

Perceptions of Smoking-Related Risks and Benefits as Predictors of Adolescent Smoking Initiation

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Tobacco use is the leading cause of preventable deaths in the United States. Tobacco use causes approximately 440 000 deaths annually, which is twice the number of deaths attributed to alcohol, homicide, illicit drug use, and suicide combined.¹ There are more than 60 million daily smokers in the United States.² Each year, approximately 1 million additional people become daily cigarette users, 44.2% of whom are younger than 18 years.² Every day, more than 4000 adolescents aged 12 to 17 years try their first cigarette, and 1300 of them go on to become daily smokers.² Given these statistics, it is clear that preventing initiation of tobacco use among adolescents is crucial to reducing adult-onset disease and mortality.

A prominent explanation for adolescent smoking is that adolescents have poor decision-making and risk-judging skills, leading them to believe they are invulnerable to harm.^{3,4} This explanation is consistent with major theories of health behavior, including decisional balance theory, the health belief model, and the theory of planned behavior.⁵⁻⁹ These theories serve as the basis for many tobacco-use intervention programs that aim to decrease initiation and increase cessation by giving adolescents information about tobacco risks.¹⁰ However, it is unclear whether the practice of communicating tobacco-related risk information to adolescents is evidence-based, because most of the research providing evidence to support this strategy is based on cross-sectional data. Cross-sectional research has shown that adolescents who smoke perceive tobacco-related risks to be lower than do adolescents who have not smoked,¹¹⁻¹³ adolescents' perceptions of tobacco-related benefits play a role in smoking,¹⁴⁻¹⁶ and adolescents who have smoked perceive more tobacco-related benefits than do adolescents who have never smoked.^{16,17}

Only 2 studies have used longitudinal data to examine whether perceptions of risks actually predict future tobacco use. One of these studies found that the belief that smoking is generally risky to one's health predicted levels

of 30-day smoking 1 year after high school.¹⁸ The other study used data collected over 3 years to demonstrate that the belief that cigarettes cause cancer or heart disease deters smoking onset.¹⁹ No studies have been conducted to determine whether beliefs about different types of harm—namely, short-term risks like smelling bad, developing a cough, or having shortness of breath—influence adolescent smoking. Moreover, no longitudinal research has included perceptions of tobacco-related risks and perceptions of tobacco-related benefits in a single analysis examining their impact on smoking.

We conducted a prospective, longitudinal study to test whether adolescents' perceptions of smoking-related risks or benefits predicted smoking initiation. We also tested whether there was a difference in predictive value between perceived short-term risks and perceived long-term risks, and whether there was a difference in predictive value between perceived risks and perceived benefits. We gathered data by administering surveys to 395 adolescents, beginning in the fall semester of ninth grade and continuing with follow-up surveys every 6

months until the spring semester of 10th grade, obtaining 4 waves of data.

METHODS

Participants

Participants were 395 adolescents (46.8% boys, 53.2% girls); mean age at baseline was 14 years (SD=0.40 years). The sample was ethnically diverse, with 52.0% describing themselves as White/non-Hispanic, 24.2% as Asian/Pacific Islander, 18.5% as Hispanic or Latino, 1.9% as African American, and 3.4% as other.

Of the 395 participants, 49 had started smoking before the start of the study. To test the research questions set forth in this study, we needed assessments of perceived risks and benefits prior to initiation of smoking, but for these 49 participants, such assessments were not possible. Therefore, these 49 participants were eliminated from further analyses, resulting in a total of 346 adolescents included in the study.

Objectives. We used prospective, longitudinal data to directly test whether smoking-related perceptions predict smoking initiation among adolescents.

Methods. We administered surveys assessing perceptions of smoking-related risks and benefits to 395 high school students, beginning at the start of their ninth-grade year. We conducted follow-up assessments every 6 months until the end of 10th grade, obtaining 4 waves of data.

Results. Adolescents who held the lowest perceptions of long-term smoking-related risks were 3.64 times more likely to start smoking than were adolescents who held the highest perceptions of risk. Adolescents who held the lowest perceptions of short-term smoking-related risks were 2.68 times more likely to initiate smoking. Adolescents who held the highest perceptions of smoking-related benefits were 3.31 times more likely to initiate smoking.

Conclusions. Smoking initiation is directly related to smoking-related perceptions of risks and benefits. Efforts to reduce adolescent smoking should continue to communicate the health risks of smoking and counteract perceptions of benefits associated with smoking. (*Am J Public Health.* 2009;99:487-492. doi: 10.2105/AJPH.2008.137679)

Procedures

Study participants were recruited from 2 public high schools (school A in 2001–2002 and school B in 2002–2003) in northern California. Researchers visited ninth-grade classes, described the study to the students, invited them to participate, and distributed study information, parental consent forms, and student assent forms to all students. Of the 790 students who received consent packets (302 at school A and 488 at school B), 418 (53%) returned completed consent forms (79.5% of eligible students at school A and 36.5% of those at school B). Of these 418 students, 395 (94.5%) completed the baseline survey, for an overall response rate of 50% (75.5% response rate from school A and 34.2% response rate from school B). There were no significant differences between the 2 schools in terms of the patterns of results. Consequently, results are reported for the total sample, aggregated across both schools.

Every 6 months during ninth and tenth grades (once in each fall semester and once in each spring semester), participants completed questionnaires during a regular class period at their school. Before each survey administration, researchers provided instructions for the surveys and remained available to answer questions during the survey.

Measures

Smoking behavior. Participants were asked whether they had ever “smoked a whole cigarette.” Responses were coded dichotomously (0=no; 1=smoked a whole cigarette).

Perceptions of smoking-related risks and benefits. Participants were asked to estimate their chances of experiencing various smoking-related negative consequences and benefits. All of the chance estimates relied on conditional assessments of the risks and potential benefits associated with a specified behavior, namely smoking 2 to 3 cigarettes. (We preferred this methodology over unconditional assessments in which no behavioral antecedent is provided.²⁰) Participants were presented with a short scenario in which they themselves were hypothetically smoking: “Imagine that you just began smoking. You smoke about 2 or 3 cigarettes each day. Sometimes you smoke alone, and sometimes you smoke with friends.”

Participants estimated the chance (from 0% to 100%, specified by the participant) that, in the given hypothetical scenarios, they would personally experience each of the following smoking-related negative consequences and benefits: looking cool, getting into trouble, feeling relaxed, smelling like an ashtray, getting a bad cough, having trouble breathing, becoming popular, having bad colds, looking grown-up, having bad breath, getting lung cancer, having a heart attack, getting a chronic cough, having chronic trouble breathing, and getting facial wrinkles.

To reduce these 15 questions to meaningful categories, we factor analyzed the items by means of principal component extraction with Varimax rotation. This analysis revealed 3 underlying factors: perceived likelihood of long-term risks, perceived likelihood of short-term risks, and perceived likelihood of social benefits. Perceived long-term risks included items describing physical problems caused by habitual smoking: getting lung cancer, having a heart attack, getting a chronic cough, having chronic trouble breathing, and getting wrinkles. Perceived short-term risks included getting into trouble, smelling like an ashtray, getting a cough, having trouble breathing, getting colds, and having bad breath. Perceived social benefits included looking cool, feeling relaxed, becoming popular, and feeling grown-up. We computed composite scores for perceptions of long-term risks, short-term risks, and benefits by averaging items that loaded onto each of the 3 factors. For ease of interpretation and discussion, we converted these scores into quartile scores coded as 0 for the first quartile and 3 for the fourth quartile.

Statistical Analysis

In general, previous studies have measured and analyzed perceptions and behaviors at concurrent data points, which does not allow one to test the predictive relationship between perceptions and behavior.²¹ If smoking onset occurred, the actual behavior happened before the time of measurement, but reported perceptions are participants’ estimates of likelihood at the time of measurement. To address whether perceptions are predictive of initiation, we needed to use perceptions measured before the time point at which the behavior occurred. In the current study, we employed a

prediction-structured dataset, whereby preinitiation perceptions were created from perceptions recorded at the time point prior to the first time point when they reported smoking a whole cigarette. Among adolescents who did not initiate during the course of the study, perceptions recorded at baseline were used. Once preinitiation perceptions were isolated, we used factor analysis to reduce items into meaningful categories (as described in the “Methods” section).

We used univariate and multivariate logistic regression to examine the relationship between smoking a whole cigarette as a dependent variable and perceptions of long-term risks, short-term risks, and benefits measured in the immediately preceding wave as independent variables. The multivariate logistic regression represents a model that includes all 3 perceptions entered simultaneously. Logit plots were created for each perception variable to test for a linear relationship between perceptions and the logit of smoking a whole cigarette. When the relationship was linear, the variables were treated as continuous predictors. This analysis showed that perceptions of long-term risks, short-term risks, and benefits, measured as quartiles, were related to smoking initiation in a linear fashion. Therefore, we treated the quartile scores of perceptions as continuous variables, rather than categorical variables. We confirmed the results of our primary analysis by means of discrete-time survival analysis, applying a multivariate logistic regression to a person-period dataset, which showed the same results.²² For ease of presentation, we present the results of application of our logistic regression model to the prediction-structured dataset. We used SPSS 15.0 (SPSS Inc, Chicago, IL) to conduct all calculations.

RESULTS

Tobacco Use

Of the 346 adolescents included in the analyses, 20.4% of the sample had smoked a whole cigarette by the end of 10th grade. The proportion of initiation from wave 2 through wave 4 was relatively equally distributed, with 7.2% initiating at the end of ninth grade, 6.6% initiating at the beginning of 10th grade, and 6.6% initiating at the end of 10th grade.

Perceptions of Smoking-Related Risks and Benefits

Figures 1 to 3 show histograms of chance estimates (0%–100%) for smoking-related long-term risks, short-term risks, and benefits as reported by the participants. On average, respondents believed that there was a 78.76% (SD=18.25%) chance that long-term negative consequences would occur if they smoked cigarettes. No respondent believed that smoking was free of long-term risks. The first quartile of Figure 1 represents estimates of the likelihood of experiencing long-term negative consequences that are from 20% to 69%; the second quartile, 70% to 83%; the third quartile, 84% to 93%; and the fourth quartile, 94% to 100%.

On average, respondents believed that there was a 78.22% (SD=18.10%) chance that short-term negative consequences would occur if they smoked. Some respondents did perceive no chance of short-term negative consequences occurring. The first quartile of Figure 2 represents estimates of the likelihood of experiencing short-term negative consequences that are from 0% to 68%; the second quartile, 69% to 81%; the third quartile, 82% to 91%; and the fourth quartile, 92% to 100%. Respondents

generally believed that smoking-related benefits were less likely to occur than were smoking-related negative consequences, and many respondents believed there was no chance of benefits occurring if one smoked. On average, respondents believed there was a 24.44% (SD=21.27%) likelihood that benefits would occur if they smoked. The first quartile of Figure 3 represents estimates of the likelihood of experiencing smoking-related benefits that are from 0% to 7%; the second quartile, 8% to 20%; the third quartile, 21% to 37%; and the fourth quartile, 38% to 100%.

Perceptions of Smoking-Related Risks as Predictors of Smoking Initiation

Univariate analysis revealed that adolescents who perceived high long-term smoking-related risks were less likely to initiate tobacco use (Table 1). The unadjusted odds of smoking a whole cigarette decreased by a factor of 0.56 for each quartile increase in perceptions of long-term risk. This decrease in odds corresponded to unadjusted odds ratios of 0.56, 0.31, and 0.18 for the second, third, and fourth quartiles, respectively. The adjusted odds of smoking a whole cigarette decreased by a

factor of 0.65 for each quartile increase in perceptions of long-term risks. This decrease in odds corresponded to odds ratios of 0.65, 0.42, and 0.28 for the second, third, and fourth quartiles, respectively. The inverse of these odds ratios represents a comparison between the adolescents who reported the lowest estimates of risk (first quartile) and adolescents who held higher estimates of risk (second, third, and fourth quartiles). Compared with the second quartile, adolescents in the first quartile were 1.54 times more likely to start smoking. Likewise, in comparison with adolescents in the third and fourth quartiles, adolescents in the lowest quartile were respectively 2.37 and 3.64 times more likely to start smoking.

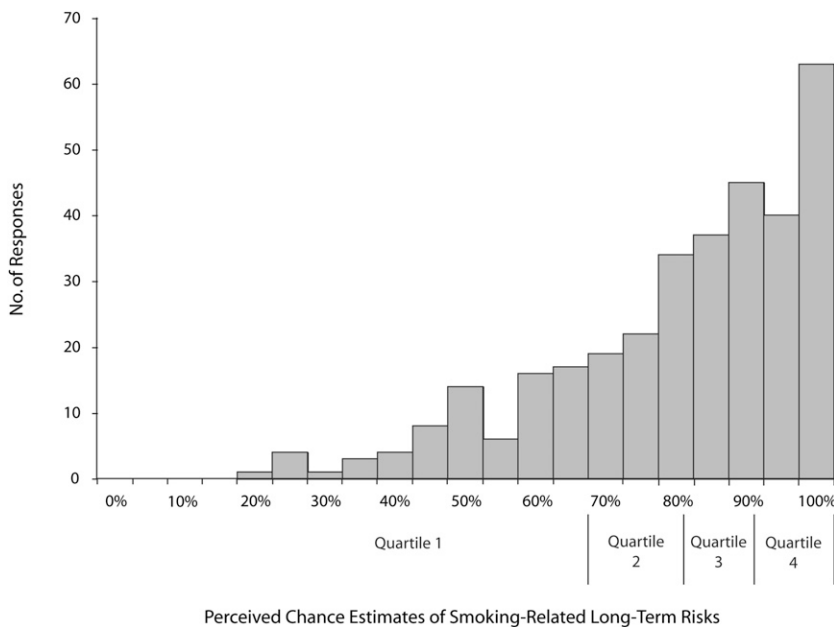
Perceptions of short-term risks also significantly predicted smoking initiation (Table 1). The unadjusted odds of smoking decreased by a factor of 0.55 for each quartile increase in perceptions of short-term risk. The corresponding odds of initiating tobacco use for the second, third, and fourth quartiles were 0.55, 0.30, and 0.17, respectively. The adjusted odds of smoking a whole cigarette decreased by a factor of 0.72 for each quartile increase in perceptions of short-term risks. This translated to odds of 0.72, 0.52, and 0.37 for smoking a whole cigarette for the second, third, and fourth quartiles of perception of short-term risk. Compared with adolescents in the second, third, and fourth quartiles, adolescents in the first quartile were 1.39, 1.93, and 2.68 times more likely to start smoking.

Perceptions of Smoking-Related Benefits as Predictors of Smoking Initiation

Adolescents who believed that smoking-related benefits were likely to occur were significantly more likely to start smoking (Table 1). The unadjusted odds of smoking increased by a factor of 1.49 for each quartile increase in perception of benefits. This odds ratio did not change in the multivariate analysis. Adolescents in the second, third, and fourth quartiles of perceived likelihood of benefits were 1.49, 2.22, and 3.31 times more likely to start smoking than were adolescents in the first quartile.

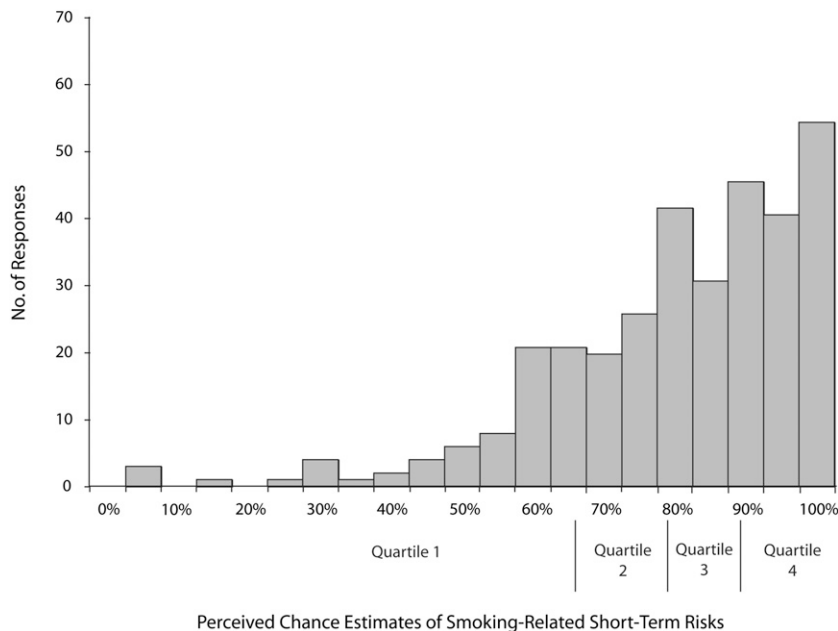
Stability of Perceptions and Smoking Initiation

In light of these results, it seems clear that smoking-related perceptions predict adolescent



Note. The first quartile represents estimates of the likelihood of experiencing long-term smoking-related consequences between 20% to 69%; the second quartile, 70% to 83%; the third quartile, 84% to 93%; and the fourth quartile, 94% to 100%.

FIGURE 1—Adolescents' perceptions of long-term risks of smoking, by chance estimate quartiles: 2001–2003.



Note. The first quartile represents estimates of the likelihood of experiencing short-term smoking-related consequences between 0% to 68%; the second quartile, 69% to 81%; the third quartile, 82% to 91%; and the fourth quartile, 92% to 100%.

FIGURE 2—Adolescents' perceptions of short-term risks of smoking, by chance estimate quartiles: 2001-2003.

smoking initiation. However, these findings could have been caused by decreases in perceived risk, increases in perceived likelihood of benefits, and increases in rates of smoking initiation across time.¹⁸ This explanation for our findings is not likely to be true, because smoking initiation in the current sample was heaviest before the study began and was approximately equally distributed across subsequent waves of data; nevertheless, we conducted further analyses to examine the relationship between stability of tobacco-related perceptions and smoking initiation.

We conducted a repeated-measures ANOVA comparing perceptions before adolescents smoked (baseline data for noninitiators) and after adolescents smoked their first cigarette (second-wave data for noninitiators, to keep the time span between perceptions consistent). Consistent with the results of the logistic regression, we observed a main effect for smoking status. Regardless of time of initiation, adolescents who had smoked a whole cigarette believed that long-term and short-term negative consequences were less likely to occur and benefits more likely to occur than did

noninitiators ($f_{1, 298} = 29.25, P < .001$; $f_{1, 298} = 55.74, P < .001$; and $f_{1, 298} = 4.41, P < .05$, respectively). In general, smoking-related perceptions were stable across time.

Perceptions of long-term risks and perceptions of benefits did not significantly differ across 2 points in time. Only perceptions of short-term risk decreased across time ($f_{1, 298} = 20.54, P < .001$), but this variable changed for both initiators and noninitiators. Indeed, interactions between smoking status and time were not significant for all 3 categories of perceptions. This means that, compared with noninitiators, adolescents who had smoked a whole cigarette held lower perceptions of risks and higher perceptions of benefits both before and after they smoked their first cigarette. These findings suggest that smoking-related perceptions were relatively stable and did not change as a result of smoking initiation.

DISCUSSION

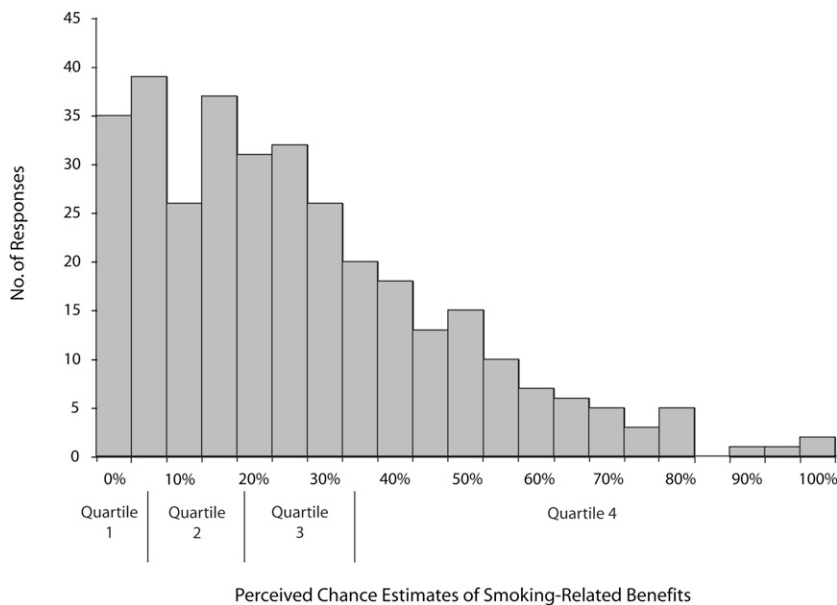
This study is the first to employ prospective, longitudinal data to determine whether and to what extent perceptions of smoking-related

risks and benefits predict adolescent smoking initiation. Consistent with theories and cross-sectional studies, we found that perceptions of risks and benefits do predict smoking initiation. Adolescents who believed that smoking-related long-term risks were least likely to occur were 3.64 times more likely to start smoking than were adolescents who believed that long-term risks were most likely to occur. The same relationship can be seen with perceptions of short-term risks. Adolescents who believed that smoking-related short-term risks were least likely to occur were 2.68 times more likely to start smoking than were adolescents who believed that short-term risks were most likely to occur. Adolescents who believed that smoking-related benefits were most likely to occur were 3.31 times more likely to start smoking than were adolescents who believed that benefits were least likely to occur.

Even before initiating smoking, adolescents who smoked a whole cigarette held lower perceptions of risk and higher perceptions of benefits than did adolescents who did not smoke. Comparison of perceptions across 2 time points showed that the differences between these 2 groups remained roughly the same across time. Thus, the act of smoking a whole cigarette did not influence perceptions of smoking-related risks and benefits.

Because adolescents who initiated smoking at the start of the study were eliminated for further analysis, we are able to make strong inferences that perceptions of low long-term risks, perceptions of low short-term risks, and perceptions of high benefits increased tobacco initiation. The results provide empirical support that adolescents do engage in reasonably logical decision-making processes. These behavioral decisions are consistent with major theoretical models, such as the health belief model, decisional balance theory, and the theory of planned behavior.⁵⁻⁹ Because adolescent tobacco initiation is caused, in part, by perceptions of low risks and high benefits, it is important for adolescent tobacco prevention programs to communicate these risks in order to reduce or prevent tobacco initiation.

To our knowledge, this is the first study to examine the effects of perceptions of long-term risks, perceptions of short-term risks, and perceptions of benefits concurrently. We found



Note. The first quartile represents estimates of the likelihood of experiencing benefits are from 0% to 7%; the second quartile, 8% to 20%; the third quartile, 21% to 37%; and the fourth quartile, 38% to 100%.

FIGURE 3—Distribution of adolescents' perceptions of benefits of smoking, by chance estimate quartiles: 2001-2003.

that the beliefs that smoking would make adolescents look cool, feel relaxed, become popular, or feel grown-up motivated them to smoke just as strongly as the beliefs that smoking caused lung cancer, heart attacks, coughing, shortness of breath, and wrinkles motivated them not to smoke. In addition to perceiving that smoking may confer benefits, adolescents may also perceive that not smoking imposes costs. For example, studies on adolescent sexual behavior have shown that adolescents report potential social consequences associated

with not having sex.²³ Similarly, adolescents may believe that refraining from smoking may cost them socially. We did not measure adolescents' perceptions of the social risks of abstaining from smoking; this is a potentially important area of future research.

Limitations

A potential limitation of this study is that the limited sample size prevented us from controlling for covariates of smoking behavior, such as gender, socioeconomic status, and ethnicity.

Perceptions of risks and benefits may differ across these groups, as may the relationships between perceptions and smoking behavior. Future studies should investigate these questions.

Another limitation is that our measure of behavior was smoking 1 whole cigarette. It is possible that perceptual change occurs only with prolonged use and not with experimentation. Moreover, this study focused on a comparison between 2 time points. Future studies should examine the relationship between prolonged tobacco use and perceptions across longer periods of time, particularly across developmental experiences, such as graduation, initiation in other risk behaviors, and smoking-related experiences of other adolescents known to the respondent, such as siblings, friends, and acquaintances.

Conclusions

Taken as a whole, this study's results indicate that, consistent with theories of risk behaviors and health promotion, adolescent risk behavior decision-making is not based solely on perceived risks or perceived benefits. Instead, adolescents' decisions about tobacco use are based on a balance of both perceived risks and perceived benefits. Accordingly, public-health efforts to reduce adolescent smoking should not focus solely on perceptions of long-term risks, such as lung cancer or heart disease; interventions also should provide information about the social risks that adolescents find so salient, such as getting into trouble and having bad breath. Programs that solely focus on perceptions of long-term risks are relaying messages that may not be as effective in preventing tobacco initiation, because they do not represent the full picture of what adolescents are considering. Programs also should aim to decrease perceptions of benefits associated with smoking. For instance, intervention efforts may wish to focus on counteracting sources of the message that smoking is beneficial, such as movies and other media.^{24,25} ■

TABLE 1—Perceptions as Predictors of Smoking Initiation Among Northern California Adolescents: 2001-2003

	OR (CI, 95%)	Adjusted OR ^a (CI, 95%)
Perceptions of long-term risks	0.56 (0.43, 0.73)	0.65 (0.47, 0.90)
Perceptions of short-term risks	0.55 (0.42, 0.72)	0.72 (0.52, 0.99)
Perceptions of benefits	1.49 (1.16, 1.92)	1.49 (1.13, 1.96)

Note. OR=odds ratio; CI=confidence interval. Significance was set at less than .05. Perceptions were treated as a continuous variable, coded 0 for the first quartile, 1 for the second quartile, 2 for the third quartile, and 3 for the fourth quartile. For perceptions of long-term risks, the first quartile represents chance estimates ranging from 20% to 69%; the second quartile, 70% to 83%; the third quartile, 84% to 93%; and the fourth quartile, 94% to 100%. For perceptions of short-term risks, the first quartile ranges from 0%-68%; the second quartile, 69%-81%; the third quartile, 82%-91%; and the fourth quartile, 92%-100%. For perceptions of benefits, the first quartile ranges from 0%-7%; the second quartile, 8%-20%; the third quartile, 21%-37%; and the fourth quartile, 38%-100%.

^aAdjusted ORs represent a logistic regression model in which all 3 perceptions were entered simultaneously.

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Contributors

B.L. Halpern-Felsher originated and designed the study, supervised the data collection, supervised all aspects of the analyses, and contributed to the writing of the article. A.V. Song developed the data-analysis plan, conducted the statistical analyses, and wrote the first draft of the article. H.E.R. Morrell consulted on the statistical analyses. J.L. Cornell, M.E. Ramos, M. Biehl, and R.Y. Kropp collected the data and contributed to the writing of the article. All authors revised drafts of the article.

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Human Participation Protection

This study was given institutional review board approval by the Committee on Human Research of the University of California, San Francisco. All participants provided informed consent.

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