Published in final edited form as:

J Adolesc Health. 2009 March ; 44(3): 229–236. doi:10.1016/j.jadohealth.2008.07.012.

Smoking Patterns in Oregon Youth: Effects of Funding and Defunding of a Comprehensive State Tobacco Control Program

Barbara A. Pizacani, Ph.D.^{a,*}, Clyde W. Dent, Ph.D.^a, Julie E. Maher, Ph.D.^a, Kristen Rohde, M.A.^a, Michael J. Stark, Ph.D.^a, Anthony Biglan, Ph.D.^b, and Jill Thompson, B.S.^c

^aProgram Design and Evaluation Services, Multnomah County Health Department and Oregon Public Health Division, Portland, Oregon

^bOregon Research Institute, Eugene, Oregon

^cOregon Public Health Division, Portland, Oregon

Abstract

Purpose—Comprehensive tobacco control programs have included school-based prevention programs as a key strategy to reach adolescents. Unfortunately, these programs have undergone extensive budget reductions in recent years. In 2003, funding for the Oregon Tobacco Prevention and Education Program was reduced by about 70%, and the school component was entirely defunded. To assess the effects of program funding and subsequent defunding on smoking prevalence within targeted Oregon schools, we compared the change in 30-day smoking prevalence between grades 8 and 11 in school districts in two periods: namely, during funding and after funding was eliminated.

Methods—We used annual school-based survey data for grades 8 and 11 to describe district-level changes in smoking prevalence in five age cohorts: two during the funding period and three after defunding. Each cohort was comprised of districts whose 8th-graders completed the survey and participated again 3 years later. Using mixed models, we compared the change in 30-day adjusted smoking prevalence among cohorts in funded districts, defunded districts, and districts that never received funding.

Results—Smoking prevalence growth was significantly higher among cohorts from the defunded period than for cohorts from the funded period ($p = .04$) and was not significantly different from schools that were never-funded ($p = .79$).

Conclusions—In Oregon, funding a school component of a comprehensive tobacco control strategy was associated with depressed uptake of smoking. Gains were quickly lost upon program defunding. School programs are an important strategy if they are long term, comprehensive, and reinforced in the larger environment.

Keywords

Adolescence; Cigarette smoking prevention and control; Health surveys

Preventing youth from initiating tobacco use is a key aspect of all tobacco prevention efforts. One third of youth smokers will die prematurely from a smoking-related disease [1], and most smokers become tobacco dependent before age 18 years [2]. A clear opportunity for intervening with youth lies in the school setting, and so statewide comprehensive tobacco control programs typically allocate funds for school-based programs.

School-based programs to prevent initiation of tobacco use began in the 1970s after the publication of the first U.S. Surgeon General Report on the dangers of cigarette smoking. Strategies used in these programs were based on the premise that adolescents who initiate smoking have a deficit of information about the harms of smoking. This approach had limited results, and gave way to the “social influences” model, which holds that the social environment is the most important determinant of smoking onset [3].

Studies assessing the effects of curricula using the “social influence” approach showed positive effects [4], but results were generally not sustained [5]. Because adolescents typically face pressure to initiate smoking from multiple sources—peers at school, mass media, adults in their environment, and external social norms related to tobacco use—investigators began to test prevention strategies that used multiple sources. In addition, it was believed that the school program itself should also include parental involvement and schoolwide nonsmoking policies. [6].

Studies were then initiated testing the relative efficacy of various components. Perry et al assessed a school program conducted in communities where adults were involved in risk factor screening and smoking cessation, and where clean indoor air ordinances were being passed comparing it to reference communities with no program [7]. Biglan et al tested a school program alone versus one that combined school and community [8]. Johnson et al tested comprehensive programs using school curriculum, parental involvement, community work, and media versus controls that received only the community and media components [9]. Vartiainen et al, in North Karelia, tested a school and community program against a community that received neither component [10]. Finally, Flynn et al and Flay et al tested school alone against media plus school [11,12]. All studies found that multiple channel interventions were superior to classroom curriculum interventions alone.

These studies laid the foundation for school-based youth prevention programs delivered within the context of a statewide, comprehensive tobacco control program. These state programs represented the first large-scale public health applications of rigorously fielded and tested experimental efforts at reducing youth tobacco use. They used a comprehensive approach, delivering interventions through multiple channels emphasizing policy and social norm change, and have generally experienced excellent results in lowering both youth and adult tobacco use [13,14].

There have been a few studies that have assessed comprehensive school programs in the context of statewide programs. In Texas, researchers examined the relative effects of eight possible combinations of exposures to a statewide comprehensive program and found the comprehensive program superior to the school program alone [15]. Other statewide comprehensive tobacco control programs that included school components were established

in California, Massachusetts, and Arizona, and Florida. All experienced greater reductions in youth smoking-related behavior than the rest of the nation [13,16]. In Oregon, we previously reported on the significantly greater declines in 8th-grade smoking prevalence in funded Oregon school districts in the first years of a comprehensive program, compared with unfunded districts during the same period [17]. Results were promising, but were based only on cross-sectional 8th-grade prevalence at two time points. No study, to our knowledge, other than the Texas assessment noted above, has examined the individual effect of school funding within a comprehensive state program.

Unfortunately, state-level comprehensive tobacco control programs have undergone extensive budget reductions in recent years [18]. The Oregon Tobacco Prevention and Education Program (TPEP) was established in 1997, but then in 2003, overall program funding was reduced by about 70%, and the school component was entirely defunded. Little is known about whether smoking prevalence reductions seen in comprehensive youth prevention programs persist after interventions are withdrawn. Only two published studies have attempted to examine this question by assessing changes in youth susceptibility and other outcomes to smoking after defunding of a statewide comprehensive tobacco program [19,20]. Both found increased susceptibility to smoking initiation after defunding, but neither reported changes in smoking prevalence.

The purpose of this study was twofold. The first aim was to provide evidence for the effectiveness of a comprehensive school program as one component of a statewide tobacco control program, and the second was to describe trends in smoking prevalence after program defunding. To address these aims, we compared the change in smoking prevalence between 8th and 11th grade in funded districts to districts that received no funding. We then compared the change in prevalence in defunded districts to the patterns we observed while those districts were funded, and to the districts that never received funding. We also compared these patterns to those seen over the same time period in the rest of the nation.

Methods

Description of TPEP school-based program

Approximately 12% of TPEP's annual \$10 million budget was allocated to implementation of the Centers for Disease Control and Prevention (CDC) Guidelines for School Health Programs to Prevent Tobacco Use and Addiction [21]. From July 1999 through June 2003, the state awarded competitive grants on a biennial basis to 29 of the approximately 200 school districts in Oregon, either individually or as members of a consortium of districts, for implementation of comprehensive school-based tobacco programs. Approximately one-third of Oregon students were enrolled in these 29 school districts. Awards ranged from \$13,000 to \$274,000 per district, in proportion to district enrollment.

Funded programs were required to address seven critical components identified by the CDC. These included (a) district- wide adoption and enforcement of model tobacco-free school policies, including no tobacco use by students, staff, or visitors on school grounds or at school-sponsored events as a priority activity; (b) classroom instruction in kindergarten through 8th grade, with an intensive focus on middle school, and booster sessions in high

school, using only evidence- based curriculum; (c) ongoing training of school staff on components of the comprehensive school and statewide programs; (d) parental and familial involvement; (e) linkages to local tobacco-free coalitions through joint activities; (f) linkages to cessation services to both students and adults in the school environment; and (g) student participation in annual, statewide assessments of youth tobacco use.

Beginning in July of 2003, TPEP funding was reduced from \$10 million to \$3.5 million annually and funding for the school component of the program was entirely eliminated. We refer here to those districts that received TPEP funding during the interval between 1999 and 2003 generically as “funded” districts, and those districts that never received TPEP funding as “never-funded.” Subsequent to 2003, no districts received TPEP funding, and we use the term “defunded” to refer to districts that lost funding between 2003 and 2006.

Statewide assessments of youth tobacco use

Data on smoking behavior among students were collected using the Youth Risk Behavior Survey (YRBS) (1999 and 2000), the Oregon Public School Drug Use Survey (OPS-DUS) (2000) or the Oregon Healthy Teens Survey (OHT) (2001 forward). Each survey used an anonymous, in-class, self-report questionnaire. Funded districts were requested to participate in the survey as a condition of funding. Never-funded districts were randomly selected and participated voluntarily. The OHT student survey is a collaborative effort of the Oregon Research Institute, the Oregon Departments of Human Services and Education, and the Oregon Commission on Children and Families, and provides an annual random sample of 8th and 11th graders statewide [22].

Birth cohorts

Student birth cohorts were defined as the population of students entering 8th grade during any given survey year. For example, students entering the 8th grade in the year 1999 comprise one birth cohort (i.e., are born within a specific 12-month interval) and students entering 8th grade in the year 2000 comprise a second, subsequent birth cohort, and so on.

The analyses presented are restricted to districts (funded and never-funded) that allowed examination of student birth cohorts across a 3-year interval, that is, those that had 8th grade survey participation as a baseline and 11th-grade classroom participation at a 3-year follow-up. Because different districts were sampled and/or agreed to participate over years, we were able to retain for analyses approximately 50% of all funded districts in any given cohort and about 10% of all unfunded districts. On the student level, student survey participation rates ranged from 55–82% (for funded/ defunded cohorts), and 55–65% (for never-funded cohorts). There are a total of 72 districts involved in the analyses across five birth cohorts, 27 funded/defunded and 45 never-funded. The total number of student surveys was 44,531, with 19,501 in funded/defunded and 25,030 in never-funded districts. Table 1 displays the characteristics of the funded/defunded and never-funded districts for each cohort.

Measures

Smoking prevalence—On all surveys except the OPSDUS, the question used to determine smoking prevalence was, “During the past 30 days, on how many days did you

smoke cigarettes?” On the OPSDUS (used in 1998, and for a split sample in 2000), the question used was, “How frequently have you smoked cigarettes during the past 30 days?” For all surveys, student responses were categorized as having smoked one or more days during the past month or not.

Birth cohort indicators—Over the measurement interval 1999 to 2006, there were five student birth cohorts defined. Cohort 1 consisted of students in districts with 8th-grade measurements in 1999 and 11th-grade measurements in 2002; cohort 2, students in districts with 2000 8th- and 2003 11th-grade measurements; cohort 3, students in districts with 2001 8th- and 2004 11th-grade measurements; cohort 4, students with 2002 8th- and 2005 11th-grade measurements; and cohort 5, students in districts with 2003 8th- and 2006 11th-grade measurements. A nominal variable, cohort, was defined with values 1–5.

Funding indicators—We defined a binary indicator variable for each district’s tobacco funding status. Districts that never received any TPEP funding (never-funded) were coded zero for funding status, and served as “control” districts. Those districts that had ever received funding were coded as one for funding status. Funding status was considered to be related to change in smoking prevalence in cohorts 1 and 2 (which were in 8th and 11th grades before defunding). Defunding was considered to be related to change in smoking prevalence in cohorts 3, 4, and 5 (which were in 8th grade during the funding period and 11th grade after defunding).

District-level covariate measures—District K-12 enrollment was used to index district size. The percentage of students receiving free or reduced lunch (supplied by ODE records) was averaged over 1999–2005 and provided a proxy measure of district socioeconomic status. We also used as a control variable the estimated prevalence of alcohol use in the district based on the OHT survey item “During the past 30 days, on how many days did you have at least one drink of alcohol?” Student responses were categorized as having used alcohol one or more days in the past month or not.

National prevalence—For a descriptive reference, we used national 30-day smoking prevalence of 8th graders in 1999–2006 [23]. We derived national prevalence for 11th grade as the mean of the published 10th- and 12th-grade smoking prevalence.

Data analysis

We used a multilevel modeling approach [24–27] to examine the relationship of district-level funding on the change in youth smoking prevalence over time. Conceptually, each district was the primary unit of intervention and analysis, and districts were observed repeatedly. The prevalence of smoking by student birth cohorts within each district at each time point were the primary data points, and the difference in the prevalence between the 8th and 11th grade (prevalence change) was the primary outcome variable of interest.

The model incorporated the effects of district level variables over time by simultaneously estimating several combined regression equations. At the student level, the cigarette use variable, Smoke_{ijk} , of individual student i residing in district j belonging to cohort k is predicted by the equation:

$$\text{Smoke}_{ijk} = \beta_{0jk} + \beta_{1jk} \text{Grade} + r_{ijk},$$

where values of β_{0jk} and β_{1jk} were allowed to vary across the j districts such that the term β_{0jk} represented the proportion of eighth grade smokers in each district j for a particular cohort k ; and the β_{1jk} represented the relative increase in smoking prevalence in each district j for a particular cohort k 3 years (grades) later, as measured in the district's eleventh grade students. The term r_{ijk} is the student-level random error term. Individual student data were not linked over the 3 years, as students were surveyed anonymously; instead birth cohort groups within districts were linked over time.

While the individual-level analysis estimates can be of substantive interest, the extent to which there is variability in the increase in smoking prevalence across districts, and the extent to which that variability can be explained as a function of the district-level variable of funding status was our primary analytical goal. At the district level, each cohort's eighth grade smoking prevalence (β_{0jk}) and grade slopes (β_{1jk}) were modeled as a function of district variables:

$$\beta_{0jk} = \gamma_{00} + \gamma_{0z}(\text{Funding}_j) + \gamma_{0x} \text{Cohort}_k + \gamma_{0w}(\text{Covariates}_j) + \mu_{0jk},$$

and

$$\beta_{1jk} = \gamma_{10} + \gamma_{1z}(\text{Funding}_j) * \text{Cohort}_k + \mu_{1jk},$$

where in the first equation the intercept term γ_{00} is the average smoking prevalence in eighth grade across all never-funded districts, and the coefficient γ_{0z} on the funding status indicator of each district represents the average of any eighth grade prevalence difference between funded and never-funded districts. The term β_{0x} on the variable cohort indexed the 5-year time trend in eighth grade smoking prevalence (1999–2003). District level covariates included enrollment, school socioeconomic status, and prevalence of alcohol use.

In the second equation the intercept term β_{10} was the average increase in smoking prevalence of never-funded districts. The coefficient β_{1z} on the district funding indicator represented the rise or fall in the smoking prevalence of the cohorts in funded districts between eighth and eleventh grades. The change in smoking prevalence is allowed to vary for each cohort by using the interaction term between funding status and the cohort indicator Cohort_k . The terms μ_{0jk} and μ_{1jk} represented the district level random errors.

After specifying the parameters of interest in the above model, we then specified several sets of *a priori* contrasts that examined smoking patterns over time. First, we tested the equivalence of the smoking prevalence changes in never-funded districts over the five cohorts by adding a cohort interaction term $\gamma_{10} * \text{Cohort}_k$ to the district level model. Failure of that term to reach statistical significance indicated that never-funded district estimates could be pooled into a single reference value (γ_{10}) across the five cohorts. Similarly, we tested whether we could pool cohorts among the funded districts by testing equivalence of

prevalence change for the two cohorts during the funding period (cohorts 1 and 2), and the three cohorts after the defunding (cohorts 3, 4, 5). These tests were accomplished as specific linear contrasts among the estimates in the $\gamma_{Iz} (Funding_j) * Cohort_k$ term.

We then tested the equivalence of change in smoking prevalence of the pooled funded districts during the funding and defunded intervals (cohorts 1 and 2 pooled versus 3, 4 and 5 pooled). This was also accomplished as a specific linear contrast among the estimates in the $\gamma_{Iz} (Funding_j) * Cohort_k$ term.

Finally, we tested the equivalence of change in smoking prevalence between the pooled cohorts in never-funded districts and the pooled cohorts both during and after funding. These were accomplished as specific contrasts among the estimates in the $\gamma_{Iz} (Funding_j) * Cohort_k$ term.

For descriptive purposes, we plotted the average smoking prevalence values for each cohort by funding status over time, and for the pooled cohorts over grades. We performed computations using SAS version 9.1.3(SP3) Proc Glimmix [28], which provides a general linear mixed model capability when the dependent variables are binary [29], and used a value of .05 to denote the level of significance.

Results

Growth in smoking prevalence in never-funded districts

Figure 1 shows the growth in smoking prevalence for the reference group, students from districts that never received funding during the period of TPEP school program funding. Lines connect the average 8th- and 11th-grade raw prevalence values for each cohort. The slopes of these lines reflect the growth in each cohort's smoking prevalence over the study interval, and are our outcome of interest. Note that whereas the annual prevalence for both grades was declining, prevalence change for each cohort remained fairly constant, producing roughly parallel lines. Model estimates indicated that that the cohorts could be pooled ($t = 1.18, p = .120$), and had an average growth of 4.7% (standard error [SE] = 7%) (Table 2). Nationally, the growth in smoking prevalence between 8th and 11th grade increased an average of seven percentage points over this same period, and also appeared to be constant [23].

Growth in smoking prevalence in funded/defunded districts

Figure 2 displays the growth of smoking prevalence for each of the five cohorts over the funded/defunded period (1999–2006.) There is a clear visual pattern in the figure with the two cohorts from the funded period exhibiting little growth in smoking prevalence, and almost flat slopes. In contrast, the later three cohorts from the defunded period exhibited much steeper growth—8th-grade prevalence decreased, yet 11th-grade prevalence did not. If the growth patterns associated with funding had persisted, we would have observed flatter uptake patterns for the later cohorts. Instead, we observed slopes that returned to the patterns of the never-funded period cohorts.

Mixed models and associated contrasts confirmed that the two cohorts from the funded period could be pooled ($t = .81, p = .407$), and that the three cohorts from the defunded period could also be pooled ($t = 1.0, p = .397$). As noted, the pooled cohorts from the funded period showed a small increase (1.6%, SE = 1.3%), and the pooled cohorts from the defunded period increased more steeply (5.1%, SE = 1.0%). The growth in smoking prevalence for the pooled cohorts from the funded period was significantly slower than for the pooled cohorts from the defunded period (difference = -3.5%, SE = 1.7%, $p = .042$), as shown in Table 2 and Figure 3.

Comparisons of smoking prevalence growth patterns in funded and never-funded districts

Using the pooled never-funded district growth in smoking prevalence as a reference, we tested the difference between that growth and the growth for cohorts before and after defunding. For cohorts from the funded period, growth in smoking prevalence was significantly slower than the growth for the cohorts from the never-funded districts (difference = -3.1%, SE = 1.5%, $p = .039$). For cohorts from the defunded period, however, the growth in smoking prevalence was virtually identical to the growth in the cohorts from never-funded districts (difference = .3%, SE = 1.3%, $p = .786$) (Table 2 and Figure 3).

Discussion

Few studies have shown that comprehensive school-based tobacco prevention programs, conducted within the context of a statewide tobacco control program are associated with decreased smoking prevalence. No study, to our knowledge, has assessed whether any gains are reversed upon termination of these programs. This is an important issue to examine in light of the trend toward extensive budget reductions of many statewide tobacco programs. In this study, we did observe a pattern of significantly slower growth of smoking prevalence in cohorts of youth from school districts that received funding as part of a comprehensive tobacco prevention program, compared with cohorts of youth from districts that did not receive funding. When funding was withdrawn, the growth in smoking prevalence for subsequent cohorts increased significantly, mirroring growth in districts that had never been funded. Thus, our results reinforce the importance of conducting comprehensive school prevention programs in the context of a comprehensive tobacco control program, with interventions such as mass media and community action [29].

This study's results also underscore the importance of adequate funding for comprehensive tobacco control programs. While funded at 40% of the CDC recommended level TPEP was able to reach one-third of Oregon students with its comprehensive school-based program. At this funding level, the prevalence of youth smoking statewide was only moderately affected. From the launch of TPEP in 1997 to its funding cut in 2003, Oregon's decline in youth smoking was consistent with the declines seen in the United States as a whole with two exceptions: the steep declines in youth smoking began earlier in Oregon, and the percentage of Oregon 11th graders who smoked was lower than that of the nation [30]. If funded at the level recommended by the CDC, many more students in Oregon could have been reached with the comprehensive school-based program.

One of the strengths of this study was the choice of outcome measure. We assessed the rate of change in prevalence in single cohorts over time, rather than comparing 8th- or 11th-grade smoking prevalence across cohorts. The evidence of the much slower uptake of smoking in the funded cohorts would have been missed in that kind of evaluation.

The study had a number of limitations. First, district funding was awarded on a competitive basis, and so funded districts could have differed in ways that affected growth in youth smoking prevalence. However baseline 8th-grade smoking prevalence was similar in funded and never-funded districts in 1999 decreasing concern that pre-existing differences might have affected subsequent prevalence patterns. We also attempted to control for any differences in districts by adjusting models for differences in youth alcohol use, socioeconomic status, and district enrollment.

Second, individuals within cohorts could not be matched because school health surveillance data are anonymous; however we did restrict our analyses as much as possible to the same 8th- and 11th-grade participants in each cohort by matching districts at the two time points. Analyses of program effects can be affected by student mobility, such that students who received program exposure may transfer to districts without programs, and *vice versa*; however this effect would bias observed differences toward the null.

Third, although survey participation was required for funding, not all schools within a district were able to comply, and our data may be limited to the extent that nonparticipation at either point in time could be related to smoking prevalence. We have confidence in our results, however, because our focus was on relative group differences, and so each district served as its own control. Also, we observed consistency in the growth in smoking prevalence by funding status.

Fourth, because of a split sample, two different questions were used to measure smoking prevalence in year 2000. The use of the two questions affects only the baseline smoking prevalence in cohort 2 and the estimates generated by the two questions were not significantly different.

The study had one surprising finding. The growth in smoking prevalence among cohorts of youth from never-funded districts was similar to the pattern in the rest of the nation over the same time period, even though those youth had been exposed to the Oregon statewide comprehensive program. However, as comprehensive programs have become more widely implemented, it becomes more difficult to use a national sample of U.S. youth to represent a group that is unexposed to comprehensive tobacco control programs, especially with the inclusion of California, a state with a longstanding, successful statewide program.

In summary, our results suggest that comprehensive school-based programs, conducted in the context of a statewide tobacco control program may slow smoking uptake between 8th and 11th grades. Moreover, the gains achieved through these programs can be quickly lost upon termination of funding. Given that youth continue to be exposed to pro-tobacco influences, school programs appear to be an important prevention strategy if they are long-term, comprehensive, reach youth at all grade levels, and are reinforced in the larger environment.

Acknowledgments

This work was conducted with support from the Oregon Tobacco Prevention and Education Program, and the Oregon Research Institute. In addition, the National Cancer Institute (CA38273) provided financial support for several of the authors during their work on this manuscript.

References

- Centers for Disease Control and Prevention. Projected smoking-related deaths among youth – United States. MMWR. 1996; 45:971–974. [PubMed: 8965796]
- U.S. Department of Health and Human Services. Preventing Tobacco Use Among Young People: A Report of the Surgeon General. Atlanta: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health; 1994. p. 65
- U.S. Department of Health and Human Services. Preventing Tobacco Use Among Young People: A Report of the Surgeon General. Atlanta: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health; 1994. p. 218
- Thomas R. School-based programmes for preventing smoking. The Cochrane Database for Systematic Reviews. 2002; (Issue 2) Article No. CD001293.
- Wiehe SE, Garrison MM, Christakis DA, Ebel BE, Rivara FP. A systematic review of school-based smoking prevention trials with long-term follow-up. J Adolesc Health. 2005; 36:162–169. [PubMed: 15737770]
- Pentz MA, Brannon BR, Charlin VL, Barrett EJ, MacKinnon DP, Flay BR. The power of policy: The relationship of smoking policy to adolescent smoking. Am J Public Health. 1989; 79:857–862. [PubMed: 2735472]
- Perry CL, Kelder SH, Murray DM, Klepp K. Communitywide smoking prevention: Long-term outcomes of the Minnesota heart health program and the class of 1989 study. Am J Public Health. 1992; 82:1210–1216. [PubMed: 1503159]
- Biglan A, Ary DV, Smolkowski K, et al. A randomised controlled trial of a community intervention to prevent adolescent tobacco use. Tob Control. 2000; 9:24–32. [PubMed: 10691755]
- Johnson CA, Pentz MA, Weber MD, et al. Relative effectiveness of comprehensive community programming for drug abuse prevention with high-risk and low-risk adolescents. J Consult Clin Psych. 1990; 58:447–456.
- Vartiainen E, Paavola M, McAlister A, Puska P. Fifteen-year follow-up of smoking prevention efforts in the North Karelia youth project. Am J Public Health. 1998; 88:81–85. [PubMed: 9584038]
- Flynn BS, Worden JK, Secker-Walker RH, Pirie PL, Badger GJ, Carpenter JH, Geller BM. Mass media and school interventions for cigarette smoking prevention: Effects 2 years after completion. Am J Public Health. 1994; 84:1148–1150. [PubMed: 8017542]
- Flay BR, Miller TQ, Hedeker D, et al. The television, school, and family smoking prevention and cessation project. Prev Med. 1995; 24:29–40. [PubMed: 7740012]
- Wakefield M, Chaloupka F. Effectiveness of comprehensive tobacco control programmes in reducing teenage smoking in the USA. Tob Control. 2000; 9:177–186. [PubMed: 10841854]
- Siegel M. The effectiveness of state-level tobacco control interventions: A review of program implementation and behavioral outcomes. Annu Rev Public Health. 2002; 23:45–71. [PubMed: 11910054]
- Meshack AF, Hu S, Pallonen UE, et al. Texas tobacco prevention pilot initiative: Processes and effects. Health Educ Res. 2004; 19:657–668. [PubMed: 15199003]
- Bauer UE, Johnson TM, Hopkins RS, Brooks RG. Changes in youth cigarette use and intentions following implementation of a tobacco control program. J Am Med Assoc. 2000; 284:723–728.
- Centers for Disease Control and Prevention. Effectiveness of school-based programs as a component of a statewide tobacco control initiative—Oregon 1999–2000. MMWR. 2001; 50:663–666. [PubMed: 11785566]

18. Nelson DE, Reynolds JH, Luke DA, et al. Successfully maintaining program funding during trying times: Lessons from tobacco control programs in five states. *J Public Health Manage Pract.* 2007; 13:612–620.
19. Sly DF, Arheart K, Dietz N, et al. The outcome consequences of defunding the Minnesota youth tobacco-use prevention program. *Prev Med.* 2005; 41:503–510. [PubMed: 15917046]
20. Niederdeppe J, Farrelly MC, Hersey JC, Davis KC. Consequences of dramatic reductions in state tobacco control funds: Florida, 1998–2000. *Tobacco Control.* 2008; 17:205–210. [PubMed: 18390911]
21. Centers for Disease Control and Prevention. Guidelines for school health programs to prevent tobacco use and addiction. *MMWR.* 1994; 43:1–18.
22. Oregon Healthy Teens. Available at: <http://www.dhs.state.or.us/dhs/ph/chs/youthsurvey>.
23. Monitoring the Future. Available at: <http://www.monitoringthefuture.org>.
24. Aitkin M, Longford N. Statistical modelling issues in school effectiveness studies. *Journal of Royal Statistical Society.* 1986; 149:1–43. Series A.
25. Goldstein, H. *Multilevel Models in Educational and Social Research.* London: Charles Griffin; 1987.
26. Kreft IGG. Using multilevel analysis to assess school effectiveness: A study of Dutch secondary schools. *Sociol Educ.* 1993; 66:104–129.
27. Raudenbush S, Bryk AS. A hierarchical model for studying school effects. *Sociol Educ.* 1986; 59:1–17.
28. Statistical Analysis System (SAS). Available at: www.sas.com.
29. Centers for Disease Control and Prevention. *Best Practices for Comprehensive Tobacco Control Programs—2007.* Atlanta: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health; 2007 Oct.
30. Oregon Department of Human Services, Health Services. *Make Oregon Healthier: Saving Lives and Saving Dollars. Program Report 2001–2003.* Oregon Tobacco Prevention and Education Program. 2003

Figure 1.

Smoking prevalence growth in never-funded cohorts, Oregon, 1999–2006. Note: each line represents the increase in smoking prevalence from the 8th grade to the 11th grade for a cohort of students from matched, never-funded districts.

Figure 2.

Smoking prevalence growth by cohort in funded/defunded districts, Oregon, 1999–2006.

Note: each line represents the increase in smoking prevalence from the 8th grade to the 11th grade for a cohort of students from matched, funded or defunded districts.

Figure 3.

Pooled smoking prevalence growth in funded, defunded and never-funded cohorts, Oregon 1999–2006. Note: percentage values are unadjusted. The p value for comparison of prevalence growth between never-funded and funded cohorts = .039, and p value for comparison of prevalence growth between neverfunded and defunded cohorts = .786.

Table 1

Characteristics of districts by funding status, Oregon 1999–2006

Characteristic	District type	Cohort 1 1999/2002	Cohort 2 2000/2003	Cohort 3 2001/2004	Cohort 4 2002/2005	Cohort 5 2003/2006
Number of districts	Funded/defunded	16	24	18	24	22
	Never-funded	14	12	30	30	32
Number of students (8 th /11 th)	Funded/defunded	1204/1463	2892/1455	1394/1792	2061/2847	1917/2476
	Never-funded	2257/1141	1654/1139	3093/3326	2624/3307	2599/3890
District K-12 median enrollment	Funded/defunded	1943	723	1020	723	723
	Never-funded	2331	4261	2406	2406	2318
Percentage of students with meal assistance	Funded/defunded	14	14	12	12	12
	Never-funded	8	10	12	13	12
Percentage of students with any alcohol use in past 30 days (8 th grade)	Funded/defunded	26	29	27	25	23
	Never-funded	28	28	29	23	25

Table 2

Model estimates comparing pooled cohort smoking prevalence growth by funding status, Oregon, 1999–2006

Prevalence growth rates in funded/defunded cohorts			
Effect	Estimate	SE	p
Pooled prevalence growth, grades 8–11, funded cohorts	.016	.013	.230
Pooled prevalence growth, grades 8–11, defunded cohorts	.051	.010	<.0001
Difference in pooled growth between funded and defunded cohorts	–.035	.016	.042
Prevalence growth rates in never-funded cohorts compared to growth rates in funded/defunded cohorts			
Effect	Estimate	SE	p
Pooled prevalence growth, grades 8–11, never-funded cohorts	.047	.007	<.0001
Difference in pooled growth between funded and never-funded cohorts	–.031	.014	.039
Difference in pooled growth between defunded and never-funded cohorts	.003	.011	.786

Note: All models adjusted for cohort, district enrollment, district meal assistance, and district level alcohol use.