The study was designed to examine how intensity of anti-smoking media campaigns and differing types of anti-smoking community-based programs influence young adolescents’ tobacco use and related psychosocial variables. Sixth grade students attending 11 middle schools in eight study communities assigned to varying intervention conditions were assessed by a pre-intervention survey conducted in spring 2000. The assessment was followed by summer and fall 2000 media and community interventions that were evaluated by post-intervention data collection taking place with a new cohort of sixth graders in the same 11 schools in late fall 2000. In analyses conducted at the school level, the enhanced school and comprehensive community program conditions outperformed the no intervention program condition to reduce tobacco use and intentions to use tobacco. Combining the intensive or low media campaign with the comprehensive community program was most effective in suppressing positive attitudes toward smoking, while the enhanced school program alone was less effective in influencing attitudes. The most consistent changes, at least short-term, to reduce teen tobacco use, susceptibility to smoking and pro-smoking attitudes were achieved by combining the intensive media campaign with the comprehensive community program condition.

Introduction

To receive compensation for the approximately $5 billion spent for the costs of treating persons with tobacco-related diseases, the state of Texas brought and won a lawsuit against the tobacco industry (Texas Department of Health, 2001). Approximately $20 million from the settlement was allocated by the Texas Legislature to the Texas Department of Health (TDH) for activities to reduce tobacco use during the 1999–2001 biennium. These funds were used to implement and evaluate different types and levels of prevention activities. Earlier community and regional level tobacco control activities have produced positive long-term effects when comprehensive activities were provided. The North Karelia Project in Finland combined cessation and prevention activities (McAlister et al., 1980, 1982) to reduce smoking in the entire community. Ten- to 15-year follow-up findings provided evidence of long-term reductions in both adult and youth tobacco use (Puska et al., 1985; Vartiainen et al., 1998). The Stanford Five-City Study in California showed that comprehensive programs can have desired effects on tobacco use among children and adults (Farquhar et al., 1990). Similar findings were reported among adolescents from the Minnesota Heart Health Study.
(Perry et al., 1992), and from research conducted in Vermont, California, Florida, Massachusetts and Oregon (Flynn et al., 1994; Biglan et al., 2000; National Association of County and City Health Officials, 2001).

With the exception of work by Botvin et al. (Botvin et al., 1998), most tests of single-component programs (Ellickson et al., 1993; COMMIT Research Group, 1995; Peterson et al., 2000; US Department of Health and Human Services, 2000) do not appear to be effective. Therefore, a ‘comprehensive’ approach with combined prevention and cessation efforts involving mass media, school-based programs, health care providers and outreach to community organizations is recommended (US Department of Health and Human Services, 1999).

To guide decisions about funding allocations during the 2001 legislative session, the TDH in 1999 used its initial allocation of settlement funds to develop the Texas Tobacco Prevention Initiative (TTPI), testing the effects of a variety of single and multiple activity options on tobacco control with an annual study population per capita range of $0.50–3.00. Based on research indicating greater effectiveness among multi-component interventions supported by media, we hypothesized that Texas residents exposed to comprehensive programs would show enhanced program results.

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**Methods**

**Design**

This quasi-experimental study used a nested, cross-sectional pre-test–post-test design. The TTPI was implemented in 14 sites, each with a population of approximately 100,000, in East Texas and the city of Houston, selected because of their high rates of lung cancer and other tobacco-related diseases compared to other areas in the state, and for their demographically diverse ethnic populations that are often targets of tobacco industry advertising (Stoddard et al., 1997). A 15th site served as a comparison area. Each site was located within a county that in some cases consisted of more than one smaller community. A design committee consisting of university and TDH researchers assigned these sites to various program conditions based on random assignment. To prevent contamination between treatment sites, a selection criterion was for the area to have a unique media market.

To match per capita expenditures with those that have appeared to influence behavior in other major state tobacco control initiatives, the funds were concentrated in law enforcement, cessation, low or intensive media, enhanced school programs, or a combination of two or more of the preceding four program conditions. Law enforcement, established at a level equal to approximately $.50 in annual per capita implementation costs, focused on increasing retailers’ adherence to Texas’ existing tobacco sales and use laws. Cessation programs established at $.50 per capita included educational outreach to health providers about current tobacco cessation clinical practice guidelines. The low ($.50 per capita) and intensive ($1 per capita) media campaign levels included paid advertisements aimed at youth prevention, and contained age-appropriate messages disseminated through television, radio, print media and billboards as well as free public service announcements. The media campaign levels differed in the number and frequency of ad placement. Enhanced school programs ($1 per capita) consisted of school-centered and community-oriented activities that engaged parents, teachers, community leaders and resources in support of non-tobacco use. The comprehensive program condition consisted of law enforcement, cessation, media and enhanced school conditions combined. Areas with the greatest ethnic diversity were assigned to the comprehensive treatment condition.

Entire communities within the study sites received the intervention conditions to which they were assigned; however, students attending schools in these communities were surveyed to assess the impact of youth interventions. To provide more reliable estimates of the effects of the programs on teen tobacco use, the largest and most ethnically diverse school in each study condition was systematically selected for program participation after administrators at the schools agreed to annual
surveys of their students. If administrators declined participation, the next largest and most ethically diverse school was selected as a replacement. The replacement process was repeated 12 times in eight study communities.

Because the first year of middle school (sixth grade) is a critical time for the initiation of tobacco use, the experimental conditions targeting youth prevention were designed to appeal to this population in terms of media messages developed and the school-based curriculum implemented. Researchers from the University of Texas School of Public Health (UTSPH) Center for Health Promotion and Prevention Research along with Texas Department of Health, Baylor College of Medicine and other collaborating institutions implemented the TTPI in the spring and autumn of 2000. To assess the effects of youth programs, this study focused on analyses of cross-sectional baseline and follow-up data collected from sixth grade students attending middle schools located in the comparison and varying intervention community conditions.

Because the law enforcement and cessation programs were not designed for adolescents, they were excluded from the analyses for this study, while the comprehensive program condition, which included law enforcement and cessation programs, was retained because this condition included media and enhanced school programs that were designed specifically for youth. The final 3 × 3 design, shown in Figure 1, included three media program levels: none, low and intensive, and three program options: none, enhanced school and comprehensive. Since the comprehensive program was assumed to also include a media campaign element, this requirement eliminated the no media/comprehensive program condition reducing the final number of program conditions to eight. There were 11 middle schools that remained in these eight conditions. Among the 11 schools, two were assigned to the no program/no media condition, two were assigned to the no program/low media condition, one was assigned to the no program/intensive media condition, one was assigned to the enhanced school/no media condition, one was assigned to the enhanced school/low media condition, one was assigned to the enhanced school/intensive media condition, two were assigned to the comprehensive/low media condition and one school was assigned to the comprehensive program/intensive media condition. There are two schools in some conditions because the original study sites were made up of more than one community. The students in the largest school in each community were surveyed.
Data collection

Youth tobacco use was measured through anonymous, self-administered questionnaires. Schools, therefore, rather than communities were chosen as the primary sampling unit for this study. Pre-intervention data were collected in spring 2000 using a passive consent procedure approved by the UTSPH committee for the protection of human subjects. Parents of students attending the selected schools were notified in English or Spanish about the purpose of the survey 2 weeks prior to its administration. Among the parents notified, 19 returned forms denying their children’s participation. These students, on the day of survey administration, were provided alternate classroom activities. Students who did participate were informed of their rights as research subjects, provided an explanation about the purpose of the study and informed that their participation was voluntary. No teachers reported refusals among students for whom implied consent was obtained. After the intervention programs were implemented, the post-intervention survey was administered in fall 2000 utilizing the spring 2000 protocol.

Measures

The pre- and post-intervention surveys assessed a wide range of socio-demographic, environmental, behavioral and personal factors related to adolescent smoking and exposure to school anti-tobacco programs. In addition to these measures, the post-intervention survey assessed exposure to the media campaign and community programs using a format proven useful in other studies of health promotion campaigns (McAlister et al., 2000).

Tobacco use was assessed by asking students if they had used any tobacco product (i.e. cigarettes, pipes, cigars or spit tobacco) in the past 30 days. Response categories included: none; 1 or 2, 3–5, 6–9, 10–19, 20–29 or all 30 days. A response indicating tobacco use on at least one of the past 30 days defined a student as a current tobacco user. Current cigarette use was measured by asking students on how many days during the past 30 days...
they had smoked cigarettes. The same response categories were used.

Students’ self-reported exposure to the media campaign was assessed at the post-intervention survey with a three-item sum scale including the number of daily exposures to the DUCK cartoon character’s messages through TV and radio commercials and billboards in the last 30 days. The response categories for each of the three exposure sources included none (coded 0), 1–3 times in the past 30 days (coded 2), 1–3 times per week (coded 8), daily or almost daily (coded 30) and more than once a day (coded 45). The range of the measures was 0–135.

A modified algorithm for the well-validated susceptibility scale (Pierce et al., 1993, 1996) that integrates intentions (Ajzen, 1980; Sussman et al., 1987) and expectations of future behavior (Bandura, 1977, 1986; Bauman, 1987) was used to identify youth having a cognitive predisposition toward smoking. Students were asked if they were thinking about smoking cigarettes during (1) the next year, (2) 5 years from now or (3) whether they would smoke a cigarette if their best friend offered it. Likert-type response alternatives to each question ranged from definitely yes (1) to definitely no (4). The sum score assessing susceptibility varied ranged from 0 (no susceptibility) to 1 (maximum susceptibility).

Scales measuring youths’ beliefs about the ability of tobacco to control mood and to provide social benefits were also utilized. Each scale item had four response categories (definitely not, probably not, probably yes and definitely yes). The Cronbach coefficient $\alpha$s of the scales both in the pre- and post-intervention surveys, respectively, are indicated in parentheses. The mood control scale ($\alpha = 0.77, 0.78$) consisted of three items: ‘Do you believe smoking can help people when they are bored?’ ‘Do you believe cigarette smoking helps people relax?’ and ‘Do you think smoking cigarettes helps people feel more comfortable at parties and in other social situations?’.

The social benefits scale ($\alpha = 0.74, 0.72$) contained three items: ‘Do you think young people who smoke cigarettes have more friends?’ ‘Do you think smoking cigarettes makes young people look cool or fit in?’ and ‘Is smoking a sign of being older or more grown-up?’.

An anti-tobacco attitude scale ($\alpha = 0.65, 0.68$) included five items: ‘Can people get addicted to cigarette smoking just like they can get addicted to cocaine or heroin?’, ‘Does tobacco kill more Texans than alcohol, AIDS, illegal drugs, auto accidents, suicides, homicides, and fires combined?’, ‘Does tobacco smoke smell and taste horrible?’, ‘Do you think the smoke from other people’s cigarettes is harmful to you?’ and ‘If I smoke (or were to smoke), I would consider this stupid of me’.

A self-efficacy scale ($\alpha = 0.90, 0.91$) contained four items: ‘If your friends offer you a cigarette, are you able not to smoke?’ ‘If you are with friends who smoke, are you able not to smoke?’, ‘If you feel nervous, are you able not to smoke?’ and ‘If you are depressed, are you able not to smoke?’.

**Analysis**

Outcomes of the TTPI media and community interventions were examined at post-intervention applying a $3 \times 3$ design; however, as previously noted, the final number of conditions was reduced to eight because of the removal of the comprehensive/no media campaign condition. Changes from the pre- to post-intervention assessments are proportional using the formula: $(post-intervention – pre-intervention)/pre-intervention \times 100$, to adjust for potential pre-treatment differences in age, gender and race. Differences were tested with the $\chi^2$-test. In order to adjust for the intraclass correlation and to remove variability due to demographics from the time × intervention condition, general linear and non-linear mixed model procedures were used to model changes in students’ current tobacco use, current cigarette use, susceptibility to tobacco use, and beliefs about the mood control and social benefits of smoking. In these analyses for the nested, cross-sectional pre-test–post-test design, correlation among students within a school and correlation among students with a time × school survey are random effects, while time and
intervention condition and their interaction are fixed effects (Murray, 1998). These analyses also allow for adjustment for covariates (age, gender and race) as the intervention effect on outcome variables were assessed as the adjusted difference in the intervention condition relative to the comparison condition [(treatment at post-test – treatment at pre-test) – (reference at post-test – reference at pre-test)]. All analyses were performed using SAS version 8.

Results

Overall, 3618 sixth graders responded to the pre-intervention survey in the spring of 2000. The post-intervention survey took place with a new grade six cohort of 3374 in November/December, 2000. The demographic characteristics of the samples are shown in Table I.

The proportion of males and females was, as expected, approximately equal. The mean age in the pre-intervention sample was 11.8 (SD = 0.8) and 11.6 years (SD = 0.8) in the post-intervention sample reflecting the administration of the pre-intervention survey in the spring toward the end of the school year and the post-intervention survey in the fall during the start of the school year. The statistical difference in the ethnic distributions between the pre- and post-intervention surveys [$\chi^2$ (d.f. = 5) = 33.79; $P < 0.001$] was mainly due to an increase in African-American and a decrease in Hispanic enrollment from baseline to follow-up. Compared to 2000 census data on the ethnic distribution of youth of the same age as the study population in the state of Texas (white 25%, Hispanic 55%, black 15%, Asian 3% and other 2%), on the whole blacks and Asians were over-represented minorities, and Hispanics under-represented in the two study samples (US Census Bureau, 2000).

Response rates to the pre- and post-intervention surveys were calculated based on school administrators’ reports on student enrollment at the time of the survey and the number of returned questionnaires. The overall response rates were 78.7 and 67.2%, respectively.

Table I. Characteristics (%) of sixth grade students in spring 2000 and fall 2000 surveys

<table>
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<th>Spring 2000 (N = 3618)</th>
<th>Fall 2000 (N = 3374)</th>
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<tr>
<td>Gender</td>
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</tr>
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</table>

The mean of 30-day tobacco use among the entire sample was 15.5% (range 5.3–28.6) at the pre-intervention survey and 8.5% (range 4.2–13.8%) at the post-intervention survey. Mean adjusted reductions by type of community program were: 37.6% in the no program condition, 48.5% in the enhanced school program condition and 51.4% in the comprehensive program condition (Figure 3). The reductions in the enhanced school and comprehensive conditions were similar and significantly greater than in the no program condition ($\chi^2 = 52.37$, d.f. = 2, $P < 0.001$).

Figure 3 also shows tobacco use reductions by level of media campaign: 40.3% in the no campaign condition, 41.2% in the low media condition and 61.6% in the intensive media condition ($\chi^2 = 109.72$, d.f. = 2, $P < 0.001$). Surprisingly, the low media condition was not more effective than the no media condition. However, reductions in six of the seven treatment conditions exceeded that observed in the no media/no community program (no treatment) condition (28.3%). The exception was the no community program/intensive media condition experiencing only a 20.8% reduction. The most effective was the intensive media/comprehensive program condition (−60.8%), but also the intensive media/enhanced school program condition (−52.9%) and the enhanced school program condition alone (−51.1%) effectively reduced teens’ tobacco use. The difference between each of these observations may be attributable to non-random
variation between tobacco use rates among students attending schools in communities assigned to differing program conditions and to randomly distributed measurement errors. Some variation may also be attributed to systematic (non-random) differences between trends in communities in which the schools are located that is not related to the experimental design, e.g. tobacco prevention activities not supported by the TTPI. In addition, Figure 3 also shows that some variation is related to the research design.

These results were validated using non-linear mixed model analysis. Using this method, the reduction in current tobacco use ranged from 0.14 to 10.9%. The most significant reduction (10.9%) occurred in the intensive media/comprehensive program condition ($P < 0.01$). Reductions, although not significant, were also observed in the low media/enhanced school program condition (5.0%, $P = 0.14$) and the enhanced school program condition alone (4.2%, $P = 0.24$). These findings confirm that the intensive media/comprehensive program condition was the most effective in preventing tobacco use as shown in Figure 3.

Overall, 9.4% of the students (range 3.2–17.4%) at pre-intervention and 6.0% (range 2.6–11.5%) at post-intervention survey had smoked cigarettes in the last 30 days. The mean adjusted reductions were very similar to those observed for 30-day tobacco use: 30.7% in the no community program condition, 42.4% in the enhanced school condition and 36.7% in the comprehensive condition. The reductions in the enhanced school and comprehensive program conditions were highly statistically significant compared to the no program condition ($\chi^2 = 30.9$, d.f. = 2, $P < 0.001$), but also differed significantly from each other ($\chi^2 = 7.66$, d.f. = 1, $P < 0.05$). Adjusted reductions in tobacco use by media campaign (27.3% in no media, 29.5% in low media and 57.4% in intensive media) followed the same pattern as did 30-day tobacco use. In six of seven treatment conditions, current cigarette use was reduced more than in the control (no media/no community program) condition (13.7%). The exception was the enhanced school program/low media condition showing only a 10.9% reduction. Again, there is some unexplained variation that is not related to the research design. The greatest
reduction took place in the intensive media campaign/comprehensive program condition (56.7%) followed by the intensive media/enhanced school program condition (54.5%).

The results from non-linear mixed model analysis revealed reductions in current cigarette smoking that ranged from 0.6 to 6.9%. The reduction in the intensive media/comprehensive program condition (6.9%) was highly statistically significant ($P < 0.05$). The reduction in the low media/enhanced school program condition (4.9%) approached significance ($P = 0.08$), but the remainder of the conditions produced no statistically significant effects on current smoking status.

The adjusted susceptibility to tobacco use score was reduced by 24.6% among the entire sample at post-intervention assessment. Figure 4, which depicts the effects of the community program and media campaign conditions, reveals that reductions in the enhanced school (30.1%) and comprehensive community program conditions (27.1%) were significantly greater than in the no-program condition (17.9%) ($\chi^2 = 49.93$, d.f. = 2, $P < 0.001$). The intensive media campaign was by far the most effective in reducing susceptibility (45.5%) compared to modest reductions in the low media (19.6%) and no media campaign (13.1%) conditions ($\chi^2 = 272.94$, d.f. = 2, $P < 0.001$). Figure 4 also reveals the positive and strong impact the intensive media campaign had in suppressing students’ susceptibility to smoking when combined with an enhanced school or comprehensive community program.

These findings were confirmed using general linear analysis. As expected, the intensive media/comprehensive program condition produced the greatest reduction (0.08) in students’ susceptibility to smoking ($P < 0.01$). Other reductions were more modest in the intensive media/enhanced school program condition (0.05, $P = 0.06$), low media/enhanced school program condition (0.05, $P = 0.06$) and enhanced school program condition alone (0.05, $P = 0.06$).

The two belief indicators, mood control and social benefits of smoking, were reduced overall by 2.6 and 13.3%, respectively, from pre- to post-intervention assessment.
post-intervention assessment (Tables II and III). The reductions were significantly greater in the comprehensive condition (mood control benefits, 12.3%, $\chi^2 = 237.46$, d.f. = 2, $P < 0.001$; social benefits, 21.8%, $\chi^2 = 140.14$, d.f. = 2, $P < 0.001$) than in the enhanced school or no-program condition. The enhanced school program condition did not outperform the no-program condition in either measure ($P > 0.10$). Tables II and III also show that the intensive and low media campaigns produced greater reductions in both belief in mood control ($\chi^2 = 228.14$, d.f. = 2, $P < 0.001$) and social benefits ($\chi^2 = 261.34$, d.f. = 2, $P < 0.001$) as compared to the no-media campaign condition.

An examination of the eight conditions demonstrates the importance of the media campaign. Program conditions combined with the intensive or low media campaign produced a reduction in beliefs about the beneficial effects of smoking, while a lack of media campaign resulted in an increase in beliefs about such benefits. The only unexpected exception was mood control benefits in the intensive media/comprehensive program condition (see Table II). As stated when other unanticipated findings occurred, this may be explained by the existence of outliers and significant variations in trends unrelated to the research design.

Results from general linear analysis confirmed that the greatest reduction (0.09, $P < 0.01$) in beliefs about mood control of smoking occurred in the intensive media/comprehensive program condition. Reductions were also observed in the low media/comprehensive program condition (0.06, $P < 0.01$) and the low media/enhanced school program condition (0.09, $P < 0.01$). Intervention effects on students’ beliefs about tobacco use as a mood enhancer ranged from –0.01 to 0.09. The intervention effect on social benefits ranged from 0.03 to 0.08. The greatest reduction (0.08, $P < 0.01$) in students’ beliefs about the social benefits of smoking occurred in the intensive media/comprehensive program condition. The importance of the media campaign is also demonstrated here. The intensive media/comprehensive condition also produced a reduction (0.05, $P < 0.01$) in beliefs about the social benefits of smoking as did the low media/enhanced school condition (0.05, $P < 0.05$) and intensive media (0.05, $P < 0.05$) and low media alone (0.05, $P < 0.05$).

Observed changes in anti-tobacco attitudes and self-efficacy were more modest than those seen in beliefs. The overall pre-/post-intervention reduction in anti-tobacco attitudes was 4.5% and in self-efficacy was 2.8%. Consequently, none of the community programs or media campaign comparisons was significant.

### Discussion

The present study was conducted to evaluate the effects of three levels of media and three conditions on youth tobacco prevention program effects in Texas.
community program options on tobacco use among middle school youth in Texas. The study design allowed a more detailed look into the ways in which tobacco control interventions work at the community level. Consistent with the findings of other studies (Bauer et al., 2000; Biglan et al., 2000; Wakefield and Chaloupka, 2000; National Association of County and City Health Officials, 2001), this study supports the conclusion that short-term reductions in teen tobacco use, smoking intentions and positive beliefs about tobacco use can be achieved by combining media campaigns with community-based programs. Overall, the intensive media campaign appeared to magnify the effects of the varying program conditions when compared to the low-level media campaign. The findings reveal that while the enhanced school program condition was equally effective in reducing 30-day tobacco use and susceptibility to tobacco use as the comprehensive community program condition, the school-based program worked less well to reduce beliefs about the beneficial effects of tobacco use, a precursor to susceptibility and tobacco use. The overall effects of anti-smoking media campaigns also seemed to vary by the precursor–susceptibility–behavior continuum. The intensive media campaign was needed to reduce behavior and susceptibility, while the low-level media campaign was sufficient to diminish pro-smoking beliefs.

Limitations
A quasi-experimental research design has several limitations since it is virtually impossible to find research units in the community that are completely comparable to estimate treatment effects. For instance, the intensive media and comprehensive program conditions had the highest tobacco use rates at pre-intervention. Thus, regression toward the mean is a probable explanation for outcomes. The relatively small number of units (11 schools) in eight conditions limits the degree to which changes in youth tobacco use and beliefs can be attributed to treatment effects. A randomized trial was not conducted, thereby limiting the degree to which changes in youth tobacco use behavior could be attributed to media and community program conditions. Lack of randomization in the research design was driven by the Texas Legislature’s objective to obtain information about how the state’s tobacco income could be optimally used to achieve the greatest prevention effect based on per capita spending. The researchers would have preferred to design a fully randomized controlled trial with intensive intervention areas and then to compare them to similar areas receiving no or lesser interventions. Some variation in the outcomes may be attributed to systematic (non-random) differences between trends in communities that are not related to the experimental design and to the existence of outliers. The lack of longitudinal data is another study limitation. No causal relationships can be established. While the various groups were roughly comparable, unmeasured variations among communities can introduce error into estimations of media and program effects. We also note that intervention activities were organized and implemented in less than a year. Greater effects may manifest once programs become fully operational and established in the community. Despite these caveats, the present findings were used by the TDH to estimate the effects of different types and levels of state spending for tobacco control. While the federally recommended spending level of $5.00 or more per capita may produce better results (US Department of Health and Human Services, 2000), activities involving annual expenditures of $3.00 per capita (comprehensive program conditions) supporting intensive media campaigns and comprehensive community programs of TTPI appear to be associated with a significant reduction in adolescent tobacco use. Although statewide implementation of high-level media campaigns combined with comprehensive community programs is expensive, a cumulative reduction in smoking of at least 20–30% can be obtained within 15–20 years. Great benefits, then, would come from the reduction in disease and death rates that will ensue, with tens of thousands of early deaths eventually prevented and hundreds of thousands of healthy years of living gained.
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