

# Preventing Tobacco Use Among Young People in India: Project MYTRI

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In the 21st century, India has become one of the countries most affected by tobacco-related mortality. It is anticipated that nearly 1 million Indians will die annually from smoking by 2010, with 70% of those deaths prematurely occurring among people between the ages of 30 and 69 years.<sup>1</sup> One of the challenges in global chronic disease prevention is reducing tobacco use, particularly in developing countries, such as India, with large populations (i.e., more than 1 billion residents).<sup>2</sup>

In India, the onset of tobacco use typically occurs in adolescence, with an estimated 5500 young people initiating use of tobacco every day.<sup>3</sup> A recent national survey revealed that more than 25% of adolescents aged 13 to 15 years in India had used tobacco, and 17% reported current use.<sup>4</sup> In our own research, in which we surveyed approximately 12 000 students in 2004, we found that 6th graders were 2 to 4 times more likely than were 8th graders to have used tobacco, potentially signaling a large increase in the onset in this younger cohort.<sup>5</sup> Any increase in the prevalence of tobacco use will translate to even greater rates of premature disability and death in India.<sup>1</sup>

To date, no controlled community trials, to our knowledge, have assessed a multicomponent strategy for tobacco use prevention among youth in India. In the United States, a recent Institute of Medicine report highlighted the importance of tobacco use prevention among young people as 1 of 3 major strategies (the others being cessation treatment and regulatory approaches) that can be used to “end the tobacco problem.”<sup>6</sup> The report recommended that middle schools and high schools implement evidence-based tobacco use prevention programs and that a national youth-oriented mass media campaign be initiated in coordination with school and community programs.<sup>6</sup> The evidence-based prevention programs implemented in the United States<sup>7</sup> may not be applicable to India (e.g., as a result of between-country cultural, structural, and language differences).<sup>8</sup>

**Objectives.** We assessed the effectiveness of a 2-year multicomponent, school-based intervention designed to reduce tobacco use rates among adolescents in an urban area of India.

**Methods.** Students from 32 schools in Delhi and Chennai, India, were recruited and randomly assigned to an intervention or control group. Baseline, intermediate, and outcome data were collected from 2 cohorts of 6th- and 8th-grade students in 2004; 14 063 students took part in the study and completed a survey in 2004, 2005, or 2006. The intervention consisted of behavioral classroom curricula, school posters, a parental involvement component, and peer-led activism. The main outcome measures were self-reported use of cigarettes, bidis (small hand-rolled, often flavored, cigarettes), and chewing tobacco and future intentions to smoke or use chewing tobacco.

**Results.** Findings showed that students in the intervention group were significantly less likely than were students in the control group to exhibit increases in cigarette smoking or bidi smoking over the 2-year study period. They were also less likely to intend to smoke or chew tobacco in the future.

**Conclusions.** School-based programs similar to the intervention examined here should be considered as part of a multistrategy approach to reducing tobacco use among young people in India. (*Am J Public Health*. 2009;99:899–906. doi:10.2105/AJPH.2008.145433)

Thus, it seems critical to develop and evaluate a tobacco use prevention program based on interventions that have proven effective in developed countries but adapted and translated for India.<sup>8</sup>

Project MYTRI (Mobilizing Youth for Tobacco-Related Initiatives in India) was a group-randomized trial designed to assess a multicomponent intervention aimed at preventing tobacco use among Indian adolescents. The project was the result of a partnership between researchers at the University of Texas School of Public Health and Health Related Information and Dissemination Among Youth, a nongovernmental organization in Delhi, India. The project involved 4 phases: (1) the assessment of factors predictive of tobacco use among youth in urban India,<sup>9,10</sup> (2) the development of the intervention program and measurement methods,<sup>8,10</sup> (3) the assessment of baseline and first-year follow-up data,<sup>5,11–13</sup> and (4) the evaluation of final outcomes. For our study, we focused on the project’s final outcomes.

## METHODS

Project MYTRI focused on reducing tobacco use among adolescents in schools in Delhi and Chennai, India. We hypothesized that a multicomponent prevention program would have a positive impact in terms of altering rates of cigarette smoking, bidi (small hand-rolled, often flavored, cigarettes with leaf wrappers) smoking, and use of chewing tobacco among students, reducing the expected increases in such behaviors over time.

### Study Design

Students from 16 schools in Delhi and 16 schools in Chennai were recruited to participate in the group-randomized trial. As a means of ensuring representativeness, schools within each city were matched according to type of school (private vs government, and coeducational vs girls only vs boys only) and then randomly assigned to receive the tobacco use intervention program over 2 academic years or to serve as a delayed intervention control

school. The intervention was implemented over 2 consecutive academic years, 2004–2005 and 2005–2006. The study design has been described in detail elsewhere.<sup>11</sup>

At each school, 2 cohorts of students—those in the 6th and 8th grades when the study began in 2004—participated in the project. Students in these cohorts were surveyed 3 times to assess their tobacco use as well as associated social, environmental, and intrapersonal factors: (1) at baseline (before the intervention, at the beginning of the 2004 academic year), (2) after the first year of intervention (at the beginning of the 2005 academic year, when students were in the 7th and 9th grades), and (3) after completion of the intervention (at the beginning of the 2006 academic year, when students were in the 8th and 10th grades). We present results from all 3 time points.

### Participants

In 2004, all 32 schools participated in the survey; in 2005 and 2006, 2 schools did not participate as a result of conflicting academic schedules and priorities. An additional 3 schools would not allow 10th graders to participate in 2006 because of upcoming national exams. All students enrolled in the participating schools in the 6th and 8th grades in 2004 ( $n=12\,484$ ), in the 7th and 9th grades in 2005 ( $n=12\,075$ ), and in the 8th and 10th grades in 2006 ( $n=12\,752$ ) were eligible and invited to participate in the survey. Response rates were 94.1% in 2004 ( $n=11\,748$ ), 94.7% in 2005 ( $n=12\,821$ ), and 84.0% in 2006 ( $n=10\,625$ ).

Reasons for nonparticipation included parent refusals (which occurred in less than 1% of cases), student refusals (also less than 1%), and student absentees or school lack of participation (range=4%–16%). Makeup surveys were conducted to accommodate students who were absent on the day of the survey. The 2 schools that did not participate in the survey were in Delhi; one was an intervention school and one was a control school. The 3 schools that did not allow 10th graders to participate in 2006 were also in Delhi; 2 were control schools and one was an intervention school. Students who answered 4 or more survey questions inconsistently (e.g., reporting no history of tobacco use while also reporting tobacco use in the past

month; less than 1% of the sample provided inconsistent responses) were eliminated to increase study validity and reliability.

We focused on the 14 063 students who completed 1 or more of the study surveys; 6365 (45.3%) students completed 3 surveys, 3780 (26.9%) completed 2 surveys, and 3918 (27.9%) completed 1 survey. Approximately 43% of the students were female, 62.1% were enrolled in government (lower socioeconomic status) schools, 46.5% were from Delhi, 50.9% were 6th (vs 8th) graders at baseline, and 45.3% were enrolled in intervention schools. Rates of missing data (at any time point) were higher among students who reported tobacco use ( $P<.01$ ), but there were no between-group (intervention vs control) differences in missing data according to tobacco use (current vs ever) status ( $P>.05$ ).

### Intervention Program

The Project MYTRI intervention was developed with social cognitive theory and existing evidence-based smoking prevention programs as a frame of reference.<sup>7,9,14</sup> The objectives of the intervention were to influence environmental factors (social norms, role models, social support, opportunities) and intrapersonal factors (knowledge, values, meanings, beliefs, skills) that predict tobacco use among urban Indian youths.<sup>10</sup> Three types of tobacco use—cigarette smoking, bidi smoking, and use of chewing tobacco—were addressed. The intervention program has been described in detail elsewhere.<sup>8,10,11</sup>

The 2-year school-based intervention consisted of 4 primary components. First, the behavioral component consisted of 7 peer-led classroom activities for 6th- and 8th-grade students in 2004–2005 and 6 additional activities for 7th- and 9th-grade students in 2005–2006. Second, 6 posters were hung in schools each year, corresponding with classroom activity themes. In the third, parental involvement component, 6 postcards were sent home to parents during the 2004–2005 school year. Finally, the peer leadership component focused on peer-led health activism outside of the classroom, including competitions between classrooms and schools. The components were designed to be generally relevant to the schools' settings, developmental stages, and educational approaches. However,

unique strategies were implemented as well, notably the use of an activity format in which elected peer leaders facilitated small groups.

Implementation of the intervention included the training of field staff, teachers, and peer leaders in each city at the beginning of both school years. There was also ongoing support in the schools as needed by field staff. The intervention spanned approximately 4 months of each school year. Sets of manuals for teachers and peer leaders were provided, as well as activity classroom supplies and a handbook for each student. Materials were developed in English, Hindi, and Tamil as appropriate to each school's need.

### Evaluation

The primary evaluation consisted of a self-administered scannable survey implemented in classrooms by 2-person teams of trained research staff utilizing standardized protocols. Students completed the survey before the beginning of the intervention (2004), at the midpoint of the intervention (2005), and after completion of the intervention (2006). The confidentiality of student responses was ensured through the use of a unique identification tag that was not recognizable to students or school staff but could be used to track students over time. The survey, which was administered in English, Hindi, or Tamil, was adapted from existing instruments<sup>4</sup> and underwent rigorous pilot testing as well as reliability and validity testing.<sup>5,10</sup>

The survey assessed current tobacco use via 3 questions to which students answered yes or no: (1) "During the last 30 days, did you chew tobacco in any form?" (2) "During the last 30 days, did you smoke 1 or more bidis?" and (3) "During the last 30 days, did you smoke 1 or more cigarettes?" Students who responded yes to 1 or more of these 3 questions were considered current users of any tobacco product. Two composite scores were developed to assess future intentions (in the subsequent year, in college, or as an adult) to chew or smoke tobacco. In addition, the survey assessed 14 social, environmental, and intrapersonal factors associated with tobacco use, including knowledge of the health effects of tobacco use, beliefs about the social consequences of tobacco use, reasons to use or not to use tobacco,

perceived prevalence of tobacco use, and knowledge and support of tobacco-control policies. Details on the survey instrument and the reliability and validity of the measures used have been published elsewhere.<sup>10,11</sup>

**Data Analysis**

We used mixed-effects regression models for repeated measures data (i.e., growth curve analyses) to examine differences between the intervention and control groups over time. This method of analysis is appropriate for longitudinal investigations that seek to address questions about changes in behavior over time and is robust and flexible, especially in regard to accommodating missing data<sup>15</sup> and nested study designs.<sup>16</sup> In our analyses, we used a 3-level random coefficients model. Mean trajectories (i.e., changes in use or risk over time) for each student were modeled at level 1, mean trajectories for each school were modeled at level 2, and mean trajectories for each study group were modeled at level 3 (with appropriate variability modeled at each level).

In some cases, the 3-level model did not converge because there was no significant variability between schools; in these instances a 2-level model was used instead. We elected to use a linear model because there were only 3 time points. Time was centered at baseline and coded in years to reflect the timing of the surveys (i.e., 0, 1, 2). We assessed city (Delhi or Chennai), grade level (6th or 8th), type of school (government or private), and gender as possible effect modifiers of the intervention outcomes. Maximum likelihood methods (via the LISREL<sup>17,18</sup> multilevel module) were used in estimating all of the models.

**RESULTS**

Program activities were implemented in all 16 intervention schools; participation rates were high, and levels of fidelity to the intervention were good. In the first year, 88% of all curriculum activities were completed, and in the second year, 93% of activities were completed. All posters were routinely hung in the schools and classrooms, and, during the first year, at least 76% of postcards were delivered to parents. In the first and second years, 678 and 761 students, respectively, were trained to be peer leaders and 153 and 133 teachers,

respectively, were trained to supervise and assist peer leaders and to structure the classroom activities. The peer leaders organized an interschool activity in each of the cities, with 3569 students attending in the first year (67% of the intervention cohort) and 4652 students attending in the second year (81%).

**Tobacco Use Outcomes**

Baseline levels of chewing tobacco use and cigarette smoking were equivalent among intervention- and control-group students. Table 1 presents outcomes from the growth curve analyses focusing on the main tobacco use outcomes (i.e., cigarette smoking, bidi smoking, chewing tobacco use, and any tobacco use during the prior 30 days). There were significant between-group differences in the trajectories of cigarette smoking ( $P<.05$ ), bidi smoking ( $P<.01$ ), and any tobacco use ( $P<.04$ ) over the 2 years of the intervention. Whereas rates of cigarette smoking and bidi smoking, as well as any tobacco use, increased over time in the control group (as would be expected with this age population), the rate of tobacco use in the intervention group actually decreased over time. There were no significant between-group differences in the trajectories of chewing tobacco use ( $P>.10$ ). Overall, tobacco use increased by 68% in the control group and

decreased by 17% in the intervention group over the 2 years.

**Intentions and Psychosocial Factors**

At baseline, there were no differences between groups in intentions to use tobacco or on any of the scales assessing psychosocial factors associated with tobacco use. There were significant differences in the trajectories (rates of growth) of students' intentions to chew tobacco ( $P<.03$ ) and to smoke ( $P<.01$ ) over time, with the intervention students decreasing their intentions more so than the control group. Intentions to smoke increased by 5% in the control group and decreased by 11% in the intervention group. Intentions to chew tobacco decreased by 12% in the control group and by 28% in the intervention group (Table 2).

There were also significant differences in students' social, environmental, and intrapersonal factor trajectories over time (Table 2). For example, there were between-group differences with respect to knowledge of the health effects of tobacco use, reasons to use and not use tobacco, perceived prevalence of chewing tobacco use, perceived prevalence of smoking, normative beliefs regarding tobacco use, advocacy skills self-efficacy, knowledge of tobacco-control policies, and social susceptibility

**TABLE 1—Differences in Tobacco Use Between Intervention (n = 6365) and Control (n = 7698) Group Students Over Time: Project MYTRI, 2004–2006**

	Control Group, % (95% CI)	Intervention Group, % (95% CI)	P
<b>Chewing tobacco use</b>			
Baseline	0.14 (-1.15, 1.43)	0.97 (-0.32, 2.26)	.38
Linear rate of change	0.78 (-0.12, 1.68)	0.37 (-0.53, 1.27)	.53
<b>Bidi smoking</b>			
Baseline	0.00 (-0.72, 0.72)	1.25 (0.53, 1.97)	<.01
Linear rate of change	0.90 (0.37, 1.43)	-0.24 (-0.77, 0.29)	<.01
<b>Cigarette smoking</b>			
Baseline	0.00 (-0.77, 0.77)	0.43 (-0.34, 1.20)	.36
Linear rate of change	1.37 (0.72, 2.02)	0.46 (-0.19, 1.11)	.05
<b>Any tobacco use</b>			
Baseline	1.38 (-0.09, 2.85)	3.42 (1.95, 4.89)	.05
Linear rate of change	0.94 (-0.10, 1.98)	-0.59 (-1.63, 0.45)	.04

Note. MYTRI = Mobilizing Youth for Tobacco-Related Initiatives in India; CI = confidence interval. The data shown represent the cohort of students present for all surveys, excluding missing data from 2005 and 2006. Baseline scale scores were raw (not standardized) scores; use during the past 30 days was assessed. The growth curve is derived from a 3-level, linear, random coefficients regression model. P values reflect tests for differences between study groups at baseline (2004), over time (2004–2006), and at the final follow-up (2006).

**TABLE 2—Differences Over Time in Intervention (n=6365) and Control (n=7698) Group Students' Intentions to Use Tobacco and in Social, Environmental, and Intrapersonal Factors Associated With Tobacco Use: Project MYTRI, 2004–2006**

	Control Group, Mean Scale Scores (SE)	Intervention Group, Mean Scale Scores (SE)	P
<b>Intentions</b>			
Intentions to use chewing tobacco <sup>a</sup>			
Baseline score <sup>b</sup>	0.86 (0.07)	0.87 (0.07)	.90
Linear rate of change <sup>b</sup>	-0.10 (0.05)	-0.24 (0.05)	.03
Intentions to smoke cigarettes <sup>a</sup>			
Baseline score <sup>c</sup>	0.55 (0.02)	0.57 (0.02)	.58
Linear rate of change <sup>c</sup>	0.03 (0.02)	-0.06 (0.02)	<.01
<b>Social, environmental, and intrapersonal factors</b>			
Knowledge of health effects of tobacco use <sup>d</sup>			
Baseline score <sup>b</sup>	7.90 (0.08)	7.93 (0.08)	.77
Linear rate of change <sup>b</sup>	0.01 (0.05)	0.36 (0.05)	<.01
Beliefs about social consequences of tobacco use <sup>d</sup>			
Baseline score <sup>c</sup>	11.30 (0.06)	11.36 (0.06)	.54
Linear rate of change <sup>c</sup>	0.47 (0.04)	0.57 (0.04)	.10
Reasons to use tobacco <sup>d</sup>			
Baseline score <sup>c</sup>	15.63 (0.04)	15.53 (0.04)	.08
Linear rate of change <sup>c</sup>	0.18 (0.03)	0.46 (0.03)	<.01
Reasons not to use tobacco <sup>d</sup>			
Baseline score <sup>c</sup>	7.96 (0.07)	7.83 (0.08)	.18
Linear rate of change <sup>c</sup>	0.53 (0.05)	0.79 (0.05)	<.01
Refusal skills efficacy <sup>d</sup>			
Baseline score <sup>c</sup>	5.45 (0.08)	5.26 (0.09)	.12
Linear rate of change <sup>c</sup>	0.91 (0.06)	0.80 (0.06)	.20
Perceived prevalence of chewing tobacco use <sup>d</sup>			
Baseline score <sup>c</sup>	6.90 (0.03)	6.84 (0.03)	.15
Linear rate of change <sup>c</sup>	-0.07 (0.02)	-0.33 (0.02)	<.01
Perceived prevalence of cigarette smoking <sup>d</sup>			
Baseline score <sup>c</sup>	7.04 (0.03)	7.09 (0.03)	.25
Linear rate of change <sup>c</sup>	-0.22 (0.02)	-0.49 (0.02)	<.01
Normative beliefs about tobacco use <sup>d</sup>			
Baseline score <sup>c</sup>	16.61 (0.03)	16.60 (0.03)	.77
Linear rate of change <sup>c</sup>	0.13 (0.02)	0.30 (0.03)	<.01
Normative beliefs about tobacco use <sup>d</sup>			
Baseline score <sup>b</sup>	16.00 (0.22)	15.96 (0.22)	.91
Linear rate of change <sup>b</sup>	0.37 (0.16)	0.53 (0.15)	.49
Advocacy skills efficacy <sup>d</sup>			
Baseline score <sup>c</sup>	17.31 (0.09)	17.41 (0.10)	.46
Linear rate of change <sup>c</sup>	-0.40 (0.07)	-0.08 (0.07)	<.01
Knowledge of tobacco control policies <sup>d</sup>			
Baseline score <sup>c</sup>	3.40 (0.02)	3.26 (0.02)	<.01
Linear rate of change <sup>c</sup>	0.08 (0.02)	0.34 (0.02)	<.01
Support of tobacco control policies <sup>d</sup>			
Baseline score <sup>c</sup>	13.80 (0.03)	13.83 (0.03)	.53
Linear rate of change <sup>c</sup>	0.16 (0.02)	0.20 (0.02)	.23

Continued

TABLE 2—Continued

Social susceptibility to chewing tobacco use <sup>a</sup>			
Baseline score <sup>d</sup>	0.65 (0.07)	0.71 (0.07)	.53
Linear rate of change <sup>b</sup>	-0.06 (0.05)	-0.22 (0.05)	.02
Social susceptibility to cigarette smoking <sup>a</sup>			
Baseline score <sup>b</sup>	0.44 (0.08)	0.46 (0.08)	.89
Linear rate of change <sup>b</sup>	0.04 (0.05)	-0.08 (0.05)	.09

Note. MYTRI = Mobilizing Youth for Tobacco-Related Initiatives in India. The data shown represent the cohort of students present for all surveys, excluding missing data from 2005 and 2006.

<sup>a</sup>Scale score is a raw (not standardized) score; higher scores indicate more risk (see Stigler et al.<sup>10</sup> for details).

<sup>b</sup>The growth curve is derived from a 3-level, linear, random coefficients regression model. *P* values reflect tests for differences between study groups at baseline (2004), over time (2004–2006), and at the final follow-up (2006).

<sup>c</sup>The growth curve is derived from a 2-level, linear, random coefficients regression model. *P* values reflect tests for differences between study groups at baseline (2004), over time (2004–2006), and at the final follow-up (2006).

<sup>d</sup>Scale score is a raw (not standardized) score; higher scores indicate less risk (see Stigler et al.<sup>10</sup> for details).

to chewing tobacco use (all:  $P < .05$ ). All of these differences were in the hypothesized direction with the exception of perceived prevalence of chewing tobacco use and perceived prevalence of smoking, for which the trajectories of intervention students' perceptions increased more than did those of control students.

### Gender and Grade-Level Effects

As mentioned, city, grade level, gender, and type of school were examined as potential effect modifiers. Both gender and grade-level interaction terms proved to be statistically significant in the case of all variables ( $P < .01$ ); thus, subgroup analyses were conducted. The results of these analyses are shown in Table 3. The trajectories for girls in the intervention schools increased less than did the trajectories for girls in the control schools with respect to bidi smoking ( $P < .03$ ), cigarette smoking ( $P < .01$ ), and any tobacco use ( $P < .01$ ); the difference was marginal for chewing tobacco use ( $P < .06$ ). The trajectories for boys in the intervention schools also increased less than did the trajectories for boys in the control schools, but differences were significant only in the case of smoking ( $P < .01$ ).

The trajectories for intervention group students who were 6th graders in 2004 (6th-grade cohort) increased less than did the trajectories for the control group 6th-grade cohort with respect to bidi smoking ( $P < .01$ ), cigarette smoking ( $P < .04$ ), and any tobacco use ( $P < .02$ ). The trajectories for the intervention group 8th-grade cohort increased less than did those for the control group 8th-grade cohort,

but differences were significant only for bidi smoking ( $P < .04$ ). There were no significant interaction terms for type of school or city.

### DISCUSSION

Project MYTRI was successful in reducing tobacco use, particularly cigarette smoking and bidi smoking, among adolescents in Delhi and Chennai over time. Given that adolescence is the period during which acceptability and peer reinforcement of smoking typically increase<sup>10</sup> and the point at which experimentation is generally predictive of future use,<sup>19</sup> reducing rates of use among young people can have long-term health implications.<sup>1</sup> Primary prevention via school-based programs is but one component of a multilevel approach to addressing the global tobacco epidemic. However, Project MYTRI provides an example of an evidence-based intervention that can be adapted and implemented in urban areas of countries such as India. Given that India is home to more children than any other country,<sup>20</sup> the impact of Project MYTRI could be substantial if the intervention is disseminated across the country.

Project MYTRI outcomes were similar across cities and types of schools, reinforcing its potential for generalizability across schools in other urban areas of India. Also of note is that the project was successful in schools of both higher socioeconomic status (private schools) and lower socioeconomic status (government schools). Although this outcome is clearly very important, many adolescents do not attend school at all,<sup>21</sup> and it can be presumed that their tobacco use rates are higher than those of

young people who attend school.<sup>22,23</sup> Thus, additional types of community-based strategies are needed to reduce tobacco use among Indian youth, with a focus on those living in poverty.

Project MYTRI was more successful in reducing tobacco use rates among girls and 6th graders, respectively, than among boys and 8th graders. Although more boys than girls use tobacco in India, the male–female ratio of tobacco use is much smaller in adolescence (2:1) than adulthood (10:1), suggesting that girls may be initiating tobacco use at higher rates than did their mothers and grandmothers.<sup>4</sup> Given that currently 1 of every 20 women in India die from smoking-related diseases, as compared with 1 of every 5 men, any strategy that prevents young women from using tobacco will eventually translate into maintaining a relatively lower rate of female smoking-related morbidity.

Also, as reported previously,<sup>5</sup> tobacco use rates at the beginning of our study were higher among 6th graders than among 8th graders; thus, Project MYTRI's success in altering the behaviors of this group at a relatively early age is significant. Additional research on changes in psychosocial factors associated with tobacco use among boys and 8th graders might identify areas of the intervention that need to be strengthened to increase its effectiveness with these groups.

Project MYTRI was not successful in reducing rates of chewing tobacco use among adolescents in the study schools. Although lessons on the use of chewing tobacco were emphasized, much more information was provided about smoking-related consequences,

**TABLE 3—Differences in Tobacco Use Between Intervention (n=3626) and Control (n=4321) Group Students Over Time, by Gender and Grade Level: Project MYTRI, 2004–2006**

	Control Group, % (95% CI)	Intervention Group, % (95% CI)	P
<b>Boys</b>			
Chewing tobacco use			
Baseline	0.20 (-1.68, 2.08)	0.46 (-1.36, 2.28)	.84
Linear rate of change	1.14 (-0.19, 2.47)	1.08 (-0.21, 2.37)	.95
Bidi smoking			
Baseline	1.21 (0.80, 1.62)	1.59 (1.14, 2.04)	.22
Linear rate of change	0.14 (-0.19, 0.47)	-0.27 (-0.63, 0.09)	.11
Cigarette smoking			
Baseline	0.00 (-1.12, 1.12)	0.20 (-0.90, 1.30)	.37
Linear rate of change	2.11 (1.50, 2.72)	0.96 (0.40, 1.52)	<.01
Any tobacco use			
Baseline	1.07 (-1.01, 3.15)	3.32 (1.30, 5.34)	.13
Linear rate of change	1.72 (0.25, 3.19)	0.00 (-1.41, 1.41)	.10
<b>Girls</b>			
Chewing tobacco use			
Baseline	0.57 (-0.27, 1.41)	1.77 (0.95, 2.59)	.05
Linear rate of change	0.00 (-0.53, 0.53)	-0.67 (-1.20, -0.14)	.06
Bidi smoking			
Baseline	0.84 (0.51, 1.17)	1.25 (0.88, 1.62)	.12
Linear rate of change	-0.30 (-0.48, -0.12)	-0.59 (-0.79, -0.39)	.03
Cigarette smoking			
Baseline	0.36 (-0.13, 0.85)	0.68 (0.21, 1.15)	.35
Linear rate of change	0.37 (0.06, 0.68)	-0.02 (-0.33, 0.29)	.01
Any tobacco use			
Baseline	1.98 (1.00, 2.96)	3.24 (2.28, 4.20)	.07
Linear rate of change	-0.10 (-0.71, 0.51)	-1.29 (-1.90, -0.68)	<.01
<b>6th-grade cohort</b>			
Chewing tobacco use			
Baseline	1.20 (-0.43, 2.83)	1.00 (-0.63, 2.63)	.87
Linear rate of change	-0.09 (-1.13, 0.95)	0.13 (-0.91, 1.17)	.78
Bidi smoking			
Baseline	0.00 (-0.90, 0.90)	2.45 (1.55, 3.35)	<.01
Linear rate of change	0.55 (-0.06, 1.16)	-0.98 (-1.59, -0.37)	<.01
Cigarette smoking			
Baseline	0.00 (-1.02, 1.02)	0.73 (-0.29, 1.75)	.27
Linear rate of change	1.09 (0.40, 1.78)	0.09 (-0.60, 0.78)	.04
Any tobacco use			
Baseline	2.08 (0.18, 3.98)	5.56 (3.66, 7.46)	.01
Linear rate of change	0.16 (-1.02, 1.34)	-1.89 (-3.07, -0.71)	.02
<b>8th-grade cohort</b>			
Chewing tobacco use			
Baseline	0.00 (-1.14, 1.14)	0.47 (-0.67, 1.61)	.12
Linear rate of change	1.69 (0.81, 2.57)	0.92 (0.04, 1.80)	.23
Bidi smoking			
Baseline	0.00 (-0.69, 0.69)	0.22 (-0.47, 0.91)	.26
Linear rate of change	0.97 (0.64, 1.30)	0.47 (0.14, 0.80)	.04

Continued

TABLE 3—Continued

Cigarette smoking			
Baseline	0.41 (-0.16, 0.98)	0.00 (-0.57, 0.57)	.23
Linear rate of change	0.95 (0.66, 1.24)	0.97 (0.68, 1.26)	.91
Any tobacco use			
Baseline	0.48 (-0.75, 1.71)	1.52 (0.29, 2.75)	.25
Linear rate of change	2.13 (1.01, 3.25)	0.78 (-0.34, 1.90)	.10

Note. MYTRI = Mobilizing Youth for Tobacco-Related Initiatives in India; CI = confidence interval. The data shown represent the cohort of students present for all surveys, excluding missing data from 2005 and 2006. Baseline scale scores were raw (not standardized) scores; use during the past 30 days was assessed. The growth curve is derived from a 3-level, linear, random coefficients regression model. *P* values reflect tests for differences between study groups at baseline (2004), over time (2004–2006), and at the final follow-up (2006).

influences, norms, and policies. Given the high rates of chewing tobacco use in the sample<sup>5</sup> and the high rates of morbidity and mortality among adults who chew tobacco,<sup>24</sup> it is clear that additional, specific interventions are needed to address this form of tobacco use among young people.

### Strengths and Weaknesses

Project MYTRI's considerable strengths included its strong research design in which schools were randomized to groups yet were representative of all of the types of urban schools in the study cities. There was also very high program participation. It is notable that all of the intervention schools participated each year, and thus the intervention could be evaluated with some assurance that it was delivered as anticipated. The sample of students was large, and our use of reliable and valid measures of tobacco use, future intentions, and psychosocial risk adds to our confidence in the results.<sup>10</sup> Finally, the use of growth curve analysis methods strengthened our ability to conclude that, over time, Project MYTRI was able to affect the trajectory of smoking in the study cohorts.<sup>16,25</sup>

Our study involved weaknesses as well. The most significant was the lack of follow-up data from 2 of the Delhi schools (1 intervention school and 1 control school), which was a result of time constraints at these schools. Three additional schools in Delhi (2 control schools and 1 intervention school) would not allow their 10th-grade students to be surveyed because of ensuing exams (despite the previous agreement of school officials to take part in the study). This is not an unusual situation in school-based research, given ongoing changes

in school administration and priorities.<sup>26,27</sup> Fortunately, rates of missing data were not different in the intervention and control groups, and the results were similar in Delhi and Chennai. Also, our use of growth curve analysis methods allowed estimates of tobacco use trajectories over time among students who did not complete the final survey.<sup>15</sup>

Another limitation is that we did not use any biochemical markers of tobacco use, because of the expense of obtaining and analyzing such data. However, our use of confidential survey methods and repeated surveys helped maintain the validity of students' self-reported tobacco use behaviors. In addition, changes in psychosocial factors predictive of tobacco use<sup>10</sup> were consistently modified by the intervention.

### Conclusions

There is clearly a need to replicate Project MYTRI in other urban areas in India and to modify the program so that it is more effective with older adolescents and boys and more successful in addressing chewing tobacco use. Project MYTRI was able to target a population of more than 6000 adolescents and maintain scientific standards comparable to studies conducted with much smaller samples in the United States. Project MYTRI provides evidence that a multicomponent school-based program, as part of an overall strategic approach to reducing the global burden of smoking, can be effective in developing country settings. ■

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### Contributors

C.L. Perry helped design the intervention study, worked on all aspects of intervention and evaluation planning, and wrote the article. M.H. Stigler developed the evaluation measures for the study, worked on intervention development, and conducted the data analyses. M. Arora developed the intervention program, planned the implementation of the intervention, and oversaw the collection of data and data management. K.S. Reddy helped design the intervention study, worked on all aspects of intervention and evaluation planning, and examined the outcomes of the study.

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### Human Participant Protection

This study was approved by the Independent Ethics Committee of Mumbai, India, and the institutional review boards of the University of Minnesota and the University of Texas Health Sciences Center. Parents provided passive informed consent, and students provided written informed consent.

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