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Tobacco: Smoking Intervention

Project ASPIRE: An Interactive, Multimedia Smoking Prevention and Cessation Curriculum for Culturally Diverse High School Students

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A Smoking Prevention Interactive Experience (ASPIRE) is an innovative, computer-based smoking prevention and cessation intervention delivered to a culturally diverse population of high school students. Founded in the Transtheoretical Model of Change, five main and two "booster" sessions comprise the interactive intervention. Here we describe the intervention and the baseline characteristics from our study sample of 1,574 10th graders from 16 high schools in Houston, Texas. Environmental and behavioral smoking risk factors were assessed, and the two intervention groups were comparable with respect to most measured variables. The intervention program holds considerable promise in its ability to reduce smoking among teens.

Keywords tobacco; smoking; tobacco use cessation; adolescent; clinical trials; health promotion

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Introduction

Cigarette smoking remains the leading preventable cause of morbidity and mortality and compromises life expectancy at all ages (Proctor, 2004). Tobacco use typically begins during adolescence; therefore, vulnerable youth remain the key targets for health promotion efforts. The Monitoring The Future study shows an overall decline in smoking prevalence during the past decade. However, adolescent smoking prevalence remains unacceptably high: the 30-day prevalence of smoking for 12th, 10th, and 8th graders in 2008 was 20.4%, 12.3%, and 6.8%, respectively (Johnston, O'Malley, Bachman, and Schulenberg, 2009). Developing innovative and effective approaches to control tobacco use among youth through both prevention and cessation strategies remains a high public health priority (Institute of Medicine, 2009).

Most adolescents can be reached at school, and school-based programs remain the mainstay of group-oriented tobacco prevention and cessation strategies. However, even after 30 years of prevention research, the efficacy of prevention programs is mixed, and further research is needed to determine more effective strategies. Effect size, on average, ranges up to .24, representing a 12% reduction in rate of smoking initiation (Institute of Medicine, 2007). Further, without sustained intervention, the effects of successful programs appear to be short-lived, and at the dissemination phase, programs are either sporadically and poorly implemented or not used at all (Barnoya and Glantz, 2005; Institute of Medicine, 2007; National Cancer Institute, 2001; Wiehe, Garrison, Christakis, Ebel, and Rivara, 2005).

Although ample evidence is available supporting interventions for the cessation of adult tobacco use, little is known about how to effectively help youth quit (Milton et al., 2004; Ranney et al., 2006). Computer-tailored programs have been shown to facilitate quitting among young smokers from groups that are usually resistant to change, such as precontemplators and "heavy smokers"; computer-tailored programs have also been found to be effective among the different types of "self-help" smoking cessation applications (Etter and Perneger, 2001; Strecher, Greenwood, Wang, and Dumont, 1999).

The computer-based approach to tobacco smoking prevention and cessation solves several key problems inherent to school-based health promotion. Programs delivered via computer can efficiently customize information and strategies for a particular individual rather than using a "one-size-fits-all" approach. In addition, program delivery is not dependent on the skills and motivation of school personnel, many of whom are neither trained in nor directly responsible for health education. An additional benefit of the computer-based approach in schools is that combining prevention and cessation into a tailored computerized program removes social fear and pressure associated with divulging sensitive personal information and smoking status. Furthermore, participating during health class in computer game-like educational activities on smoking is likely to be more attractive to students than enrolling in a formal smoking cessation program. Finally, computer-based programs are appealing to young audiences as these are more attractive than uniform, printed self-help materials (Lieberman et al., 1997), and most adolescents are comfortable with using computer technology (Shegog et al., 2001).

It remains unclear to what extent computer-based programs are capable of inhibiting initiation or promoting cessation among predominantly low-socioeconomic status and minority teens. There is a need for further research that applies theory-driven, technologically sophisticated programs tailored to the needs of adolescents, particularly those of various racial/ethnic backgrounds, to determine the most effective approaches and in what combination they should be provided. There is also a need for more smoking programs targeted at high school students because most interventions to date appear to have targeted middle school students (Wiehe et al., 2005).

A Smoking Prevention Interactive Experience (ASPIRE) is an innovative computer-guided intervention for high school students. We will herein describe its theoretical underpinnings and the baseline characteristics of a culturally diverse sample of students in which we have begun to implement the intervention.

Methods

Study Design

Project ASPIRE is aimed at the development of a CD-ROM-based intervention, beta testing of this intervention, and evaluation of this intervention using a nested-cohort, group-randomized control-group design (Murray, 1998a). This study design is considered to be the most rigorous means of testing such an intervention approach (Murray, 1998a, 1998b). The CD-ROM-based intervention is being tested against a standard-care (self-help booklet) group. The research protocol was approved by the Institutional Review Board of The University of Texas M. D. Anderson Cancer Center.

Recruitment Procedures

Project ASPIRE is being implemented in school districts in the greater Houston area. We specifically targeted schools that were ethnically diverse and located in socioeconomically challenged neighborhoods. Principals at the participating schools assigned a school coordinator to assist with all project-related activities. Participating schools ($N = 16$) were randomly assigned to the control or intervention arm, and students were recruited from 10th grade classes, although some classes were not entirely homogeneous with respect to grade.

To inform and recruit students, assembly and in-class presentations were conducted by Project ASPIRE staff and school personnel working with Project ASPIRE staff. To be eligible for participation, students were required to be able to speak, read, and write in English and to submit a signed consent form (provided in English and Spanish). Signed informed consent forms were obtained from parents of students under 18 years of age; students who were 18 years of age or older signed their own consent forms.

Theoretical Foundation

Our intervention is largely guided by the Transtheoretical Model of Change (TTM). The TTM is widely described in the literature and incorporates (a) a continuum of stages of change in the problem behavior; (b) a framework for understanding the hypothesized processes that mediate health behavior change; (c) measures (e.g., self-efficacy, decisional balance) that are sensitive to the earliest signs of behavior change; and (d) a means of tailoring education and intervention approaches to an individual's level of readiness for change (Prochaska, DiClemente, and Norcross, 1992a, 1992b). Below, we briefly delineate how we applied the TTM to adolescent smoking behavior in the design of our intervention.

Stages of Change. We grounded our theoretical approach in the remarkable similarity found between the TTM constructs in adult and adolescent smokers (Pallonen, 1998a). The principal investigator of Project ASPIRE was a member of an earlier research effort that validated the existence of the following nine stages of smoking-related changes among adolescents: (1) acquisition-precontemplation, (2) acquisition-contemplation, (3) acquisition-preparation, (4) recent acquisition, (5) precontemplation, (6) contemplation, (7) preparation, (8) action, and (9) maintenance (Pallonen et al., 1998c). The continuum represents a refined extension of previous models that also employed the concept of stages of

change but with different theoretical foundations. These nine stages are used in the present study. Specifically, students receive motivation and/or behavioral strategies pertinent to their current stage membership identified via answers to a computerized pretreatment survey.

Processes of Change. The processes of change used in our intervention include five cognitive and five behavioral mechanisms: consciousness raising, social liberation, dramatic relief, environmental reevaluation, self-reevaluation, self-liberation, stimulus control, counter-conditioning, helping relationships, and reinforcement management. It has been documented that people consistently use these processes as they move across the continuum of stages of change (Perz, DiClemente, and Carbonari, 1996).

In the context of intervention design and evaluation, the processes of change not only suggest strategies for intervention delivery but also serve as measures of behavior change, thereby contributing to the creation of meaningful program objectives.

Addiction Framework. An addiction framework was used in the study because of the increasing evidence of teenage smokers exhibiting nicotine dependence. Our own previous research indicates that close to 20% of high school smokers exhibit substantial levels of dependence (Prokhorov, Pallonen, Fava, Ding, and Niaura, 1996).

Description of ASPIRE

Project Aspire is programmed with MacroMedia Director and FLASH software and contains embedded animations, video, and interactive activities. It is recorded on three CD-ROMs and is installed on desktop or laptop computers. The curriculum consists of five sessions delivered over 6 weeks. Each session lasts approximately 30 min. Two booster sessions (also lasting approximately 30 min) are provided during the subsequent school semester. ASPIRE is accessed individually in a classroom setting.

Before beginning the CD-ROM-based intervention, participants complete a computerized questionnaire that assesses demographics, current smoking behavior, and stage of change (Figure 1). Dichotomous yes/no questions are used to assess present smoking status and future smoking intentions; these data enable us to classify students on the basis of their stage of smoking acquisition (nonsmokers) or cessation (smokers). A mountain metaphor is used to represent the stages of change for the participants. This metaphor is extended to include two main paths on an imaginary Mount ASPIRE: A cessation path for smokers on the left side of the mountain and a prevention path for nonsmokers on the right side of the mountain (Figure 2).

The program helps students choose a tobacco-free-lifestyle. A smoker entering as a precontemplator can progress through the stage-relevant material toward becoming motivated to quit, making successful quit attempt and remaining abstinent. Similarly, a nonsmoker entering in acquisition-preparation can move through educational tracks tailored to prevent the acquisition of smoking and can reach stable acquisition-precontemplation, where the participant is rewarded for not contemplating adoption of smoking.

The five main sessions and the two follow-up sessions are tailored to address the individual needs of the students who interact with the program. The curriculum modules, which include animations, video segments, and interactive activities, aim to engage cognitive processes that facilitate the student's progression into the next stage of change (for preventing or stopping smoking behavior); the student's movement to the next stage of change prompts delivery of the next stage-appropriate module. Students who do not progress out of a stage after one session receive new messages designed for the same stage during the subsequent session; these messages continue to encourage movement toward more advanced stages of prevention or cessation.

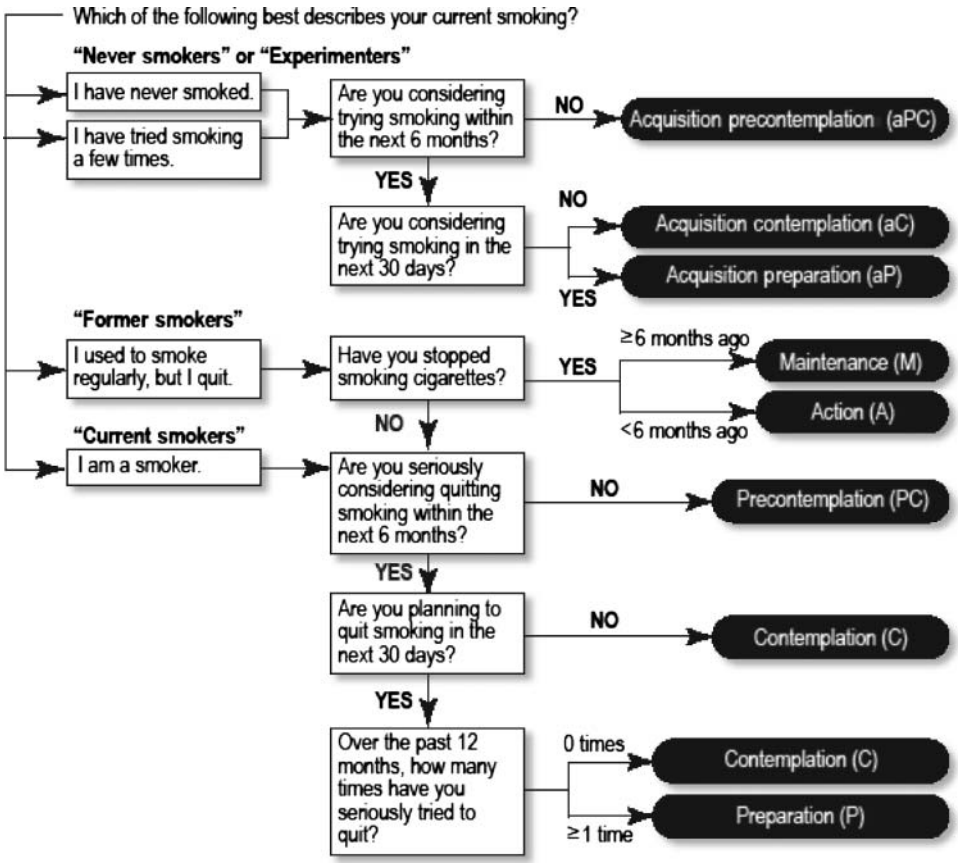

Figure 1. Staging algorithm for smoking acquisition and cessation.

Within each stage-based module, processes of change were used as the basis for content that theoretically facilitates stage movement (Figure 3). Smokers in the precontemplation stage for quitting, for example, receive information designed to raise consciousness regarding the long- and short-term health effects of smoking, social influences, and environmental impacts of smoking. Smokers in the contemplation stage receive exercises designed to influence decisional balance. The content for smokers in the preparation stage is designed to help users identify and cope with their temptations. Action-stage content is designed to help participants set a quit date, solicit support, follow a plan for quitting, and recognize the difference between a slip and a relapse. Maintenance-stage content reviews the slip-relapse difference and encourages successful quitters to advocate quitting to other smokers. Between modules, interactive quizzes and feedback using normative comparison are used to tailor the program content for users who may be experiencing addiction or negative affect. Also between modules, users receive positive or negative reinforcement based on their forward or backward stage movement as determined by responses to staging questions.

Module content is further tailored on the basis of the student's decisional balance, smoking temptations, depression, and addiction to smoking. Students who do not progress to the next stage after one session continue to have access to messages and program activities within the same stage but are also given the option and are encouraged to advance

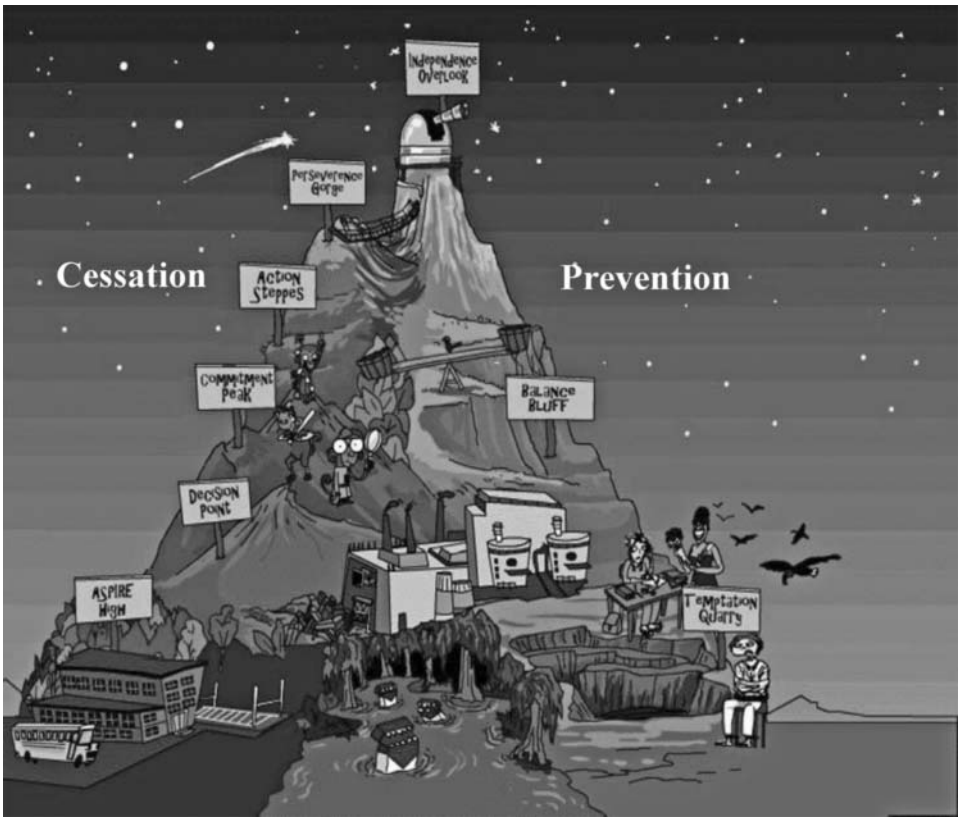

Figure 2. Mount ASPIRE metaphor for stages of cessation and acquisition.

to the next stage, with appropriately tailored messages recognizing their reticence toward change.

Role models presented within video and animated teaching segments represent a diversity of gender and ethnicity. Messages for females include additional information about the impact of smoking on pregnancy, physical appearance, and body weight. The intervention messages are informed by qualitative interview data with the target population and reflect ethnic-specific characteristics of appearance, language, and mannerisms.

On completion of their first ASPIRE session, students receive a colorful, laminated, wallet-sized card with information about Internet, walk-in, and telephone mental health and tobacco resources; they also receive stickers that reinforce the content they were exposed to during the ASPIRE computer session.

Development of ASPIRE

Intervention Mapping, a stepped method for developing theoretically and empirically based behavioral interventions, was used to identify target behaviors for cessation and prevention and critical determinants of these behaviors (Bartholomew, Parcel, and Kok, 1998). The processes of change from the TTM guided the development of learning objectives, methods, and strategies (Figure 3). The ASPIRE content focuses on the mechanisms mediating adolescent smoking as outlined in the empirical literature. These include engaging in risk-taking

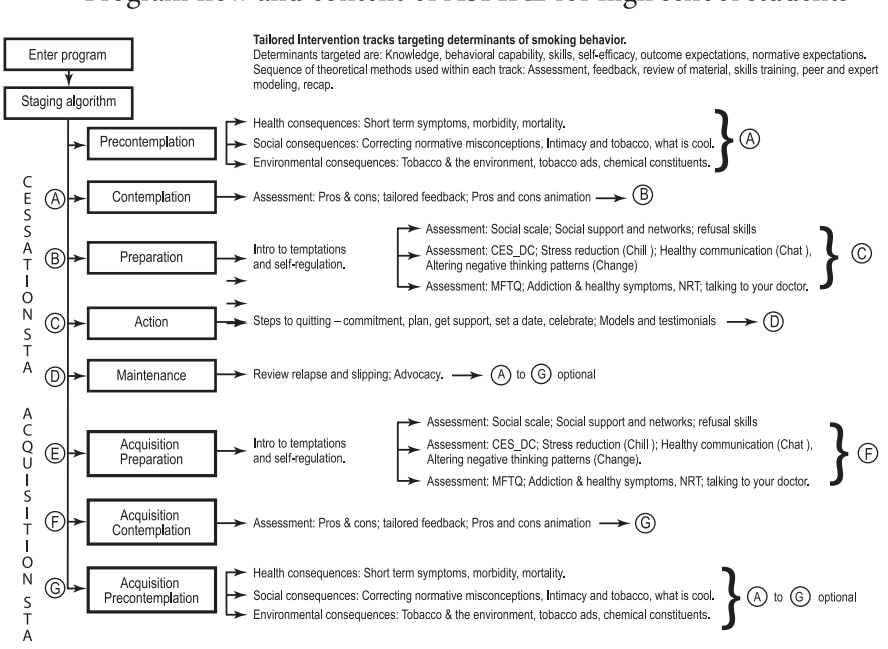

Figure 3. Program flow and content of ASPIRE.

behavior, normative beliefs, friends' reactions to cigarette use, commitment not to smoke, resistance skills, self-esteem, goal-setting skills, stress management, depression, and addiction (Biglan, Duncan, Ary, and Smolkowski, 1995; Hansen, 1996; Hansen and McNeal, 1997; MacKinnon, 1994; MacKinnon et al., 1991; Proctor, 2004; Wahlgren et al., 1997).

Implementation of ASPIRE

Preparatory steps for the implementation of ASPIRE included obtaining school district approval, conducting a needs assessment of school computer hardware early in the study, providing computers to schools with insufficient numbers of in-house computers, arranging for field staff to monitor computer classes during the evaluation period, and identifying key school coordinators within the schools to assist with intervention placement and logistics. High school-based coordinators were selected with the assistance of school principals and included substance abuse monitors, vice-principals, physical education coaches, science teachers, school nurses, and one English teacher. The coordinators helped to resolve logistic issues such as those related to classroom availability, student schedules, and computer accessibility.

Students worked on the ASPIRE intervention individually as a stand-alone program and used headphones for privacy and noise reduction. The intervention was accessed in the context of classes in computer labs or as individual study. ASPIRE project staff monitored the program fidelity. Daily updates between investigators, project directors, and field staff allowed for immediate upload of monitoring data, discussion of potential problems (i.e., school logistics problems, hardware breakage, software bugs), brainstorming regarding possible solutions, and rapid site-specific resolution. Clear communication channels with key school personnel provided immediate resolution and confidence building between research and school staff.

Survey Procedures and Study Variables

Baseline surveys were completed by students in classrooms, the cafeteria, the gymnasium, or the library. The baseline survey packets contained a student assent form (for students under 18 years of age; this form was completed in addition to the parental consent form) and a baseline survey. Students in the standard-care control group received the National Cancer Institute's *Clearing the Air* self-help booklet (USDHHS, 2003). Students who were absent on the day of the survey completed the survey upon their return to school, under the supervision of either a member of our project staff or the school coordinator.

The baseline survey was an 87-item questionnaire addressing sociodemographic characteristics and environmental and behavioral aspects known or hypothesized to be associated with smoking. Many of these items were derived from the existing validated scales or were utilized in our previous studies of adolescent smoking (Gritz et al., 1998, 2003).

Sociodemographic factors included sex, age, race/ethnicity, parental education level and marital status, number of persons living in the household, student's academic performance, and number of detentions or suspensions during the previous school year.

Environmental factors included smoking status of the family and other persons who lived in the same household and the student's three closest friends.

Depression was assessed using the Center for Epidemiological Studies Depression Scale for Children (CES-DC) 20-item scale suitable for estimating past-week depressive symptoms in children and adolescents (Fendrich, Weissman, and Warner, 1990). A total score was computed by summing the scores for the individual responses (options were 0, "not at all"; 1, "a little"; 2, "some"; and 3, "a lot"). The CES-DC total score was dichotomized as less than 15 versus 15 or more, on the basis of the established cutoffs (Fendrich et al., 1990).

Tobacco use measures were selected to capture past, current, and future aspects of tobacco use. *Smoking status* was defined as follows: Never smokers were students who had never smoked even part of a cigarette, experimenters were students who reported smoking part of a cigarette or having smoked a few times, former smokers were students who used to smoke regularly (100 or more cigarettes during their lifetime) but had quit, and current smokers were students who reported currently smoking at least one cigarette every other week.

The *intensity of smoking* was characterized using the Minnesota Smoking Index (Pechacek et al., 1984), a composite scale that reflects the number of cigarettes smoked per week and has been shown to be highly correlated with biochemical measures among adolescents (Murray et al., 1994). For our study, the scale reflected the number of cigarettes students smoked in the last 30 and 7 days, and 24 hr.

Nicotine dependence was assessed using the modified Fagerström Tolerance Questionnaire (Prokhorov, Koehly, Pallonen, and Hudmon, 1998; Prokhorov et al., 1996, 2000), a seven-item scale that has been psychometrically and biochemically validated among adolescent smokers. We also used the Hooked on Nicotine Checklist, a relatively new measure of nicotine dependence proposed by DiFranza and colleagues (DiFranza et al., 2002a, 2002b). This measure has been validated among young smokers (DiFranza et al., 2002a, 2002b). Wheeler and colleagues (Wheeler, Fletcher, Wellman, and Difranza, 2004) demonstrated the Hooked on Nicotine Checklist's internal consistency, reliability over time, and correlation with self-described smoking behavior among teenagers. The number of items endorsed on the checklist indicated the degree of severity of nicotine dependence.

Our measures to characterize *smoking initiation* were derived primarily from Pierce and colleagues' Susceptibility to Smoking framework (Choi, Gilpin, Farkas, and Pierce, 2001; Pierce, Choi, Gilpin, Farkas, and Merritt, 1996), which categorizes adolescents as

either "susceptible" or "not susceptible" to initiating smoking. Participants who describe themselves as nonsmokers and respond "definitely not" to the questions "At any time during the next year, do you think you will smoke a cigarette?" and "If one of your best friends were to offer you a cigarette, would you smoke it?" are classified as not being susceptible to smoking initiation. Participants who describe themselves as current smokers or nonsmokers and who answer either one or both of the same questions with "probably not," "probably yes," or "definitely yes" are classified as being susceptible to smoking initiation. An algorithm adapted from Pallonen, Prochaska, Velicer, Prokhorov, and Smith (1998b) was used to classify students into one of the stages of smoking acquisition. In addition, we integrated the stages of smoking acquisition with the susceptibility to smoking construct according to the algorithm described by our research team elsewhere (Prokhorov et al., 2002), thereby creating a more sensitive measure of predisposition to smoking among nonsmokers.

Analytical Strategies

The study population was characterized using standard summary statistics, and the relationships between categories of smoking and the various variables of interest were examined using analysis of variance for continuous variables and contingency tables with chi-squared analyses for categorical variables. All analyses were conducted using SPSS version 10.1.3.

Results

Study Population

The study design required 125 10th grade students per school in 16 schools, randomized to intervention or control condition, for power adequate to assess statistical significance at the alpha = .01 level. Thus, a total of 2,000 students were initially approached out of which 1,608 (80.4%) were eligible, i.e., 392 students failed to provide signed informed consent to participate in the study. All 1,608 students who provided consent and agreed to participate completed the baseline assessment. Random assignment to the treatment and control arms yielded 783 (48.7%) students in the control group and 825 (51.3%) in the intervention group. Thirty-four students were excluded from the analyses because they did not report their smoking status. Hence, the results described in this report were derived from 1,574 participating students (78.7% of the target sample).

Sociodemographic and Environmental Characteristics by Treatment Group

Table 1 shows that the intervention group participants were slightly younger (mean age, 15.6 years vs. 15.8 years, $p < .001$), lived with fewer people in the home (mean, 4.4 vs. 4.9, $p < .001$), were more likely to be Hispanic (58.0% vs. 42.5% $p < .001$), were more likely to have married parents (55.9% vs. 46.4%, $p < .001$), and were less likely to have parents with college degrees (27.2% vs. 30.5%, $p < .001$). The intervention and control groups were similar with respect to sex, academic performance, number of suspensions/detentions during previous year, depression levels, number of close friends who smoked, and number of household members who smoked (Table 1).

Sociodemographic and Environmental Characteristics and Baseline Smoking Status

Table 2 shows students' characteristics stratified by self-reported baseline smoking status. The mean age for the overall sample was 15.7 (±0.9) years, and 58.8% of

Table 1
Baseline comparison of intervention and control students

Characteristics	Category	Intervention ($N = 811$)	Control ($N = 763$)	Total ($N = 1{,}574$)
		Mean ± SD	Mean ± SD	Mean ± SD
Age, years		15.59 ± .84	15.75 ± .96*	15.7(±.90)
Average number of people living in home		4.35 ± 1.76	4.90 ± 1.61*	4.5 ± 1.71
		% (*N*)	% (*N*)	% (*N*)
Sex	Male	40.6 (329)	41.8 (319)	41.2 (648)
	Female	59.4 (482)	58.2 (444)	58.8 (926)
Race/ethnicity	Hispanic	58.0 (462)	42.5 (314)*	50.6 (776)
	African-American	35.2 (280)	44.1 (326)	39.5 (606)
	Caucasian	3.3 (26)	8.7 (64)	5.9 (90)
	Other	3.5 (28)	4.7 (35)	4.1 (63)
Academic performance	Mostly As, Bs Cs	91.9 (741)	92.1 (691)	92.0 (1, 432)
	Mostly Cs, Ds, Fs	8.1 (65)	7.9 (59)	8.0 (125)
≥1 suspensions or detentions in past yr	Yes	36.1 (293)	39.3 (300)	37.7 (593)
	No	63.9 (518)	60.7 (367)	62.3 (981)
Marital status of parents	Married	55.9 (482)	46.4 (323)*	51.3 (805)
	Not married	44.1 (356)	53.6 (407)	48.7 (763)
Highest level of education of either parent	Some high school	22.8 (184)	16.6 (126)*	19.8 (310)
	High school graduate and/or vocational school	30.0 (232)	29.1 (221)	29.5 (463)
	Some college or college degree	27.2 (220)	30.5 (308)	33.7 (528)
	Unsure	20.0 (162)	13.9 (106)	17.1 (268)

CES-DC past week depressive symptom scale score	Less than 15	40.9 (331)	37.8 (287)	39.4 (618)
	15 or more	59.1 (478)	62.2 (472)	60.6 (950)
Number of three best friends who smoke	0	50.7 (410)	51.3 (388)	55.9 (874)
	1	21.1 (171)	21.5 (103)	21.3 (334)
	2	15.2 (115)	12.9 (104)	14.0 (219)
	3	9.6 (78)	8.1 (61)	8.9 (139)
Others in household who currently smoke	None	45.0 (365)	48.0 (366)	46.4 (731)
	One or more parent	29.5 (239)	28.4 (217)	29.0 (456)
	One or more sibling	9.0 (73)	10.4 (79)	9.7 (152)
	One or more parent and one or more sibling	16.5 (134)	13.2 (101)	14.9 (235)

*$p < .001$.

Table 2
Respondent characteristics by self-reported smoking status

Characteristic and categories		Smoking status ($N = 1,574$)							
		Never smoker ($N = 907$)	Ever smoker ($N = 667$)	p^a	Experimenter ($N = 500$)	Current smoker ($N = 111$)	Former smoker ($N = 56$)	p^b	Total ($N = 1,574$)
Continuous variables		Means and standard deviations							
Age, years		15.6 ± .9	15.7 ± .9	.007	15.7 ± .9	16.0 ± 1.0	15.8 ± .9	.001	15.7 ± .9
Average number of people living in the home		4.5 ± 1.6	4.5 ± 1.8	NS	4.5 ± 1.8	4.5 ± 1.7	4.2 ± 1.7	NS	4.5 ± 1.7
Categorical variables					*N* (%)				
Sex	Male	335 (51.7)	313 (48.3)	<.001	217 (33.5)	64 (9.9)	32 (4.9)	<.001	648 (41.2)
	Female	572 (61.8)	354 (38.2)		283 (30.6)	47 (5.1)	24 (2.6)		926 (58.8)
Race/ethnicity	Hispanic	395 (50.9)	381 (49.1)	<.001	281 (36.2)	66 (8.5)	34 (4.4)	<.001	776 (50.6)
	African-American	405 (66.8)	201 (33.2)		166 (27.4)	23 (3.8)	12 (2.0)		606 (39.5)
	Caucasian	42 (46.7)	48 (53.3)		26 (28.9)	16 (17.8)	6 (6.7)		90 (5.9)
	Other	40 (63.5)	23 (36.5)		17 (27.0)	4 (6.3)	2 (3.2)		63 (4.1)
Academic performance	Mostly As & Bs	460 (64.2)	257 (35.8)	<.001	218 (30.4)	23 (3.2)	16 (2.2)	<.001	717 (46.1)
	Mostly Bs & Cs	391 (54.7)	324 (45.3)		230 (32.2)	60 (8.4)	34 (4.8)		715 (46.0)
	Mostly Cs & Ds or Ds & Fs	50 (40.3)	74 (59.7)		46 (37.1)	24 (19.4)	4 (3.2)		124 (8.0)
≥1 suspensions or detentions in past yr	Yes	293 (49.4)	300 (50.6)	<.001	207 (34.9)	46 (11.0)	28 (4.7)	<.001	981 (62.3)
	No	614 (62.6)	367 (37.4)		293 (29.9)	65 (4.7)	28 (2.9)		593 (37.7)
Marital status of parents	Married	498 (61.9)	307 (38.1)	<.001	234 (29.1)	50 (6.2)	23 (2.9)	<.001	805 (51.3)
	Not married	406 (53.2)	357 (46.8)		263 (34.5)	61 (8.0)	33 (4.3)		763 (48.7)
Highest level of education of either parent	Some high school	145 (46.8)	165 (53.2)	<.001	130 (41.9)	23 (7.4)	12 (3.9)	<.001	310 (19.8)
	High school graduate and/or vocational/business school	263 (56.8)	200 (43.2)		145 (31.3)	38 (8.2)	17 (3.7)		463 (29.5)
	Some college or college degree	331 (62.7)	197 (37.3)		146 (27.7)	31 (5.9)	20 (3.8)		528 (33.7)
	Unsure	165 (61.6)	103 (38.4)		78 (29.1)	18 (6.7)	7 (2.6)		268 (17.0)

CES-DC past week depressive symptom scale score	Less than 15	401 (64.9)	217 (35.1)	<.001	166 (26.9)	33 (5.3)	18 (2.9)	<.001	618 (39.4)
	15 or more	501 (52.7)	449 (47.3)		333 (35.1)	78 (8.2)	38 (4.0)		950 (60.6)
Number of three best friends who smoke	0	606 (69.3)	268 (30.7)	<.001	233 (26.7)	14 (1.6)	21 (2.4)	<.001	874 (55.8)
	1	179 (53.6)	155 (46.4)		113 (33.8)	32 (9.6)	10 (3.0)		334 (21.3)
	2	80 (36.5)	139 (63.5)		102 (46.6)	24 (11.0)	13 (5.9)		219 (14.0)
	3	36 (25.9)	103 (74.1)		51 (36.7)	40 (28.8)	12 (8.6)		139 (8.9)
Others in household who currently smoke	None	468 (64.0)	263 (36.0)	<.001	214 (29.3)	27 (3.7)	22 (3.0)	<.001	731 (46.4)
	One or more parent	267 (58.6)	189 (41.4)		145 (31.8)	26 (5.7)	18 (3.9)		456 (29.0)
	One or more sibling	79 (52.0)	73 (48.0)		48 (31.6)	20 (13.2)	5 (3.3)		152 (9.7)
	One or more parent and one or more sibling	93 (39.6)	142 (60.4)		93 (39.6)	38 (16.2)	11 (4.7)		235 (14.9)

Notes:
[a]Comparisons for never smokers and ever smokers.
[b]Comparisons for never smokers, experimenters, former smokers, and current smokers.
NS: not significant.

participants were females. The race/ethnicity distribution of the sample was representative of the race/ethnicity distribution at participating school districts; participants were primarily Hispanic (50.6%) and African-Americans (39.5%). Forty-two percent had smoked at least part of a cigarette in their lifetime, and 7.1% were current smokers. Sixty percent had a score of at least 15 on the CES-DC. Table 2 also compares the characteristics of (a) never smokers (never smoked even part of a cigarette) and ever smokers (reported smoking at least part of a cigarette) and (b) never smokers, experimenters, current smokers, and former smokers. Significantly, more males than females reported ever smoking a cigarette. With the exception of the number of people living in the home, each of the variables we examined differed significantly by self-reported smoking status.

Baseline Stages of Change Among Nonsmokers

An algorithm, adapted from Pallonen et al. (1998b) was used to classify students into one of the following stages of smoking acquisition: (1) acquisition-precontemplation, (2) acquisition-contemplation, and (3) acquisition-preparation. A total of 1,302 nonsmokers (never smokers and experimenters) provided responses for the stage membership survey items; of these, the majority were classified as acquisition-precontemplation (98.3%), and 1.7% were classified as acquisition-contemplation or acquisition-preparation. To investigate this skewness toward being "not at risk" for smoking initiation, we applied our originally developed algorithm (Prokhorov et al., 2002), integrating the aforementioned stages of smoking acquisition and the cognitive susceptibility to smoking (Choi et al., 2001; Pierce et al., 1996). This additional analysis identified 30.3% of students in the acquisition-precontemplation stage as being susceptible to smoking. Among former smokers, 49 students provided responses for the stage membership survey items. Most (69.4%) were classified as being in the maintenance stage and 30.6% in the action stage.

Baseline Stages of Change, Quit Attempts, and Nicotine Dependence Among Current Smokers

A total of 111 students indicated that they were current smokers; of these 94 (85%) completed the current smokers section of the survey and are described here. The distribution of current smokers according to the stage of change for quitting was as follows: 51 (55.4%) were in the precontemplation stage, 24 (26.1%) were in the contemplation stage, and 17 (18.5%) were in the preparation stage (two cases had missing data on stage of change). Twenty-five students (26.9%) indicated that they continued to smoke because it was too difficult to quit. In the past year, 55 current smokers (58.5%) had made a serious quit attempt that lasted at least for 24 hr. In response to a question about whether they had tried to cut down on their smoking (as opposed to trying to quit completely), 56 students (59.6%) reported that they had cut down, 15 (16.0%) had tried to cut down but failed, and 23 (24.5%) had not tried to cut down. According to the modified Fagerström Tolerance Questionnaire, 36 students (62.1%) exhibited no nicotine dependence, 21 (36.2%) exhibited moderate nicotine dependence, and 1 (1.7%) exhibited high nicotine dependence.

The only variables (among those listed in Tables 1 and 2) that differed significantly between students who had made a quit attempt in the past year ($N = 55$) and students who had not ($N = 39$) were academic performance and number of three best friends who smoked. Students with worse grades and a greater number of best friends who smoked were more likely to have tried to quit. Students with better grades reported a lower median number of cigarettes smoked in the past 7 days (two cigarettes for students with mostly As

and Bs vs. seven cigarettes for students with mostly Cs, Ds, and Fs) and exhibited lower median scale scores on the Hooked on Nicotine Checklist (3.5 for students with mostly As and Bs vs. 5.0 for students with mostly Cs, Ds, and Fs).

Discussion

Our team has designed and initiated the implementation of a smoking prevention and cessation intervention that is targeted primarily toward minority adolescents. In this report, we describe the underlying theoretical framework for the intervention program as well as our approach toward operationalizing the theory into a series of concrete, practical strategies and learning objectives for the target audience. We also describe the principles of message tailoring and matching. Given the paucity of materials providing systematic descriptions of intervention content development, we believe that researchers and practitioners will find this paper both useful and educational.

Our baseline data indicate that the recruited sample is generally suitable for testing this highly innovative computer-based intervention because (a) the sample consists mostly of minority adolescents and (b) widely established risk factors for smoking initiation and progression (having friends who use tobacco, being depressed, etc.) are common among the study participants. Although we would have much preferred a larger sample of current smokers, our cohort of smokers nonetheless appears—due to factors described below—to be sufficient to estimate the trends in smoking cessation in the intervention and control groups. Our sample might not allow us to demonstrate the intervention's full smoking cessation potential due to the small sample of smokers. However, we might be able to detect trends in smoking cessation and progression through the stages of change.

An important advantage of our study is that it does not require adolescent smokers to publicly reveal their smoking behavior and participate in smoking intervention activities. By considering all classroom students to be eligible for the study, we were able to circumvent a well-documented subject recruitment barrier—teens' unwillingness to participate in smoking cessation programs (Massey et al., 2003; McCormick et al., 1999). This barrier is likely to be even more pronounced among teens from minority households because of the parents' lower tolerance of underage smoking compared to that of Caucasian parents (Gritz et al., 1998).

We also incorporated promising behavioral theory to develop the program's individualized content. In a Cochrane review (Grimshaw and Stanton, 2006) of smoking cessation interventions for adolescents, the authors found that trials incorporating the TTM achieved moderate to long-term success, whereas interventions using pharmacological and cognitive behavior therapy approaches were for the most part not as effective. Similarly, an earlier review of the literature applying the TTM to tobacco cessation and prevention (Spencer, Pagell, Hallion, and Adams, 2002) concluded that interventions tailored to a smoker's stage were successful more often than nontailored interventions. Although the predictive value for the use of TTM variables in smoking has been debated (Carlson, Taenzer, Koopmans, and Casebeer, 2003), overall, findings from previously described reviews speak to the importance of testing and incorporating the TTM stage of change approach in youth smoking interventions, as was done in Project ASPIRE.

A few smoking cessation efforts among adolescents have primarily utilized instructor-led cessation classes, but this approach requires further investigation and is limited by recruitment issues (Flay, Ockene, and Tager, 1992a, 1992b; Glynn, Anderson, and Schwarz, 1991). Several studies have evaluated programs aimed at smoking cessation among less

culturally diverse adolescents than our sample, but results were at best mixed and often inconclusive, often due to compromised methodology.

Researchers began to apply sophisticated computer-assisted smoking cessation interventions for adolescents less than a decade ago (Redding et al., 1999). Computer technology approaches hold considerable promise and have appeal for youth because of the ability to tailor program messages and the familiarity of use among adolescents (Mermelstein, 2003). Because individually tailored materials consider the relevant characteristics of each participant, smokers may be more interested in reading these materials and more likely to apply the advice included therein.

Our computer-based trial is innovative in its intervention approach, because it is one of the first, if not the first, to attempt to apply modern interactive multimedia technologies in combating smoking among predominantly minority youth. In designing our intervention, we drew upon previous work by ourselves and other investigators. We agree with Charlton (1992), who suggested that a lack of effective social support networks and social skills is predictive of adolescents' relapse. A significant portion of Project ASPIRE's modules for smokers who are ready to quit and recent quitters is dedicated to building social support networks and developing skills to resist pro-tobacco pressures, thus sustaining abstinence. According to our previous research and reports from other investigators, low perceived tobacco-attributable risks, perceived "functional utilities" of smoking, and lack of recognition of the benefits of cessation are addressed in our program as contributors to smoking behavior among adolescents (Ershler, Leventhal, Fleming, and Glynn, 1989; Prokhorov et al., 1995; Stanton, Lowe, and Gillespie, 1996; van Roosmalen and McDaniel, 1992).

Pallonen and colleagues (1998c) utilized a three-session, computer "expert system"-guided intervention based on the TTM, and their results showed a 20% cessation rate among predominantly white high school students residing in New England. At the 6-month follow-up assessment, however, the intervention effect had disappeared. On the basis of these authors' recommendations for "booster" sessions as a means of maintaining abstinence, we have integrated "booster" sessions into our study. In addition, the authors utilized cross-sectional data with no condition differences between intervention and control. Another "expert system"-based study, conducted in the United Kingdom, also did not bring about anticipated results (Aveyard et al., 1999), again quite possibly because of the insufficient number of intervention sessions. Key design features for Project ASPIRE are intensive program exposure, i.e., five main sessions and two "booster" sessions, consistent channel of delivery, i.e., computers versus teachers, as used in a project by Aveyard and colleagues (1999), and a sufficient duration of follow-up to better enable us to detect behavior change among early-stage individuals.

Compared with the previous interventions, our classroom curriculum takes a considerable further step by providing a plethora of quizzes, animations, and videos, which make the experience even more age-appropriate and audience-friendly. We believe that such a hybrid of educational and skill-building activities with the rich entertainment makeup ("edutainment") is optimal for the target audience.

Our innovative interactive, multimedia smoking prevention and cessation curriculum features many of the desired prerequisites for effectively assisting young, ethnically diverse populations of smokers in quitting tobacco use (Backinger et al., 2003; McDonald, Colwell, Backinger, Husten, and Maule, 2003). In light of the tobacco industry's efforts to target ethnic minorities (Balbach, Gasior, and Barbeau, 2003), prevention and cessation programs tailored toward these populations are needed. While Project ASPIRE might not demonstrate the intervention's smoking cessation potential because of the small sample of smokers, it holds considerable promise in preventing smoking initiation among the

predominantly minority participants. Our trial, along with other ongoing federally and privately funded research projects, will advance the field of tobacco control among predominantly minority adolescents, particularly in the area of applying computer technologies to smoking prevention and cessation.

Study's Limitations

A cause for concern is related to the lower than expected number of recruited smokers in our sample. However, the low proportion of current smokers in our sample can be explained by two factors. First, we included inner-city schools with mostly minority participants, who typically exhibit lower smoking rates than white adolescents nationwide (Johnston, O'Malley, Bachman, and Schulenberg, 2004). Second, the requirement of active parental consent for data collection likely skewed our sample toward a more health-conscious segment of the population—in other words, parents who cared more about their children's health, and whose children would consequently be less likely to smoke, might have been more likely to return the signed consent forms. However, as indicated above, we believe that the sample is adequate to detect the cessation trends.

Our longitudinal phase of Project ASPIRE will show whether this innovative, computer-tailored intervention is feasible and effective in helping teens learn more about the hazards of tobacco and adopt tobacco-free lifestyles.

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RÉSUMÉ

ASPIRE (A Smoking Prevention Interactive Experience – une expérience interactive de prévention de l'usage du tabac) est un programme novateur informatisé d'intervention pour la prévention et cessation d'usage du tabac ciblant une population culturellement diversifiée d'étudiants d'école secondaire. Fondé sur le modèle transthéorique de changement de comportement, l'intervention interactive se compose de cinq séances principales et de deux séances de rappel. Nous décrivons ici l'intervention et les caractéristiques fondamentales de notre échantillonnage de 1574 étudiants de seconde année dans 16 écoles secondaires de Houston, dans l'État du Texas. Les facteurs de risque environnemental et comportemental liés à l'usage du tabac ont été évalués et les deux groupes d'intervention ont été comparables en ce qui concerne la plupart des variables mesurées. Le programme d'intervention est extrêmement prometteur par sa capacité de réduire l'usage du tabac chez les adolescents.

RESUMEN

El programa ASPIRE es una experiencia interactiva para la prevención del fumar (A Smoking Prevention Interactive Experience, ASPIRE por sus siglas en inglés). Es una intervención innovadora, que usa como base un programa de computadora para la prevención y cese del fumar, enfocada a una población culturalmente diversa de estudiantes de escuela secundaria. Esta intervención interactiva basada en el Modelo Transteórico del Cambio (Transtheoretical Model of Change), incluye cinco sesiones principales y dos "de refuerzo". Aquí describimos las características de la intervención y línea basal de nuestra muestra de estudio de 1.574 estudiantes de décimo curso de 16 escuelas secundarias en Houston, Texas. Se determinaron los factores de riesgo de tabaquismo, ambientales y de comportamiento. Los dos grupos de intervención fueron equiparables con respecto a la mayoría de las variables medidas. El programa de intervención representa una promesa considerable en su habilidad para reducir el tabaquismo entre adolescentes.

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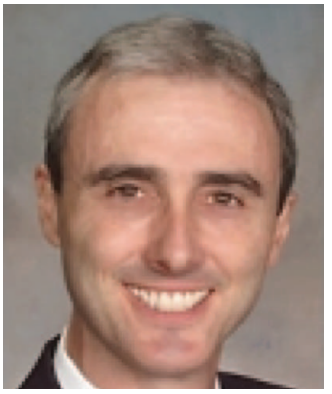

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