Second, this analysis does not control fully for other factors unrelated to price (e.g., differences between states in social and policy environments) that could reduce demand and be confounded with the state's excise tax level. Third, because not all respondents for whom price data was available reported family income, the analysis by income categories could be less representative than other subpopulation analyses. Fourth, the sample sizes in subpopulation analyses by race and age (Figure 1) are reduced and make the estimation of price elasticities within

Cigarette Prices — Continued

specific age groups by race less stable. Nevertheless, the pattern and magnitude of the estimated parameters are consistent with those observed in previous studies, and the parameters for the control variables remained stable across models. Finally, because of the changing composition (e.g., Mexican, Cuban, or Puerto Rican) and smaller size of the Hispanic samples within the 14 NHIS samples used in this analysis, the estimates for Hispanics are subject to greater error than those for non-Hispanic blacks and non-Hispanic whites.

Comprehensive measures for promoting cessation and reducing the prevalence of smoking include increasing tobacco excise taxes, enforcing minors' access laws, restricting smoking in public places, restricting tobacco advertising and promotion, and conducting counter-advertising campaigns. Because state tax increases are more effective when combined with a comprehensive tobacco prevention and control program (8), price increases should be combined with such programs to increase the public health impact. Court settlements with several states and other market factors have resulted in the tobacco industry increasing the wholesale price of cigarettes by 12.2% since January 1997 (9). Although this and potential future industry price increases will reduce smoking prevalence and consumption—particularly among adolescents and young adults (7)—most adult smokers will continue to smoke and pay the higher cigarette prices. Tobacco-use prevention and cessation programs should be made available to benefit those populations paying the greatest share of the increased prices. Smoking prevention will always remain a primary public health objective, but public health efforts encouraging cessation particularly are needed for smokers aged ≥40 years, who would be the most likely group to continue smoking and paying the higher cigarette prices. In addition, tobacco-use prevention and cessation programs should be directed toward lower-income and minority populations in which the burden of tobacco-related disease is high (10).

#### References

1. US Department of Health and Human Services. Preventing tobacco use among young people: a report of the Surgeon General. Atlanta, Georgia: US Department of Health and Human Services, Public Health Service, 1994.
2. Congressional Budget Office. The proposed settlement: issues from a federal perspective. Washington, DC: Congressional Budget Office, April 1998.
3. Viscusi WK. Smoke and mirrors. *Brookings Rev* 1998;16:14-9.
4. Warner KE, Chaloupka FJ, Cook PJ, et al. Criteria for determining an optimal cigarette tax: the economist's perspective. *Tob Control* 1995;4:380-6.
5. Tobacco Institute. The tax burden on tobacco: historical compilation. Vol 32. Washington, DC: Tobacco Institute, 1998.
6. Pearce DW. The MIT dictionary of modern economics. 4th ed. Cambridge, Massachusetts: The MIT Press, 1994:342.
7. Evans WN, Farrelly MC. The compensating behavior of smokers: taxes, tar, and nicotine. *Rand J Econ* (in press).
8. CDC. Cigarette smoking before and after an excise tax increase and an antismoking campaign—Massachusetts, 1990–1996. *MMWR* 1996;45:966-70.
9. US Department of Agriculture. Tobacco: situation and outlook report. Washington, DC: US Department of Agriculture, Economic Research Service, April 1998. (Report TBS.)
10. US Department of Health and Human Services. Tobacco use among U.S. racial/ethnic minority groups—African Americans, American Indians and Alaska Natives, Asian Americans and Pacific Islanders, and Hispanics: a report of the Surgeon General. Atlanta, Georgia: US Department of Health and Human Services, CDC, 1998.