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Meta-Analysis on the Effects of the Smoke-Free Class Competition on Smoking Prevention in Adolescents

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Key Words

School-based intervention · Smoking prevention · Smoke-Free Class Competition · Adolescents · Incentives · Prizes

Abstract

Background: The 'Smoke-Free Class competition' (SFC) is a school-based smoking prevention programme including commitment not to smoke, contract management and prizes as rewards broadly implemented in Europe. ***Objectives:*** To meta-analyse (randomised) controlled trials on the effects of SFC on current smoking at latest follow-up in adolescents. ***Methods:*** A systematic review of articles using MEDLINE and the Cochrane Library was conducted. The study selection included randomised controlled trials and controlled trials with follow-up assessment that investigated the efficacy of SFC on current smoking in students participating in SFC compared to non-participating students. Independent extraction of articles was performed by both authors. ***Results:*** Of 24 records identified, five fulfilled the inclusion criteria. These studies were conducted in three European countries (Finland, The Netherlands and Germany) and recruited 16,302 students altogether. A random effects meta-analysis of these five studies revealed a pooled risk ratio of 0.86 (95% CI 0.79–0.94; z = 3.44, p = 0.001) on current smoking at follow-up by participation in the competition. ***Conclusion:*** SFC appears to be an effective tool in school-based smoking prevention.

Introduction

Smoking often starts during adolescence and is still one of the leading causes of morbidity and premature mortality worldwide [1]. Because of its major health consequences [2] the prevention of smoking onset during adolescence is an important public health goal. School-based prevention programmes are considered to be an appropriate and suitable strategy to tackle juvenile substance use [3–5]. Several approaches, including programmes focussing on information, on psychosocial strategies, on social norms and influences, on life skills, and on fostering skills for resisting social influence and substance-specific skills in adolescence have all been implemented and evaluated. Empirical evidence of the efficacy, especially on the long-term effects, of these approaches is not yet uniquely convincing [6–14]. Furthermore, it has been challenging to disseminate these programmes widely.

The 'Smoke-Free Class Competition' (SFC) is a smoking prevention programme with a broad dissemination in Europe running since 1997 (http://www.smokefreeclass.info). It is conceptualised for implementation in schools with a focus on targeting pupils aged 11–14. Participating SFC classes commit themselves by contract management to stay smoke-free for up to 6 months. Students in these classes report regularly on whether or not they have smoked. At the end of the competition period successful classes can win attractive prizes in a lottery.

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The methodological approach of this intervention framework with the commitment, contract management and prize rewards as the core elements relies on the following theoretical models for behaviour modification. (1) Learning theory: Positive reinforcement enhances the probability of producing a given behaviour [15]. By rewarding smoke-free classes with prizes, the desired behaviour – to remain smoke-free – becomes attractive and worthwhile. The commitment to being smoke-free is documented and amplified by contract management (i.e. signing a class and/or individual contract), which is a well-established strategy in behaviour modification [16]. (2) Social learning theory/model learning [17, 18]: Classmates are very relevant peers for adolescents and serve as influential models for smoking initiation. (3) Theory of planned behaviour [19]: Subjective norms are one important determinant of behavioural intent. It is assumed that the competition influences social norms by denormalising smoking within the peer group. (4) Developmental psychology: The competition emphasises positive short-term consequences (e.g. winning a prize), while traditional information approaches rely mainly on the negative long-term health consequences of smoking. Emphasis of short-term favourable consequences is consistent with adolescents' orientation towards the present, rather than to future long-term planning [20].

SFC can be easily integrated in many different subjects in schools and implementation of SFC is not time consuming, yet it can offer a perfect platform to deal with smoking-related issues on a more in-depth basis if schools wish to do so. During the past 15 years, the area of implementation has grown to more than 20 European countries and SFC has become an integral part of the school curriculum in many of these. A best practice guide compiles background, rules and hints for the implementation of SFC [21].

The ease of implementation and the broad reach with comparably low costs seem to be advantages of SFC. Another important criterion to judge a prevention programme is its efficacy. The aim of this paper is to examine whether SFC prevents smoking in adolescents. We reviewed and meta-analysed randomised controlled trials and controlled trials with follow-up assessment that investigated the efficacy of SFC on current smoking in students participating in SFC as compared to students who are not.

Methods

Eligibility Criteria

The following types of studies, participants, interventions and outcome measurements were considered for the meta-analysis. (1) Types of studies: controlled trials and randomised controlled trials with pre- and post-test, and at least one follow-up of at least 6 months. No language or publication date restrictions were imposed. (2) Type of participants: due to intervention, only students primarily at age 11–14 were considered. (3) Type of intervention: trials studying the effects of interventions like SFC including the commitment of classes not to smoke and rewarding smoke-free classes with prizes in a competition. (4) Type of outcome measurement: current smoking at latest follow-up.

Search Strategy

Studies were identified by searching electronic databases and enriched by studies known to the authors. No limits were applied for language or publication date. This search was applied to MEDLINE (PubMed) and Cochrane Library. We used the following search terms to search the databases: (a) 'smoke-free class competition', 'evaluation'; (b) 'smoke-free class competition', 'effect'; (c) 'class', 'smoking', 'competition', 'evaluation'; (d) 'class', 'smoking', 'competition', 'effect'; (e) 'school', 'smoking', 'competition', 'evaluation'; (f) 'school', 'smoking', 'competition', 'effect'. The search was run in August 2011 and rerun on October 8, 2011.

Study Selection

An assessment of studies was performed independently by both authors. Records were screened by analysing the abstracts of all studies using decision categories of 'no', 'yes', and 'maybe' to be analysed for eligibility on the basis of the full text in the second step.

Data Extraction

One author (B.I.) extracted data on current smoking at baseline and latest follow-up from the included study and the second author (R.H.) checked the extracted data. There were no discrepancies to be resolved. If there had been and discussion between the two authors had not led to an agreement, a third independent colleague of the institute would have been involved. We contacted the authors of one study for further raw data that had not been presented in the published paper, which was forthcoming.

Data Items

The following information was extracted from each trial included in the meta-analysis: (a) sample size, (b) design (randomised controlled trial or controlled trial, length of follow-up), (c) outcome measure (operationalisation of current smoking, frequency of current smoking at baseline and latest follow-up in the intervention and control groups).

Summary Measures

The relative risk of current smoking at latest follow-up was the measure of intervention effect. The risk of bias in individual studies or across studies was not assessed and therefore not used in the meta-analysis.

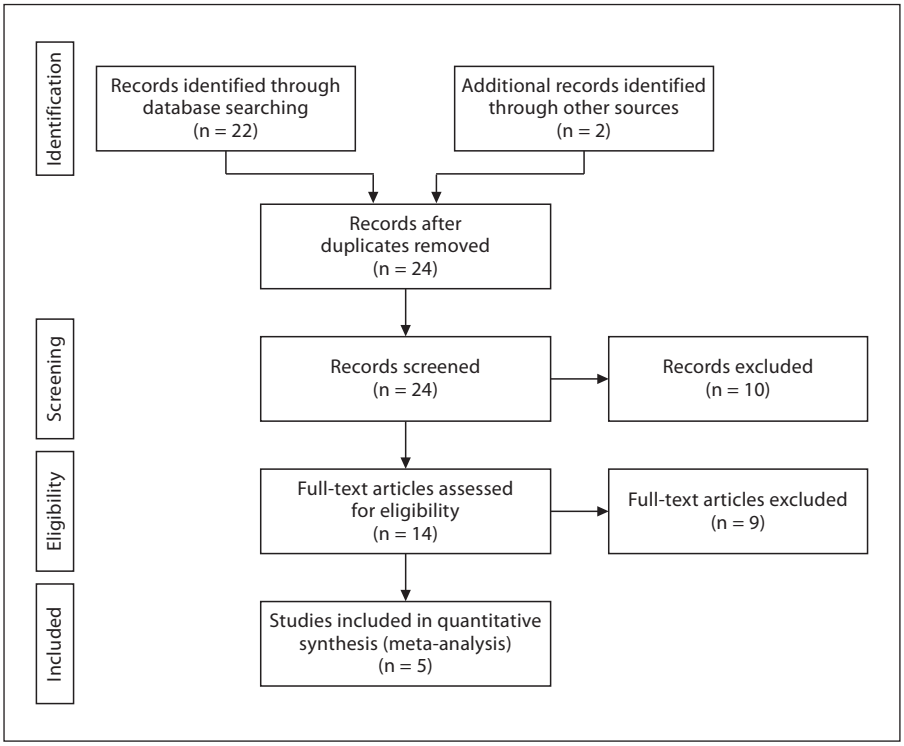

Fig. 1. Flowchart of study selection.

Statistics

A random effects meta-analysis was performed by computing relative risks pooling all event rates for latest follow-up from included studies and using the metan and metannt procedures for Stata 11 [22]. The metan procedure, specified as a random effect model, uses the DerSimonian and Laird approach and tests for heterogeneity from the Mantel-Haenszel model revealing as indicators both χ^2 and I^2 tests representing the percentage of variation in the relative risk attributable to heterogeneity. The metannt procedure also reports the number needed to treat.

Results

Selection of Studies

Database searching identified 22 records and two further records were identified through other sources. Of these 24 records, 10 were excluded because after reviewing the abstract it appeared that these records clearly did not meet the criteria. The remaining 14 studies were reviewed in more detail on the basis of the full text. Among them six records were excluded since the report data was from trials without a control group or without any original data at all [23–28], two trials were excluded since they did not report the pre-defined outcome [29, 30] and one record was excluded since it reported only on the subanalyses of another trial [31]. Finally, five studies were included in the meta-analysis. We obtained no unpublished relevant studies. The study selection process is summarised in figure 1.

Characteristics of Included Studies

The five studies on the effects of SFC on current smoking included in the meta-analysis were all published in English, came from three European countries (Finland, The Netherlands and Germany) with altogether 16,302 students at baseline assessments, including three randomised trials and covering follow-up periods between 6 months and 2 years [32–36]. Details of the five studies are presented in table 1.

Results of Individual Studies and Synthesis of Results

The rates for current smoking at baseline and latest follow-up in all five studies are summarised in table 2. The effect estimates and confidence intervals for individual studies as well as results of the meta-analysis are presented in figure 2. Pooling all event rates for latest follow-up from the five included studies yielded a pooled risk ratio of 0.86 (95% CI 0.79–0.94; z = 3.44, p = 0.001) on current smoking at follow-up by participation in SFC. This corresponds with a number needed to treat of 23.4,

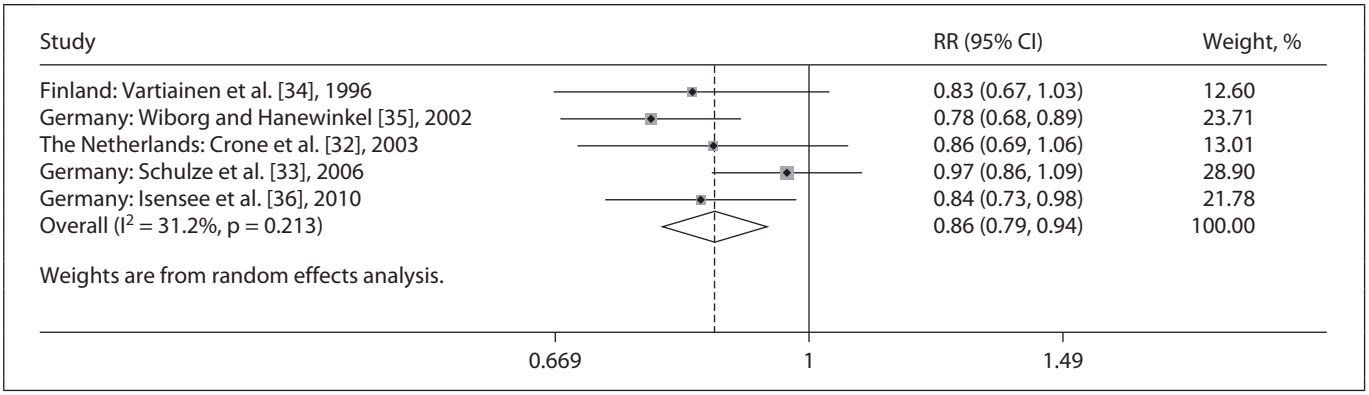

Fig. 2. Summary of studies of the effects of SFC on current smoking.

Table 1. Characteristics of included studies evaluating the effects of the SFC on current smoking

Source (first author)	Country	Sample size at baseline	Design	Follow-up period, months	Operationalization of outcome 'current smoking'
Vartiainen [34]	Finland	1,835	controlled	18	daily smoking
Wiborg [35]	Hamburg/Berlin/Hanover, Germany	4,372	controlled	12	smoking in the last 4 weeks
Crone [32]	The Netherlands	2,562	randomised	20	smoking in the last week
Schulze [33]	Heidelberg, Germany	4,043	randomised	24	regular smoking
Isensee [36]	Saxony-Anhalt, Germany	3,490	randomised	19	at least monthly smoking

Table 2. Rates of current smoking at baseline and latest follow-up in included studies on the effects of the SFC

Source (first author)	Intervention group				Control group			
	baseline	%	follow-up	%	baseline	%	follow-up	%
Vartiainen [34]	78/976	7.99	183/976	18.75	50/443	11.29	100/443	22.57
Wiborg [35]	227/1,495	15.18	383/1,495	25.62	118/647	18.24	213/647	32.92
Crone [32]	80/532	15.04	133/532	25.00	60/402	14.93	117/402	29.10
Schulze [33]	75/980	7.65	399/980	40.71	106/872	12.16	419/872	48.05
Isensee [36]	102/757	13.49	179/757	23.65	288/1,663	17.34	467/1,663	28.12

i.e. participation of a class with 23 or 24 students in SFC leads to the prevention of smoking in about 1 student in a period of up to 24 months.

Moderate heterogeneity within the studies ($I^2 = 31.2\%$; $\chi^2(4) = 5.82$, $p = 0.213$) was reduced by the exclusion of one trial [33] with the longest follow-up period and possible methodological shortcomings [24, 37]. This did not affect the finding that SFC reduced the risk of current smoking (relative risk = 0.82; 95% CI 0.75–0.90; $z = 4.62$, $p = 0.000$; $I^2 = 0.0\%$; $\chi^2(3) = 0.86$, $p = 0.835$).

Discussion

Controlled studies investigating the effects of SFC, a school-based prevention programme broadly implemented in Europe, on current smoking at follow-up were searched for, reviewed and meta-analysed. Five studies from three European countries with all together 16,302 students and covering follow-up periods up to 24 months fulfilled inclusion criteria. The meta-analysis revealed a significant pooled risk ratio of 0.86 on current smoking

at follow-up by participation in the competition, i.e. there is some evidence that SFC contributes to smoking prevention in adolescents. Besides statistical significance, the clinical relevance of this finding might be better demonstrated by the number needed to treat, which was 23.4 in the meta-analysis of these five studies. In other words, the participation of one class in the competition helps to prevent smoking in about 1 student for up to 2 years.

Limitations

The meta-analysis reported here combines data across five studies and is therefore unavoidably limited by the fact that the study population, design, length of follow-up, outcome assessment and operationalisation were different in each case. Limitations at study level to consider are a lack of randomisation in two studies [34, 35], failure to address the complex requirements inherent in an evaluation of SFC (the hierarchical structure of data, compatibility of the voluntariness of class participation, randomisation procedure and dealing with non-complying classes; for a detailed discussion compare [36]) in four studies [32–35], and further methodological shortcomings like baseline differences in smoking, hints for selective attrition and missing data, or reliance on complete-cases analyses only, which could overestimate the treatment effect [compare e.g. 24, 33, 37]. Limitations at outcome level concern differences in the operationalisation of current smoking and reliance on self-reports only, without biochemical validation. Limitations at review level include that risk of bias was not assessed and different forms of operationalisation, follow-up period, baseline rates or confounders were not included in the analysis. Even though we tested for heterogeneity, inferences about heterogeneity should be very cautious since only a few studies were included in the meta-analysis. Finally, reporting bias could not be investigated since the literature search revealed only published studies.

Conclusion

The Society for Prevention Research set criteria for prevention programmes which can be considered as efficacious, effective and ready for dissemination [38]. SFC fulfils these criteria. The meta-analysis presented herein condenses findings that SFC is a tool for smoking prevention with evidence of its effectiveness. Further studies have shown that SFC is a cost-effective tool [26] and does not provoke negative side effects [29]. A guide for implementation [21] exists, which compiles the long-term experience of dissemination in different European countries. Therefore, there is broad evidence to recommend the implementation of SFC as an efficacious and effective school-based prevention programme.

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Disclosure Statement

The authors are responsible for both the implementation of SFC in Germany and for two of the five evaluation studies included in the meta-analysis.

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