ORIGINAL ARTICLE

# Valuation of Tobacco Control Policies by the Public in North Carolina:
## Comparing Perceived Benefit With Projected Cost of Implementation

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**BACKGROUND** After 40 years of continuous decline, smoking rates in the United States have stabilized signaling a challenge for tobacco control. Renewed decline may be guided by public opinion where support for tobacco control is strong. This study sought the public's preferences about tobacco control strategies.

**METHODS** This contingent valuation study investigated whether the public's valuations of 2 tobacco control policies outweighed their implementation costs. In a hypothetical referendum, a representative sample of North Carolinians aged 45-64 years (n = 644) was asked to indicate whether they would prefer a policy that would halve the youth smoking rate or one that would reduce smoking-related deaths by 10%, and to indicate how much additional tax they would be willing to pay to implement their preferred policy. This willingness-to-pay value formed the perceived "benefit" component in a cost-benefit analysis. Costs to halve youth smoking were calculated from evidence about the resources required to increase the state tobacco excise tax. Costs to reduce tobacco-related deaths were based on evidence about the resources required for a counseling quitline offering free nicotine replacement therapy.

**RESULTS** The majority (85%) of respondents voted to halve the youth smoking rate. The mean maximum amount per person that voters were willing to pay in 1 year to do that was $14.90 (95% CI, $10.10-$19.60), and the maximum amount per person they were willing to pay in 1 year to reduce smoking-related deaths was $13.70 (95% CI, $2.10-$25.40). When aggregated to the North Carolina population aged 45-64 years (N = 2,400,144), the perceived benefit of halving youth smoking was $35.8 million. Implementation of a program to achieve this outcome would cost $109.8 million. Aggregating to the same population, the perceived benefit of a 10% reduction in tobacco-related deaths was $32.9 million, an amount that exceeds the $12.8 million estimated cost of achieving the outcome.

**CONCLUSION** A counseling quitline with free nicotine replacement therapy would achieve a positive net benefit.

**P**ublic support for tobacco control is strong. A proposal to deny provision of tobacco to citizens born in 2000 or later was supported by 60% of smokers and 73% of non-smokers in Singapore [1]. In England, 45% of respondents believed that the government should ban the sale of tobacco completely within 10 years [2]. Even in China, where 35% of male physicians smoke [3], and 76% of all smokers have no plan to quit [4], a 2007 study found that more than 80% of respondents supported bans on tobacco advertising and on smoking in public places [5]. Support in the United States is weaker than in countries with stronger regulations [6]. In North Carolina in 2006-2007, 70% of adults reported that they supported smoking bans at work sites, but only 52% supported smoke-free restaurants, and only 36% supported smoke-free bars [7].

It is unknown whether the public is willing to pay for tobacco control in exchange for its benefits. Public support for tobacco control in the face of stable smoking rates [8] has prompted the criticism that tobacco-control policies are out-of-step with public opinion [9].

This study quantified the direction and strength of public preferences for tobacco control using contingent valuation methodology. This methodology, based in welfare economics theory, is a form of cost-benefit analysis used for non-traded goods, such as the effects of government policy [10]. Contingent valuation presents a hypothetical scenario in which respondents choose between 2 programs and indicate how much they are willing to pay for their preferred program. The benefit to society is the sum of how much the public is willing to pay. Costs for the policies are compared with this perceived benefit. When the perceived benefit exceeds the costs, the program is deemed to have a positive net benefit.

Our first aim was to elicit preference for policies for North Carolina that, if enacted, would: (a) halve the rate of youth smoking in the state, or (b) reduce the rate of premature smoking-related deaths in the state by 10%. Our second aim was to estimate costs of feasible and realistic policies to achieve those outcomes and to determine whether either program yielded a positive net benefit.

## Materials and Methods

The biomedical Institutional Review Board of the University of North Carolina at Chapel Hill (UNC-CH) approved the study.

*Study and sampling designs.* The North Carolina County Study was a cross-sectional sample survey of North Carolina residents aged 45–64 years, which was conducted to investigate whether attributes of the counties were associated with outcomes. A target sample size of 1,000 interviews was determined based on the study's aim to detect county-level factors with odds ratios of at least 2.0 that were hypothesized to be associated with oral disorders.

Sampling was restricted to this age group because it represents the numerically large post–World War II baby boom cohort, which predated widespread introduction of the major public health interventions of the 20th century, including tobacco control and fluoridation of public water supplies.

A stratified 2-stage sampling design drew a random sample of counties and households. Where more than 1 eligible adult was present in a sampled household, the telephone interviewer sampled 1 occupant by random selection. Interviews were conducted by the Survey Research Unit at UNC-CH in 2009.

*Data collection.* Questions were pretested for comprehensibility and acceptability. The first contact by telephone allowed interviewers to explain the purpose of the study and to collect details about cigarette-smoking status, health insurance coverage, and sociodemographic characteristics. Out of 1,405 eligible households, 420 did not participate in the telephone interview, so the participation rate was 70.1%.

### Contingent Valuation Methodology

*Hypothetical scenario.* The contingent valuation was conducted by means of a questionnaire that was mailed to interviewees after the telephone interview. The questionnaire limited social desirability bias arising from contact with an interviewer and allowed participants to view the policy descriptions and payment amounts. One addressed primary prevention (preventing youth from smoking). The other addressed tertiary prevention (reducing smoking-attributable mortality in adults). The 2 policies were described in a hypothetical scenario posed as a referendum and described as follows:

Suppose a referendum is held in North Carolina this week. This referendum will enact policies that will halve the rate of smoking in youths (grades 9–12) from 22% to 11%. This means that 55,158 fewer youths aged 14–17 in North Carolina will smoke cigarettes. This will result in a substantial reduction in illness and premature deaths and a decrease in the social and medical costs of smoking-related disease.

Now suppose the same referendum offered more medical treatment for tobacco-related diseases to reduce tobacco-related deaths by 10%. Based on current figures in North Carolina for one year, this will save 1,174 lives among people aged 35 years or older.

Set aside how these policies would operate; just accept with certainty that they are effective. In this hypothetical referendum you can only vote for one of these two options.

The size of the reductions in youth smoking and smoking-related premature death were guided by evidence. The North Carolina Department of Health and Human Services reported that from 2003–2010, smoking prevalence among high school students decreased by 43% (from 27.3% to 15.5%), and among middle school students smoking prevalence decreased by 55% (from 9.3% to 4.2%) [11]. The effect of a policy on smoking-related premature death takes longer to accrue, is more modest, and is most beneficial for adults 45-60 years of age [12]. Consequently we nominated a smaller effect size of 10%. The model assumption of a linear effect of price on tobacco sales comes from economic modeling of price elasticities of demand [13]. Our own analysis showed that for each additional $0.10 in cigarette excise tax, predicted per capita sales fell 0.74 packs per month [14]. Further, consistent data exist about the additive effects of comprehensive (multiple) policy interventions, and this research applies both to adults and to youth. The effects appear to be additive rather than multiplicative [15, 16].

*Elicitation of public preferences and willingness to pay.* Participants were asked to either vote or indicate that they would not vote. Those abstaining were asked no further questions. Voters were asked whether they were willing to pay anything in extra taxation for their preferred policy. Those who were willing were asked to state the maximum in extra taxation they would be willing to pay per month over a 10-year period. A payment card presented 12 amounts that ranged from 10 cents to 10 dollars. Maximum-willingness-to-pay amounts (hereafter "benefit") were multiplied by 12 to scale values in dollars per year.

*Explanatory variables.* Characteristics of individuals were age, sex, race, socioeconomic status, cigarette-smoking status, and health insurance status. County-level variables (for the county in which the participant resided) were the proportion of the county classified as rural, the number of acres in the county that were devoted to tobacco production, and the percentage of the population of the county that was registered to vote.

*Costing.* Cost estimates for feasible and realistic interventions were based on published evidence.

*Program to halve the rate of youth smoking.* We concluded that in order to achieve the goal of halving the rate of youth smoking, 2 things would be necessary: The North Carolina state tobacco excise tax would need to be increased substantially, and the state's annual funding for tobacco control programs would need to increase to $106.8 million, the level recommended by the Centers for Disease Control and Prevention (CDC) (only $18.3 million was spent on such programs in 2011) [17, 18].

The Campaign for Tobacco-Free Kids reports that a 6.5% decline in youth smoking follows every 10% increase in price of tobacco products [18]. The price of a pack of cigarettes in North Carolina in 2010 was $4.36 [19]. Increasing the state cigarette excise tax from the current rate of $0.45 per pack [18] to $2.50 per pack would have increased the

price of a pack to $6.86, an increase of 57.3%. This would be expected to decrease youth smoking by 37.2% (5.73 × 6.5%). In 2008 there were 417,168 high school students in North Carolina (aged 14-17 years old) [20], 79,262 (19%) of whom smoked [21]. A 37.2% decrease in that number would mean that 29,541 fewer high school students smoked. We used this number for costing estimates as this was the actual number at the time of the cost calculation. Using the real number in the cost calculation ensures that we do not over-estimate cost-savings by overstating the number that had quit. We also conservatively used only students rather than all youth this age. Based on data from the Robert Wood Johnson Foundation's SmokeLess States National Tobacco Policy Initiative [22], we estimated that a campaign to raise the excise tax by $2.50 would require lobbying, media campaigns, community surveys, direct mail, and paid staff at a minimum cost of $3 million.

Research on the relation between state spending on tobacco control and the prevalence of youth smoking [23] suggests that spending the CDC-recommended amount ($106.8 million) on a targeted comprehensive program would produce a 14.4% decrease in the number of youths who smoke, resulting in 11,414 fewer high school smokers (79,262 × 14.4%). This targeted program and the increase in the excise tax of $2.50 together would decrease North Carolina youth smoking by 51.7% (resulting in 40,955 fewer youth smokers), at a total cost of $109.8 million. Data indicate that these 2 measures would act in concert to achieve the desired outcome [15, 16].

*Policy to increase medical care to reduce the rate of tobacco-related deaths by 10%.* We projected that establishment of expanded quitline services with greater promotion and free nicotine replacement therapy for 1 year would save the lives of 1,174 adults 35 years of age or older. Three assumptions underpinned this estimate. First, we assumed that increasing promotional expenditure for QuitlineNC, an existing program that provides free cessation services to any North Carolinian trying to quit tobacco, would increase call volume to levels comparable with those achieved by additional spending on quitline services in New York, as reported by Farrelly and colleagues [24]. Second, we assumed that adding free nicotine replacement therapy to quitline services would double call volume, as happened in Oregon when free nicotine patches were offered there, according to Fellows and colleagues [25]. Finally, we assumed that the lives of 72% of those who quit would be saved, and that 28% of those who quit would nevertheless die prematurely from smoking related-illness [26, 27].

In 2008, there were 4,860,711 North Carolinians age 35 years or older [28], and 20.9% of the adult population of the state smoked [29], so there were 1,015,888 smokers in that age group. QuitlineNC data for the year 2008-2009 show that with a media campaign, the QuitlineNC call volume during that period for adults 35 years of age or older was 3,661 (approximately 0.36% of smokers in that age group) [29].

A 2007 study of the New York smokers' quitline [24] demonstrated that increases in expenditure for television and radio advertising of 0.87% and 153%, respectively, increased call volume by 0.1% and 5.7%, respectively—figures that were arrived at by multiplying the percentage increase by an elasticity figure (.151 for television advertising, and .037 for radio advertising) accounting for the effectiveness of the particular medium in increasing call volume [24]. Using those elasticity figures, we projected that increasing television spending by 425% would increase call volume by 64% (.151 × 425%) and that increasing radio spending by 500% would increase call volume by 18.5% (.037 × 500%), for an average increase in call volume of 41%, resulting in a new call volume of 0.51% (0.36% × 1.41). We projected that adding free nicotine replacement therapy would then double that new 0.51% rate to 1.02%. The new call volume would then be 10,362 callers (1,015,888 × 1.02%). Combining the behavioral counseling already offered by the quitline with the provision of free nicotine replacement therapy would increase the average long-term quit rate from to 16% (which is the mean quit rate from 6 treatments) [25]. So 1,658 (16%) of those 10,362 callers could be expected to quit. Although 28% of those who quit would nevertheless die prematurely of tobacco-related illness, the premature deaths of the remaining 1,194 (1,658 × 72%) would be prevented [26, 27]. During 2005-2009, an estimated 13,000 North Carolinians died each year from tobacco-related illness [30], so the 1,194 lives saved would represent a reduction of approximately 9.2% in that number—close to the size of the 10% reduction called for in the scenario.

Cost calculations are based on the cost of 2008-2009 QuitlineNC media buys and on cost-per-caller estimates. In 2008-2009, 66% of a media buy of $1.61 million was spent on television advertising and 34% on radio advertising. Increasing television and radio spending by 425% and 500%, respectively, would result in a 4.5-fold increase in spending, from $1.61 million to $7.25 million. Additional expenditures would be needed for increased provision of services concomitant with increased use of QuitlineNC. Based on an analysis of QuitlineNC expenditures for 2008-2009 by McCullough and Ramney [31, 32], we estimate that, when these additional expenditures are combined with media campaign costs, they would amount to $296.56 per caller; multiplied by 10,362 callers, the expenditures would total $12,103,023.24 million. In addition, it would cost $125 per caller to provide an 8-week supply of free nicotine replacement therapy to those interested in using it. Based on research on interest among smokers in free nicotine replacement therapy by Cunningham and Selby [33], we project that 55.2% of callers (5,725) would choose it, at a cost of $719,602. So the total cost of the program would be $12,818,625—approximately $12.8 million.

*Analytic methods.* Sample weights took account of the sampling probability with adjustment for nonresponse. The complex survey design was taken into account in STATA

SE 12.0 software to produce correct variance estimates with Taylor series linearization methods. Poststratification adjustments were made to improve the representativeness of age, race, and education characteristics using 2007 American Community Survey data from the US Census Bureau [34] as the calibration population.

Bivariate associations of categorical variables were tested for statistical significance with the Pearson chi-square test. A multivariable analysis using binary logistic regression produced odds ratios for adjustment for potential confounders. To ascertain the robustness of the benefit estimates, a sensitivity analysis assumed that the true benefit could be as low or as high as the lower or upper limits of the 95% confidence interval for the mean maximum benefit. Linear multiple regression identified characteristics associated with maximum benefit; this was done separately for each of the 2 programs.

## Results

Of the 985 interviewees, 644 returned a completed questionnaire (response rate=78.6%). Among these, smoking

**TABLE 1.**

**Associations of Selected Variables With Decision to Vote and With Tobacco-Control Policy Preference of Questionnaire Respondents (North Carolina Adults Aged 45-64 Years), 2009**

| Characteristic of participant | No. of survey respondents (% in population) | % who voted | P-value[a] | % who favored policy to reduce youth smoking rate weighted/ unweighted | % who favored policy to reduce deaths from smoking weighted/ unweighted | P-value[a] |
|---|---|---|---|---|---|---|
| All participants | 644 (100.0) | 76.7 | | 84.9 | 15.1 | |
| **Sex** | | | | | | |
| Male | 221 (34.5) | 90.4 | 0.107 | 76.4 | 23.6 | 0.241 |
| Female | 423 (65.5) | 72.4 | | 90.5 | 9.5 | |
| **Age in years** | | | | | | |
| 45-54 | 310 (52.2) | 80.7 | 0.778 | 90.6 | 9.4 | 0.257 |
| 55-64 | 334 (48.8) | 76.3 | | 78.4 | 21.6 | |
| **Race** | | | | | | |
| White | 553 (72.5) | 82.6 | 0.384 | 92.2 | 7.8 | 0.017 |
| African American or Black | 69 (19.7) | 63.3 | | 62.3 | 37.7 | |
| Other | 22 (7.8) | 79.7 | | 59.8 | 40.2 | |
| **Highest level of educational attainment** | | | | | | |
| ≤ High school diploma | 160 (32.5) | 58.1 | | 73.1 | 26.9 | 0.267 |
| College, 1-3 years | 202 (32.0) | 84.9 | | 87.2 | 12.9 | |
| College, ≥4 years | 282 (35.5) | 91.8 | 0.017 | 89.9 | 10.1 | |
| **Household income** | | | | | | |
| <$35,000 | 139 (25.3) | 64.7 | | 91.2 | 8.8 | 0.490 |
| $35,000-$74,999 | 211 (33.7) | 80.4 | | 79.4 | 20.6 | |
| ≥$75,000 | 241 (41.0) | 96.7 | 0.008 | 85.0 | 15.1 | |
| Missing | 53 | | | | | |
| **Cigarette-smoking status** | | | | | | |
| Current | 89 (20.1) | 85.0 | 0.164 | 69.9 | 30.1 | 0.082 |
| Former | 183 (16.7) | 92.1 | | 92.7 | 7.3 | |
| Never | 372 (63.3) | 73.1 | | 87.8 | 12.2 | |
| **Health insurance status** | | | | | | |
| Uninsured | 79 (13.4) | 80.9 | 0.853 | 94.3 | 5.7 | 0.135 |
| Insured | 565 (86.6) | 78.3 | | 83.4 | 16.6 | |
| **Proportion of county of residence that is rural** | | | | | | |
| <50% rural | 350 (46.5) | 92.3 | 0.002 | 93.6 | 6.4 | 0.029 |
| ≥50% rural | 294 (53.5) | 66.8 | | 74.5 | 25.5 | |
| **No. of acres devoted to tobacco production in county of residence** | | | | | | |
| < 2000 acres | 373 (49.7) | 85.9 | 0.224 | 94.6 | 5.4 | 0.011 |
| ≥ 2000 acres | 271 (50.3) | 71.4 | | 73.5 | 26.5 | |
| **Proportion of population registered to vote in county of residence** | | | | | | |
| <80% | 149 (21.7) | 82.7 | 0.673 | 84.1 | 15.9 | 0.939 |
| ≥80% | 495 (78.3) | 77.5 | | 85.1 | 14.9 | |

All of the percentages in this table have been weighted to take account of sampling probability with adjustment for nonresponse.
[a]P-values were determined using Pearson's chi-square test.

prevalence for whites (20.3%) and African Americans and blacks (24.4%) closely approximated 2008 US estimates of 22.0% and 21.3% for non-Hispanic whites and non-Hispanic blacks respectively [35].

*Characteristics of voters.* The 76.7% of respondents who voted (Table 1) were more likely than were nonvoters to have a college education, to have an annual household income of $75,000 or more, and to live in predominantly urban counties (P < 0.05). The decision to vote was not associated with sex, age, race, smoking status, health insurance status, number of acres devoted to tobacco production in the participant's county of residence, or the proportion of the population of the participant's county of residence that was registered to vote. A clear majority (84.9%) of those who voted preferred the program that would halve youth smoking (Table 1).

*Willingness to pay: the benefit.* Of those who voted, 60.1% were willing to pay at least $0.10 per month of additional tax to fund their preferred program (Table 2). More than half (55.1%) of those favoring a policy to reduce youth smoking were willing to pay that much, and 88.1% of those who favored a policy to reduce smoking-related deaths were willing to pay that much (Table 3).

After adjustment for age, sex, household income, smoking status, and rural density of county of residence, nonwhites were more likely than whites to state that they were willing to pay (Table 4). In addition, for each 20% increase in the proportion of the county that was rural (based on population density), the odds of being willing to pay increased 60%.

The mean perceived benefit (the sum of each person's maximum-willingness-to-pay amount) was similar for the 2 programs after a value of $0.00 was imputed to the 44.9% who were unwilling to pay for the policy to reduce youth smoking and the 11.9% who were unwilling to pay for the program to reduce tobacco-related deaths. Specifically, the mean perceived benefit of the policy to reduce youth smoking was $14.90 per year (95% CI, $10.10-$19.60), and the mean perceived benefit of the policy to reduce smoking-related deaths was $13.70 per year (95% CI, $2.10-$25.40) (Table 3). No sociodemographic factor was associated with the level of perceived benefit of the policy for reducing youth smoking. Greater rural density and lower household income were associated with higher perceived benefit for the policy reducing smoking-related deaths (results not tabulated).

*Costs.* Aggregated to the 2009 North Carolina population aged 45-64 years (n = 2,400,144), the estimated perceived benefit for the policy to halve youth smoking was $36 million, which is approximately one-third of the projected implementation cost of $109.8 million for a policy to reduce youth smoking by 51.7%, representing a perceived benefit-to-cost ratio of 0.3:1. Based on our assumptions of a linear effect of expenditures on health outcomes, we expect that a $36 million investment in youth smoking programs would therefore reduce youth smoking by approximately one-third

of 51.7%—that is, by 17%. Given the lower and upper limits of the 95% confidence interval for the mean amount participants were willing to pay, the perceived benefit could be as little as $24 million or as much as $41 million. Aggregating to the same population (those aged 45-64 years), the mean perceived benefit of $33 million for a reduction in tobacco-related deaths of 1,174 deaths would exceed the $12.8 million cost of reducing the risk of tobacco-related death with a program of increased quitline promotion and free nicotine replacement therapy. This represents a perceived benefit-to-cost ratio of 2.6:1. Given the lower and upper limits of the 95% confidence interval for the mean amount participants

**TABLE 2.**

**Percentage of All Voting Participants (n=304) Who Were Willing to Pay at Least $0.10 per Month in Taxes for Their Preferred Tobacco-Control Policy**

| Characteristic of participant | % willing to pay $0.10 or more per month for preferred tobacco-control policy weighted | P-value[a] |
|---|---|---|
| **All** | 60.1 | |
| **Sex** | | |
| Male | 50.0 | 0.239 |
| Female | 67.0 | |
| **Age in years** | | |
| 45-64 | 65.3 | 0.376 |
| 55-64 | 54.2 | |
| **Race** | | |
| White | 52.7 | 0.007 |
| African American or black | 88.0 | |
| Other | 75.4 | |
| **Highest level of educational attainment** | | |
| ≤ High school diploma | 75.5 | 0.159 |
| College, 1-3 years | 54.5 | |
| College, ≥4 years | 55.8 | |
| **Household income** | | |
| <$35,000 | 74.3 | 0.268 |
| $35,000-$74,999 | 60.5 | |
| ≥$75,000 | 52.2 | |
| **Cigarette-smoking status** | | |
| Current | 65.1 | 0.786 |
| Former | 55.0 | |
| Never | 60.0 | |
| **Health insurance status** | | |
| Uninsured | 69.1 | 0.528 |
| Insured | 58.7 | |
| **Proportion of county of residence that is rural** | | |
| <50% rural | 47.1 | 0.011 |
| ≥50% rural | 75.4 | |
| **No. of acres devoted to tobacco production in county of residence** | | |
| < 2000 acres | 49.7 | 0.026 |
| ≥ 2000 acres | 72.9 | |
| **Proportion of population registered to vote in county of residence** | | |
| <80% | 60.3 | 0.992 |
| ≥80% | 60.1 | |

[a]P-values were determined using Pearson's chi-square test.

**TABLE 3.**
**Maximum Willingness to Pay (WTP) Overall and for Each Type of Tobacco-Control Policy**

| | WTP Overall | WTP of those favoring a policy to halve youth smoking | WTP of those favoring a policy to reduce deaths from smoking |
|---|---|---|---|
| % of voters (n=304) who were willing to pay | 60.1% | 55.1% | 88.1% |
| **Mean amount per year that those willing to pay more than $0.00 were willing to pay** | | | |
| Mean amount (95% CI)[a] | $23.7 ($16.0-$31.5) | $26.2 ($18.8-$33.6) | $15.2 ($0.5-$29.9) |
| 25 percentile | $6.0 | $12.0 | $3.0 |
| 50 percentile | $12.0 | $12.0 | $3.0 |
| 75 percentile | $30.0 | $24.0 | $30.0 |
| **Mean amount per year that all voters were willing to pay, imputing $0.00 for those unwilling to pay anything** | | | |
| Mean amount (95% CI)[a] | $14.70 ($10.10-$19.30) | $14.9 ($10.1-$19.6) | $13.7 ($2.1-$25.4) |
| 25 percentile | $0.0 | $0.0 | $1.2 |
| 50 percentile | $3.0 | $3.0 | $3.0 |
| 75 percentile | $18.0 | $18.0 | $30.0 |

[a]CI, confidence interval.

were willing to pay, the perceived benefit could be as little as $5 million or as much as $61 million.

## Discussion

*Key findings.* This is the first contingent valuation survey to investigate the public's preferences for tobacco control policies and the first to estimate the perceived net benefits of such programs. Although the policy to halve youth smoking was the clear preference of the majority, only half of voters were willing to pay more in personal taxes to achieve it. In contrast, 88% of voters were willing to pay for policies to reduce smoking-related deaths by 10%. We calculated the cost of policies to achieve these outcomes and found that the amount spent to decrease smoking-related premature loss of life by 1,174 deaths among smokers was less expensive than the amount that would need to be spent to halve the rate of youth smoking. The establishment and promotion of a quitline service offering free nicotine replacement therapy along with counseling would cost $12.8 million. The mean maximum perceived benefit (the amount the public was willing to pay in 1 year) exceeded those costs of implementation by a ratio of 2.6:1, revealing a positive perceived net benefit.

The amount the public was prepared to pay in 1 year to halve the rate of youth smoking was approximately one-third of the cost of policy implementation. We calculated that to halve the youth smoking rate, the North Carolina state tobacco excise tax would need to increase substantially, and state funding for tobacco-control programs would need to increase to the level recommended by the CDC.

It is cheaper to induce quitting for a small number of adults than it is to reduce smoking by a large number of adolescents. However, the actual return on investment

from substantial declines in youth smoking are far greater than the much smaller return on investment from smaller declines in smoking by adults. Thus the public's willingness to pay likely does not reflect a full understanding of the actual economic benefits of the programs. Still, this information is helpful in understanding why certain public health policies may receive more support from the public or from those who make health policy decisions with insufficient knowledge.

One factor possibly explaining the weaker support of racial minorities for a reduction in youth smoking is that African Americans initiate smoking at an older age than do whites [36-39]. African Americans adolescents smoke fewer cigarettes than their white peers and are less likely to be regular smokers [37, 40]. Consequently, youth smoking may be of less concern to this group.

*Other studies.* The contingent valuation method has been applied in several public health settings to value such diverse benefits as a reduction heart in attack risk [41], a reduction in childhood obesity [42], a reduction in dental caries [43], a reduction in the number of babies born with neural tube defects [44], and a reduction in severity of injuries from road traffic accidents involving motorcycle users [45]. As was the case in our study, in each of these studies, not all respondents were at risk of the condition and therefore not all stood to benefit personally.

*Interpretation.* Despite the fact that in our study the number of respondents preferring primary prevention was greater than the number preferring tertiary prevention, fewer supporters of the primary prevention program were willing to pay for it. One interpretation is that although it is easy to describe youth smoking as a problem, once respondents were confronted with a hypothetical tax burden, few

**TABLE 4.**

**Multivariable Binary Logistic Regression Results Modeling Odds of Being Willing to Pay at Least $0.10 per Month for Either Tobacco-Control Policy**

| Participant characteristic | Odds ratio (95% CI)[a] |
|---|---|
| Male sex | Reference case |
| Female sex | 2.1 (0.6-7.4 ) |
| Age in years | 0.9 (0.8-1.0) |
| White race | Reference case |
| Nonwhite | 6.3 (2.6-15.3) |
| Household income <$35,000 | Reference case |
| Household income $35,000-<$75,000 | 0.6 (0.2-2.0) |
| Household income U$75,000 | 0.7 (0.2-2.2) |
| Current smoker | Reference case |
| Former smoker | 1.3 (0.4-3.7) |
| Never smoked | 1.1 (0.5-2.5) |
| Rural density of county of residence (quintiles)[b] | 1.6 (1.2-2.1) |

Note. Unweighted n = 505 people who voted.
[a]CI, confidence interval.
[b]For each 20% increase in the proportion of the county that was rural, the odds of being willing to pay increased 60%.

of them felt strongly enough to pay for their convictions. If this interpretation is correct, the apparent support for the youth program may have been inflated by social desirability bias. The implication for tobacco control is that if the goal is to maximize net perceived benefit, the greatest gain will come from the program designed to reduce smoking-related loss of life through counseling and free pharmacotherapy, based on the valuations of these people aged 45-64 years, a numerically large age group.

## Strengths and Limitations

Our study complied with the recommendations for use of contingent valuation methodology. We used a referendum approach, asked about willingness to pay for a policy with higher taxes, and ascertained maximum willingness to pay. We used a payment card for eliciting valuations. Unlike the iterative bidding approach [46], which starts at an initial monetary value and adjusts it until the respondent's maximum willingness to pay is reached, the payment card is not prone to starting-point bias [47].

We did not discount costs, because both programs were calculated to be fully funded in 1 year. Neither did we discount perceived benefit, because few data exist on which to base a valid assessment. Although on face value, the public preferred a policy to reduce youth smoking, we cannot be certain how sensitive this preference was to the magnitude of nominated health benefits. For instance, what might be the effect on preferences if a referendum specified a 10% reduction in youth smoking and a 20% reduction in rate of tobacco-related deaths? What would occur if we told the participants about the number of lives that would be saved by the large reduction in youth smoking? These questions can and should be the focus of additional work that can seek to better understand

how the public perceives health benefits and what influences their willingness to pay for those benefits.

Nonetheless, this study revealed that although respondents preferred to reduce youth smoking, they placed an approximately equal value on treatment to reduce tobacco-related deaths. Future research could investigate whether the choice of intervention influences public preferences. Finally, we assumed that the overall sustained quit rates from quitline promotions and services combined with free nicotine replacement therapy would result in sustained quit rates of 16%. Despite some relapse among those who quit during the course of a year, this projected overall quit rate is consistent with published data and is probably conservative.

These valuations are informative for policymakers who are considering how best to allocate scarce resources. In addition, the probability sample allows valuations to be generalized to all North Carolinians aged 45-64 years, not just to smokers or to users of a health care program.

The age-restricted sample limits the generalizability of our findings. We weighed this limitation against the potential of confounding by age inherent in sampling adults of all ages and decided that reduced generalizability was the lesser limitation. Values about smoking are shaped by social context and historical experience. This cohort began smoking at a time before the health hazards were widely recognized, and well before cigarette advertising was banned on television and radio and current social norms about the undesirability of smoking were established. Our conclusion that there would be a positive net perceived benefit for the program to reduce smoking-related deaths is dependent upon the interventions used in costing the program. For example, costs for surgical revascularization treatments to reduce an equivalent number of deaths from coronary heart disease in smokers would far exceed the costs of smoking cessation used here, creating a negative net benefit.

## Conclusion

This study is the first of its kind, and so its conclusions must be interpreted with caution until future studies provide more evidence to substantiate or refute these findings. Policy preference may be sensitive to the magnitude of the change proposed, and this effect may overshadow the focus of the policy. In addition, different age groups may express quite different valuations.

In this study, the ratio of perceived benefit-to-cost ratio for the program to halve youth smoking was 0.3:1, and the perceived benefit-to-cost ratio for the program to reduce the rate of tobacco-related deaths was 2.6:1. When costed using a counseling quitline with free nicotine replacement therapy, it achieved a positive perceived net benefit. **NCMJ**

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KNOW THE FACTS ABOUT

# High Cholesterol

## What is high cholesterol?

Cholesterol is a waxy, fat-like substance that your body needs. But, when you have too much in your blood, it can build up on the walls of your arteries. This can lead to heart disease and stroke—leading causes of death in the United States.[1]

## Are you at risk?

About one in every six adult Americans has high cholesterol.[2] Anyone, including children, can develop it.

Several factors that are beyond your control can increase your risk. These include your age, sex, and heredity. But, there are some risk factors that you can change. Examples include eating an unhealthy diet, being overweight, and not getting enough exercise.

## What are the signs and symptoms?

High cholesterol itself does not have symptoms. Many people do not know that their cholesterol level is high. That's why it's important to schedule regular visits with your doctor. Be sure to ask about having your cholesterol tested.

## How is high cholesterol diagnosed?

Doctors can do a simple blood test to check your cholesterol. Most adults should get their cholesterol levels checked every five years. If your total cholesterol is 200 mg/dL* or more, or if your HDL (good cholesterol) is less than 40 mg/dL, you will need to have a lipoprotein profile blood test done. Ask your doctor about what may be right for you.

## What levels of cholesterol are healthy?

|  | Desirable Levels |
|---|---|
| Total cholesterol | Less than 200 mg/dL* |
| LDL ("bad" cholesterol) | Less than 100 mg/dL |
| HDL ("good" cholesterol) | 40 mg/dL or higher |
| Triglycerides | Less than 150 mg/dL |

* Cholesterol levels are measured in milligrams (mg) of cholesterol per deciliter (dL) of blood.

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National Center for Chronic Disease Prevention and Health Promotion
Division for Heart Disease and Stroke Prevention

CDC