Field Trial to Test and Evaluate Primary Tobacco Prevention Methods in Clusters of Elementary Schools in Barbados

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ABSTRACT

To evaluate methods of preventing young children from experimenting with tobacco and to determine cost effectiveness, students (n = 1005) in 31 primary schools, from randomly selected higher grade-levels were recruited into a partially randomized, single blinded controlled trial in which seven groups of schools were randomly assigned to a combination of teaching, leaflet, and drama, in order to modify students' knowledge, attitudes, beliefs and behaviour (KAB). The eighth group (n = 346) with ten schools, distantly separated from the former, was assigned to be the control, but was dropped from comparison analysis for lack of randomness at baseline. The mean, standard deviation and median age of the intervention groups was 9.94 years (0.81), 10.0 years, (n = 669) at baseline; and 10.62 years (0.66), 11.0 years, (n = 397), at 12 months follow-up. In all, 6.6% had ever used tobacco at least once at a median age of seven years. Teaching health education at school when combined with other methods was significantly better at improving KAB. In 2003, after a year post-intervention, the occurrence of experimentation smoking in the last 30 days, dropped from 9.2% to 1.2% (p = 0.00), equivalent to 87% (95% CI 78, 93) reduction in the group exposed to health education compared to none in the leaflet-only group and Numbers Needed to Treat (NNT) = 12.5. Due to its cost-effectiveness (comparable to child immunizations) at BDS$1.89 to 2.89 or US$1 to 1.5 per child contacted and BDS$100 to 140 (US$50 to 70) capital investment in other resources per school, the experience could be utilized routinely in elementary schools.

Ensayo de Campo para Probar y Evaluar Métodos Primarios de Prevención del Consumo de Tabaco en Grupos de Niños de Escuelas Primarias en Barbados

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RESUMEN

A fin de evaluar los métodos usados para impedir que los niños en edad escolar experimenten con tabaco, y determinar la efectividad del costo, estudiantes (n = 1005) en 31 escuelas primarias – de los grados más altos seleccionados aleatoriamente – fueron enrolados en una prueba parcialmente aleatoria controlada, de simple ciego. En este ensayo, a siete grupos de escuelas se les asignó aleatoriamente una combinación de instrucción, folletos, y drama, con el propósito de modificar sus conocimientos, actitudes, creencias y comportamiento (CAC). El octavo grupo (n = 346) con diez escuelas, separado a distancia de los anteriores, fue escogido como control, pero fue dejado fuera del análisis comparativo debido a falta de aleatoriedad en la línea de base. La media, la desviación estándar, y la mediana de la edad de los grupos de intervención fue de 9.94 años (0.81), 10.0 años, (n = 669) en la línea de base; y 10.62 años (0.66), 11.0 años, (n = 397), a los 12 meses de seguimiento. En total, 6.6% habían usado por lo menos una vez tabaco a la edad mediana de siete años.

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INTRODUCTION

Primary prevention in children is the most effective way to prevent adverse health effects of tobacco. Similar to trends elsewhere (1), in Barbados between 1970 and 1999, the median age of tobacco experimentation dropped from 15.5 to 11.5 years (2, 3). The prevalence of ever using tobacco in

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adolescents increased from 18% to 36%. In girls, it increased from 7.2% to 36%. Prevalence of current habitual smoking for those aged 15 years and over was 9% and 11% in 1992 and 2000 respectively (4, 5). In 2000, 8% of school youths aged 11–17 years had smoked in the past 30 days, 0.7% smoked daily and 1% believed they could not quit (6).

Early adolescent smoking is associated with higher frequencies of: mental problems, poor performance at school, nicotine dependence leading to hardcore smoking (7–10). Yet in the Caribbean, like other developing regions, little or no effort has been invested in primary tobacco prevention in children (11–13). Local efforts (*eg* by the National Council on Substance Abuse) have been made in a few schools on promotion of skills to prevent substance abuse but none was evaluated scientifically with valid data.

The aim of this study was to: (a) develop methods for primary prevention skills against tobacco use in elementary school children aged 9–11 years through information, education, and communication (IEC) that modify knowledge, attitudes, beliefs and behaviour (KAB); (b) determine cost-effectiveness; and (c) recommend suitable prevention strategies. Built on trans-theoretical and health belief models, it was hypothesized that anti-tobacco IEC modifies KAB positively and that some methods were more effective than others.

METHOD

Study design: A single blinded controlled field trial, with two parallel groups in which the exposed group consisted of seven random school (cluster) groups. It was designed to measure change in KAB as the primary outcome between intervention and control in two parallel non-randomized cluster groups; while for secondary outcomes, effectiveness of the different modes of interventions by comparison of seven randomly selected and assigned intervention clusters. Subjects were blinded to exposure of other clusters. After it was found out that the two parallel groups were different (not random) in 16 of 37 variables at baseline, the analysis was restricted to the different levels of KAB exposure in the 7 intervention clusters. Clusters of schools rather than individuals were selected. Individuals in the same school interact and are more similar. In order to reduce contamination of effects and for practical convenience, feasibility of exposure, and to economize resources, blinding between groups and a cluster design were the most suitable.

Sample and setting: (Fig 1). The following grade-levels cover the seven years in Barbados' primary education: Reception-1 (age 4–5), Reception-2 (age 5–6), Infant (age 6–7), Grade-1 (age 7–8), Grade-2 (age 8–9), Grade-3 (age 9–10) and Grade-4 (age 10–11). Nationally, there are 80 primary schools and eight polyclinics. Primary schools in Barbados are largely similar as regards possible confounders: the teaching environment, staff complement and similar age sets.

Step 1: For follow-up purposes, schools were grouped into clusters as the unit of selection according to geographic location of polyclinics service areas, and therefore blinding of clusters by distance. Forty-two (42/80) schools located within four service areas of Warrens, Black Rock, Maurice Byer polyclinics formed a geographically continuous block stretching from central west to the north of the island. In addition, the southern Randal Phillip was entered in the study as two parallel clusters. The former was assigned to the intervention, as its many schools (32/42), could further be divided into sub-intervention clusters for testing seven different methods of exposure. Both areas were separated from each other deliberately by a cordon of unselected polyclinics' service areas.

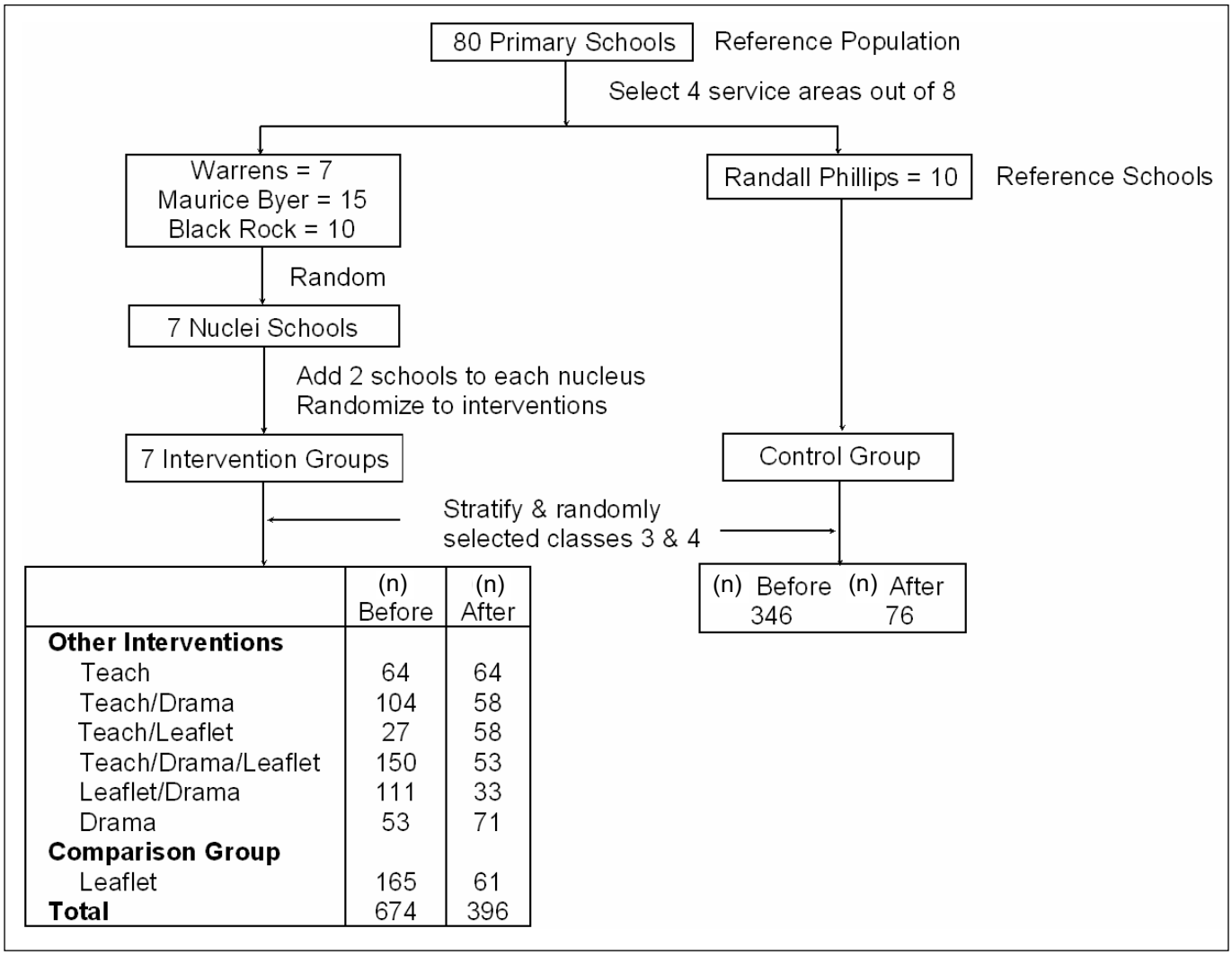
Step 2: The sample size (n = 1005) was computed to detect a difference between exposed and control of ± 4.8% for the change in proportions reporting smoking in the last 30 days in students in grade-levels 3 and 4 at power 80% in ratio of 5 : 2 in two parallel groups. It was estimated that 31 schools each contributing a minimum of 32 students would make the required sample size, from all the ten schools in the control area and 21 of 32 in the exposed area. Cluster effects were not considered at this level of two parallel groups.

Step 3: Forming clusters within the exposed group: seven of 32 schools within three conjoined polyclinic service areas were selected randomly. To each of the selected seven nuclei schools, two geographically adjacent schools, cordoning off others by distance to enhance blinding between clusters, were added to form the seven clusters. In turn, these clusters were again randomly assigned to the seven interventions. In the southern area, all 10 schools (except one that opted not to enter the study) became the control.

Eligibility: None of the schools had ever been involved in a similar promotion. Participants were from the two higher grade-levels, three and four, who were capable of filling in a self-administered questionnaire, under supervision at school. At large schools, with more than one class within grade-levels 3 and 4, classes were stratified at grade-levels at each school and at least one was picked randomly from each grade-level.

Intervention: The experimental series, in step 3 above, consisted of seven sub-intervention arms: teaching, drama, leaflet, teaching and drama, teaching and leaflet, teaching and drama and leaflet, leaflet and drama. The eighth group, the control, was left to usual school activities. Preparations and implementation activities started in November 2001 and last contacts ended in 2004.

Developing teaching curriculum: Schools in the teaching arms of experimental series nominated contact teachers for a one-day workshop. It examined background information and



	(n) Before	(n) After
Other Interventions		
Teach	64	64
Teach/Drama	104	58
Teach/Leaflet	27	58
Teach/Drama/Leaflet	150	53
Leaflet/Drama	111	33
Drama	53	71
Comparison Group		
Leaflet	165	61
Total	674	396

Fig. 1: Profile of field trial design

Notes: n = average size of groups. During analysis, group size varied because some students did not respond to all parts of the questionnaires. Secondly, participating students in a cluster may increase when the absentees join. Dropouts occurred due to school activities, and senior graders left primary to join secondary schools. It was difficult to account for individuals, as many students did not use personal identifiers consistently.

rationale for the project; dealt with teachers' concerns and misconceptions in question and answer sessions. Its three working groups modified a draft questionnaire and made a list of topics to cover in one or two classroom sessions, and teaching resources. The list, not limited to the following, centred on: description of tobacco and its constituents; misconceptions and myths of the glamour of tobacco and commercial advertising; tobacco abuse and its effects on body parts, diseases associated with and/or caused by tobacco; immediate and later consequences: loss of pocket money, hygiene, fitness, life expectancy, and quality of life; prevention by developing healthy lifestyles: good personality, making choices, pledge to abstain, making friends and overcoming peer pressure. The workshop's proceedings and the questions and answers were circulated as part of an action plan. Absentees were updated subsequently. In the implementation, contact teachers were asked to exclusively use the method assigned to their school and only materials for the selected activity were resourced for the school. At baseline, and at 12 months of follow-up, students filled in questionnaires consisting of 40 items.

A modified and simplified data collecting tool was based on the extensively used global youth tobacco survey, GYTS, available in GYTS Barbados country report at Centre for Disease Control and Prevention, USA, website (cdc.gov) (1). Questionnaires had blinded identifiers (student ID). The teacher read out the instructions, emphasized that it was not a test but asked for sincere responses and told students that the process ensured personal confidentiality at all levels. Completed and uncompleted questionnaires in sealed envelopes were forwarded to the principal investigator. A primary school students' drama team performed the drama, one session in 10 schools: "The life you save may be your own" and this proved quite popular. It was videotaped and interactively recorded on CD. All contact teachers attended a mid-year review as a feedback on the first questionnaire,

during which they watched the drama. After the final questionnaire, all primary schools in the island were sent teaching instructions, a book, drama CD, drama videotape and leaflets to initiate or continue their own anti-tobacco activities.

Ethics: The Ministry of Health research ethics committee reviewed and approved the study, while the Ministry of Education gave permission to contact schools. Schools were given a choice as to whether to participate and there was no hindrance of activities in the control schools. Participatory schools used minimal contact time and nominated contact teachers for the project. Students were the beneficiaries of the project.

Analysis

Variables: Questionnaires collected information from each subject concerning 40 items; some are listed here. Demographic data: name of school, allocated study group number, student admission number (ID), birth date, age, gender, class, parents and people living with subject. Data on tobacco use: friends, brothers, sisters, parents who use tobacco, if ever experimented with tobacco, what age and type, and cigarettes smoked per month. Data on attitudes: desire to smoke and banning smoking in public. Knowledge data: is smoking good for: boys, girls, adults? Does it make a person: smart, popular, or sociable? Is it harmful to: the public, pregnancy and passive smokers? Is it easy to quit? Where did they learn about tobacco and what was the source of information. Knowledge of diseases caused and its effects on: fine coordination, mental concentration, cognitive functions, sports, spending money, skin and lips, accidents and injuries, fertility, res-piration and circulation. Most responses were simple: yes, no, don't know or fill in.

Data were entered in SPSS version 11, recoded as necessary and analyses run through the software. EPInfo 6 statistic calculator was employed on some of collapsed categories in cross-tables.

Outcome measures: The control group was dropped after initial analysis as explained earlier. Henceforth, the analysis refers to other intervention group(s) *vs* leaflet only. The primary outcome was efficacy by change in 30-days smoking prevalence in other experimental groups *vs* leaflet-only group; and within and between groups' differences in variables for intervention arms; and cost-effectiveness in unit cost per student, as the secondary outcome. All p-values used 2-tail tests at # 0.05 for significance. Established smoking in young childhood being rare, annual incidence would have been an insensitive indicator. Instead, last 30-days reported smoking prevalence was used and therefore individuals were not followed for progression from smoking initiation.

Cluster as unit of analysis: Cluster being the unit of allocation of the intervention was analysed by summary measures as described by Wear (14). It is known to be more reliable than intercluster correlation coefficient and modelling methods, given that the clusters are few, < 10, but, it reduces sample size, power and makes the confidential intervals and p-values larger (14). A database post-hoc random sample drawn by statistical processor from all clusters was used to standardize, or test the comparability of each cluster across variables. For univariate analysis, summary statistics were checked for homogeneity and heterogeneity of the comparison groups at the two time periods.

Categorical variables analysis: Proportions and prevalence of responses for variables *yes, no, don't know* were expressed as per cent; and level of significance tested by chi-square or Fishers exact test, if number was small in table cells.

Continuous variables analysis: Difference of groups' means were compared for significance by Anova; by two independent groups t-test used for other experimental and leaflet only groups; and Levene's test for equality of variance was applied. Age four was assumed to be the earliest subjects could have remembered experimentation, so, age reported at four years or less was recoded as four years.

Efficacy: To summarize how well a sub-intervention group did relative to others in its outcomes for 27 variables, an efficacy index was devised. Each sub-intervention group's performance, measured by absolute change from the before to the after data was ranked relative to the other groups; and total rank score, mean and median rank computed. (A post-hoc matrix for the 27 variables in rows and experimental groups in columns was constructed with cells filled in with intervention ranked performance for each variable). Example, if a group was ranked second all through, relative to others in 27 variables, its cells would be filled with twos. From its total, 54, its mean rank and median rank for 27 variables is two. The derived mean rank distribution and median rank score for each group were displayed as the efficacy ranking of the interventions in box whisker plots.

Cost effectiveness: Smoking prevalence rather than incidence in the last 30 days is used in youth studies because smoking status is erratic and not established. Therefore, the number needed to avert smoking in a student, NNT, the reciprocal of attributable risk reduction, in this case 30-days smoking prevalence reduction in relation to that in leaflet-only, was not the basis for effectiveness. Cost-effectiveness analysis was based on per school resource investment and resource expenditure per child contacted. The components per student were one hour part-time teaching per student, costs for staged drama per student, and costs per leaflet. Resource investment per school included: orientation workshop, handouts, teaching guides and references (15) per teacher; videocassette (VC) and interactive DVD. School and technological infrastructure were assumed to be available from other sources.

RESULTS

Significant differences (data not displayed) in 16/37 variables at baseline between experimental groups and control disqualified controls for comparison. Instead, the least exposed group, the leaflet-only, with fewer than six significant differences was used for comparison analysis (Tables 1, 2 and Fig. 2). At baseline, 669 and 346 primary school children responded, in experimental and control groups respectively. For reasons stated above, analysis of the control was excluded from the report, henceforth. At each analysis, group sizes varied for each variable because some students did not fill out all information on the questionnaires, but this did not

Table 1: Comparison of other exposed groups and leaflet-only group at baseline, (the Before), and follow up, (the After).

	Baseline sample, (Before)			**Follow-up sample, (After)**			**Absolute Change (After minus Before = Differences in Proportions and p values for the differences.) Negative = desired change. Positive = undesired change.**	
% Yes, Y, Response	Other Exposed gps	Leaflet gp	p-level	Other Exposed gps	Leaflet gp	p-level	**Other Exposure gps**	**Leaflet gp**
M/F Ratio	0.98 (n = 486)	0.81 (n = 163)	NS	0.78 (n = 334)	0.86 (n = 60)	NS		
Age (Mean)	9.97 (n = 500)	9.87 (n = 116)	0.94^T	10.57 (n = 338)	10.49 (n = 59)	0.32^T		
Persons in home, mean	4.89	3.31	0.28^T	4.69	5.08	0.12^T		
Friends using tobacco – Mean	0.99 (n = 505)	0.63 (n = 166)	0.08^T	0.69 (n = 337)	1.31 (n = 59)	0.19^T		
% parents using tobacco	14.9 (n = 495)	10.5 (n = 161)	NS	12.5 (n = 336)	16.5 (n = 61)	NS		
% with siblings using tobacco	6.1 (n = 505)	7.2 (n = 166)	NS	3.9 (n = 337)	8.5 (n = 59)	NS		
% ever used tobacco: Y	3.1 (n = 481)	1.8 (n = 163)	NS	3.4 (n = 298)	11.5 (n = 61)*			
% current SMK in last 30days	9.2 (n = 496)	2.5 (n = 165)	*	1.2 (n = 336)	3.3 (n = 61)	NS	- 8.0 (**)	+0.8 (NS)
% want to experiment: Y	0.8 (n = 493)	1.2 (n = 163)	NS	0.9 (n = 334)	0 (n = 61)	NS	+0.1 (NS)	-1.2 (NS)
% tobacco is good: Y	1.2 (n = 499)	1.8 (n = 164)	NS	0 (n = 320)	1.6 (n = 61)	NS	-1.2 (*)	-0.2 (NS)
% tobacco smartens: Y	1.6 (n = 499)	0 (n = 165)	NS	0 (n = 340)	0 (n = 60)	NP	-1.6 (*)	0 (NP)
% makes person popular Y	2.7 (n = 504)	1.8 (n = 165)	NS	10.9 (n = 320)	5 (n = 60)	NS	+8.2 (**)	+3.2 (NS)
% relaxes: Y	3.8 (n = 494)	3.7 (n = 164)	NS	0 (n = 336)	0 (n = 59)	NS	-3.8 (**)	-3.7 (**)
% good for boys: Y	1.2 (n = 505)	3.0 (n = 160)	NS	0.3 (n = 260)	1.7 (n = 60)	NS	-0.9 (NS)	-1.3 (NS)
% good for girls: Y	0.14(n = 498)	0 (n = 153)	NS	0.06 (n = 341)	5.2 (n = 58)	0.00	-0.08 (NS)	+5.2 (*)
% good for adults: Y	14.2 (n = 494)	14.0 (n = 141)	NS	5.7 (n = 335)	6.7 (n = 59)	NS	-8.5 (**)	-7.3 (NS)
% passive SMK harm: Y	58.6 (n = 500)	63.0 (n = 162)	NS	83.6 (n = 396)	68.3 (n = 60)	**	-25.0 (**)	-5.8 (NS)
% ban public SMK: Y	73.3 (n = 498)	72.0 (n = 161)	NS	85.9 (n = 333)	77.9 (n = 59)	NS	-2.6 (*)	-5.9 (NS)
% revent in pregnancy: Y	91.1 (n = 492)	90.8 (n = 163)	NS	95.2 (n = 336)	86.7 (n = 60)	NS	-4.1 (*)	+4.1 (NS)
% easy to quit: Y	17.2 (n = 494)	19.5 (n = 164)	NS	22.9 (n = 336)	13.6 (n = 59)	NS	+5.7 (*)	-5.9 (NS)
(Mean) tobacco diseases listed	1.85 (n = 494)	1.50 (n = 164)	0.12^T	2.25 (n = 336)	1.78 (n = 59)	0.00^T		
% affects fine movements: Y	8.7 (n = 504)	27.6 (n = 116)	**	35.9 (n = 410)	18.6 (n = 59)	**	-27.2 (**)	+9.0 (NS)
% affects class-work: Y	9.9 (n = 504)	17.4 (n = 166)	**	60.5 (n = 385)	33.3 (n = 60)	**	-50.6 (**)	-16.3 (*)
% affects sports: Y	9.6 (n = 501)	17.5 (n = 166)	**	53.3 (n = 329)	16.6 (n = 42)	**	-43.9 (**)	+0.9 (NS)
% wastes money: Y	8.3 (n = 505)	14.6 (n = 116)	*	59.6 (n = 329)	28.2 (n = 29)	*	-51.3 (**)	-13.6 (NS)
% affects lips/skin: Y	8.2 (n = 503)	14.7 (n = 116)	NS	58.9 (n = 329)	52.5 (n = 40)	NS	-50.7 (**)	-37.9 (**)
% affects/injuries: Y	8.3 (n = 504)	10.2 (n = 166)	NS	54.4 (n = 331)	27.5 (n = 40)	**	-46.1 (**)	+2.7 (NS)
% affects fertility: Y	9.3 (n = 504)	15.7 (n = 165)	*	47.7 (n = 331)	26.8 (n = 41)	**	-37.4 (**)	-11.1 (NS)
% affects breathing: Y	9.1 (n = 502)	13.3 (n = 166)	NS	59.2 (n = 331)	29.5 (n = 41)	**	-50.1 (**)	-16.0 (**)
% affects heart: Y	8.3 (n = 503)	6.6 (n = 166)	NS	58.1 (n = 327)	28.2 (n = 39)	NS	-49.8 (**)	-21.6 (**)
% leant/discussed tobacco: Y	79.2 (n = 500)	74.7 (n = 166)	NS	81.5 (n = 396)	73.7 (n = 76)	NS		

Notes:

Prevalence per cent is quoted for Y = yes response. The p value at $\alpha = 0.05$ was quoted for chi-square or Fishers exact test when appropriate.

*p < 0.05, **p < 0.01 and NS, not significant = p > 0.05 and NP = not computable. Actual values can be derived from proportions.

T = t-test for equality of means for independent samples, at $\alpha = 0.05$, in which Levene's F-test for equality of variance was considered. 95% confidence intervals for differences of means between Other Exposed groups and the Leaflet group at baseline before and at follow-up a year later were for: (1) Age of subjects: -0.028; 0257 and -0.140; 0.442; (2) Persons in home: -0.177; 0.343 and -0.886, 0.103; (3) Friends using tobacco: 0.206; -0.043; -1.56; 0.32; (4) (Mean) tobacco diseases listed: 0.126, 0.552; 0.123, 0.883.

Table 2: Sources of anti-tobacco information reported by students.

	% Before (n = 669)	% After (n = 397)
Home	12.5	6.4
Schools and environment	51.1	69.9
Public media	20.6	13.1
Friends	2.2	1.8
Others	5.2	8.0
No response	8.1	0.8
p-values for between sub-groups	NS	NS

$p < 0.001$
Note the prominent role of school and its environment. NS = Not significant.

matter because the clusters were the unit of analysis. The mean, standard deviation (sd), and median at baseline (n = 669), and at follow-up (n = 397) for the intervention group were respectively 9.94 (0.81), 10.0 and 10.62 (0.66), 11.0. Overall, students who had ever used tobacco, at least once, were 6.6%; mainly by smoking cigarettes, at a median age of 7.0 years. Parents living with the children, predominantly mothers, in the before and after comparison; 43.7%, 6.0%, 43.3% p = 0.34 and 49%, 6.3%, 40% p = 0.19 for mother, father, and both, respectively, was similar in all groups. Post-intervention experimental group improved significantly in anti-tobacco KAB outcomes, 3.5 times better than leaflet-only group in 18 *vs* 5 of 22 variables respectively. The distribution of most variables among clusters was not significantly different, when compared using a post-hoc randomly selected overall sample (data not shown). There was a decline in smoking in the previous 30 days before filling in the baseline and the final questionnaires from 9.2% to 1.2% ($p = 0.00$) in other exposure group and a rise from 2.5% to 3.3% ($p = 0.66$) in leaflet-only group; equivalent to protecting 8% of individuals from smoking or 87% (95% CI 78, 93) of smoking in

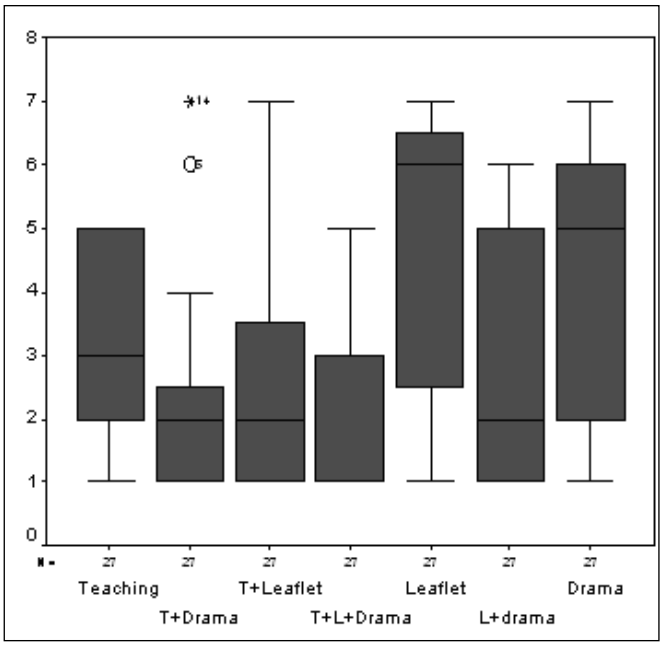


Fig. 2: Box whisker plot showing distribution of plotted effectiveness rank scores of 27 KAB variables for each intervention method; the median score line across the box indicates position of effectiveness; the lower the median rank the better the method.

Note: The box locates the 50% interquartile range. Median line, median rank index, cuts across the box. Whiskers are for boundaries of low and high values of rank scores, but exclude outliers. n = 27, variables compared. Outliers are excluded extreme ranks for variables 5 and 14, Superiority by order ranking: 1 to 7, where 1 > 2, etc. median rank for T+L+Drama is on top of box.

those experimenting with tobacco; NNT = 12.5, Table 3. The belief that it is easy to quit smoking remained high post-intervention. Important predictors of student's tendency to tobacco experimentation, by forward stepwise regression were: liberal views on smoking in public and smoking as a

Table 3: Change in the prevalence of smoking reported by children in intervention groups in 30 days prior to baseline and follow-up questionnaires, a year later.

	Before and After smoking crude and **gender standardized prevalence %				Absolute change	NNT	Rank of change
Intervention	Before		After				
Teaching	6.8 (n = 59)	7.1	0 (n = 63)	0	*6.8	*14.7	3
T+Drama	10.1 (n = 99)	10.0	0 (n = 58)	0	*10.1	*9.9	1
T+Leaflet	7.4 (n = 27)	8.1	3.4 (n = 58)	3.4	4.0	25	6
T+D+Leaflet	6.3 (n = 150)	4.9	0 (n = 53)	0	*6.3	*15.8	4
L+Drama	7.3 (n = 110)	7.3	0 (n = 33)	0	*7.3	*13.6	2
Drama	7.8 (n = 51)	7.6	2.7 (n = 71)	2.7	5.1	19.6	5
All above	9.2 (n = 496)		1.2 (n = 336)			12.5	
Leaflet-only	2.5 (n = 165)	2.5	3.3 (n = 61)	4.6	- 0.8		7

NB: In the other intervention groups 8%, were prevented from smoking *vs* none in leaflet-only; equivalent to 87% (95% CI 78–93) reduction in smoking in children experimenting with tobacco. **Prevalence changes and number needed to intervene, NNT, where the end prevalence was zero could have been higher or lower depending on the baseline prevalence and therefore should be interpreted with caution. **The gender standardized rates if whole group's male to female ratio applied to groups.*

good attribute (p # 0.02), failure to appreciate health risks/diseases (p = 0.03) and being young in age (p = 0.046). For repeated smoking: a company of siblings or friends using tobacco (p # 0.002); tobacco availability (p = 0.004); liberal views that smoking is good: for boys (p = 0.001) and that it should be allowed in public places (p = 0.019).

Desired improvement in skills in the other exposure group occurred in 20/22 variables, of which it was significant in18; and in the leaflet-only group, 12/22, of which it was significant in five. Significant concordance of both comparable groups in improvement of skills occurred in: tobacco smartens, tobacco relaxes, affects skin and lips, wastes money, affects breathing and heart. Concordance occurred in both groups with an increase in perceptions and knowledge that tobacco makes a person popular. The direction of change in the former represents perceptions and knowledge that are easy to acquire or change and the reverse for the latter. Teaching ranked best when combined with other methods, Fig. 2. The leaflet was least effective.

Ministry of Education would have paid about BDS $50/hr for part-time teaching, or $1.66 per student. A leaflet from the Government Printer would cost BDS $0.23. Staged drama targeting 600 pupils in 10 schools was about BDS$ 600 or BDS$1 per student. Investment per school: orientation workshop, handout teaching guides and references (15) would cost respectively about BDS $78, $10, $12; drama on video cassette (VC) and interactive DVD cost $40 per school; together $140 per teacher. Schools had the technological infrastructure, from other sources, to use VC and DVD (BDS$1 = US$0.5).

DISCUSSION

Overall, the experimental group, exposed to teaching, drama or to a combination of teaching, drama and leaflet improved significantly in 3.5 times more variables on KAB outcomes than the leaflet-only; and teaching combined with other methods performed best. One year post-intervention, smoking prevalence in the previous month declined from 9.2% to 1.2% in the experimental group but did not in the leaflet-only group, 2.5% to 3.3%. In the experimental group, the belief that it is easy to quit smoking increased significantly; and in both comparison groups, undesired responses in the belief that tobacco makes a person popular increased significantly. The power of tobacco addiction and its false popularity need to be stressed.

Multivariate analysis agreed with known risk factors (16–21). For predicting tobacco experimentation: liberal views on smoking in public, smoking as a good attribute, failure to appreciate health risks (diseases) and being young in age were important. For acquiring smoking habit: a company of siblings or friends using tobacco, tobacco availability and beliefs and liberal views such as smoking is good for boys and that it should be allowed in public places, were significant.

Ranked in descending order of importance for efficacy were: teaching and drama; teaching, leaflet, drama; teaching and leaflet; teaching; leaflet and drama; and leaflet-only. Therefore teaching combined or supplemented by other methods was the best strategy (Fig. 2). Singly, teaching was better than drama and in turn better than leaflet. However, drama and video are popular media and have been used successfully to promote tobacco; thus, counter promotion needs to use the same media (22–26). The latter two should not be used singly. Leaflets and drama require teaching to clarify the messages they carry. Singly, the leaflet probably entirely depends on personal initiative to read, comprehend and correctly analyze the message; while drama leaves long-term imprints and raises immediate positive curiosity. Overall, the leaflet ranked last in KAB changes. The leaflet was however effective in causing significant desired changes in six variables. This might be an attribute of how the messages on the leaflet were displayed. A human picture was labelled with types of damage and arrows pointing at organs. The role of teaching places teachers central in anti-tobacco KAB in primary schools in Barbados.

Cost effectiveness based on non-commercial transactions: one teacher-guided teaching followed-up by video shows and interactive DVD and leaflets by students at their own convenient time at BDS$1.89 – 2.89 per child contacted, compares favourably with childhood immunizations. In addition, the anti-tobacco infrastructure capital investment per school would be BDS$100 – 140. The DVD would replace drama due to its logistical demands, although, drama could be initiated locally by each school.

Weaknesses of the study: The sample size at design stage was not adjusted for cluster effects. The two geographically selected non-random groups proved to be significantly different in 16/37 variables at baseline and this bias led to the abandonment of the control group in further analysis. Post-randomization selection bias: groups varied in size; reducing power because 49% of sample size, but not clusters, was lost during follow-up. Two questionnaires in a school project are unusual, so the drop was due to waning interest in a second questionnaire by school teachers, not students, because of demands of other competing activities; and because, senior students, former grade 4, were admitted and dispersed into secondary schools. Two intervention clusters recruited more subjects than at baseline. Students might have been absent, but participated and responded to one phase of data collection. It is unlikely that absentees were different from others within the same cluster; if less related to ability or willingness to participate, selection biases would be minimal. It was difficult to follow individuals through and do sensitivity analysis or exclude them from analysis, because, students did not consistently provide personal identifiers. To

overcome the cluster effects, the study used a recommended cluster unit analysis and appropriate standardization. Reported "smoking" in the last 30 days is a proxy measure for new and repeat smokers, essentially a prevalence rather than an incidence measure. However, it is convenient, practical and widely used for adolescents (27). Without biomarkers, children's recall and "denial response" biases could reduce prevalence of tobacco use, however, only if discriminately. Single blinding and low power could minimize difference in effect tending to β error. Field standardized interventions could not be strictly ascertained, partly due to resource constraints. Schools may have tried their own initiatives that probably accounted for some (modification) of the changes in KAB scores.

Strength of the study: The nuclei schools in clusters within the intervention arm were randomly selected and clusters randomly allocated to sub-interventions. The subjects within groups were blinded by geographical isolation and teachers were requested and provided to participate in the only activity assigned to each school. Analysis confirmed that, randomized experimental groups did not differ significantly at baseline and at follow-up for confounders: age, gender, and years at school. Rigorous, innovative summary analysis was used to capture the effects and errors; yet, there were significant differences in effects and modification of the different interventions. Additionally, high cost-effectiveness may allow direct transfer of this experience. This was probably the first time to test and evaluate the efficacy and cost-effectiveness of tobacco prevention in children in primary schools in the Caribbean.

Teaching when combined with other methods was better at improving children's preventive skills against tobacco but did not tackle children's appreciation of addiction. Messages to children should clearly explain the dangers of addiction and promote positive role models to enhance the evolving 'no smoke' culture. Due to its cost-effectiveness, akin to immunization, at US$2 for 87% (95% CI 78, 93) reduction in smoking experimenters, the experience can be successfully operated routinely for children in similar primary schools.

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