

Effectiveness of a Social Influences Smoking Prevention Program as a Function of Provider Type, Training Method, and School Risk

ABSTRACT

Objectives. This study determined the effect of provider (nurse or teacher) and training method (workshop or self-preparation) on outcomes of a social influences smoking prevention program.

Methods. One hundred elementary schools were stratified by school risk score (high risk = high smoking rate among senior students) and assigned randomly to conditions: (1) teacher/self-preparation, (2) teacher/workshop, (3) nurse/self-preparation, (4) nurse/workshop, and (5) control. Intervention occurred in grades 6 to 8. Smoking status at the end of grade 8 was the primary endpoint variable.

Results. Intervention reduced grade 8 smoking rates in high-risk schools (smoking rates of 26.9% in control vs 16.0% in intervention schools) but not in low-risk schools. There were no significant differences in outcome as a function of training method and no significant differences in outcome between teacher-provided and nurse-provided interventions in high- and medium-risk schools. Although nurses achieved better outcomes than did teachers in low-risk schools, neither provider type achieved outcomes superior to the control condition in those schools.

Conclusions. Workshop training did not affect outcomes. Teachers and nurses were equally effective providers. Results suggest that programming should target high-risk schools. (*Am J Public Health* 1999;89:1827-1831)

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Social influences smoking prevention programs focus on helping young people develop skills that enable them to identify and resist social influences to smoke.¹ These programs tend to result in modest, but important, reductions in smoking onset in the short term, with the effect fading during high school years.^{2,3} Comprehensive approaches, including a media⁴ or community-based⁵⁻⁷ component in addition to school-based programming, may result in more impressive and enduring results.

Program results may be influenced by factors beyond the curriculum, such as who delivers the program, how these providers are trained, how well providers deliver the program, characteristics of the students and the schools, and the larger social context.⁸ As school-based programs are disseminated, practical questions arise: (1) Who should implement the program? and (2) What sort of training should the provider have? The current study addressed these issues.

Social influences programs have been implemented by several types of providers, including health and science teachers,⁹ a combination of teen leaders and health educators,¹⁰ and college undergraduates.¹¹⁻¹³ But little systematic experimental study of the relative effect of different provider types has been done. Ellickson and Bell¹⁰ compared the effectiveness of health educators alone vs health educators paired with teen leaders. The addition of teen leaders resulted in better outcomes with seventh graders who were "experimental smokers" at the outset but worse results among baseline "smokers" (both treatment conditions had an iatrogenic effect with baseline "smokers," but boomerang effects were largest in teen leader schools).

Questions also arise about how providers should be trained. Although conceptual frameworks have been developed to guide training activities,^{14,15} and influential guide-

lines for smoking prevention^{1,16} indicate that workshop training for providers is important, little research has examined the effect of training. Basen-Engquist and colleagues¹⁷ found that teachers who received workshop (as opposed to video) training were more likely to implement their Smart Choices smoking prevention program (although the 2 groups did not differ with respect to overall completeness or fidelity of implementation). Botvin et al.¹⁸ found that teachers who received (1) workshop training and implementation feedback vs (2) videotaped training and no implementation feedback did not differ with respect to either level of implementation or effectiveness in preventing drug (including tobacco) use. The latter findings contradict the belief that

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workshop training is important as programs are disseminated.

The current study compared program outcomes as a function of 2 training methods: (1) an intensive 1½-day workshop and (2) a self-directed learning kit for providers. The design involved a 2 (provider type: classroom teacher vs public health nurse)–by–2 (training type: workshop vs self-preparation) experimental study, with a fifth “usual care” control group. A detailed description of the intervention is included in Santi et al.¹⁹ Because risk of smoking onset is greatest in schools in which the smoking rate is high among the most senior students,²⁰ this environmental risk factor was incorporated into the design to ensure that experimental conditions were not confounded with school-level risk. Including the school risk score also enabled us to examine the possibility of an interaction between treatment conditions and school risk.

Methods

Recruitment Procedures

We approached 10 school boards and 5 health units (some health units covered regions that included 2 boards) in 5 communities in southwestern Ontario, Canada. One board declined participation because of budget cuts, and 2 declined because the prevention program did not fit with their approach to smoking prevention. Within each of the 7 participating school boards, we recruited eligible (grades 6, 7, and 8 all in one school) elementary schools; school recruitment rates ranged from 65% in 1 board to 100% in 4 boards. Of the 100 participating schools, 80 were urban and 20 were rural.

Six of 7 boards agreed to the institutional review board (IRB)–approved passive informed consent procedure (students were eligible if parents did not return a self-addressed, stamped card): average student consent rate in these boards was 91.8%. The overall student consent rate was 69.6% in the seventh board, which required active consent for research (not program) participation. The overall consent rate across 7 districts was 89.5%, yielding 4971 grade 6 students participating in the study cohort.

Providers

Public health nurses were recruited by their supervisors; those selected were regularly involved in school programming. Teachers were recruited by their principals. Originally, the study called for one provider per school. However, the size of the schools var-

ied widely: some schools had less than a full class of a given grade level; others had up to 8 full classes. In schools with many classes, there tended to be 2 or 3 providers, all in the same treatment condition.

Provider Training Conditions

All providers used identical core materials based on a curriculum developed at the University of Waterloo, Waterloo, Ontario.²¹ The grade 6 unit had six 40-minute lessons 1 week apart; the grade 7 unit had three 40-minute lessons 1 week apart; the grade 8 unit had 6 weekly 40-minute classes. Each unit included a Provider Manual, audiovisual aids, a student workbook, a peer leader manual, and a host teacher manual. All providers received a 1-hour orientation session. Training took place at the beginning of each school year.

Providers in the self-preparation condition received the materials described above, along with a videotape that demonstrated and emphasized the importance of interactive learning, including modeling, rehearsal, feedback, and expression of positive intentions.

Providers in the workshop condition received all materials (including the videotape) received by those in the self-preparation condition. They also attended a 1-day workshop before delivering the program in each grade and an additional half-day follow-up workshop after teaching 2 of the 6 lessons in grade 6. Workshops were used to engage providers in discussion, modeling of teaching strategies, and rehearsal of these strategies. All providers in this condition attended all workshop sessions, except 1 teacher who missed the half-day follow-up workshop and declined a personal session. The goal of the workshop was to familiarize providers with the program, to hone skills required for interactive learning, and to build self-efficacy. After training, the mean confidence rating for delivering the program was 85/100 (range 80–100); 78% of the participants said that training had improved their skills.

Stratification and Randomization of Schools

One hundred schools (15 in each of 6 boards, 10 in the seventh board) participated. A school risk score was established for each study school on the basis of a survey (conducted when the study cohort was in grade 6) of the senior (grade 8) students to determine the senior smoking rate (experimental + regular smokers). The principal's questionnaire provided an estimate of the prevalence of teacher smoking, and socioeconomic status of the school community also

was incorporated into the school risk score. Schools within boards were ranked by risk score and classed (on the basis of tertiles) as either high, medium, or low risk. Then schools within each board and risk level were assigned randomly to 1 of the 5 experimental conditions. In the case of the board that provided only 10 schools, schools were ranked by risk score and defined as either high or low risk based on a median split.

Measures and Data Collection

A questionnaire to assess smoking behavior, reasons for smoking, and other student characteristics was administered to the students by trained data collectors who used standardized procedures at 3 time points: before the curriculum was delivered in grade 6, at the end of grade 7, and at the end of grade 8. At the time of data collection, pre-announced breath samples were collected to enhance the accuracy of self-reported smoking behavior.²² Students who had left the study schools received the questionnaire by mail but did not provide a breath sample.

Students were classified into 1 of 5 smoking categories: (1) never smoked, (2) tried once, (3) quit (smoked more than once but stopped), (4) experimental smoker (smoked less than once a week), and (5) regular smoker (smoked weekly). To compare smokers and nonsmokers in the following analyses, experimental and regular smokers were pooled to create the smoking category. A social models risk score (high, medium, or low) was calculated for each student from the number of friends, older siblings, and parents who smoked.²³

Statistical Analyses

Statistical analyses were conducted with the SAS statistical software package (SAS Institute, Inc, Cary, NC) on a personal computer. Logistic regression analyses were used to model grade 8 smoking status as a function of the school board, the senior smoking rate, and the treatment condition. Models were constructed for all students in the cohort, as well as for the subgroups of students in grade 6 who were nonsmokers or who had never smoked.

It is reasonable to expect more variability in smoking rates between schools than would be seen if students responded independently of one another. Such “extrabinomial variation” is commonly seen in cluster randomized designs.^{24,25} Because the school was the unit of randomization, methods of analysis that consider the variation between schools need to be used. We have examined 3 such methods: Pearson goodness-of-fit

TABLE 1—Grade 8 Smoking Rates (Experimental + Regular) (%), by Condition and School Risk Score

School Risk Score ^a	Condition					
	Control	All 4 Treatments Combined	Nurse Workshop	Nurse Self-Prep	Teacher Workshop	Teacher Self-Prep
Low	16.6% (319)	17.1% (1054)	12.7% (260)	12.1% (322)	22.6% (190)	23.0% (282)
Medium	18.8% (181)	21.2% (912)	24.6% (211)	24.5% (237)	14.9% (154)	19.4% (310)
High	26.9% (305)	16.0% (1050)	13.5% (297)	18.8% (282)	16.4% (323)	14.9% (148)
Overall	21.0% (805)	17.9% (3016)	16.3% (768)	17.8% (841)	17.8% (667)	19.9% (740)

Note. All students had 3 years of cumulative treatment and a grade 8 outcome. Numbers in parentheses are the total number of students.

^aDefined, within school board, on the basis of smoking rate of grade 8 students in the school when the cohort was in grade 6, estimates of prevalence of teacher smoking at the school, and socioeconomic status of the school community.

adjustment,²⁶ which leads to approximate F tests for school-level variables; generalized estimating equation models,²⁷ which allow for the incorporation of correlation between students within schools; and quasi-likelihood models that account for extrabinomial variation.²⁸ All 3 methods produced similar results; Pearson goodness-of-fit adjustments are reported here.

Results

Equivalence of Groups After Randomization

Logistic regression analyses were used to determine comparability of groups before intervention. After the Pearson goodness-of-fit statistic was used to adjust for the variability between schools, no significant differences were found across the 5 conditions with respect to the proportion of students smoking in grade 6, the proportion of boys or girls, and the proportion of students in the high social models risk category.

Follow-Up and Attrition

A total of 4466 students—80.2% of those eligible and 89.8% of those with consent—provided data in grade 6. Of these students, 3972 (88.9%) were successfully tracked and provided data at the end of grade 8. Most of the students completed their grade 8 questionnaire in school and provided a breath sample; only 83 (2.1%) received their questionnaire in the mail and therefore did not provide a breath sample.

Measures taken in grade 6 were used as predictor variables in a logistic regression model to compare students who were successfully followed up with those who were not. No significant differences were seen between those retained and those lost by condition or school risk score. However, differences by sex ($P < .05$), board ($P < .001$), social models risk

score in grade 6 ($P < .001$), and smoking status in grade 6 ($P < .001$) were significant. Boys, students who had high social models risk scores, and students who were smoking in grade 6 were less likely to be retained. Grade 8 smoking rates in this study are therefore likely to be underestimated because (in the retained cohort) students who had high social models risk scores and students who were smoking in grade 6 were more likely to be smoking in grade 8. However, the internal validity of the study apparently was not compromised by attrition because there was no evidence of differential patterns of attrition across treatment conditions.

Of the 3972 students who provided data in grade 8, 3821 (96.2%) had received the same treatment condition for 3 years. A logistic regression analysis, comparing students who received 3 years of the same treatment condition with those who did not, revealed no significant differences by condition, school risk score, or sex. Differences by board ($P < .001$), social models risk score in grade 6 ($P < .001$), and smoking status in grade 6 ($P < .001$) were significant. Students who had high social models risk scores and students who were smoking in grade 6 were less likely to have received 3 years of the same treatment.

Outcome Analyses

All analyses that follow are based on data from the 3821 students who remained in the same treatment condition in grades 6, 7, and 8. When these students were in eighth grade, 288 (7.5%) were regular smokers and 421 (11.0%) were experimental smokers; the overall smoking rate was 18.6% (95% confidence interval [CI] = 16.8%, 20.4%). Fewer than half (46.3%; 95% CI = 44.1%, 48.5%) of the students had never smoked by the end of grade 8. Smoking rates were similar among boys and girls (17.9% of the boys and 19.2% of the girls were smoking in grade 8). All 4 treatment conditions produced smok-

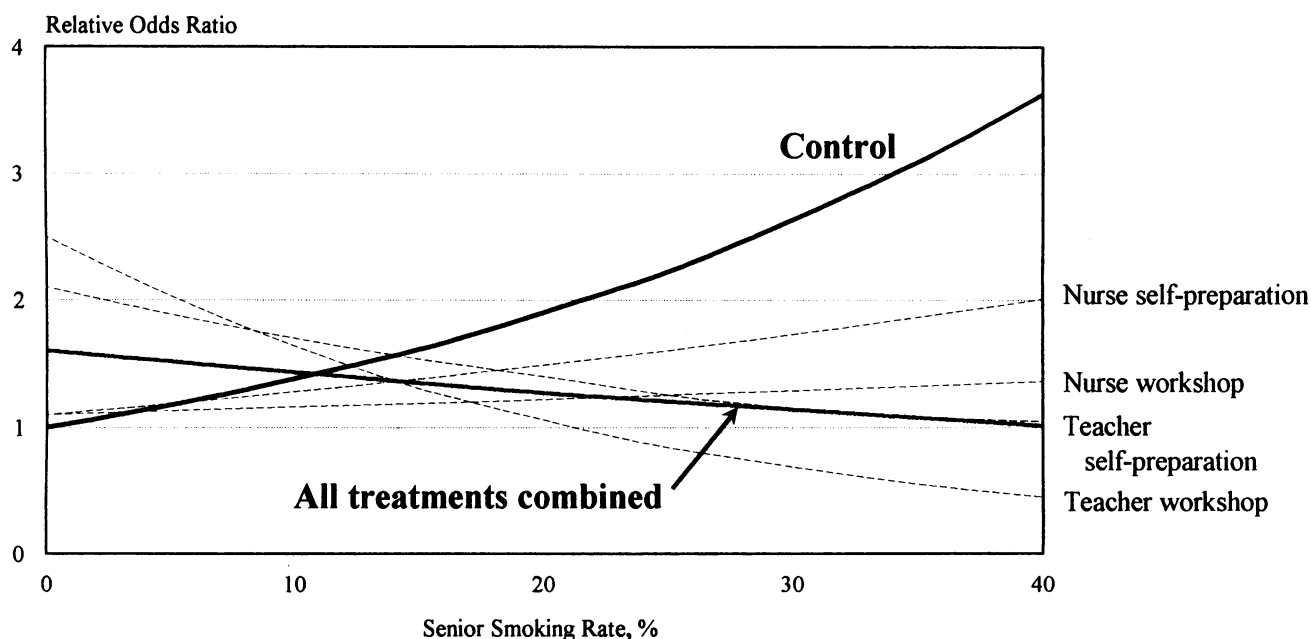
ing rates that were less than the control group rate (Table 1), but without consideration of the school risk score, differences between intervention and control schools were not significant.

The logarithm of the odds of smoking for grade 8 students was assessed in a logistic regression model. Predictor variables included board, senior smoking rate (both matching variables), and treatment condition. After adjustment for extrabinomial variation with the Pearson goodness-of-fit statistic, this model showed a significant interaction between condition and senior smoking rate ($F_{4,84} = 3.88, P = .006$).

In low- and medium-risk schools, no significant differences were found between treatment (i.e., all 4 intervention conditions combined) and control schools. In high-risk schools, students in the treatment conditions smoked significantly less than students in the control schools ($F_{1,26} = 8.99, P = .006$); students in the control schools were approximately 1.5 times as likely to be smokers (Table 1).

There were no significant differences between training methods (self-preparation or workshop) at any level of school risk. Both training methods resulted in significantly less smoking than in the control condition in high-risk schools, with outcomes similar for teachers and nurses in high-risk schools. Although nurses had significantly better outcomes than teachers in low-risk schools ($F_{1,19} = 4.58, P = .05$) and marginally better results in medium-risk schools ($F_{1,16} = 3.45, P = .08$), neither teachers nor nurses achieved results significantly different from those of the control condition in low- and medium-risk schools. Smoking rates by school risk score and treatment condition are shown in Table 1.

Among students who were nonsmokers (i.e., never smoked, tried once, or quit) in grade 6 ($n = 3432$), 216 (6.3%) were regular smokers and 357 (10.4%) were experimental smokers in grade 8. Of these students, 1657



Note. Includes students randomized at grade 6 and exposed to the same condition for 3 years. The odds ratio is estimated relative to a (hypothetical) control group school with a senior smoking rate of 0%.

FIGURE 1—Model-based estimated odds ratio for smoking at the end of grade 8, by condition.

(48.3%) had never tried smoking by the end of grade 8. Students who had never smoked in grade 6 ($n = 2560$) were also considered. Seventy-four (2.9%) of these students were regular smokers and 205 (8.0%) were experimental smokers in grade 8. Almost 65% of the students who were never smokers in grade 6 had never tried smoking by the end of grade 8. The logistic regression models for nonsmoking students indicated that the interaction between treatment and senior smoking rate remained significant. That is, treatment effectively discouraged grade 6 nonsmokers from becoming smokers in high-risk schools. The number of smoking students in grade 6 was too small to evaluate the effect of the program on those students.

The senior smoking rate, used to calculate school risk level, was a continuous variable. Therefore, the odds of smoking could be estimated as a function of school risk from the logistic regression model. In Figure 1, the model-based odds ratios (relative to control schools with 0% smoking) are given; these figures clearly show the interaction between condition and school level risk. To ascertain the level of school risk at which intervention made a difference, we graphed the relative odds ratio of smoking by senior smoking rate. It appears that the curves of intervention vs control conditions begin to diverge at the point at which the senior smoking rate in the school is approxi-

mately 20%, providing a convenient reference point for targeting of interventions. In these data, 27% of the schools had a senior smoking rate of at least 20%.

Discussion

In high-risk schools, both the teacher and the nurse provider conditions, regardless of training method, resulted in significantly lower smoking rates relative to control schools. There were no significant differences between training methods at any level of school risk. In low-risk schools (i.e., schools with low smoking rates in the senior class), school-based programming resulted in no benefit at the end of grade 8. In these low-risk schools, although nurses achieved better results than teachers, regardless of training method, neither nurses nor teachers achieved results that were statistically different from those of the control condition.

This pattern of findings suggests that different prevention programs may be appropriate in different schools, as discussed elsewhere.^{8,29} It may be wasteful to institute intensive programs in low-risk schools. Conversely, substantial benefit might accrue from offering intensive programs in high-risk schools. A simple tool that makes it practical to assess school risk would be valuable for guiding targeted dissemination.

The finding that intensive workshop training resulted in no benefit over self-preparation was unexpected but consistent with the findings of Botvin et al.¹⁸ The current study did not have an untrained provider condition, so it is not possible to determine whether both training methods were effective or whether neither made a difference. Workshop training may increase the rate of program adoption¹⁷; the current study was not designed to examine this issue. Because the cost of workshop training is substantial and may be a major barrier to dissemination,³⁰ it is important to investigate further the effect of such training on program implementation and outcomes. □

Contributors

R. Cameron and K. S. Brown planned the study design, oversaw data analyses, and wrote parts of the paper. J. A. Best was also instrumental in designing the study and contributed to the writing of the paper. C. L. Pelkman and C. L. Madill both analyzed and interpreted the data and contributed to the writing and editing of the paper. S. R. Manske and M. E. Payne designed and oversaw the implementation of the intervention and contributed to the writing of the paper.

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The study was reviewed and approved by the University of Waterloo IRB, and all participants and their parents provided informed consent.

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