

Research article

Longitudinal impact of a youth tobacco education program

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Abstract

Background: Information on the effectiveness of elementary school level, tobacco-use prevention programs is generally limited. This study assessed the impact of a structured, one-time intervention that was designed to modify attitudes and knowledge about tobacco. Participants were fifth-grade students from schools in western New York State.

Methods: Twenty-eight schools, which were in relatively close geographic proximity, were randomized into three groups; Group 1 was used to assess whether attitudes/knowledge were changed in the hypothesized direction by the intervention, and if those changes were retained four months later. Groups 2 and 3, were used as comparison groups to assess possible test-retest bias and historical effects. Groups 1 and 3 were pooled to assess whether attitudes/knowledge were changed by the intervention as measured by an immediate post-test. The non-parametric analytical techniques of Wilcoxon-Matched Pairs/Sign Ranks and the Mann-Whitney-Wilcoxon Rank Sums Tests were used to compare proportions of correct responses at each of the schools.

Results: Pooled analyses showed that short-term retention on most items was achieved. It was also found that retention on two knowledge items 'recognition that smokers have yellow teeth and fingers' and 'smoking one pack of cigarettes a day costs several hundred dollars per year' was maintained for four months.

Conclusions: The findings suggest that inexpensive, one-time interventions for tobacco-use prevention can be of value. Changes in attitudes and knowledge conducive to the goal of tobacco-use prevention can be achieved for short-term retention and some relevant knowledge items can be retained for several months.

Background

Given the epidemiology of smoking initiation, a great deal of public health policy and programmatic attention

has been directed at youth smoking in the United States [1]. Approximately 80% of tobacco users initiate use before 18 years of age, and if this trend in early initiation of

cigarette smoking continues, estimates are that 5 million children aged less than 18 years who are alive today will die prematurely as adults [2].

In an effort to discourage initiation of tobacco use, several youth tobacco education programs have been created and are currently available for presentation to elementary school students. Many of these approaches are school-based programs, and a number are cited in the evidence-based literature as demonstrations of what actually works. Surprisingly, however, despite some good research studies and important dissemination efforts by several government agencies, relatively few schools appear to have adopted any of the recommendations. Clearly, much additional work is needed to increase the use of evidence-based prevention approaches in school settings, as well as doing a better Job of communicating the results of research to the media and in turn to the general public [3].

A large number of school-based programs have been implemented over the last several years, with most of those efforts targeting elementary and/or middle school students. The evaluation results of several meta-analyses of tobacco and other drug prevention programs strongly suggest that approaches based on the social influence resistance model are the most effective. Additionally, programs that are led by peers and that are more interactive and allow for active, rather than passive learning, have produced the best results [4-6].

Several individual studies have highlighted mechanisms that are effective. These have ranged from school-based to community-based programs, they have employed media-driven efforts, and they have used coordinated combinations of multiple approaches. Reports have described both single session and multi-session interventions, with some research designs extending out over several years [7-10] Some innovative strategies engage students in one-on-one interactions [11], while others expose students to tobacco prevention theater productions [12]. Obviously, the more involved the program, the more costly it becomes, and the greater the requirements are for logistical coordination. These more extensive programs also require a greater time investment and sustained commitment on the part of participants, schools/communities and researchers.

This present study describes a quantitative evaluation of the Tar Wars tobacco use prevention program, delivered to a cohort of fifth grade students in western New York State. Focus is directed at baseline measures of tobacco-related knowledge, attitudes, beliefs, and behaviors of the students, and subsequent changes that occur after this brief intervention.

Methods

Design

Tobacco-related knowledge, attitudes, beliefs and behaviors among a cohort of fifth grade elementary school students was examined in a longitudinal fashion through use of a pre-test and two-stage post-test design. The Tar Wars program, offered by the American Academy of Family Physicians, was used as the structured tobacco use prevention program (e.g. "intervention program"). This program is designed as a single, interactive, 40-50 minute in-class presentation where students are provided with a series of dynamic exercises. The children actively learn about the short-term effects of tobacco use, they contemplate and discuss reasons why people use tobacco products and they are prompted to think critically about tobacco advertising. The program is often delivered by a Family Physician or other health care professional [9,13]. The Tar Wars program content is highlighted in table 1 and a printed curriculum is available at no charge [<http://www.tarwars.org>]. In brief, the students discuss tobacco prevalence data, the short-term effects of tobacco, including smelly clothes, yellow teeth, bad breath, coughing or hacking and difficulty breathing. Additionally, they learn to calculate the costs involved with weekly, monthly and yearly tobacco use, as well as possible alternative ways to spend their money. They also have an interactive discussion about the reasons people start to use tobacco, which focuses on awareness of media/advertising images and peer pressure that they are exposed to. Finally, through the use of tobacco advertisements, they review misperceptions generated in the public at large, and children in particular, related to tobacco use, including - that smoking is related to obtaining - romance, having good looks, attaining a 'cool' image, and making friends. The program is reinforced through the creation of individual posters emphasizing the positive effects of remaining tobacco free.

Comparisons of tobacco use knowledge, attitudes, beliefs, and behaviors of fifth grade students are made within a randomly assigned (at the level of the school) primary intervention group (study Group 1) across three points in time - 'pre-test', 'immediate post-test', and 'delayed post-test'.

Responses were also compared among children in other randomly assigned groups (Group 2 and Group 3), who took 'pre-tests', the 'intervention', and 'immediate post-tests', but at different points in time than Group 1 (see Figure 1). Although Groups 2 and 3 can not be considered true control groups, since they also received the educational 'intervention', they are used in this paper, in certain situations, in an attempt to address issues of test-retest bias, (since only one measurement instrument is used for both the 'pre-test' and the 'post-test' surveys), and historical effects, (since other factors besides the 'intervention'

Table 1: Overview of the Tar Wars tobacco-free education program for youth

Activity:	Objectives:
1. discussion of tobacco use prevalence [pre-activity]	review information on the percentage of 4 th /5 th grade students, 9 th grade students and adults who are tobacco-free, recognize that most people are tobacco-free
2. short term effects of tobacco use	discussion of the short-term effects of tobacco use (smelling clothes, yellow teeth, bad breath, cough, burn holes); interactive demonstration of how tobacco smoke decreases lung volumes
3. costs of using tobacco	calculation of the cost of tobacco use, discussion of alternative uses of money
4. reasons why people begin to use tobacco	understand reasons why people begin to use tobacco, identify responses when these situations arise
5. tobacco and advertising	increase students' knowledge of the tobacco industry's marketing strategies (image distortions) and how tobacco advertising attempts to influence product purchase, students begin think critically about tobacco advertisements/misperceptions
6. design a poster emphasizing the positive effects of not using tobacco	reinforce the Tar Wars lesson, creatively demonstrate individualized integration of curriculum along with prior information on tobacco use prevention

Note copies of the program curriculum are available at no charge at [<http://www.tarwars.org>]

may have influenced the outcomes of the 'delayed post-test').

Subjects

Following Institutional Review Board approval, 28 elementary schools were recruited to participate in the study. Fifth grade students from 27 of these schools (explanation below) participated in the research described in this paper. (The study design and group comparisons are summarized in Figure 1). Twenty-eight schools were initially separated into Group A and Group B using a randomized block design, by school size, in order to achieve roughly, equal-sized groups. Group A, which contained 16 schools, was subsequently separated into two groups by random assignment, with each group containing 8 schools. Group B contained 12 schools. The first group of 8 schools (N = 656) will be referred to as Group 1; the second group of 8 schools (N = 471) will be referred to as Group 2, and the group of 12 schools (N = 1120) will be referred to as Group 3.

In the Fall of 1998, Group 1 started with 8 schools (N= 656). Seven of these schools were public and 1 was private; while 6 were in an urban setting and 2 from a suburban setting. All of these students were scheduled to take a baseline 'pre-test', however, one school (private, urban) could not schedule the time for the 'intervention', and thus, did not participate further in this research effort. The difference between 656 and 578 students represents the missing school and anyone who was absent at the other 7 schools on the day of the post-test completion. Thus, 7 of the 8 schools (88%, N = 578) completed the baseline 'pre-test' and the 'intervention' The 'immediate post-test' was completed by 479 (82%) of the 578 students with baseline data.

During the Spring of 1999, after a delay of approximately four months, the schools in Group 1 were contacted again, so that they could complete a follow-up (delayed) 'post-test'. Two more schools were unable to schedule this follow-up survey. The difference between 489 and 371 students represents the two missing schools and anyone who was absent when the 'delayed post-test' was administered. Thus, a total of 5 (63%) out of 8 schools (note N = 371, or 54%, of the students in the original 8 school cohort) in Group 1 completed 'delayed post-test' evaluations. These five schools in Group 1, of which all were public; and 3 of which were in an urban setting and 2 from a suburban setting, ended up completing all study components (i.e., 'pre-test', 'intervention', 'post-test', and 'delayed post-test') and represent the primary group for analyses.

Group 2 also started with 8 schools (N = 471), of which 7 were public and 1 was private; and 6 of which were in an urban setting and 2 from a suburban setting. All of these students completed the same baseline 'pre-test' during the Fall of 1998. This Group was then scheduled for the 'intervention' during the early Spring of 1999 (about 4 months later), and to complete an evaluation 'post-test' immediately following the 'intervention'. Five of the eight schools were able to schedule the 'intervention' and the 'immediate post-test' during this time. The difference between 471 and 247 students represents the missing three schools and anyone who was absent on the day that the 'immediate post-test' was administered. Thus, a total of 5 (63%) out of 8 schools (note N = 247, or 52%), of the students in the original 8 school cohort) in Group 2, completed all requested components, of which 4 schools were public and 1 private; and 3 of which were in an urban setting and 2 from a suburban setting.

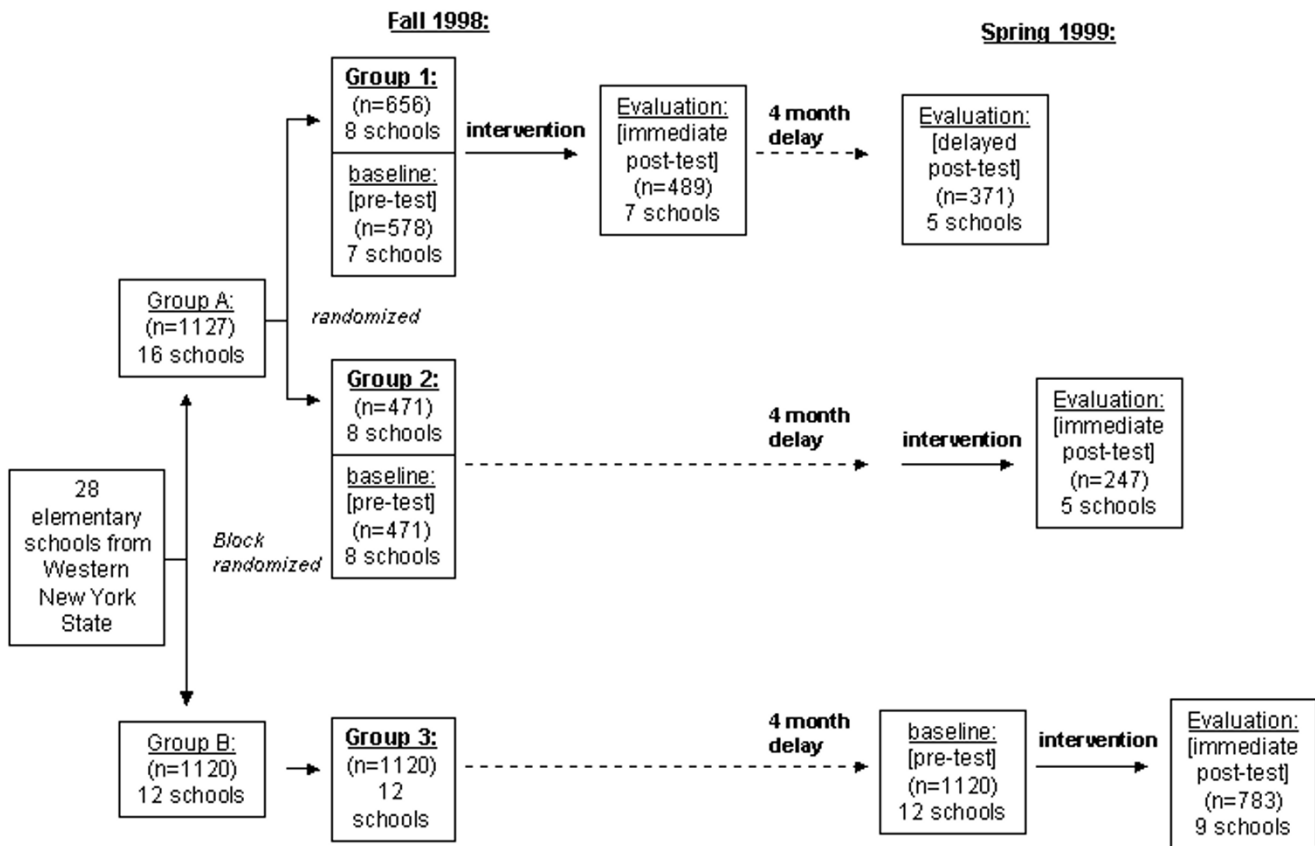


Figure 1
Overview of Tar Wars Evaluation: Western New York State, 1998–1999

The 12 schools in Group 3 (N = 1120), of which 11 were public and 1 was private; and 5 of which were in an urban setting and 7 from a suburban setting, completed a baseline 'pre-test', during the Spring of 1999. This Group was then scheduled for the 'intervention' and the 'immediate post-test' approximately 1–2 months later. Three of the twelve schools were unable to schedule the 'intervention' and the 'immediate post-test' during this time. Thus, a total of 9 (75%) out of 12 schools (note N = 783, or 61%, of the students in the original 12 school cohort) in Group 3, of which 8 were public and 1 private; and 3 of which were in an urban setting and 6 from a suburban setting, ended up completing all requested components.

For this study, the participation of both students and schools was voluntary. No exclusionary criteria were employed for any of the groups.

Analyses

Proportions of correct responses to survey items were compared at the school level using Wilcoxon-Matched Pairs /Signed Ranks Tests for analyses of data from Group

1 schools (baseline, immediate post-test and delayed post tests) and for analyses of aggregate data from the 19 schools completing baseline surveys, the intervention and immediate post-tests. P-values were identified as significant if they were less than or equal to .05, thus rejecting the null hypothesis of no change from baseline following the intervention.

To examine whether significant differences were present between groups at the time of completion of the baseline survey, the proportion of correct responses were compared at the group level (aggregated schools for each group), using the Mann-Whitney-Wilcoxon Rank Sums Test (unpaired, independent groups). P-values were identified as significant if they were less than or equal to .025 (.05 halved for a 2-tailed hypothesis), thus rejected the null hypothesis that the proportions were not significantly different from each other.

Due to skewed data for the proportion of correct responses to each survey items (at the level of both school and

Table 2: Percentage Correct Responses¹ to Survey Items on Knowledge of Short-Term Effects and Attitudes about Tobacco Use Among a Five School Aggregate of 5th Grade Students in Western New York State who were Randomized² to Receive a Tobacco Prevention Program Intervention during the 1998–1999 School Year.

Survey Item:	Fall 1998	Fall 1998		Spring 1999	
	Baseline Survey (Pre-Test) (N = 450) % ³	Evaluation Survey (Immediate Post-Test) (N = 408) % ³	p-value	Follow-Up Survey (Delayed Post-Test) (N = 371) % ³	p-value
Knowledge of short-term effects of tobacco:					
(1) Smoking causes bad breath	98.4	100	N.S.	99.7	N.S.
(2) Smokers have yellow teeth and fingers	72.0	96.5	p = 0.0313	95.1	p = 0.0313
(3) Low tar cigarettes are safe	88.2	92.6	N.S.	94.9	N.S.
(4) Smokers have clean smelling clothes	89.2	91.6	N.S.	91.9	N.S.
(5) Smoking decreases the amount of air that gets into your lungs	86.5	89.6	N.S.	90.2	N.S.
(6) Smoking 1 pack of cigarettes a day costs several hundred dollars per year.....	81.5	91.8	p = 0.0313	94.3	p = 0.0313
Attitude about tobacco use:					
(7) People who use tobacco are popular and glamorous . .	93.2	91.3	N.S.	96.9	N.S.
(8) Some people start to use tobacco because their friends do	93.4	95.9	N.S.	96.2	N.S.
(9) Smoking is relaxing	87.2	90.2	N.S.	88.9	N.S.
(10) Advertising tells the truth about the effects of tobacco use.	73.1	81.0	N.S.	79.9	N.S.

¹ Proportions were compared at the School Level (N = 19), using Wilcoxon-Matched Pairs/Signed Rank Tests. P-values were identified as significant if they were less than or equal to .05, thus rejecting the null hypothesis (that the Intervention had No Effect); n.s. = not significant. ² There were 8 schools originally selected for this group; 1 school dropped out because they could not schedule the Intervention and another 2 schools were unable to schedule the Follow-Up (Delayed Post-Test) Survey, thus the data presented have complete information for each school at every measurement point. ³ Percentages shown are Medians, which summarize the distribution of correct responses by school.

group), median values are presented in the tables and non-parametric procedures were used as described above.

Results

Responses to the baseline survey for knowledge and attitude items among all schools were compared across all combinations of groups (1 versus 2, 1 versus 3 and 2 versus 3). No significant differences were noted suggesting that randomization created comparable groups. Also, in looking at the comparison of Groups 1 and 3 at baseline, we are able to rule out historical effects, that is, the presence of any systematic tobacco programs or policies that might have impacted our dependent variables. In other words, there were no significant differences in baseline measures, even though the surveys were administered four months apart. Moreover, these results did not change

after the loss of schools from each group indicating that the final 19 schools were comparable within and across groups to the original 27 schools (excluding one school from Group 1 which dropped out prior to the baseline survey).

Table 2 presents longitudinal results for the five schools in Group 1 which completed all study components (baseline surveys, intervention, immediate post-tests and delayed post-tests). Baseline median scores for correct responses to survey items range from 73% up to 98% with several values in the mid-eighties and above suggesting a ceiling effect. Nonetheless, following the educational intervention program, significant improvements are noted on both the immediate post-test and delayed post-tests for

Table 3: Percentage Correct Responses¹ to Survey Items on Knowledge about Tobacco Use Prevalence among Peers, High School Students, and Adults Among a Five School Aggregate of 5th Grade Students in Western New York State who were Randomized² to Receive a Tobacco Prevention Program Intervention during the 1998–1999 School Year

Survey Item:	Fall 1998	Fall 1998	Spring 1999		
	Baseline Survey (Pre-Test) (N = 450) % ³	Evaluation Survey (Immediate Post-Test) (N = 408) % ³	p-value	Follow-Up Survey t-Test (Delayed Post-test) (N = 371) % ³	p-value
Knowledge of tobacco use prevalence:					
(11) What percentage of kids your age (5 th graders) use tobacco every week	30.6	45.2	N.S.	29.3	N.S.
(12) What percentage of high school students (9 th graders) use tobacco every week	20.3	31.1	N.S.	20.4	N.S.
(13) What percentage of adults use tobacco every week	4.8	33.9	p = 0.0313	11.5	N.S.

¹Proportions were compared at the School Level (N = 5), using Wilcoxon-Matched Pairs/Signed Rank Tests. P-values were identified as significant if they were less than or equal to .05, thus rejecting the null hypothesis (that the Intervention had No Effect); n.s. = not significant. ²There were 8 schools originally selected for this group; 1 school dropped out because they could not schedule the Intervention and another 2 schools were unable to schedule the Follow-Up (Delayed Post-Test) Survey, thus the data presented have complete information for each school at every measurement point. ³Percentages shown are the Medians, which summarize the distribution of correct responses by school.

items relating to recognition that smokers have yellow teeth and fingers and costs associated with tobacco use.

Knowledge of tobacco use prevalence for these five Group 1 schools is shown in table 3. The median percent scores for correct responses at baseline are much lower for all three items ranging from 5% to 30%. A significant increase from 5% at baseline to 34% correct on the immediate post-test is noted for the item examining the percent of adults who use tobacco on a regular basis, however, the delayed post-test scores fall back to baseline levels (12%). No other significant findings are apparent for this group of items.

Table 4 and 5 present pooled aggregate data for students from all 19 schools (5 schools from Group 1, 5 schools from Group 2 and 9 schools from Group 3) that completed baseline surveys, the intervention and immediate post-tests. Although baseline median scores for the pooled data in table 4 generally range between 86% and 98%, significant increases are noted for all items relating to knowledge of the short-term effects of tobacco use and half of the items examining attitudes about tobacco use (e.g., the influence of "peer pressure" and the awareness of advertising images/distortions). All of the median scores of the items related to epidemiological knowledge of tobacco use (table 5) showed significant increases between baseline and immediate post-tests, although post-test values were sub optimal in that a number of students still were not reporting correct responses.

Discussion

These results identified immediate and sustained improvements for 2 of 10 knowledge- and attitude-based survey items on tobacco use, following exposure to a single session, in-class, youth tobacco education program. These two items related to the powerful image of tobacco users having yellow teeth and fingers and the costs associated with tobacco use.

These findings hold important public health significance. First, unlike other programs that require multiple sessions and considerable coordination, Tar Wars is a single session, structured, interactive intervention program. These results suggest the presence of modest and sustained responses as a result of this single session. It is possible that these key concepts could be reinforced, and even expanded, through repeated exposures to and participation in other complementary tobacco prevention and health programs. Thus, Tar Wars can contribute as one element among a variety of educational strategies. In addition, the ultimate success of these educational programs requires the implementation of a comprehensive tobacco control strategy, including legislation, taxation, and modification of social norms.

A number of potential limitations warrant discussion. First, in assessing post-intervention changes in knowledge and attitudes, the potential of a ceiling effect among variables with a high level of correct responses at baseline can complicate interpretation. Statistical significance was not

Table 4: Percentage Correct Responses¹ to Survey Items on Knowledge of Short-Term Effects and Attitudes about Tobacco Use Among a Pooled 19 School Aggregate of 5th Grade Students in Western New York State who Received a Tobacco Prevention Program Intervention During the 1998–1999 School Year.

Survey Item:	Baseline Survey (Pre-Test) (N = 1596) % ²	Evaluation Survey (Immediate Post-Test) (N = 1438) % ²	p-value
Knowledge of short-term effects of tobacco:			
(1) Smoking causes bad breath	98.9	100	p = 0.0005
(2) Smokers have yellow teeth and fingers	76.9	96.7	p < 0.0001
(3) Low tar cigarettes are safe	93.0	96.7	p = 0.0004
(4) Smokers have clean smelling clothes	90.0	94.5	p < 0.0001
(5) Smoking decreases the amount of air that gets into your lungs	90.0	92.5	p = 0.0036
(6) Smoking 1 pack of cigarettes a day costs several hundred dollars per year.....	86.6	93.4	p = 0.0002
Attitude about tobacco use:			
(7) People who use tobacco are popular and glamorous...	94.3	94.7	N.S.
(8) Some people start to use tobacco because their friends do	95.6	97.5	p = 0.0223
(9) Smoking is relaxing	89.9	89.4	N.S.
(10) Advertising tells the truth about the effects of tobacco use.	80.0	87.3	p = 0.0162

¹Proportions were compared at the School Level (N = 19), using Wilcoxon-Matched Pairs/Signed Rank Tests. P-values were identified as significant if they were less than or equal to .05, thus rejecting the null hypothesis (that the Intervention had No Effect); n.s. = not significant. ²Percentages shown are the Medians, which summarize the distribution of correct responses by school.

Table 5: Percentage Correct Responses¹ to Survey Items on Knowledge about Tobacco Use Prevalence among Peers, High School Students, and Adults Among a Pooled 19 School Aggregate of 5th Grade Students in Western New York State who Received a Tobacco Prevention Program Intervention during the 1998–1999 School Year.

Survey Item:	Baseline Survey (Pre-Test) (N = 1596) % ²	Evaluation Survey (Immediate Post-Test) (N = 1438) % ²	p-value
Epidemiological Knowledge of Tobacco Use:			
(11) What percentage of kids your age (5 th graders) use tobacco every week	32.4	75.5	p < 0.0001
(12) What percentage of high school students (9 th graders) use tobacco every week	26.3	34.3	p = 0.0129
(13) What percentage of adults use tobacco every week	4.4	49.1	p < 0.0001

¹Proportions were compared at the School Level (N = 19), using Wilcoxon-Matched Pairs/Signed Rank Tests. P values were identified as significant if they were less than or equal to .05, thus rejecting the null hypothesis (that the Intervention had No Effect); n.s. = not significant. ²Percentages shown are Medians, which summarize the distribution of correct responses by school.

achieved for all items showing an increment in correct responses, which may be due in part to a limited number of schools and the choice to complete analyses at the level of the school. The inclusion of additional schools in the analysis would have resulted in significance for additional items.

Because student identities were anonymous, a repeated measures design could not be used. Also, the school

groups sampled at the 'delayed post-test' may not contain the same students who completed the 'pre-test', 'intervention', and 'immediate post-test' during the Fall of 1998. Also, there was some non-systematic loss of schools in each group that were unable to complete all requested components due to scheduling difficulties and competing demands for classroom time. However, the observed response rates were reasonable given the follow-up interval of several months. Further, these analyses relied upon

non-parametric tests at the level of the school. As a result, the median scores for some of individual schools are variable, making the ordering inconsistent over testing occasions, which in turn, results in the extreme p-values from the Wilcoxon tests.

Another potential limitation relates to test/re-test bias. Theoretically, the delay of several months between completion of the baseline survey and the intervention and immediate post-test in Group 2 could be used to examine the potential issue of test/re-test bias. In using the same survey instrument for the baseline and post-tests we would tend to show an impact from the intervention, where there might not be one. However, delaying the intervention and post-test should create a less pronounced test/re-test bias, if it exists. In other words, we would expect to see a greater increase on the immediate post-test in Group 1. However, a sub-analysis demonstrated no significant differences between Groups 1 and 2 at baseline or on the immediate post-test for any of the ten knowledge and attitude items. Thus, the issue of test/re-test bias does not seem to be a significant issue.

Also, through the comparison of baseline surveys for Groups 1 and 3, we were able to rule out historical effects, that is, the presence of any systematic tobacco programs or policies that might have impacted our dependent variables of knowledge and attitude. Moreover, these results did not change after the exclusion of schools that failed to complete all components, indicating that the final 19 schools were comparable with and across groups to the original 27 schools (excluding one school from Group 1 which dropped out prior to the baseline survey).

Knowledge levels regarding tobacco use prevalence among selected age groups jumps at the immediate post-test, but drops back to baseline levels at the time of the delayed post-test 4 months later. These results, in combination with the aggregate data comparing baseline and immediate post-tests, suggest that Tar Wars is having a positive impact on these children. However, virtually all program components would need to be reinforced through repetition and recall efforts at some identified interval. The active learning model of Tar Wars, which includes interactive demonstrations and classroom group discussions helps create the dynamics for long-term retention.

This study design assessed changes in health beliefs (e.g., knowledge and attitudes) rather than actual behavior. An assessment of changes in tobacco use behaviors would require a much longer period of follow-up. Also, health behaviors represent the manifestation of interactions between attitudes, knowledge and beliefs occurring within an environmental context. Thus, changes in attitudes

and knowledge are likely to yield corresponding shifts in behavior. Another potential limitation is that some students were lost to follow-up due to competing demands for classroom time.

The most effective educational programs are structured to include a social influence intervention [6,14]. Moreover, associations between cigarette smoking and social norms, peer influences and perceived tobacco use prevalence have been reported among a group of middle school students (6th-8th grades) [15]. The social influences model includes dimensions reflecting both normative beliefs (e.g., pressures to achieve peer acceptance) and informational influences (e.g., advertising) [10] to enhance awareness of potential health effects and prevent adoption of unhealthy behaviors. The Tar Wars tobacco prevention curriculum includes elements from both of these social influence dimensions with discussions of tobacco use prevalence, physical consequences, costs and misrepresentations used in advertising. Together, the Tar Wars themes emphasize an enhanced recognition of social pressures used to influence initiation of tobacco use.

A recent study [16] has reported no effects from application of a carefully constructed social influences model for a school based tobacco prevention program from grades 3 through 12. These findings were generally unanticipated and have resulted in on-going deliberation about how to assess the impact of youth prevention programs [3]. While the findings from Peterson, et al (2000) are disturbing, it would seem foolhardy to simply abandon all school based tobacco prevention programs.

Conclusions

Only a limited number of tobacco prevention materials for elementary school children are available from non-profit sources [17]. However, the tobacco use prevention program presented in this study (e.g., Tar Wars) appears readily transferable to other community-based settings. This educational program is available for presentation by Family Physicians, other health professionals or by other group leaders, at no charge and yielded measurable improvements in tobacco use knowledge- and attitude-based survey items. This tobacco use prevention program is also consistent with guidelines by the Centers for Disease Prevention and Control [18] which recommend inclusion of content which addresses the short term effects of tobacco use, social influences of tobacco use, marketing of tobacco products, initiation of educational programs in elementary school and soliciting community support. Moreover, Tar Wars appears to meet criteria established for the "programs that work" process developed by the Centers for Disease Prevention and Control for selecting tobacco use prevention curricula [<http://www.cdc.gov.nccdphp/dash/rtc/criteria.htm>].

It is important to acknowledge that youth are exposed to a variety of sources advocating tobacco-free lifestyles. As with other educational and motivational efforts in public health, tobacco prevention messages require repetition and reinforcement via slightly different, but parallel approaches. These exposures to parallel messages likely reinforce or "boost" the educational impact. Other educational interventions reinforcing the Tar War message of healthful, tobacco-free lifestyles include school health classes, science classes, alternative tobacco use prevention/education programs and community/religious youth groups. Tobacco prevention programs represent interventions designed to increase awareness of the social influences facing youth. In isolation, any single prevention program is probably inadequate to induce behavioral change. However, together, complementary messages may result in positive behavior changes through reinforcement of comparable information.

Overall, we are looking at modest effects resulting from this single intervention. However, Tar Wars and other complementary program should be viewed as interlocking pieces of a puzzle, not independent processes. Also, within the field of public health one of the most important insights is the understanding of Rose's theorem whereby, if a large number of people (in this case school-children,) are exposed to an intervention and change only a lit bit for the better, then the population health ramifications can be quite dramatic. Certainly, the results from this study suggest that a logistically uncomplicated and low cost program such as Tar Wars should be included within the educational armamentarium to aid in preventing youth from using tobacco products.

Competing interests

Dr Mahoney previously served as a former member and Chair of the Tar Wars Advisory Board, American Academy of Family Physicians He continues as a Program Advisor for Tar Wars.

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