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Schools as smoke-free zones

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SCHOOLS
SMOKE
FREE ZONES

Implementation and the impact of
outdoor school ground smoking bans
at secondary schools

Andrea Rozema

Schools as smoke-free zones

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Schools as smoke-free zones

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CHAPTER 1

General introduction

The tobacco ‘epidemic’ has caused a burden of mortality and morbidity worldwide. In 2017, direct tobacco use was responsible for 6 million deaths, and also responsible for 890,000 deaths of non-smokers exposed to second-hand smoke [1]. European countries in particular need to implement stronger and more extensive tobacco control measures, since the tobacco epidemic is most advanced in this region and imposes not only a health burden but also a considerable economic burden [2]. Recently, the WHO emphasized the urgency of protecting future generations from the burden of tobacco-related mortality and morbidity. Effective policy interventions and targets related to a long-term reduction in smoking prevalence are needed to achieve a tobacco ‘endgame’ [3]. To achieve this endgame, the WHO advises countries to be specific about what is actually meant by a ‘tobacco endgame’. For example, in the UK the endgame is reached when smoking prevalence is less than 5% of the total population in 2035 [3]; in the Netherlands, there is a ‘smoke free generation’ movement which is defined such that all babies born in 2017 should be able to grow up in an environment free of tobacco smoke. In the UK, researchers have predicted that, when achieving this endgame, this could result in the avoidance of 100,000 new cases of smoking-related diseases in the UK over 20 years.

Since smoking initiation often takes place during adolescence and as these young people are extremely sensitive for the addictive drug nicotine [4], it should be a high priority to protect them from the dangers of tobacco use. To date, smoking rates of adolescents remains high. For example, in Europe, 46% of youth aged 15-16 years have tried a cigarette, 21% have smoked in the last 30 days, and 10% smokes every day [5]. There is still a lot to be done since, in 15 European countries, more than half of the adolescents aged 15-16 years has tried a cigarette at least once (Figure 1). However, the smoking rates in some countries are promising: for example, in Iceland only 16% of the adolescents has ever tried a cigarette and 6% has smoked in the past 30 days [5]; in England, 18% of the children aged under 16 years have ever tried smoking and 3% smokes regularly [6], compared with respectively 66% and 30% in Czech Republic [5].

Recently alternative tobacco products, i.e., electronic cigarettes with nicotine, electronic cigarettes without nicotine (also known as ‘shisha-pen’) and water pipes (also known as ‘hookah’ or ‘shisha’) have become increasingly popular among youth. Internationally, the use of alternative tobacco products among adolescents has doubled or tripled in recent years [7]. In the Netherlands, whereas 34% of the adolescents aged 12-16 years ever used e-cigarettes and 23% a water pipe [8], 23% of adolescents ever used the traditional cigarette. Use of alternative tobacco products could ‘renormalize’ smoking, and undermine rules/regulations to set a smoke-free norm. Additionally, adolescents might become desensitized to the dangers of conventional smoking by smoking e-cigarettes [9]. Furthermore, although the negative health outcomes of conventional cigarettes are thoroughly researched and scientifically proven, alternative tobacco products also contain several toxic substances that can cause health problems [10-13]. Moreover, there is strong evidence that smoking alternative tobacco products can act as a ‘stepping stone’ to smoking conventional cigarettes [14-17]. Therefore, prevention should focus not only on conventional cigarettes, but also on alternative tobacco products. Since the age range of smoking onset is generally between the school grades 7 and 12, tobacco control policies should focus on these age groups [18].

Tobacco control policies

There are several types of tobacco control policies, with varying intervening degrees of public authority. Doing nothing or monitoring are the lowest levels of intervening of public authority, followed by providing information, facilitating a choice, offering help in selecting the best choice (e.g. by positive incentives or disincentives), and limited choices or forcing a choice [19]. One specific approach is not necessarily more effective than another, and integration of different policies might prove to be the most effective method.

To support countries in implementing strategies to reduce tobacco use, the WHO introduced a policy package called MPOWER [1]. MPOWER consists of the following six measures to deal with the global tobacco epidemic: 1) monitor tobacco use and prevention policies, 2) protect people from tobacco smoke, 3) offer help to quit tobacco use, 4) warn about the dangers of tobacco, 5) enforce bans on tobacco advertising, promotion and sponsorship, and 6) raise taxes on tobacco. In Europe, several tobacco control policies (varying in their level of intervening) have been implemented to prevent and curb smoking among adolescents. For example, advertising bans, health warnings on tobacco packages, increased tax on tobacco, public smoking bans, public information campaigns, and treatments to help smokers stop smoking have already been implemented [20].

Implementing smoke-free legislation that aims to protect youth from tobacco smoke and encourage smokers to quit, is a part of the integral approach of MPOWER. Smoke-free legislation can be defined as ‘providing effective measures to protect people from exposure to tobacco smoke in indoor workplaces, indoor public places, public transport and, as appropriate, other public places’ [21]. The WHO states that any country, regardless of income level, can implement smoke-free environments by legislation (i.e., forcing a choice) [1]. To date, many advances have been made in the implementation of smoke-free environments. Of the 35 European countries, only two (i.e., the UK and Ireland; both countries with relatively low smoking prevalence rates) scored maximal (100%) on implementation of (mainly indoor) smoke-free environments by legislation, whereas (for example) the Netherlands scored only 68% [20].

In the Netherlands, smoking is prohibited by law, for example, in public buildings (since 1990), workplaces and public transport (since 2004), and hospitality venues (since 2008) [22]. However, implementation of smoke-free legislation, or other policies varying in intervening degrees of public authority for indoor/outdoor environments specifically targeting youth, could be improved: 19% of parents still smoke in the presence of their child at home [23], 36% of smokers allow smoking in their cars carrying children [24], and several indoor/outdoor settings where children live, play and learn are not yet smoke-free environments (e.g. playgrounds, sport grounds, beaches/public swimming pools, school grounds). Making these settings smoke-free is essential to achieve a ‘smoke free generation’ and to make non-smoking the generally accepted social norm.

Outdoor school grounds smoking bans

Since children spend considerable (mandatory) time at schools, many children (from age 4 years) can be targeted by making school grounds smoke-free. Currently, in the Netherlands, legislation prohibits smoking *in* school buildings; however, *on* the school grounds it is up to the schools themselves to decide whether or not to prohibit smoking. In 2012, due to a lack of legislation, the Dutch Lung Foundation started a project to stimulate implementation of outdoor smoking bans at secondary schools. They developed the following guidelines for school directors who want to implement an outdoor smoking ban: i) the ban applies everywhere (i.e., the entire school location/site), ii) the ban applies to everyone (i.e., students, staff and visitors), and iii) the ban should be clearly displayed (i.e., by signs and/or in the school regulations). Additionally, they developed a step-by-step plan that school directors can use to implement an outdoor smoking ban, developed a website with substantial information and tips, and offered school directors counseling support when encountering difficulties during implementation of the ban [25]. Simultaneously, Healthy School Advisors working at the Public Health Services (i.e., they deliver health promotion to meet the health needs of e.g. students at schools) brought the implementation of outdoor smoking bans to the attention of school directors when visiting schools in their region, developed another website, and supported the school directors when required. As a result, the number of secondary schools with an outdoor smoking ban increased between 2012 and 2015, but stagnated in 2016: 26% of secondary schools had an outdoor smoking ban in 2012, 34% in 2013, 48% in 2014, 53% in 2015, and then remained at 53% in 2016 [26-30]. The question then arises: why do not all Dutch school directors adopt an outdoor smoking ban? Additionally, when school directors have decided to implement an outdoor ban, what is the best way to proceed with implementation? Also, once schools do have a ban, is it easy or difficult to sustain that ban?

Implementation of an outdoor smoking ban

To address these questions, it is important to know/understand the target group, the stakeholders involved, and the setting in which implementation of an outdoor smoking ban takes place. Many factors are involved which play a role and ultimately determine whether or not implementation of an outdoor smoking ban at schools is successful. Until now, smoking bans are often implemented top down, i.e., steered from above by decision-makers and hierarchically controlled with punitive measures.

Implementation of an intervention generally takes two to four years and can be described as a *'...specific set of activities designed to put into practice an activity or program'* [31]. Over the years, several models have been developed to understand the steps in this process of change and, although the models differ somewhat in the number, names and focus of the stages, the relevant stages described in the literature are comparable [31-34]. To summarize existing knowledge, four main stages can be distinguished in a change process, such as implementing an outdoor smoking ban at schools: 1) dissemination, 2) adoption 3) (actual) implementation, and 4) sustainability. These four stages are described by Fleuren et al. [35, 36], in a clear and convenient framework. Therefore we used it in this thesis as an underlying framework to interpret the results. The framework divides influential determinants per stage into four categories (i.e. socio-political, organizational, individual, and innovative

determinants). Determinants can influence both the completion of one stage, and the transition of one stage to another. However, at each stage the desired change may not occur [35].

The first stage, *dissemination*, can be described as a type of communication, spreading messages about new ideas; i.e. people reading or hearing about the innovation. It is a process by which an innovation is communicated through certain channels over time among members of a social system [33]. The second stage, *adoption*, is described as the process whereby people acquire and process information, and make decisions about whether or not an innovation is to be adopted [35]. The third stage, actual *implementation*, consists of installation (i.e., several tasks and actions need to be accomplished before implementation), initial implementation (i.e., practice is changing) and full implementation (i.e., when the policy integrates fully into the school) [31]. Finally, *sustainability* can be described as routinization or continuation of the programs and the presence of routinized activities [37].

To date, research identifying important factors influencing the complex change process towards an outdoor smoking ban, while making a clear distinction between the different stages of implementation, is lacking. A better understanding of factors playing a role in these different stages might help to further increase adoption, implementation and the sustainability of outdoor smoking bans at educational institutes.

Impact of an outdoor smoking ban

Once implemented, knowledge about the effectiveness of an outdoor smoking ban on the smoking behaviour of adolescents is essential to unravel whether or not outdoor smoking bans actually contribute to a 'smoke free generation'. Until now, the evidence regarding an outdoor smoking ban is inconclusive. Only one study has shown effectiveness on the smoking prevalence of adolescents [38], and another study found a difference in the amount of cigarettes smoked [39]. Other studies found no differences on smoking prevalence [39-43]. Due to this inconclusiveness, and also because all previous studies used a cross-sectional design and only one had a 1-year follow-up, researchers saw the need for quasi-experimental studies to examine the impact of outdoor smoking bans on the smoking behaviour of adolescents [44, 45]. Moreover, in the above-mentioned studies, only the use of conventional cigarettes was investigated. Since the use of alternative tobacco products is increasing [7, 8], associations between outdoor smoking bans and both conventional *and* alternative tobacco smoking need to be examined.

Aim and research questions

Part I: Implementation of an outdoor smoking ban

The first part of this thesis aimed to identify important determinants during the adoption, (actual) implementation and sustainability stage of an outdoor school ground smoking ban.

The research questions were:

1. What are the perceived barriers and facilitators of various stakeholders in secondary schools affecting the adoption of outdoor school ground smoking bans?
2. After adoption, which factors are important during actual implementation of an outdoor school ground smoking ban at secondary schools?
3. What is the level of sustainability at schools with an outdoor smoking ban, and which factors hinder or foster sustainability?

Part II: Impact of an outdoor smoking ban

The second part of this thesis aimed to investigate the impact of an outdoor school ground smoking ban on adolescents' smoking behaviour of both conventional smoking and use of alternative tobacco products.

The research questions were:

4. What are the short-term results of an outdoor smoking ban on the smoking behaviour of adolescents at secondary schools, taking individual characteristics into account?
5. What is the long-term impact of an outdoor smoking ban on conventional smoking and use of alternative tobacco products among adolescents at secondary schools?

Data sources and study designs

Due to a lack of legislation at the national level at the time of collecting data for this thesis, the Dutch situation was well-suited to evaluate the different stages and effectiveness of outdoor smoking bans due to the availability of: i) schools without a ban, ii) schools that decided to implement a ban at short notice, and iii) schools which had implemented an outdoor smoking ban. In total, four datasets were acquired during this project (Figure 2).

Part I: Implementation of an outdoor smoking ban

The first dataset was collected in collaboration with three Public Health Services (PHSs) throughout the Netherlands. In this qualitative study, semi-structured interviews were held with 60 different key stakeholders (i.e., directors, non-teaching staff, teaching staff, parents and students) of 15 schools *without* an outdoor school ground smoking ban.

The second qualitative dataset was collected in collaboration with six PHSs throughout the Netherlands. In this study, semi-structured interviews were held with 24 school directors of schools which were *intending to implement* an outdoor smoking ban. This dataset was complemented with observations measuring differences in smoking behaviour before implementation (T0) and after implementation (T1) on the school grounds of all participating schools.

The third dataset used a mixed-method design, based on a sequential explanatory approach with two phases. In phase I, an online survey was conducted among Dutch school directors ($n=438$) with an outdoor smoking ban. In phase II, semi-structured interviews were held with 15 school directors, who were a subgroup of the 438 directors who completed the online survey.

Part II: Impact of an outdoor smoking ban

The fourth dataset was collected during a period of three years and used a quasi-experimental design. After recruitment, 19 schools (out of 77 schools that were asked to participate) throughout the Netherlands agreed to participate. Nine schools were classified to the experimental condition as these schools had *decided to implement* an outdoor smoking ban, and 10 schools were classified to the control condition, as these schools had *no intention to implement* an outdoor smoking ban. The study population consisted of 7,733 students (aged 11-18 years at T0); questionnaires about smoking behaviour were filled out at three waves: at baseline (T0), 6 months after baseline (T1), and the last wave 18 months post-baseline (T2). In the experimental condition, schools implemented the smoking ban between T0 and T1. Observations at all participating schools were performed in the experimental condition three times (i.e., at T0, T1 and T2) to check implementation fidelity of the ban. Additionally, a questionnaire was sent to all school directors during T1 to measure the characteristics of the schools, and to ask questions related to their smoking policy.

Outline of thesis

Part I: Implementation of an outdoor smoking ban

The first part of the thesis presents the results of a process evaluation from the adoption up to the sustainability stage of outdoor smoking bans on school level, reflected by representatives of 54 Dutch schools. That is, *Chapter 2* describes why secondary schools do not adopt an outdoor smoking ban, by presenting perceived barriers and facilitators of several stakeholders of schools *without* an outdoor smoking ban. *Chapter 3* explores the process of implementation of an outdoor smoking ban by identifying important determinants according to the school directors at schools that *decided to implement* an outdoor smoking ban. *Chapter 4* examined the post-implementation period of secondary schools *with* an outdoor smoking ban.

Part II: Impact of an outdoor smoking ban

The second part of this thesis describes the impact of an outdoor school ground smoking ban on adolescents smoking behaviour of both conventional cigarettes and use of alternative tobacco products. In *Chapter 5* the short-term results of an outdoor school ground smoking ban at secondary schools on adolescents smoking behaviour is evaluated. *Chapter 6* investigates the long-term impact of an outdoor school ground smoking ban on conventional smoking and the use of alternative tobacco products among adolescents. Finally, *Chapter 7* presents a summary of the main findings. Systematic differences and similarities between important determinants during the adoption, implementation and sustainability of an outdoor smoking ban are discussed. Moreover, the impact of an outdoor school ground smoking

ban on smoking behaviour and on the use of alternative tobacco products of adolescents is addressed. The chapter concludes by discussing implications and recommendations for future research, as well as the implications for policy and practice in the context of outdoor smoking bans.

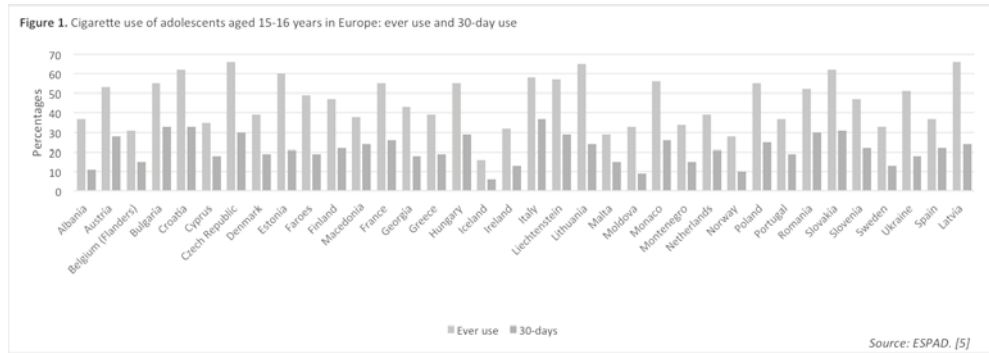
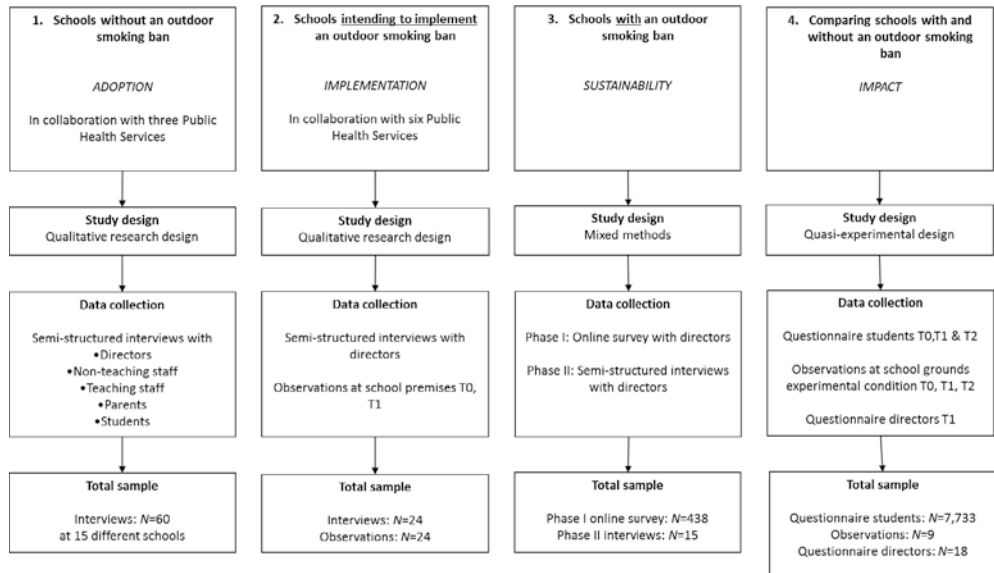


Figure 2 Flowchart of methods and participants across all studies



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PART I

**Implementation of an outdoor
smoking ban**



CHAPTER 2

Schools as smoke-free zones? Barriers and facilitators to the adoption of outdoor school ground smoking bans at secondary schools

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ABSTRACT

Background: Whereas smoking bans inside secondary school buildings are relatively widespread, a smoking ban for the outdoor school grounds is less common. Therefore, this study investigates why many secondary schools fail to adopt an outdoor school ground smoking ban. The aim is to elucidate the perceived barriers and facilitators of stakeholders at schools *without* an outdoor school ground smoking ban. *Methods:* Qualitative data were obtained from 60 respondents of 15 secondary schools. Semi-structured interviews were held with various key respondents and a thematic approach was used for analysis of the transcripts. *Results:* The perceived barriers and facilitators of the respondents fell into four categories: 1) socio-political characteristics (legislation and social norm), 2) school characteristics (policy, decision process, enforcement, resources, workforce conditions, communication and collaboration), 3) individual characteristics (support, knowledge, and target group), and 4) smoking ban characteristics (environmental factors, guideline recommendations, outcome expectations, and evidence). *Conclusions:* These findings highlight the importance of legislation for outdoor smoking bans. Moreover, collaboration, communication and involving stakeholders during an early stage of the process should be stimulated, as this might increase adoption. These results can be applied in future studies on outdoor tobacco control policies; moreover, they may facilitate tobacco control initiatives leading to more smoke-free environments to further protect youth from the harmful effects of tobacco.

BACKGROUND

Tobacco use is a leading cause of morbidity and mortality worldwide. Despite the implementation of various tobacco control interventions (e.g. increased taxation, mass media campaigns, or smoke-free laws for indoor public places and workplaces) the prevalence of tobacco use remains problematic [1]. Given that the onset of smoking generally takes place during adolescence and results in increased tobacco involvement in adult life [2], tobacco control policies should focus on the prevention of smoking behaviour of adolescents. A recent study showed that smoke-free environments have the potential to improve population health [3]. Moreover, smoke-free environments may not only reduce teenage smoking, but also exposure to second-hand smoke [4-6]. Therefore, implementing smoking bans seems promising to reduce and prevent tobacco use among adolescents.

Due to mandatory attendance, secondary schools are a potential setting for implementing smoking bans to prevent tobacco use among adolescents. Moreover, schools can play a key role in tobacco interventions as adolescence is a critical time for acquiring new patterns such as smoking initiation [7]. In fact, smoking rates among adolescents are a reason for concern. For example, in the Netherlands 31% of the adolescents are experimenters, 16% have smoked in the past 4 weeks and 9% are daily smokers [8]. In addition, in one study, 45% of the smoking adolescents stated that school is the place where their smoking behaviour most often takes place [9]. Although studies stress the importance of protecting the developing brain from exposure to tobacco products during adolescence [10, 11], only a few countries (i.e., Belgium, Finland, Australia, New Zealand, five provinces in Canada, and two states in the USA) have banned smoking at secondary school outdoor areas as well as the indoor areas [12].

In the present study, the definition of outdoor school ground smoking bans is based on three guidelines: i) the ban applies to the whole site (i.e., everywhere), ii) the ban applies to everyone, including students, staff and visitors, and iii) the ban should be displayed, e.g. in the school regulations and/or by signs [13]. A lack of legislation for a smoking ban on schools grounds (e.g. in the Netherlands) might explain the low percentage of such smoking bans, as schools are not obliged to implement the ban. In the Netherlands about 52% of the secondary schools lack adoption and implementation of the smoking ban [14]. Although the number of studies on adoption of more general prevention programs and tobacco prevention programs using curricula at secondary schools is growing [15-19], few have explored the adoption process of smoke-free policies at secondary schools. Thus, the question arises what stops secondary schools from adopting an outdoor school ground smoking ban.

Several models have been developed to improve our understanding of the innovation process, such as adopting and implementing an outdoor school ground smoking ban [20-23]. According to Fleuren et al. [21] the transition from the dissemination stage (i.e., people reading or hearing about the innovation) to the adoption stage (i.e., people acquiring and processing information and making decisions about the innovation) can be influenced by various determinants, divided into related categories [21, 24].

The present study explores which barriers and facilitators might affect adoption of an outdoor school ground smoking ban at secondary schools. This is important for two reasons. First, given that smoke-free environments internationally are increasingly important for improving general population health [3], identifying the barriers and facilitators can help in enacting smoke-free environments in school settings. In fact, a recent study emphasized the urgency for research on the adoption of tobacco control programs at schools, to more effectively facilitate tobacco prevention initiatives by policymakers and health professionals [25]. Second, to our knowledge, few studies have examined the adoption process of outdoor tobacco control policies in a school setting. The main aim of this study is to elucidate the adoption process of an outdoor school ground smoking ban by identifying the perceived barriers and facilitators of various stakeholders in secondary schools.

METHOD

Design

Qualitative methods are an effective way to explore the experiences and views of people with different roles in organizations [26]. Therefore, semi-structured interviews were held with key stakeholders in secondary schools to identify and elucidate the adoption process of an outdoor school ground smoking ban.

Participants

The study took place in three Public Health Services regions in the northern, middle and southern part of the Netherlands, as these regions have a wide range of demographic characteristics (i.e., urbanization and ethnicity) and schools varying in their characteristics (i.e., education types and school size) (Table 1). In total, 31 secondary schools (with students aged 12-18 years) were contacted, 16 refused to participate and 15 participated. In most cases lack of time was the reason for non-participation. At these 15 schools, 60 respondents participated who differed in function, gender and smoking status (Table 2). Five types of respondents were interviewed, who are directly affected when implementing an outdoor school ground smoking ban: directors, non-teaching staff, teaching staff, parents and students.

Table 1 Characteristics of the participating schools.

| | No. of schools | |
|---|----------------|----|
| | n=15 | % |
| Size | | |
| <500 students | 4 | 27 |
| 500-1000 students | 3 | 20 |
| 1000-1500 students | 3 | 20 |
| >1500 students | 5 | 33 |
| Urbanity | | |
| Highly urbanized region | 4 | 28 |
| Urbanized region | 6 | 40 |
| Moderate urbanized region | 3 | 20 |
| Rural region | 1 | 6 |
| Highly rural region | 1 | 6 |
| Education type * | | |
| Schools specialized in students with special needs ** | 1 | 6 |
| Pre-vocational secondary education | 9 | 60 |
| Senior general secondary education | 12 | 80 |
| Pre-university education | 12 | 80 |
| Ethnicity | | |
| West-European | 12 | 80 |
| Mixed | 3 | 20 |

* Several schools had more than one education type.

** School with students with psychiatric problems, physical, sensory or intellectual disabilities and behavioural disorders.

Table 2 Characteristics of the respondents

| | No. of respondents | |
|--------------------|--------------------|----|
| | n=60 | % |
| Function | | |
| Directors | 12 | 20 |
| Non-teaching staff | 15 | 25 |
| Teaching staff | 14 | 23 |
| Parents | 8 | 13 |
| Students | 11 | 18 |
| Gender | | |
| Male | 38 | 63 |
| Female | 22 | 37 |
| Smoking status | | |
| Smokers | 12 | 20 |
| Ex-smokers | 6 | 10 |
| Non-smokers | 42 | 70 |

Procedure

The study was approved by the Psychological Ethics Committee of Tilburg University and informed consent was obtained from all participants included in the study. This study was conducted in collaboration with three of the 25 Public Health Services in the Netherlands in 2014. These services deliver screening and health promotion to meet the health needs of (amongst others) school populations. Three interviewers were employed by these Public Health Services and were trained and instructed by the first author (ADR) in data collection and interview techniques. The interviewers carried out the recruitment of the schools and the interviews with the respondents in their region. Secondary schools in the three regions were contacted by the interviewers and only schools *without* an outdoor school ground smoking ban were included. Moreover, variation in school size, urbanization and education type of the schools were taken into account during selection of the schools. Thereafter, in consultation with the school director, relevant respondents were selected within the school and asked to participate in the study, with a minimum of two and a maximum of five key respondents at each school. This led to 60 interviewees in total. During selection of the respondents, their function and smoking status were taken into account.

Semi-structured interviews were conducted to explore the perceived barriers and facilitators of respondents with respect to a smoking ban in outdoor school grounds. Demographic variables were noted, i.e., function, age, smoking status, school size, percentage of smokers in school, education types, represented ethnicity at the school, and current smoking policy. Examples of questions during the interviews were: ‘What are the barriers to implement an outdoor school ground smoking ban?’ and ‘How easily could an outdoor school ground smoking ban be established?’. Data were recorded on a digital audio recorder and interviews were transcribed verbatim. The average duration of an interview was 34 (range 13-61) min.

Analysis

Transcripts were analyzed using thematic analysis [27]. The coding related to all the barriers and facilitators found in the transcripts was conducted by the first author. To establish the inter-rater reliability, all other authors coded 33% of all transcripts separately and the codes were compared and discussed until consensus was reached. Thereafter, codes were revised and divided into general themes. Subsequently, any overlap between themes was reduced by creating overarching themes which conveyed the core essence of the themes. When the overarching themes were formed, discussions were held with all authors to verify the appropriateness and correctness of the themes. The framework of Fleuren et al. [21] was useful for this, as it represents the stages of innovation (e.g. dissemination and adoption) and the related categories of determinants. Therefore, the overarching themes were integrated in these four related categories of determinants. For the purpose of this study, the four categories (socio-political context, organization, the user and the innovation) formulated by Fleuren et al. [21] were further specified into socio-political, school, individual and smoking ban characteristics, and the overarching themes were divided into these four categories. An additional analysis was conducted to explore the different views held by the respondents (i.e., which respondents perceive which barriers or facilitators). Furthermore, member checks (i.e., sending respondents a summary of their interview

and asking them to confirm that this accurately reflects their statements) were conducted with all respondents for interpretive validation [28]. Data were analyzed using the software package Atlas-Ti 7.

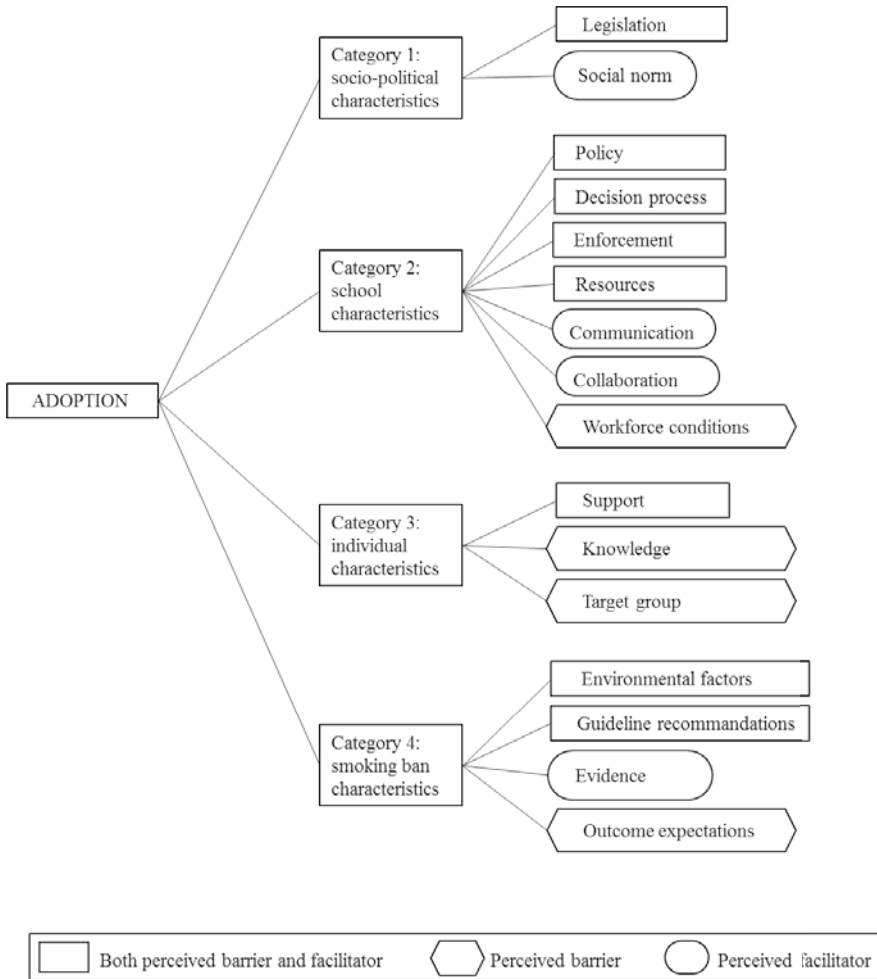
RESULTS

A total of 16 overarching themes of perceived barriers and facilitators were identified for an outdoor school ground smoking ban, divided into four related categories, i.e., socio-political characteristics, school characteristics, individual characteristics and smoking ban characteristics (Fig. 1). The results show that the perceived barriers and facilitators were often two sides of the same coin (e.g. lack of support as a barrier, and the need for support as a facilitator). However, workforce conditions, knowledge, target group and outcome expectations were only identified as perceived barriers, whereas social norm, communication, collaboration and evidence of the effectiveness of the smoking ban, were only identified as facilitators. The category 'school characteristics' included the highest number of perceived barriers and facilitators.

Category 1: Socio-political characteristics

In the category socio-political characteristics, legislation was reported as a barrier (i.e., lack of legislation) and as a facilitator (i.e., need for legislation). For example, respondents reported that i) enacting legislation for outdoor school ground smoking bans at secondary schools, ii) stricter legislation for tobacco use of adolescents, and iii) government guidelines on outdoor school ground smoking bans, would facilitate adoption. Moreover, lacking this type of legislation and lacking legislation for public areas around secondary schools, hinders adoption. Furthermore, according to respondents, the social norm for outdoor smoking bans should be strengthened (e.g. by mass media) as this is seen as a facilitator: i.e. when outdoor smoking bans are accepted as normal and considered appropriate in society, this will enhance adoption.

Fig. 1 Perceived barriers and facilitators to the adoption of a smoking ban divided into four categories.



Category 2: School characteristics

In this category, 7 overarching themes of perceived barriers and facilitators were distinguished. As a first theme, policy is mentioned by respondents as both a barrier and a facilitator. Other priorities of the school (e.g. bullying, nutrition), a laissez-faire culture (i.e., low interference with the activities of students) and a policy which prohibits students leaving the school ground during school time (i.e., blocking the possibility to smoke causes problems among smokers), function as barriers. Conversely, a policy which prohibits leaving the school ground is also mentioned as a facilitator, as enforcement might then be easier. A tailored, stepwise and comprehensive implementation approach is seen as a facilitator. In addition, a well-chosen moment for implementation is also considered a facilitator, e.g. the start of a new school year.

Second, the decision process at secondary schools is considered as both a barrier and a facilitator. For example, a negative attitude of decision-makers towards an outdoor school ground smoking ban is seen as a barrier. Similarly, respondents did not expect a smoking ban to be adopted when the decision-makers themselves were smokers. Furthermore, not only a bottom-up decision approach but also a top-down decision approach is considered a facilitator. Nevertheless, respondents more frequently referred to a bottom-up approach than to a top-down approach.

Third, enforcement is mentioned as both a barrier and a facilitator. For example, respondents mentioned enforcement as a barrier because, due to additional pressures on staff etc., difficulties were expected with the enforcement of the ban.

'Only the actual enforcement prevents us from implementing the smoking ban, just the enforcement. That's the only problem' (Director, smoker, #31).

Furthermore, some respondents mentioned that ratification of the director and strict enforcement by all staff members would facilitate the adoption of the smoking ban.

Fourth, the availability of resources is considered both a barrier and a facilitator. A lack of resources, e.g. finances (e.g. to make/place signs, etc.), staff and time, were reported as barriers to adopt the smoking ban.

'Implementing the smoking ban would take up far too much of our time. People forget that we're a school, focusing on the education of students. This takes all our time and attention, together with all the other things that we have to do. So I, as a director, don't want to invest any time at all on it.' (Director, non-smoker, #59)

On the other hand, sufficient finances and time were mentioned as facilitators. For example, receiving adequate funding for implementation would be a facilitator.

Fifth, the working conditions are considered a barrier; for example, there is insufficient staff to deal with an increase in workload due to a new task (e.g. enforcement of the ban). Furthermore, the employment terms of smoking personnel must be taken into account, e.g. personnel must have the opportunity to smoke during the breaks (i.e. their private time).

Sixth, communication is mentioned as a facilitator. For example, information and education provided by schools or external organizations are reported as facilitators. Respondents would like to start projects or workshops which increase awareness of the harmful effects of smoking and underpin implementing an outdoor school ground smoking ban.

'We'd like to receive information from the local Public Health Services. They should inform staff, parents and students about the legislation, the harmful effects of smoking and how to deal with it by implementing an outdoor school ground smoking ban. Then we'll be able to continue moving forward to an outdoor school ground smoking ban.' (Teacher, non-smoker, #32)

Finally, collaboration is mentioned as a facilitator, not only within the school (e.g. collaboration within the school resulting in a cohesive team) but also with other schools (e.g. collaborating with other schools by sharing experiences/best practices) and with other external organizations (e.g. receiving counseling and implementation instructions).

Category 3: Individual characteristics

In the category 'individual characteristics' three themes of perceived barriers and facilitators were identified. Firstly, support was both reported as a barrier (i.e., lack of support of smoking staff, smoking students and parents) and as a facilitator (i.e., need for support of smoking staff, smoking students, parents and residents). Without support for an outdoor school ground smoking ban, respondents do not foresee adoption.

'I've said it many times: I think it'll be tough confronting the smoking staff - the smoking ban will provoke resistance from the smoking staff.' (Teacher, non-smoker, #19)

On the other hand, support will facilitate adoption. Secondly, lack of knowledge about the concept and about implementation are mentioned as barriers. Lastly, an 'inappropriate' target group is considered a barrier: e.g. if a school has students with severe problems, respondents expect aggression and rebelliousness when adopting an outdoor smoking ban.

Category 4: Outdoor school ground smoking ban characteristics

Four themes were identified in the category of the smoking ban itself (i.e., what makes it difficult to adopt and what would simplify adoption). First, some environmental factors are impediments and some underpin adoption of an outdoor school ground smoking ban. For example, a large school ground and/or no clear demarcation of the school premises hinders enforcement and thus adoption. Moreover, an outdoor school ground smoking ban is irrelevant when a school does not have its own premises. Changing the school ground area (e.g. new construction, placing signs, removing ashtrays, etc.) and a vignette (i.e., an acknowledgment of a smoke-free school) are considered as facilitators in the category of environmental factors.

Second, according to respondents, guideline recommendations for an outdoor school ground smoking ban should be more flexible. For example, the guideline 'Smoking is prohibited for everyone' should not apply to staff or visitors who smoke. An exception must be made for adults, e.g. a place out of sight from the students but in the school grounds.

'When implementing the smoking ban, I think we should allow pupils aged 16 to 18 to smoke only with permission from their parents or only allow everyone who's older than 18 years to smoke on the school grounds, because I think teachers shouldn't be deprived of smoking.' (Pupil, smoker, #52)

Thirdly, a variety of negative outcome expectations are often reported by respondents as a barrier. For example, non-compliance of students and turbulence in the school (i.e., a smoking ban will cause conflicts). Moreover, respondents expect smokers to disappear from sight when leaving the school ground to smoke a cigarette, which may increase the risk of truancy and use of drugs, and/or may cause nuisance in the neighborhood. These negative outcome expectations may prevent adoption.

'If an outdoor school ground smoking ban is implemented, then students will smoke their cigarettes outside the school premises, which will increase littering in the neighborhood. That's one of the biggest obstacles: the cigarette butts and students making a mess.' (Parent, smoker, #10)

Furthermore, a negative image of the school is mentioned as an outcome expectation: respondents expect smokers will smoke outside the school entrance when they are prohibited from smoking *on* the school premises; this may give a negative impression to people entering the school. Finally, evidence based on research demonstrating the effectiveness of the outdoor smoking ban on tobacco use of adolescents is considered a facilitator.

Differences between respondents

All five types of stakeholders differed in their views regarding barriers and facilitators. Directors and parents valued outcome expectations as a barrier, while non-teaching and teaching staff and students also mentioned lack of support as a barrier. Directors and students valued collaboration as a facilitator; non-teaching and teaching staff reported communications as a facilitator; and parents mentioned legislation as a main facilitator. Smokers reported lack of support, workforce conditions and outcome expectations as barriers, and collaboration and communication as facilitators.

DISCUSSION

Until now, there is a lack of research on the adoption process of outdoor tobacco control policies in school settings, based on identifying the perceived barriers and facilitators [15-19, 25]. The present study provides insight into the perceived barriers and facilitators of stakeholders at secondary schools that affect the adoption of outdoor school ground smoking bans. Several barriers and facilitators were identified, divided into four categories: socio-political characteristics, school characteristics, individual characteristics, and characteristics of the smoking ban. Changes that positively affect adoption are needed, as a smoke-free environment in secondary schools seems promising to improve the general health of adolescents and may reduce teenage smoking and exposure to second-hand smoke [4-6].

Closer analysis of the different views of stakeholders reveals interesting insights. First, no substantial differences were found between the reported barriers and facilitators of non-teaching staff and teaching staff. Second, all main users of an outdoor school ground smoking ban (i.e., non-teaching

staff, teaching staff and students) mentioned lack of support as a barrier. Third, negative outcome expectations were mentioned by directors (i.e. the stakeholders responsible for school policies). Fourth, smokers reported lack of support, workforce conditions and negative outcome expectations as barriers, since the smoking ban might threaten their own smoking behaviour. Also, according to the smokers, communication and collaboration would facilitate adoption. Results show that the differences between the stakeholders should be taken into account when aiming to enhance adoption.

According to all stakeholders, there is a need for stricter legislation in the socio-political category. Enacting legislation depends on public acceptance of the outdoor smoking ban. For example, Diepeveen et al. [29] reported that public acceptance of government interventions is the highest for low intrusive interventions and when they target behaviour of others, rather than the participants' own behaviour. In the context of an outdoor school ground smoking ban, the extent of public acceptance will probably be high because, in the present study, the stakeholders themselves (i.e., the targets) stated their preference for legislation. Moreover, Jaine et al. [30] reported that the support of adolescents for outdoor smoking bans increased from 51% in 2009 to 59% in 2011 and that, based on these results, the government should enact legislation. However, Widome et al. [31] report that public support alone is not enough for enacting legislation, but that multiple factors determine public health policy decisions. Nevertheless, in some countries (such as Belgium, Finland, Australia, and some states in Canada and the USA), legislation for an outdoor school ground smoking ban has already been implemented [12].

Results of the present study also suggest that collaboration and communication (not only information/education provided by the school or external organizations, but also mass media in the socio-political category) might increase adoption. Indeed, meetings with key stakeholders, educational presentations and media outreach is associated with tobacco policy change [32]. In line with our results, another study showed that shared decision-making (e.g. community participation and collaboration) enhances adoption of smoking bans [18]. These findings emphasize the importance of the involvement of several relevant stakeholders or parties at an early stage, resulting in community ownership which, in turn, establishes sustainability of an innovation [33]. In other words, in the context of secondary schools, collaboration, communication and involving stakeholders during the process might be essential to increase adoption of an outdoor school ground smoking ban.

Lack of knowledge on the individual category might influence the adoption process. However, a distinction must be made between lack of knowledge about the concept (i.e., knowledge about what an outdoor school ground smoking ban implies) and lack of knowledge about implementation, as knowledge about the concept is a precondition for adoption. That is, without knowledge about the concept, stakeholders of secondary schools will not acquire and process information and make decisions about the smoking ban. Apparently, in the present study some schools were not sufficiently informed about the concept and therefore not yet in the dissemination stage (i.e. people read/heard about a smoking ban), which is an essential stage before the adoption stage [21].

Furthermore, the results of this study show that several factors in the smoking ban category played a role in the adoption process. Flexibility of the guidelines (i.e., not everyone has to adhere/ staff and visitors should be condoned) is needed to enhance the adoption rate, according to the stakeholders. Similar to our results, Durlak & DuPre [18] showed that adaptation plays an important role in innovations. It appears that users of an innovation often replicate some parts and modify other parts and that some degree of innovation adaptation is unavoidable [34]. However, adaptations can influence outcomes both positively and negatively [18]. For example, adaptation might improve non-smoking behaviour among students, in other cases it might undermine the credibility of the ban if smoking staff is excused, since teachers are recognized as role models and this influences the smoking behaviour of adolescents [35]. Future research should address the outcomes and effectiveness of an outdoor school ground smoking ban when there is some degree of adaptation of the smoking ban, since the literature showed mixed results [36, 37]. Additionally, the level of support of smoking staff should be measured both when restricting teachers smoking and when condoning them, as even after implementation of a smoking ban the level of support often remains low among smoking staff [38], and condoning them might increase support.

Some limitations should be considered when interpreting the results. First, differences between the various schools were not revealed with respect to the perceived barriers and facilitators (e.g. schools differing in size, education level). However, because an earlier study showed that adoption of a tobacco-free policy did not differ substantially between different types of schools [32], the differences between schools are probably small. A second limitation is that only Dutch secondary schools with Dutch representatives were included. Future research should address non-Dutch schools with reference to cultural diversity and international comparison. Although these limitations are relevant, we did include a large and diverse group of schools and stakeholders which led to maximal exploration of the barriers and facilitators. Overall, the wide variation and the richness of the data contribute to the generalizability of our findings [39] and offer new insight into the processes of adoption of an outdoor smoking ban in a school setting.

Conclusion

The findings highlight the importance of legislation for outdoor smoking bans in a school setting. Policymakers are advised to develop and implement legislation, as this may help normalize outdoor smoking bans in school settings. Furthermore, school-wide promotions, media messages and meetings with key stakeholders are important components for adoption. Collaboration, communication and involving stakeholders at an early stage of the process should be stimulated, as this might be essential to increase adoption. In general, the findings of this study can be used in future subsequent adoption studies of outdoor tobacco control policies. However, most importantly, the findings of this study can facilitate tobacco control initiatives which, in turn, might result in more smoke-free environments and additional protection of youth from the harmful effects of tobacco.

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CHAPTER 3

Evaluation of the process of implementing an outdoor school ground smoking ban at secondary schools

ABSTRACT

Background: Although outdoor smoking ban at schools is becoming important, it remains unclear whether successful implementation is feasible and what conditions promote it. Therefore, this study evaluates the implementation process by identifying important factors. *Methods:* Interviews were held with directors of 24 secondary schools that had decided to implement an outdoor school ground smoking ban, to identify important factors during implementation. Additionally, observations were made before and (about 4 weeks) after implementation to evaluate adherence to guidelines. Data were analyzed using a thematic approach. *Results:* During implementation, the following items were important: smoking ban (e.g. guidelines), school (e.g. policy, enforcement, environmental factors, resources, etc.) and external factors (e.g. social environment). Four schools were unable to implement the ban, 20 schools implemented the ban but student adherence was low, and at four schools the staff still smoked on school grounds. *Conclusions:* Although implementation is feasible, there are challenges. Schools need to apply a phased/dynamic process with ample lead time and clear communication of the policy. Directors should deal with offenders by strictly enforcing the ban and helping them stop smoking. This study offers information to help institutes implement an outdoor smoking ban to further protect adolescents from the harm of smoking.

BACKGROUND

Recently, the WHO emphasized the urgency of protecting future generations from the consequences of tobacco use and exposure to tobacco smoke [1]. Since smoking behaviour often starts during adolescence, and since young people spend a lot of mandatory time at school, implementation of a smoking ban in a school setting may have a beneficial impact on adolescents' smoking behaviour. Although *indoor* smoking bans at educational settings are internationally more or less the norm [2], a next step could be to implement *outdoor* smoking bans at schools. Kuipers et al. [3] argue that less exposure to smoking on school grounds might reduce the possibility that adolescents will start smoking.

Although in the last decade various countries have implemented an outdoor smoking ban on school grounds (e.g. Belgium, Finland, Australia, provinces in Canada, and New Zealand) [4], less is known about whether successful implementation of an outdoor ban is feasible and which conditions foster it. Furthermore, schools differ in their definition of an outdoor smoking ban. For example, in the Netherlands, one study reported that 53% of all Dutch secondary schools has implemented an outdoor smoking ban [5] whereas another study reported only 19% [6]. This difference can be explained by the fact that, in the latter study, the outdoor ban applied to both students *and* staff. In the Netherlands, three main guidelines are recommended for schools that want to implement an outdoor smoking ban: i) the ban applies everywhere, (i.e., the entire location/site), ii) the ban applies to everyone (i.e., students, staff and visitors), and iii) the ban should be clearly displayed (i.e., by signs and/or in the school regulations) [7]. However, providing guidelines and/or information is not always sufficient to achieve effective implementation [8].

According to Fixen et al. [8] implementation can be described as a '*...specified set of activities designed to put into practice an activity or program*', for example an outdoor school ground smoking ban. According to Fleuren et al. [9] four stages are involved when implementing an innovation such as an outdoor smoking ban, i.e., dissemination, adoption, implementation, and continuation. Furthermore, they stated that completing a stage, and the transition from one stage to another, can be influenced by various factors, divided into four categories i.e., socio-political, organization, individual, and innovation factors. Fixen et al. [8] described three somewhat comparable categories influencing successful implementation, i.e., core implementation components, organizational components, and external influences (similar to the innovation, organization and socio-political factors of the model of Fleuren et al.). Furthermore, Fixen et al. [8] stated that implementation processes take 2-4 years and (in general) have six stages instead of four, i.e. 1) exploration/adoption (i.e., exploration of options and deciding to adopt), 2) installation (i.e., after adoption tasks need to be accomplished before implementation), 3) initial implementation (i.e., changes in overall practice), 4) full implementation (i.e., when new learning becomes integrated into practitioners), 5) innovation (i.e., refine and expand practices), and 6) sustainability (i.e., long-term survival and continued implementation) [8]. To understand how successful implementation (i.e., the stage after adoption) of an outdoor ban can proceed and which conditions foster it, factors affecting actual implementation need to be identified; then, strategies can focus on those factors that promote actual implementation.

Although the number of studies on implementation of smoking bans in different settings is growing [10,11], few have explored specifically implementation of outdoor bans at secondary schools [12]. Moreover, although implementation is a complex process with different stages [9] studies do not always make an explicit distinction between these stages. Recently, two studies investigated the adoption stage, i.e., why fail many schools to adopt an outdoor smoking ban [13], and the sustainability stage, i.e., which factors hinder/increase sustainability of an outdoor school ground smoking ban [14]. However, the stage after adoption (i.e., actual implementation) has not yet been examined. The present study builds on previous research, as more effort is required to enhance our understanding of the process after adoption in order to achieve (more) effective implementation of tobacco control policies [15]. Therefore, the present study evaluates implementation by identifying important factors according to school directors related to this process.

METHODS

Design

Semi-structured interviews were conducted with directors of 24 secondary schools that had decided to implement an outdoor school ground smoking ban. In addition, to verify whether students and staff adhere to the ban, observations were made on school grounds, before (T0) and after (T1) implementation.

Procedure

This study was conducted (2015-2016) in collaboration with six of the 25 regional Public Health Services (PHS) in the Netherlands. The main task of the PHS is to deliver health promotion to meet the health needs of (amongst others) school populations. First, due to the wide area of recruitment in all regions, three coordinators were employed by the Public Health Services (PHS) and were instructed in data collection by the first author. Second, the coordinators, in turn, instructed 14 researchers of the six PHS. Finally, the researchers carried out recruitment of the schools in their region, the interviews with the participants, and the observations. Only schools that had *decided to adopt* an outdoor school ground smoking ban were included in the study (i.e., schools which had transited from the adoption to the installation stage). Of all 293 schools in the six regions of the PHS, 87 were contacted and 24 agreed to participate; the main reason for non-participation ($n=63$) was a lack of time. The Psychological Ethics Committee of Tilburg University approved the study (EC-2014-31).

Semi-structured interviews

Interviews were held with the directors of 24 Dutch secondary schools (students aged 12-18 years). Semi-structured interviews were conducted on average 4 weeks after the (planned) date on which the ban entered into force, which was often at the start of a new school year. Function, age and smoking status of the participants were noted, i.e. of the 24 directors, 2 were current smokers (8%), 12 non-smokers (50%) and 10 were ex-smokers (42%); 13 (54%) were male. Furthermore, school size, education type, urbanization level and whether (or not) the school had actually started to implement an outdoor smoking ban were also noted. All interviewees signed an informed consent form and data were recorded on a digital audio-recorder. The interviews were transcribed verbatim and lasted on average 39 (range 25-52) min.

Implementation fidelity measured by observations

To measure adherence to the guidelines, unnoticed observations (on the school ground) were made two times before implementation (T0) and about 4 weeks after the start of the implementation of the school ban policy (T1). At the four schools where the directors reported that it was not possible to introduce the ban as scheduled, no observations took place at T1. Most observations took place during a coffee break (15 min) or a lunch break (30 min).

Analysis

To analyze the interviews, a thematic approach was used [16]. First, all transcripts were coded by the first author (ADR). To establish inter-rater reliability, another researcher (in parallel) coded 33% of all transcripts. Codes were compared and inconsistencies were discussed until consensus was reached. Second, similar codes were pooled and, thereafter, themes were created based on the final code list. Third, themes were classified into three categories (i.e. 'smoking ban' 'school' and 'external factors') drawing on the structure of the framework of Fleuren et al. [9] (i.e., innovation, organization, and socio-political factors) and of Fixen et al. [8] (i.e., core implementation, organizational and external components). The appropriateness of the developed themes, and the classification of the themes into the three categories, were discussed with all authors and amended when necessary. Interpretive validation was strengthened by conducting member checks, i.e., sending all participants a summary of their interview to confirm whether their statements were interpreted correctly [17]. The software package Atlas-Ti 7 was used to analyze the data.

RESULTS

The participating schools varied in size, education type and urbanization level (Table 1). In four schools it was not possible to implement the school ban policy as scheduled.

Table 1 Characteristics of the participating schools.

| | No. of schools | |
|--|----------------|----|
| | <i>n</i> =24 | % |
| School size | | |
| <250 students | 3 | 13 |
| 250-500 students | 5 | 21 |
| 501-1000 students | 7 | 29 |
| >1001 students | 9 | 37 |
| Education type ^a | | |
| Schools specialized in students with learning difficulties | 4 | 11 |
| Pre-vocational secondary education | 16 | 44 |
| Senior general secondary education | 9 | 25 |
| Pre-university education | 7 | 20 |
| Urbanization of place of residence ^b | | |
| Highly urbanized region (>2,500) | 3 | 12 |
| Urbanized region (1,500-2,500) | 10 | 42 |
| Moderate urbanized region (1,000-1,500) | 4 | 17 |
| Rural region (500-1,000) | 5 | 21 |
| Highly rural region (<500) | 2 | 8 |

^aSeveral schools had more than one education type

^bDensity of addresses in surroundings per m²

During implementation of an outdoor school ground smoking ban, 13 important themes were identified and divided into 3 main categories: *smoking ban factors* (i.e., guidelines, side-effects), *school-related factors* (i.e., policy, decision process, enforcement, environmental factors, resources, education level, program champion, school culture, communication, collaboration), and *external factors* (i.e., social environment).

Smoking ban factors

In this category, two themes were identified.

1) Directors have a problem with the *guideline* 'Smoking is prohibited for everyone'. For example, introducing the smoking policy to visitors is perceived as difficult.

'In the second week – at the Parents' Evening - we had a situation during the break, as some of the parents went outside to smoke. But because we hadn't told the parents about the ban in advance, we were hesitant to tell them about it at that moment. This is something we have to think about - as we can't have parents smoking on the school ground when we've stated that we have a smoke-free school.' (R11, implemented)

Furthermore, as a consequence of the ban, choosing a designated area for smokers (e.g. a place where students and, especially, staff can smoke) *outside* the school grounds is perceived as difficult. In fact, several schools are indecisive about what to do with staff in the first place, i.e., should they apply the ban to students *and* staff, or only to students and let the staff smoke out of sight of students on the school ground.

'At the moment our biggest problem is that some of our teachers are still smoking in places where students can see them - and students who smoke think this is unfair: why can he/she smoke and we can't? We're searching for a solution to make sure that the staff smoke where students can't see them.' (R14, implemented)

Directors mentioned that, during implementation, it is important that the staff smoke where students cannot see them, as staff are seen as role models.

2) The *side-effects* of the ban can hinder implementation. For example, students leave the school ground to smoke their cigarettes. This results in 'hangout spots' near the school gate where the students (and students from other schools) are smoking, or students may even disappear from sight. Furthermore, it results in increased risk of drug use, cigarette butt pollution, and nuisance in the neighborhood outside/near the school ground. Another side-effect was lack of support of the ban (by smoking students and staff) resulting in non-compliance of students and staff. In contrast, a positive side-effect was that some students stopped smoking and, contrary to what the directors expected, at some schools the students did not leave the school ground to smoke. Directors mentioned that the resistance from students and staff was less than they had expected, which fostered implementation.

School-related factors

In this category, 10 themes were identified.

1) *Policy* is as an important theme. For example, some directors expected problems when they prohibited students from leaving the school ground during school hours, so that they could not smoke. Implementation is aided when schools undertake a stepwise approach. In addition, in some schools the non-smoking policy was not markedly different from the previous smoking policy; this also helps implementation. Consequently, at some schools, non-smoking was already more-or-less the norm.

'We used a stepwise procedure of implementing the ban and, recently, we made this more visible by placing signs. In addition, for many years our teachers were only allowed to smoke at one particular place – which is out of sight of the students. So, implementing the ban was not really such a drastic change.' (R22, implemented)

Furthermore, implementation was easier when the school already had policies that were oriented toward health in general (e.g. participating in health programs).

2) The *decision process*. For example, the Participation Council (i.e., a council including staff, parents and students, which has ratification authority) needs to approve the ban before the ban can be implemented. Implementation is hindered if the Council does not support the ban, or when members of the Participation Council are themselves smokers.

'The majority of the Participation Council is still against the smoking ban. The plan was that we should be implement the ban this year. However, I think it'll probably be the next calendar year - as it's been postponed again.' (R6, deferred implementation)

Furthermore, when a school has more locations and more decision-makers are involved, implementation of the ban at all locations at the same time is difficult.

'Our school has two locations. One location had always been hesitant to take this step - and they're still not planning to take action. This makes it more difficult for our location, mainly because you have to explain to everyone why we have implemented the ban at our location and not at the other one.' (R15, implemented)

Implementation is also more difficult when a school plans to implement the ban but shares the premises with another school, e.g. a secondary vocational education school (students aged 16-23 years) where the director has no intention of implementing the ban. It helps when decision-makers are positive about the ban; furthermore, according to the directors, a bottom-up decision process also supports implementation.

'The decision was made by all of us together - and not only by a few people.' (R20, implemented)

3) *Enforcement*. According to the directors, strict and increased surveillance fosters implementation. However, this is difficult, as directors do not always know how to enforce (e.g. determining sanctions is difficult; who is responsible for enforcement) or realize enforcement (e.g. when the staff is not motivated to enforce the ban). Furthermore, enforcement outside the school ground is perceived as difficult, due to the lack of judicial authority of schools beyond their premises.

'We have extensive school premises and the demarcation of these premises is unclear – this complicates implementing the ban. There's a courtyard in the front of our school which is our property. However, on the other side of our school, there's an area which is public property, where our students also stand around sometimes. Strictly speaking, I don't have any authority to enforce the ban there.' (R21, implemented)

4) *Physical environment*. For example, the layout of the site (e.g. limited space around the school, no clear demarcation, or large/unclearly structured school grounds) and the location of the school (e.g. the school has several buildings and students walk from one to another, or when the school is situated in a residential area) is perceived as difficult.

'There are plenty of places on our school ground where someone can smoke secretly if they want to - places where we wouldn't even notice non-compliance.' (R6, deferred implementation)

On the other hand, clearly structured school grounds and demarcation helps implementation.

5) *Lack of resources*, i.e., lack of manpower to enforce the ban and lack of time to implement the ban.

6) *Education level*. Directors reported that some students in a lower/younger education level (aged 12-16 years) are already heavy smokers, making it more difficult to implement the ban. Moreover, a non-smoking policy is problematic for the older/higher education level, as many students are aged 17-18 years and it is difficult to prohibit older students as these are more mature.

7) *Not having a program champion* hinders implementation. For example, when a program champion falls out e.g. due to sickness and schools are not able to find a replacement, this delays implementation.

8) A positive *school culture* supports implementation. A small school with good relationships between students and staff helps implementation, e.g. enforcement is easier. Furthermore, smaller schools generally have a low absolute number of smokers, which helps implementation.

9) *Communication*. Informing students *and* parents beforehand is essential during implementation, as this strengthens support for the ban.

10) *Collaboration* is also important. For example, collaboration *within the school* with several stakeholders via a task force aiming to implement the ban, or collaboration *with external parties* who provide information and material which helps implementation (e.g. an external party provides an example of a letter to inform parents about the ban).

External factors

In this category, *social environment* was identified as a theme. Having parents that smoke hinders implementation because there is lack of consensus between some parents and the school about smoking.

'We have children at school who grow up in an environment where it's normal that a 12-year-old child smokes heavy shag because the father is smoking - and the grandfather as well. That's something we have to deal with.' (R18, deferred implementation)

On the other hand, non-smoking is more often the norm, which supports implementation. For example, directors believe that smoke-free environments (e.g. in schools or other settings) are increasing and some reported that the absolute number of smokers at their schools is already low, making it easier to implement the ban.

Schools that deferred implementation

Reasons for the schools to postpone implementation were diverse. Two schools postponed implementation because there was no consistency during the decision process between the Participation Council and the director as to whether or not to 'exclude' staff from the policy. Whereas the Council wanted to exclude staff from the ban, the director did not. The third secondary school shared premises with another school (i.e., a vocational school with students aged 16-23 years), and the director of this latter school did not want to implement the ban whereas the director of the secondary school did. At the latter school, there was no clear demarcation (e.g. with fences) of the school ground, which stopped them from implementation. However, both of the other schools in which the director was a smoker, implemented the ban.

Observations

Table 2 Implementation fidelity: adherence to guidelines of the ban after implementation based on the observations.

| Guidelines ¹ | School identification number | | | | | | | | | | | | | | | | | | | | Total |
|-------------------------|------------------------------|---|---|---|----|----|----|----|---|---|----|---|----|----|----|----|----|----|----|----|-------|
| | 1 | 2 | 4 | 5 | 10 | 16 | 19 | 23 | 8 | 9 | 20 | 3 | 11 | 13 | 14 | 15 | 17 | 21 | 22 | 24 | |
| Ban everywhere | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 12 |
| Ban for students | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 16 |
| Ban for staff | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 16 |
| Ban displayed | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 14 |
| Total score | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |

¹0=no/1=yes

Whereas before implementation (T0) the smoking behaviour of students/staff was observed on the school grounds of 19 schools, after implementation (T1) the smoking behaviour of students ($n=4$) and staff ($n=4$) was observed at 8 schools. At the four schools where the staff smoked on the school ground, they did this out of sight of the students. Furthermore, 14 schools gave a clear notification of the ban by placing signs (Table 2).

DISCUSSION

The present study contributes to knowledge by providing insight into important factors during the process after adoption of an outdoor smoking ban at secondary schools. Of all identified factors, the majority were related to the *school*, followed by the *smoking ban* and *external factors*. Whereas 4 schools were unable to introduce the smoking ban as scheduled, 20 schools implemented the ban. The present study shows that, although successful implementation is feasible, the schools face considerable challenges.

Two recent studies examined factors affecting the adoption and sustainability of an outdoor smoking ban at secondary schools. Whereas in the adoption stage (i.e., schools *without* a ban) there was a need for early involvement of all key-stakeholders and for legislation [13], in the continuation stage (i.e., schools *with* a ban) there was a need for staff involvement and to control the enforcement [14].

Findings shows that, after adoption of the ban (i.e., the implementation stage), schools encountered difficulties with the enforcement. In 4 of the 20 schools where the ban was implemented student noncompliance was observed, implying that adherence to the policy cannot be assumed. Introducing a smoking ban at schools is known to create challenges related to enforcement and, after implementation, adherence to a smoking policy is far from optimal [18-21]. It is important to expect 'less than perfect' compliance after implementation (as smokers need time to adjust to the smoking ban) and schools should anticipate noncompliance by training staff to deal with violators [10]. Additionally, schools should initiate the dialogue with violators, use counseling methods to help them stop smoking, and consistently enforce the ban [21-23]. Overall, because the enforcement of an outdoor smoking ban is more challenging than might be expected, this factor should receive more attention during implementation.

This study also shows that, after adoption, adherence to the guidelines can be complicated. For example, some directors reported that they are indecisive about what to do with staff and sometimes chose to let staff smoke *out of sight* of students *on* school grounds, rather than smoke *in sight* of students *off* school grounds. This is in line with studies reporting different percentages in Dutch schools with an outdoor smoking ban (e.g. 53% vs. 19%) [5, 6], as schools differ in their interpretation of what smoke-free means (i.e., only for students, or also for staff) [24]. Furthermore, not all schools chose to openly display the ban by placing signs. Nevertheless, more research is needed to compare guidelines/definitions of outdoor smoking bans in different countries, to increase knowledge on how schools deal with different forms of implementation and which form is optimal.

Four schools postponed implementation of the ban. These schools stayed in the adoption stage and did not transit to the implementation stage [9]. In contrast to another study [12], we found that the main reasons for postponing implementation were rooted in the decision process and the environmental factors, and not in the safety risk for students who leave the school ground, lack of support from staff regarding the ban or no expected effects of the ban. The differences between our

results and those of Pickett et al. [12], are probably due to different methodology and the fact that the studies were performed in different cultures/settings with differing guidelines/legislation. Furthermore, our findings show that schools should accept that a phased/dynamic process is required with ample lead time and clear communication of the policy with all stakeholders involved; this is in line with the findings of Fox & Shovein [10].

Limitations and strengths

The current study has some limitations. First, only school directors were interviewed and their view may not reflect the prevailing view of all the stakeholders. On the other hand, the director is probably the person most involved in implementation and, therefore, the most relevant to interview. Directors of 24 different schools participated which helps to maximize exploration of the implementation process. Nevertheless, future studies should interview more stakeholders in the participating schools (e.g. smoking students and (non) smoking staff). Second, as the percentage of smoking students was unknown it was not possible to evaluate differences in implementation between schools with a low or high absolute number of smokers.

This study has also some strengths. For example, a socially desirable bias was probably not present because four directors openly acknowledged that it was impossible to introduce the smoking ban as scheduled. Moreover, combining interviews and observations contributed to the richness of the data and the generalizability of our findings [17]. In general, this is one of the first in-depth study to the implementation of outdoor bans at secondary schools and offers a better theoretical understanding of which conditions foster implementation.

Conclusion

Although implementation appears feasible, schools face challenges when implementing an outdoor smoking ban, such as realizing the enforcement and selecting an appropriate form of implementation. Some schools found it impossible to implement the ban as scheduled, mainly due problems related to the decision process and environmental factors. To improve the process of implementation more attention should be paid to the enforcement. Directors should deal with violators by strictly enforcing the ban, initiating a dialogue with them and/or using counseling methods to help offender stop smoking. More research is needed to increase knowledge how schools deal with different implementation forms and which form is optimal for schools. Lastly, schools should apply a phased/dynamic process with ample lead time, and clearly communicate the policy to all persons involved. Most importantly, this study contributes to knowledge on implementation and may help educational institutes to more effectively implement smoke-free environments to protect future generations from the consequences of tobacco consumption and exposure to tobacco smoke.

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CHAPTER 4

Sustainability of outdoor school ground smoking bans at secondary schools: a mixed-method study

Rozema, A. D., Mathijssen, J. J. P., Jansen, M. W. J., & van Oers, J. A. M. (2017). Sustainability of outdoor school ground smoking bans at secondary schools: a mixed-method study. *European Journal of Public Health*, 28 (1), 43-49. cxx099, <https://doi.org/10.1093/eurpub/ckx099>

ABSTRACT

Background: Although increasing numbers of countries are implementing outdoor school ground smoking bans at secondary schools, less attention is paid to the post-implementation period even though sustainability of a policy is essential for long-term effectiveness. Therefore, this study assesses the level of sustainability and examines perceived barriers/facilitators related to the sustainability of an outdoor school ground smoking ban at secondary schools. *Methods:* A mixed-method design was used with a sequential explanatory approach. In phase I, 438 online surveys were conducted and in phase II, 15 semi-structured interviews were obtained from directors of relevant schools. ANOVA (phase I) and a thematic approach (phase II) were used to analyze data. *Results:* Level of sustainability of an outdoor school ground smoking ban was high at the 48% Dutch schools with an outdoor smoking ban. Furthermore, school size was significantly associated with sustainability. The perceived barriers/facilitators fell into three categories: 1) smoking ban implementation factors (side-effects, enforcement, communication, guidelines, collaboration), 2) school factors (physical environment, school culture, education type, school policy), and 3) community environment factors (legislation, social environment). *Conclusion:* Internationally, the spread of outdoor school ground smoking bans could be further promoted. Once implemented, the ban has become 'normal' practice and investments tend to endure. Moreover, involvement of all staff is important for sustainability as they function as role models, have an interrelationship with students, and share responsibility for enforcement. These findings are promising for the sustainability of future tobacco control initiatives to further protect against the morbidity/mortality associated with smoking.

BACKGROUND

Tobacco use is a leading cause of preventable death worldwide. Therefore, several countries have implemented a range of tobacco control policies to protect people from the harmful health effects of smoking [1]. Whereas implementation of tobacco control policies is growing, less attention is paid to what happens after the initial implementation. Generally, after implementation, the focus is on short-term outcomes and impact on smoking behaviour, whilst sustainability is essential for the long-term effectiveness of such policies [2, 3].

According to Shediac-Rizkallah & Bone [3] sustainability refers to the continuation of intervention. Four levels of sustainability can be distinguished: 1) absence of sustainability (i.e., no intervention activity is maintained), 2) precarious sustainability (i.e., some activities are pursued), 3) weak sustainability (i.e., intervention is continued but activities are not routinized), and 4) sustainability through routinization (i.e., intervention activities are routinized for the long term) [4]. Factors influencing these levels of sustainability can be divided into three categories: 1) implementation factors, 2) factors within the organizational setting, and 3) factors in the broader community environment [3].

To achieve a high level of sustainability of tobacco control policies it is important that non-smoking becomes 'normal' [5]; i.e. tobacco policies no longer require effort when everyone has adapted to the new pattern of non-smoking. In Europe, non-smoking is not yet the norm and smoking rates are still a reason for concern, especially among adolescents [6]. Initiation of smoking generally starts during adolescence [6, 7]. Although the Netherlands is relatively high ranked in the Tobacco Control Scale (9th) (i.e., a scale that quantifies implementation of tobacco control policies at country level in Europe) [1], more government measures could be taken targeting youth. For example it is not illegal for adolescents under 18 years to possess or to smoke cigarettes and taxes on tobacco could be raised. Moreover, since a smoke-free environment seems promising to reduce tobacco use among adolescents [8-11], and due to the mandatory attendance of adolescents at schools, it seems feasible to focus on smoking bans at secondary schools.

Whereas *indoor* smoking bans at secondary schools are generally the standard internationally, *outdoor* smoking bans are less common. For example, only a few countries (e.g. Belgium, Finland, and Australia) have banned, by law, outdoor smoking on school grounds at secondary schools [12]. In the Netherlands, only 48% of all secondary schools have implemented an outdoor school ground smoking ban in 2014 [13]. In the Netherlands, guidelines for an outdoor school ground smoking ban state that: i) the ban applies everywhere (i.e., the entire location/site), ii) the ban applies to everyone (i.e., students, staff and visitors), and iii) the ban should be clearly displayed (i.e., by signs and/or in the school regulations) [14].

Although sustainability has been examined in social interventions in general [15, 16] and in school settings in particular [17-19], to our knowledge no studies have investigated the sustainability of tobacco control policies. Exploring sustainability of outdoor smoking bans is important for two reasons. First, the sustainability of new policies or interventions cannot simply be taken for granted [19].

Moreover, sustainability research may elucidate whether investments in outdoor smoking bans endure (or not) after initial implementation, and which factors may hinder/increase sustainability. For example, this might help policymakers in their decision-making concerning implementing the legislation. Second, sustainability is a complex phenomenon and literature emphasizes the urgency of both quantitative and qualitative research to improve its understanding [20, 21].

Therefore, this study aims to 1) assess the level of sustainability and 2) elucidate the perceived barriers and facilitators to sustainability of an outdoor smoking ban at secondary schools.

METHOD

Design

A mixed-method design was used: in this way the qualitative data could deepen our insight of the quantitative data, based on a sequential explanatory approach consisting of two phases [22, 23]. In phase I quantitative data were collected via an online survey, and in phase II qualitative data were obtained by semi-structured interviews with directors of Dutch secondary schools that have an outdoor school ground smoking ban.

Participants

In phase I, directors of all secondary schools in the Netherlands ($n=1727$) were contacted with the request to complete an online questionnaire about the current smoking policy of their school. Of these directors, 919 (response rate 53%) responded to this survey. Directors with an outdoor smoking ban ($n=438$) received an additional questionnaire about the sustainability of their outdoor smoking ban. Schools with a ban did not differ significantly from schools without a ban on education type ($\chi^2(3)=6.1$, $p=0.1$). However, schools without a ban had more often 1000 students and less often 251-500 students than schools with a ban ($\chi^2(3)=14.24$, $p<0.003$).

In phase II, 19 school directors were randomly selected out of a subset who expressed (in the additional questionnaire) their willingness to participate in the interviews (141 of 438), stratified by school size and education type. Of these 19 directors, 4 declined to participate for the following reasons: lack of time ($n=3$) and maternity leave ($n=1$). Participants were included until data saturation was reached, which was at a sample size of 15. Of the final 15 participants, 9 were male (60%) and 6 female (40%); 2 were current smokers (13%), 9 were non-smokers (60%) and 4 were ex-smokers (27%).

Measures

In phase I, the following variables were noted: school size, type of education, and implementation year of the smoking ban (Table 1).

Table 1 Phase I: Characteristics of the participating schools and level of sustainability relating to school characteristics

| School characteristics | No. of schools | | Level of sustainability | |
|---|----------------|----|-------------------------|-----------|
| | <i>n</i> =438 | % | Mean | <i>SD</i> |
| School size | | | | |
| <250 students | 105 | 24 | 6.05 | 0.66 |
| 251-500 students | 120 | 27 | 5.66 | 0.99 |
| 501-1000 students | 117 | 27 | 5.57 | 0.86 |
| >1001 students | 96 | 22 | 5.51 | 1.05 |
| | | | 5.70 | 0.92 |
| Education type ^a | | | | |
| Specialized education | 51 | 12 | 6.12 | 0.72 |
| Low-level education | 134 | 33 | 5.61 | 0.93 |
| Middle-level education | 160 | 40 | 5.71 | 0.78 |
| High-level education | 59 | 15 | 5.20 | 1.24 |
| | | | 5.67 | 0.93 |
| Year of implementation of outdoor smoking ban | | | | |
| <2010 ^c | 121 | 29 | 5.84 | 0.93 |
| 2011 | 28 | 7 | 5.85 | 0.87 |
| 2012 | 53 | 13 | 5.85 | 0.83 |
| 2013 | 61 | 14 | 5.60 | 1.06 |
| 2014 | 158 | 37 | 5.56 | 0.91 |
| | | | 5.70 | 0.93 |

^a Specialized education refers to schools providing education to students with learning difficulties only or in combination with pre-vocational secondary education; Low-level education refers to schools only providing pre-vocational secondary education; middle-level education refers to schools with the education levels pre-vocational secondary education, senior general secondary education and pre-university education; high-level education refers to schools only providing pre-university education.

^b In total 34 schools were enrolled in a type of education that does not fit within the four levels that the Dutch educational system offers and are therefore set as missings.

^c Implementation between 1975 and 2010; total numbers in row do not add up to 438 due to missing responses

Based on literature [4, 21, 24-26] a questionnaire was developed with 14 items assessing the presence of elements of sustainability (e.g. support, organizational capacity, communications) of an outdoor smoking ban; responses were given on a 7-point Likert scale, ranging from 1 (little or no extent) to 7 (very great extent). In phase II, the following variables were also noted: school size, type of education, and level of urbanization (Table 2). Semi-structured interviews were conducted to assess the perceived barriers/facilitators of sustaining an outdoor school ground smoking ban. For example, questions asked during the interview were: 'What are the barriers to maintain an outdoor smoking ban?' and 'What are the facilitators to maintain an outdoor smoking ban?'.

Table 2 Phase II: Characteristics of the respondents

| School characteristics | No. of schools | % |
|---|----------------|----|
| | <i>n</i> =15 | |
| School size | | |
| <250 students | 3 | 20 |
| 250-500 students | 5 | 33 |
| 501-1000 students | 3 | 20 |
| >1001 students | 4 | 27 |
| Education type ^a | | |
| Specialized education | 2 | 13 |
| Low-level education | 5 | 33 |
| Middle-level education | 5 | 33 |
| High-level education | 3 | 20 |
| Urbanization of place of residence ^b | | |
| Highly urbanized region (>2,500) | 2 | 13 |
| Urbanized region (1,500-2,500) | 6 | 40 |
| Moderate urbanized region (1,000-1,500) | 3 | 20 |
| Rural region (500-1,000) | 3 | 20 |
| Highly rural region (<500) | 1 | 7 |

^a Specialized education refers to schools providing education to students with learning difficulties only or in combination with pre-vocational secondary education; Low-level education refers to schools only providing pre-vocational secondary education; middle-level education refers to schools with the education levels pre-vocational secondary education, senior general secondary education and pre-university education; high-level education refers to schools only providing pre-university education.

^b Density of addresses in surroundings per m²

Procedure

Both parts of the study were approved by the Psychological Ethics Committee of Tilburg University (EC-2014.37) and informed consent was obtained from all participants.

For phase I, in November 2014 all school directors in the Netherlands were contacted by email with a link to the questionnaire and the request to complete the online survey. A reminder was sent a few days later; in some cases, the adjunct director, vice-president, team leader or dean was requested to complete the survey if the director did not respond.

In phase II, an information letter explaining the aim of the research was sent to the 19 selected directors. These directors were contacted by telephone to schedule the interview with a researcher (ADR), resulting in 15 interviewees. Then, semi-structured interviews were conducted in May and June 2015. Data were audio-recorded and the interviews transcribed verbatim. Interviews lasted on average 53 (SD 10; range 33-67) min.

Analysis

Phase I data were analyzed using SPSS, version 22. First, internal consistency between the 14 items was calculated. Second, descriptive statistics were generated to illustrate the level of and difference between the characteristics of sustainability in the schools. Third, ANOVA was conducted to determine the associations between the school characteristics (i.e., school size, education type and year of implementation) and sustainability. To determine the independence of the effects of the school characteristics, two-way ANOVA was performed.

In phase II a thematic approach was used to analyze the transcripts [27]. First, one researcher (ADR) coded all transcripts. To determine inter-rater reliability, 33% of all transcripts were independently coded (in parallel) by another researcher (JJPM). Inconsistencies regarding codes were discussed until consensus was reached. Second, codes were refined and comparable codes were pooled, resulting in a final code list. Third, themes were developed based on the code list and themes were classified into the three overarching categories of the conceptual framework of Shediac-Rizkallah and Bone [3]. For the purpose of the present study the three categories were further specified in: 'smoking ban implementation factors', 'school factors' and 'community environment factors'. The appropriateness and classification of the themes in the overarching categories were discussed with all authors until consensus was reached. Interpretive validation was strengthened by conducting member checks with all participants (i.e., sending participants a summary of their interview to confirm interpretation of their statements) [28]. Data were analyzed using Atlas-Ti 7.

RESULTS

Phase I

Internal consistency between the 14 items was good (Cronbach's $\alpha=0.89$). Results of the online survey showed that sustainability at schools with an outdoor smoking ban is high ($M=5.70$, $SD=0.92$): range 1-7. Significant differences were found for school size ($F(3, 378) = 6.53$, $p \leq 0.001$) and education type ($F(3, 348) = 8.01$, $p \leq 0.001$), whereas there was no significant difference for year of implementation ($F(4, 362) = 1.96$, $p \leq 0.10$) and sustainability. However, two-way ANOVA with school size and education type as independent variables, and sustainability as dependent variable, revealed that only school size ($F(15, 348) = 2.53$, $p < 0.057$), and not education type ($F(15, 348) = 0.95$, $p = 0.4$), was significantly associated with sustainability. Smaller schools were associated with a higher level of sustainability (Table 1).

Phase II

There was no substantial difference in sustainability between the schools in phase II ($n=15$, $M=5.80$, $SD=0.80$) and schools in phase I ($n=438$, $M=5.70$, $SD=0.92$): range 1-7. Eleven overarching themes of perceived barriers/facilitators regarding sustainability of an outdoor smoking ban were identified and could be classified into the three categories of the conceptual framework. Specific themes were

considered to be both a barrier and a facilitator depending their absence or presence (i.e., enforcement, communication, guidelines, physical environment and social environment); this indicates that barriers and facilitators can be considered as two sides of the same coin. However, side-effects were only mentioned as a barrier, while collaboration, school culture, education type, school policy and legislation were mentioned as facilitators only (Figure 1).

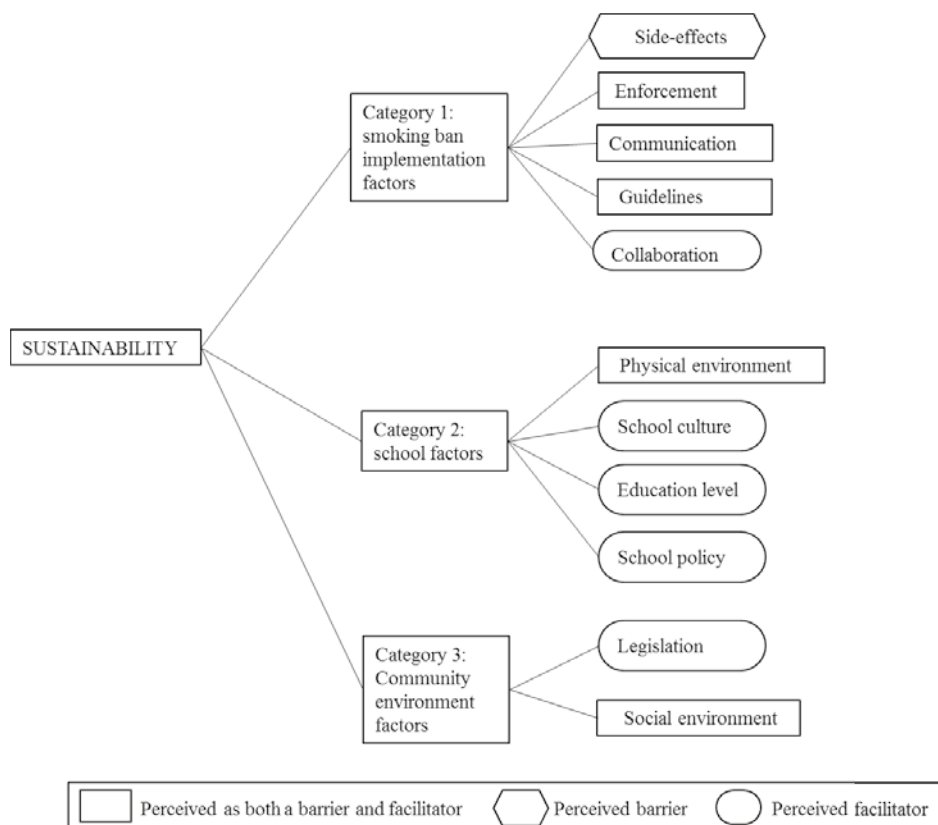


Fig. 1 Perceived barriers and facilitators to the sustainability of an outdoor smoking ban

Category 1: Smoking ban implementation factors

In this category, five overarching themes of perceived barriers and facilitators were distinguished.

First, side-effects could hinder sustainability of an outdoor smoking ban, e.g. students leaving the school premises to smoke a cigarette was mentioned as a negative side-effect, resulting in that students smoke near the school gate or disappear from teachers' control sight, increasing the risk of unsafe or unfavorable situations such as drugs use, littering/cigarette butt pollution, nuisance in the

neighborhood, conflicts between students, and intimidating places with 'loitering' youth.

'The second thing we noticed is that when you prohibit students smoking on school grounds, they search for a place to smoke outside school grounds and they become very vulnerable to those who want to sell drugs to our students. Thus, students have become a very easy target for drug dealers.' #13

Second, strict enforcement was considered to be a facilitator, and lack of enforcement was reported as a barrier, resulting in non-compliance of students and staff during school hours, and visitors after school hours. For example, respondents reported that sustaining the smoking ban is difficult as enforcement cannot (always) be realized (e.g. due to increased workload, lack of manpower), especially when the staff is not motivated to enforce the ban.

'... sometimes the staff think: "I'm just going to look the other way and drink my coffee ... it's my break". That's a weak element when trying to sustain the outdoor school ground smoking ban.' #13

Respondents also reported that when students leave the school premises, enforcement of the school policy is more difficult due to lack of judicial authority beyond the premises.

Third, communication is considered both a facilitator and a barrier. According to respondents, focusing on the ban by providing information, argumentation and education, facilitates sustainability. Not communicating with and not explaining to all stakeholders why the school prohibits outdoor smoking is considered a barrier. In contrast, paying no attention to the smoking ban can facilitate sustainability, as the smoking ban has become common practice and communication is no longer needed.

Fourth, guidelines are both a facilitator and a barrier. The statement 'The ban applies to everyone' facilitates sustainability, because equity between staff and students is considered important by students. Moreover, staff smoking out of sight of the students, offering smoking cessation training, prohibiting smoking or assigning a smokers' stand outside the school premises, and listing all students who have their parents' permission to smoke outside the school premises, facilitates sustainability. In contrast, placing cameras and condoning the smoking of staff hinders sustainability.

Fifth, collaboration with stakeholders in the school is mentioned as a facilitator. For example, involving all stakeholders during the process of policy decision-making, the dedication of all staff, and consensus between the entire managing board on the policy, fosters sustainability.

Category 2: School factors

Four overarching themes were identified in the category of school factors. The first theme was the physical environment of the school, e.g. size and demarcation of the school premises. Whereas a large unclearly structured school ground is mentioned as a barrier, a clearly structured school ground and demarcation are considered facilitators. Additionally, the location of the school is considered a facilitator.

'I'm aware of the fact that we were able to sustain the ban because of the school's geographical location ... the school is located in an industrial area and not in a residential area.' #3

It is considered a barrier when a tobacco selling point is situated close to the school, and a facilitator when there is no tobacco selling point. Additionally, sustainability is facilitated when municipalities install bins outside the school premises (i.e., preventing littering of cigarette butts).

Second, the school culture is mentioned as a facilitator. Good interrelationships between students and staff are reported as a facilitator. Furthermore, a small school facilitates sustainability.

'This school has 205 students and 40 employees, which is an ideal situation because you don't need cameras.' #5

Social control at small schools is substantial, e.g. when non-compliance of the smoking ban is noticed, students often report this.

Third, education type is considered a facilitator. For example, respondents reported that schools are obliged to protect young students at schools with a low education level (aged 12-16 years) from the harmful effects of smoking. On the other hand, schools with a high education level generally show more compliance with the smoking ban, probably because they have more 'obedient' students, which facilitates sustainability.

Fourth, school policy is mentioned as a facilitator. For example, enforcement is easier when it is prohibited to leave the school premises during school hours. Furthermore, when the school policy has always been smoke-free, the smoking ban is easier accepted. Additionally, schools should take their time and select a well-chosen moment for implementation. Finally, a stepwise implementation approach functions as a facilitator.

Category 3: Community environment factors

Two themes were identified in the category of community environment factors. First, legislation functions as a facilitator. For example, increasing the price of tobacco, stricter reinforcement of the sale of tobacco products to adolescents, and prohibiting youth under the age of 18 years to smoke, facilitates sustainability. Moreover, respondents mentioned that existing legislation (e.g. minimum legal age of 18 years for sale of tobacco products) supports sustainability (i.e., the mindset of the population is changing due to laws on smoking).

Finally, the social environment is mentioned both as a barrier and facilitator. Smokers in a student's peer group, smoking staff, and smoking parents are reported as barriers. Parents' support of the ban, and consensus between parents and school in communications about smoking, is considered a facilitator.

'Smoking parents don't think it's dangerous for their child to smoke. Parents say: 'I allow my child to smoke at home, so I don't understand why it's forbidden to smoke at school' I consider this very problematic and prefer to have consensus about this between the parents and the school.' #4

Furthermore, a low absolute number of smokers at the school is reported as a facilitator, as this generally involves little resistance. Moreover, nowadays, non-smoking is increasingly the norm at schools, as there is an increasing number of schools with an outdoor smoking ban, which also strengthens sustainability.

DISCUSSION

This study shows that sustainability is relatively high among Dutch schools with an outdoor smoking ban (i.e., 48%) and it seems that outdoor smoking bans at these schools have been fairly good routinized [4]. The level of sustainability at schools is reflected by the identified barriers/facilitators. The present study highlights that, internationally, outdoor smoking bans could become more widespread, as investments tend to endure after policy implementation, and once implemented the ban has become 'normal'.

Closer analysis of the perceived barriers/facilitators revealed interesting insights. First, strict enforcement, and communication/collaboration with all stakeholders can strengthen sustainability. These findings are consistent with others reporting that involvement of all stakeholders at multiple levels is critical for sustainability, as this strengthens commitment to the intervention [29, 30]. Moreover, based on the present study, outdoor smoking bans should apply to everyone (including staff, or staff should smoke out of sight of the students). Indeed, exemptions from the smoke-free tobacco control policies are counterproductive, as they can undermine the smoking ban [31]. Additionally, non-smoking staff (or who smoke but are unseen by students) are essential, as they function as role models [32].

Second, the school culture facilitates sustainability, e.g. good interrelationship between students and staff. The effectiveness of the staff should not be underestimated in school-based interventions, as they know their students, can communicate with them, and can provide students with continuous support [33].

Finally, results of the present study suggest that legislation discouraging youth smoking (e.g. price increase, prohibiting minors to smoke) should be introduced. A previous study has demonstrated that legislation for outdoor smoking bans in school settings is also perceived as important by stakeholders, as this might facilitate adoption and normalization of outdoor smoking bans in general [34]. Furthermore, the pedagogic role of the parents should be strengthened, as some anti-smoking parenting strategies decreases adolescent's engagement in smoking [35].

In the present study, the relatively high level of sustainability might be explained by two factors. First, an outdoor smoking ban is a relatively inexpensive strategy (e.g. surveillance and placing signs) compared to comprehensive time-consuming classroom-based interventions (e.g. course material,

training of teachers, and lesson time). Schools can implement an outdoor smoking ban without funding, whereas cutting budgets is an important factor in decreasing sustainability [17]. Second, our findings show that dedication and support of both staff and students facilitates sustainability of an outdoor smoking ban; this is better than e.g. dependence on one person. For example, the situation can be vulnerable when sustainability depends on one person, such as a program champion, as sustainability might diminish when that person leaves the organization [18, 21].

Smaller schools show a higher level of sustainability, which is probably explained by the type of school premises. For example, smaller schools often have clearly structured school premises, fostering enforcement (i.e., staff can discern non-compliance more rapidly) and, in turn, sustainability. School culture is another explanation, as small schools generally display more social control and cohesion; this might strengthen enforcement, as non-compliance is immediately detected and seen by others. This probably helps to shift the norm to 'non-smoking' more rapidly, which is an important factor in achieving sustainability [5]. Additionally, small schools often have a low absolute number of smokers, resulting in less resistance to the ban and the ability of staff to communicate with the smokers individually. Furthermore, it should be noted that since schools without a ban in general had more students, it might be for them more difficult to reach a high level of sustainability.

Strengths and limitations

Some limitations of our study need to be addressed. First, despite that sustaining an intervention is a process and that components of an intervention change over time [36], sustainability was assessed at only one point in time. Nevertheless, the high level of sustainability and the fact that the year of implementation was not associated with sustainability, suggest that sustainability of outdoor smoking bans in a school setting does not change over time. Second, the data represent only the Dutch situation, which limits generalizability to other countries. The Netherlands is relatively high ranked in the Tobacco Control Scale (9th) [1], and sustainability may be different in countries with less policy regulations. Third, social desirability bias might have occurred as directors may have been inclined to project a favorable image of their school. Fourth, as smoking prevalence was not measured it was not possible to evaluate differences in sustainability between schools with a low or high percentage smokers.

Despite these limitations, the response rate of the online survey was relatively high and a diverse range of schools were included in the interviews. Additionally, combining quantitative and qualitative research allows to deepen our insight in sustainability, a combination that is considered valuable and called for in the literature [20, 21].

Conclusion

The present study shows that schools have the capacity to maintain and routinize an outdoor smoking ban. Internationally, the spread of outdoor smoking bans could be further promoted, as investments tend to endure after implementation. Strict enforcement, and communication/collaboration with all stakeholders can also strengthen sustainability. Outdoor smoking bans should apply to everyone, without exceptions or staff should smoke out of sight of the students. Furthermore, a good interrelationship is needed between students and staff, and the pedagogic role of the parents could be strengthened. Overall, these findings are promising for the sustainability of future tobacco control initiatives to decrease the morbidity and mortality associated with smoking. Future studies could examine the relationship between the level of sustainability and long-term effectiveness of outdoor smoking bans at secondary schools, and their impact on smoking prevalence.

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PART II

Impact of an outdoor smoking ban



CHAPTER 5

Short-term results of outdoor school ground smoking bans at secondary schools on adolescents smoking behaviour: a quasi-experimental study

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Results of outdoor school ground smoking bans at secondary schools on adolescents smoking
behaviour: a quasi-experimental study.

ABSTRACT

Background: Research on the effectiveness of school smoking policies on adolescents' smoking behaviour remains inconclusive and therefore literature is calling for quasi-experimental studies. This study evaluates the results of an outdoor school ground smoking ban at secondary schools on adolescents smoking behaviour, taking individual characteristics into account. *Methods:* An outdoor school ground smoking ban was evaluated in a quasi-experimental study at 18 Dutch secondary schools (nine *with* and nine *without* an outdoor smoking ban). Data on 2684 adolescents were obtained at two moments (i.e., 6 months in between). Associations between outdoor school ground smoking bans, individual characteristics, and smoking prevalence and frequency were measured. Multilevel logistic regression analyses were used. At schools with a ban implementation fidelity was checked. *Results:* Although smoking prevalence and frequency appeared to make a slower increase at schools *with* an outdoor smoking ban compared to schools *without* an outdoor smoking ban, the differences were not significant. The existing differences between schools in the prevalence of smoking behaviour of students, could not be attributed to having or not having an outdoor smoking ban. It seems that these differences could mainly be explained by individual characteristics of the students. Smoking prevalence and frequency were higher among adolescents with a positive attitude towards smoking and when significant others were more positive about smoking. Smoking behaviour was significantly lower when adolescents perceived it as easy not to smoke. Implementation fidelity was good at schools with a ban. *Conclusions:* This is one of the first quasi-experimental studies on effectiveness of outdoor school ground smoking bans. The results indicates that implementation of an outdoor smoking ban is feasible, but a ban seems to have no short-term effects on reducing smoking behaviour of adolescents. On the short-term individual characteristics are more important predictors of smoking behaviour. A longer follow-up time than 6 months is needed. Additionally, future research should investigate effectiveness in relation to the enforcement of the ban, comprehensiveness of the ban and when it is prohibited to leave school grounds, as smoking behaviour might be transferred off school grounds.

BACKGROUND

Tobacco use remains an important cause of preventable mortality and morbidity worldwide [1]. The use of tobacco products finds its origin mainly in adolescence [2]. Several tobacco control policies have been implemented in Europe to reduce the prevalence of smoking among adolescents, e.g. increased tax on tobacco, public smoking bans, public information campaigns, advertising bans, health warnings on tobacco packages, and treatments to help smokers stop [3]. Despite all these policies and, although in some European countries smoking rates of adolescents are declining slightly, smoking rates of adolescents remain a reason for concern [2]. For example, in the Netherlands, 23% of all adolescents (aged 12-16 years) smoked at least once [4].

Several important individual and environmental factors predict smoking behaviour in adolescents. Based on the Theory of Planned Behaviour [5], proximal individual factors (such as attitudes towards smoking, subjective norms and perceived behavioural control) affect intention to smoke and, in turn, intention to smoke affects smoking behaviour of adolescents [6]. In the broader context, environmental factors are also important determinants of smoking initiation [7], such as parent and peer influence [8-10] or tobacco control policies in general [11-13]. Since adolescents spend much time at schools, where they might be exposed to smoking, a direct strategy to prevent or curb smoking behaviour is to implement tobacco control policies at schools.

Implementing smoking bans is one example of a tobacco control policy at secondary schools. Internationally, although most countries only have an *indoor* smoking ban, the number of countries (e.g. Australia, New Zealand, Belgium) implementing an outdoor school ground smoking ban is increasing [14]. Since legislation for outdoor smoking bans is lacking in the Netherlands, guidelines are established to support schools to implement the ban. These guidelines are: i) the ban applies everywhere (i.e., the entire location/site), ii) the ban applies to everyone (i.e., students, staff and visitors), and iii) the ban should be clearly displayed (i.e., by signs and/or in the school regulations) [15]. Nevertheless, lack of legislation remains a barrier to adopt an outdoor school ground smoking ban [16].

Since the evidence for the effectivity of school smoking policies is generally inconclusive, there is a need for knowledge regarding what actually works, using quasi-experimental designs to test the effectiveness [11, 17-19]. More specifically, research is needed to quantify the impact of outdoor smoking bans. So far, only four studies have evaluated associations between smoking behaviour and *outdoor* school ground smoking bans, all with a cross-sectional design and with mixed results: i.e. only one study showed effectiveness [19] while the others found no effect [20-22]. In the present study, because several tobacco control policies in Europe have been implemented [3], outdoor smoking bans in a school setting are evaluated in a quasi-experimental study, as an additional tobacco control initiative in this context.

The present study aims to investigate the relations between an outdoor school ground smoking ban at secondary schools on smoking prevalence and smoking frequency of adolescents, taking individual characteristics into account.

METHODS

Design and study population

This study used a quasi-experimental design and data were obtained at two moments (i.e., 6 months in between). For 919 Dutch secondary schools, the smoking policy, and whether or not the schools had the intention to implement an outdoor smoking ban, was known from a national monitor questionnaire [23]. In total, 77 schools were randomly contacted by telephone and asked whether they would participate, taking their current smoking policy into account. That is, schools *intending to implement* an outdoor school ground smoking ban were categorized as the experimental condition ($n=9$) and schools that had *no intention to implement* were categorized as the control group ($n=10$). During the first questionnaire, one school in the control condition dropped-out, as they were intending to implement an outdoor smoking ban. Data of students of this school were excluded ($n=763$) and data of students whose school was missing were also excluded ($n=54$).

Descriptive statistics of the 18 participating schools (i.e., 9 schools in the intervention condition and 9 schools in the control condition) are presented in Table 1. Participating schools ($n=18$) did not differ substantially from the non-participating schools ($n=59$) in school size ($p = .87$), education type ($p = .30$) and urbanity ($p = .21$). The most common reason for non-participation was lack of time.

Data of the adolescents at the 18 schools were collected at baseline (T0) and approximately 6 months later (T1). The baseline questionnaire (T0) was completed on average two months before implementation of the school ground smoking ban (March 2014-May 2015) at schools in the experimental condition. At eight schools implementation took place between T0 and T1 during the new schoolyear of 2014 and 2015 (i.e., August 2014 and August 2015). One school implemented the ban after the school holiday in February 2015. The second questionnaire (T1) was completed approximately four months after implementation (October 2014-November 2015). Respondents in the control condition only filled out the questionnaires and these schools did not implement a school ground smoking ban during the study period. At T0, questionnaires were administered to adolescents in grade 7, 8 and 9 as smoking onset starts in this age-range. The adolescent questionnaire was administered in classrooms online or on paper under the supervision of a teacher.

Table 1 Characteristics of the participating schools (n=18)

| School-level variables | | Total population <i>n</i> =18 | Control group <i>n</i> =9 | Intervention group <i>n</i> =9 |
|-----------------------------|-------------------------|-------------------------------------|------------------------------|--------------------------------------|
| School size | | | | |
| | 1-500 students | 7 | 5 | 2 |
| | 501-1000 students | 4 | 2 | 2 |
| | 1001-1500 students | 4 | 1 | 3 |
| | >1500 students | 3 | 1 | 2 |
| Education type ¹ | | | | |
| | Low | 11 | 4 | 7 |
| | Average | 12 | 5 | 7 |
| | Middle | 7 | 4 | 3 |
| | High | 8 | 5 | 3 |
| Urbanization ² | | | | |
| | Very strongly urbanised | 2 | 2 | - |
| | Strongly urbanised | 7 | 4 | 3 |
| | Urbanised | 2 | - | 2 |
| | Slightly urbanised | 2 | 1 | 1 |
| | Not urbanised | 5 | 2 | 3 |

¹Several schools had more than one education level

²Density of addresses in surroundings per m²: >2500=very strongly urbanised, 1500-2500=strongly urbanised, 1000-1500=urbanised, 500-1000=slightly urbanised, <500=not urbanised.

Variables were measured at individual and school level. At the individual level the study population consisted of 6165 students aged 10-18 years. Since teachers were asked to request their students to fill out the questionnaire, some students participated in both T0 and T1 (*n*=2901), some only at T0 (*n*=2069), and others only at T1 (*n*=1195). After data collection, data were merged based on first and surname of the students and on school. Next, data were anonymized. This study included only those students who completed the questionnaire at both T0 and T1 (*n*=2901) and excluded students with missing values on smoking behaviour (*n*=57). In total 151 students were enrolled in a type of education that does not fit within the regular four levels that the Dutch educational system offers and were, therefore, excluded from the analysis. Also excluded were students in grade 10 at T0 (*n*=7) and students with missing values on grade (*n*=2). As a result, the sample for the present study was *n*=2684. At school level, all school directors of the participating schools completed an online survey about the characteristics of their schools at T1 (*n*=18).

The study was approved by the Psychological Ethics Committee of Tilburg University (EC-2014.19). Active informed consent was obtained from all participants included in the study. Beforehand, passive informed consent was asked by the parents of the students and they were informed about

the research because students were of minority age (<18 years). In total, a small group of parents ($n=30$) refused study participation of their child at T0. The questionnaire was not administered to these students.

Implementation fidelity of the ban

School directors in both conditions (experimental and control) were asked to provide information about the current smoking policy in the online survey at T1, to check implementation of the ban in the experimental condition and to check whether schools in the control condition did not implement an outdoor smoking ban. Furthermore, at T0 and T1, unnoticed observations were performed at schools in the experimental condition ($n=9$) to double check implementation fidelity of the outdoor smoking ban. In these observations the number of smokers (i.e., students and staff) was counted during a coffee or lunchbreak at the schools, both on and off school grounds. In addition, it was observed whether the school placed signs about smoking on school grounds.

Measures

Individual-level characteristics

Smoking status of all adolescents was measured on a five-point scale with the answering options: 1] never smoked, 2] smoked only once or twice, 3] smokes occasionally, but not every day, 4] smoked in the past, and 5] smokes every day. Based on smoking status, two outcome variables were calculated, i.e. *smoking prevalence* and *smoking frequency*. In this study, to calculate *smoking prevalence*, 'non-smokers' were defined as adolescents who 'never smoked' a cigarette, and 'smokers' as adolescents ranging from who at least 'smoked only once or twice', 'smokes occasionally, but not every day' 'smoked in the past a cigarette' to 'daily smokers'. *Smoking frequency* is defined among smokers in a dichotomy as 'irregular smoking' or 'regular smoking'. An irregular smoker is an adolescent who 'smoked only once or twice' or 'smokes occasionally, but not every day'. A regular smoker 'smokes every day'.

Demographic characteristics were included, i.e., sex (male vs. female), age (in years at T0), migration background (native vs. migrant descent), grade (7th, 8th and 9th), education level (low, average, middle or high). In this study, participants with one or both parents born in a country other than the country of residence were defined as migrant descent. In addition, low education refers to schools specialised in students with learning difficulties and pre-vocational secondary education. Average education refers to lower general secondary education, middle education refers to higher general secondary education, and high education refers to pre-university education (Table 2).

A questionnaire used in a study similar to ours [24], where attitude, subjective norm and perceived behavioural control were operationalized in accordance to guidelines of the theoretical literature [25, 26], was also used in the present study.

Attitude towards smoking was measured using seven item semantic differential scales, all on a 7-point Likert scale (1= *unhealthy*; 7= *healthy*). All seven items were preceded by the text 'I think that

smoking is...'. Scores were dichotomized into 'negative' and 'positive' attitude towards smoking.

Subjective norm was measured using three items (all on a 7-point Likert scale) what 'student's perception was' of people who are important to him/her (e.g. parents and friends) think he/she should not smoke. Scores were dichotomized into 'low' subjective norm, which implies that the respondent thinks significant others disapprove of his/her smoking behaviour and 'high' subjective norm implies that significant others approve his/her smoking behaviour.

Perceived behavioural control (PBC) was measured by two items: 1] 'to what extent do you have an influence on your smoking behaviour' and 2] 'to what extent is it easy or difficult not to smoke?' on a 7-point Likert scale. Scores were dichotomized into 'low' PBC which implies that it is difficult not to smoke and 'high' PBC, which implies that it is easy not to smoke.

The three variables attitude, subjective norm and perceived behaviour control were dichotomized in 'low/negative' and 'high/positive' scores because they were skewed variables (i.e., most adolescents scored 1.0 on the Theory of Planned Behaviour predictors as most participants were non-smokers). Therefore, score 1.0 was coded as 'low/negative' and all scores above 1.1 up to 7 were coded as 'high/positive'.

Table 2 Characteristics of the study population (n=2684)

| | | Control group T0 | | Control group T1 | | Experimental group T0 | | Experimental group T1 | |
|--|----------------------|------------------|------|------------------|------|-----------------------|------|-----------------------|------|
| | | n=1107 | % | n=1107 | % | n=1577 | % | n=1577 | % |
| Demographic variables^{1,2} | | | | | | | | | |
| Sex | Male | 560 | 50.6 | | | 733 | 46.5 | | |
| | Female | 547 | 49.4 | | | 844 | 53.5 | | |
| Age (years) | | 13.4 | | | | 13.9 | | | |
| Grade | 7 th | 410 | 37.0 | | | 492 | 31.2 | | |
| | 8 th | 386 | 34.9 | | | 588 | 37.3 | | |
| | 9 th | 311 | 28.1 | | | 497 | 31.5 | | |
| Migration background | Native | 907 | 82.5 | | | 1374 | 87.6 | | |
| | Migrant descent | 192 | 17.5 | | | 194 | 12.4 | | |
| Education level | Low | 179 | 16.2 | | | 829 | 52.6 | | |
| | Average | 385 | 34.8 | | | 412 | 26.1 | | |
| | Middle | 274 | 24.8 | | | 168 | 10.7 | | |
| | High | 269 | 24.3 | | | 168 | 10.7 | | |
| Individual characteristics | | | | | | | | | |
| Attitude | Negative | 503 | 45.4 | 509 | 46.0 | 757 | 48.2 | 712 | 48.2 |
| | Positive | 604 | 54.6 | 597 | 54.0 | 814 | 51.8 | 858 | 51.8 |
| Subjective norm | Low | 626 | 56.6 | 617 | 55.8 | 874 | 55.7 | 823 | 55.7 |
| | High | 480 | 43.4 | 488 | 44.2 | 696 | 44.3 | 749 | 44.3 |
| Perceived behavioural control | Low | 161 | 14.5 | 164 | 14.8 | 260 | 16.5 | 250 | 16.5 |
| | High | 946 | 85.5 | 943 | 85.2 | 1317 | 83.5 | 1327 | 83.5 |
| Smoking behaviour^{1,2} | | | | | | | | | |
| Smoking prevalence | Never smoked | 890 | 80.4 | 830 | 75.0 | 1251 | 79.3 | 1169 | 74.1 |
| | Smoked at least once | 217 | 19.6 | 277 | 25.0 | 326 | 20.7 | 408 | 25.9 |
| Smoking frequency | Irregular | 158 | 81.0 | 197 | 76.1 | 239 | 78.4 | 275 | 75.1 |
| | Regular | 37 | 19.0 | 62 | 23.9 | 66 | 21.6 | 91 | 24.9 |

¹ Results of chi-square tests and t-tests between schools *with* and *without* a ban at T0 of demographic variables and smoking behaviour were as follows: sex $\chi^2(1) = 5.7$, $p = 0.02$, age $t(2682) = -12.5$, $p < 0.001$, migration background $\chi^2(1) = 12.4$, $p < 0.001$, grades $\chi^2(2) = 14.7$, $p < 0.001$, education level $\chi^2(3) = 404.9$, $p < 0.001$, smoking prevalence $t(2682) = -.68$, $p = 0.49$, smoking frequency $t(326) = -.27$, $p = 0.79$.

² Results of chi-square tests and t-tests between schools *with* and *without* a ban at T1 of smoking behaviour were as follows: smoking prevalence $t(2682) = -.50$, $p = 0.62$ and smoking frequency $t(498) = -.72$, $p = 0.47$.

³ Only included students who did not smoke at T0 and started smoking at T1.

School-level variables

In the online survey of the school directors, the school size was measured on a four-point scale: 1] <500 students, 2] 501-1000 students, 3] 1001-1500 students, and 4] >1500 students. Education type was categorised into four levels: 1] low, 2] average, 3] middle or 4] high. Urbanisation of place of the school was measured on a five-point scale: 1] very strongly urbanised; >2500 addresses per m², 2] strongly urbanised; 1500-2500 addresses per m², 3] urbanised; 1000-1500 addresses per m², 4] slightly urbanised; 500-1000 addresses per m² and 5] not urbanised; <500 addresses per m² (Table 1).

Statistical analysis

Due to the clustered data, with the students (first level) nested within schools (second level) multilevel logistic regression analyses were used. Smoking prevalence ('non-smoker' and 'smoker') and frequency of smoking ('irregular' and 'regular') were used as dichotomous outcome variables.

Per outcome variable three multivariate models were used. In Model 1 time (T0 and T1) and smoking policy (*with* and *without* ban), and the interaction between time and smoking policy, were entered. In Model 2 demographic variables (i.e., sex, grade, migration background and education level) were added. Since age and grade are nested, only grade was entered in the model. In Model 3, three predictive variables on individual level (attitude, subjective norm and perceived behavioural control) were entered. Finally, interaction effects were systematically tested between smoking policy and individual characteristics on smoking behaviour. All data management and recoding were performed using SPSS version 22. The Logistic Multivariate analyses were performed with MLwiN version 2.02 [27].

RESULTS

Table 1 presents the characteristics at school level (i.e., school size, education type and urbanization) and Table 2 the characteristics of the study population (i.e., demographic variables, individual characteristics and smoking behaviour). Between T0 and T1, 205 students started smoking and 101 students quit smoking. Analyses showed significant small differences between the schools *with* and *without* a ban on sex, age, migration background and grades. Differences between smoking policy and education level were larger. For example, a low education level is present more often in schools *with* a ban compared to schools *without* a ban. In contrast, middle and high education levels are underrepresented in schools *with* a ban. At both T0 and T1, no significant difference was found in smoking prevalence and frequency between schools *with* or *without* a ban (Table 2).

Smoking prevalence

Table 3 presents the associations between time, smoking policy, demographic and individual characteristics with *smoking prevalence* in the three models ($n=2684$). When controlling for all confounding variables (Model 3), at T1 smoking prevalence was significantly higher compared to T0 (OR1.54, 95% CI 1.22-1.96). Although smoking prevalence was lower at schools *with* an outdoor

smoking ban compared to schools *without* an outdoor smoking ban, this difference was not significant (OR 0.75, 95% CI 0.53-1.06). Furthermore, no significant interaction effect between time and smoking policy was found for smoking prevalence (OR 0.92, 95% CI 0.68-1.24).

Smoking prevalence was significantly lower in girls (OR 0.78, 95% CI 0.65-0.94), higher in students with a migrant descent (OR 1.39, 95% CI 1.08-1.80), and lower in students with a high education level (OR 0.24, 95% CI 0.17-0.35). Furthermore, smoking prevalence was significantly higher in students with a positive attitude towards smoking (OR 3.64, 95% CI 2.96-4.48) and when students think significant others (i.e., family and friends) are more positive about smoking (OR 3.05, 95% CI 2.53-3.68). Smoking prevalence was significantly lower in students with high perceived behavioural control (OR 0.40, 95% CI 0.33-0.49).

Smoking frequency

Table 4 presents the associations between time, smoking policy, demographic and individual characteristics with *smoking frequency* in three models ($n=686$). When controlling for all confounding variables (Model 3), smoking frequency at T1 was significantly higher compared to T0 (OR 1.81, 95% CI 1.06-3.09). Differences between smoking frequency at schools *with* an outdoor smoking ban compared to schools *without* an outdoor smoking ban were not significant (OR 0.79, 95% CI 0.42-1.48). Furthermore, no significant interaction effect between time and smoking policy was found for smoking frequency (OR 0.81, 95% CI 0.41-1.60).

Smoking frequency was significantly lower in girls (OR 0.70, 95% CI 0.47-1.03) and in students with a high education level (OR 0.12, 95% CI 0.04-0.35). Smoking frequency was significantly higher in students with a positive attitude towards smoking (OR 3.99, 95% CI 1.64-9.70) and when students think significant others (i.e., family and friends) are more positive about smoking (OR 5.05, 95% CI 2.42-10.5). Frequency of smoking was significantly lower in students with high perceived behavioural control (OR 0.48, 95% CI 0.33-0.70). No significant interaction effects were found between smoking policy and individual characteristics on smoking behaviour.

Table 3 Associations between time, smoking policy, demographic and individual characteristics with smoking prevalence in three models ($n=2684$)

| Multivariate analysis | Odds ratio (OR) with 95% confidence interval (95% CI) | | | |
|--|---|-------------------|-------------------|-------------------|
| | | Model 1 | Model 2 | Model 3 |
| Time and Smoking policy | | | | |
| Time | T0 | Ref | Ref | Ref |
| | T1 | 1.36 (1.13-1.63)* | 1.42 (1.16-1.75)* | 1.54 (1.22-1.96)* |
| Smoking policy | <i>Without</i> ban | Ref | Ref | Ref |
| | <i>With</i> ban | 0.76 (0.38-1.53) | 0.71 (0.46-1.10) | 0.75 (0.53-1.06) |
| Time x smoking policy interaction | | 0.99 (0.77-1.26) | 0.96 (0.74-1.26) | 0.92 (0.68-1.24) |
| Demographic variables | | | | |
| Sex | Boy | | Ref | Ref |
| | Girl | | 0.74 (0.63-0.88)* | 0.78 (0.65-0.94)* |
| Grade | 7 th | | Ref | Ref |
| | 8 th | | 1.85 (1.49-2.30)* | 1.67 (1.32-2.10)* |
| | 9 th | | 2.99 (2.40-3.72)* | 2.40 (1.90-3.03)* |
| Migration background | Native | | Ref | Ref |
| | Migrant descent | | 1.26 (1.00 -1.61) | 1.39 (1.08-1.80)* |
| Education level | Low | | Ref | Ref |
| | Average | | 0.65 (0.50-0.85)* | 0.60 (0.46-0.77)* |
| | Middle | | 0.33 (0.23-0.47)* | 0.31 (0.22-0.45)* |
| | High | | 0.26 (0.17-0.38)* | 0.24 (0.17-0.35)* |
| Individual characteristics¹ | | | | |
| Attitude | negative | | | Ref |
| | positive | | | 3.64 (2.96-4.48)* |
| Subjective norm | low | | | Ref |
| | high | | | 3.05 (2.53-3.68)* |
| Perceived behavioural control | low | | | Ref |
| | high | | | 0.40 (0.33-0.49)* |
| <i>Number of students and observations (T0 and T1)²</i> | | 2684 5368 | 2684 5334 | 2684 5289 |

¹Intention to start smoking was not used as a predictor as the two outcome variables included adolescents who already smoked.

²Listwise deletion of missing

Table 4 Associations between time, smoking policy, demographic and individual characteristics and smoking frequency in three models ($n=686$)

| Multivariate analysis | | Odds ratio (OR) with 95% confidence interval (95% CI) | | | | | |
|--|--------------------|---|--|-------------------|--|-------------------|--|
| | | Model 1 | | Model 2 | | Model 3 | |
| Time and Smoking policy | | | | | | | |
| Time | T0 | Ref | | Ref | | Ref | |
| | T1 | 1.52 (0.94-2.47) | | 1.57 (0.95-2.61) | | 1.81 (1.06-3.09)* | |
| Smoking policy | <i>Without ban</i> | Ref | | Ref | | Ref | |
| | <i>With ban</i> | 0.99 (0.42-2.34) | | 0.75 (0.42-1.34) | | 0.79 (0.42-1.48) | |
| Time x smoking policy interaction | | 0.83 (0.44-1.57) | | 0.85 (0.45-1.61) | | 0.81 (0.41-1.60) | |
| Demographic variables | | | | | | | |
| Sex | Boy | Ref | | Ref | | Ref | |
| | Girl | | | 0.78 (0.53-1.14) | | 0.70 (0.47-1.03) | |
| Grade | 7 th | Ref | | Ref | | Ref | |
| | 8 th | | | 1.59 (0.92-2.76) | | 1.51 (0.85-2.67) | |
| | 9 th | | | 3.54 (2.10-5.97)* | | 3.20 (1.85-5.51)* | |
| Migration background | Native | Ref | | Ref | | Ref | |
| | Migrant descent | | | 0.99 (0.58-1.70) | | 1.12 (0.63-1.98) | |
| Education level | Low | Ref | | Ref | | Ref | |
| | Average | | | 0.51 (0.33-0.80)* | | 0.55 (0.34-0.89)* | |
| | Middle | | | 0.16 (0.07-0.40)* | | 0.17 (0.07-0.44)* | |
| | High | | | 0.11 (0.04-0.29)* | | 0.12 (0.04-0.35)* | |
| Individual characteristics¹ | | | | | | | |
| Attitude | negative | | | | | Ref | |
| | positive | | | | | 3.99 (1.64-9.70)* | |
| Subjective norm | low | | | | | Ref | |
| | high | | | | | 5.05 (2.42-10.5)* | |
| Perceived behavioural control | low | | | | | Ref | |
| | high | | | | | 0.48 (0.33-0.70)* | |
| <i>Number of students and observations (T0 and T1)²</i> | | 686 1125 | | 686 1118 | | 686 1104 | |

¹Intention to start smoking was not used as a predictor as the two outcome variables included adolescents who already smoked.

²Listwise deletion of missing

Differences between schools

The multivariate analyses provided insight not only into the effect of an outdoor smoking ban and individual characteristics on smoking behaviour of adolescents, but also information on whether these factors explain differences in smoking prevalence and frequency *between* schools. In Model 0 with smoking prevalence as dependent variable and no independent variables (not presented here) the variance between schools was 0.52 ($SE= 0.19$), indicating a statistically significant difference between schools in smoking prevalence of students ($z = 2.69$, $p \leq .01$). In Model 1 the differences between schools had a variance of 0.48 ($SE=0.18$; $z=2.63$, $p \leq .01$). In Model 2, the unexplained differences between schools were reduced to a variance of 0.13 ($SE=0.06$; $z=2.13$, $p \leq .01$). In Model 3, the unexplained variance between schools is reduced further to 0.04 ($SE=0.03$; $z=1.37$, $p > .05$). For smoking frequency, a similar effect was found, however, differences between schools were not statistically significant. The variance was 0.39 ($SE=0.21$ $z=1.83$, $p \leq . p > .05$), 0.39, ($SE=0.39$ $z=1.00$, $p \leq . p > .05$), 0.05, ($SE=0.04$ $z=1.32$, $p \leq . p > .05$) and 0.02, ($SE=0.05$ $z=0.38$, $p \leq . p > .05$) in Model 0, 1, 2 and 3, respectively.

Implementation fidelity of the ban

Results of the online survey revealed that schools in the experimental condition did implement the ban, and schools in the control condition still had a smoking area on the school grounds at T1. Data from the observations showed that at T0, whereas at eight of the nine schools in the experimental condition the students smoked on the school grounds (reason for non-smoking at one school might be attributed to the rain during the observation), at T1 no smoking students were observed in any of the nine schools. Furthermore, at T0 in four of the nine experimental condition schools students were smoking *off* school grounds. However, at T1, in eight of the nine schools students smoked *off* school grounds. Four schools with a ban placed signs on their school ground after implementation of the ban.

DISCUSSION

This is one of the first quasi-experimental studies on effectiveness of outdoor school ground smoking bans. This study presents the results of an outdoor school ground smoking ban at secondary schools on smoking behaviour of adolescents, taking individual characteristics into account. No clear evidence is found that an outdoor smoking ban influences smoking behaviour of adolescents. Furthermore, this study shows that, on the short-term, individual characteristics are important predictors of smoking behaviour and tend to prevail compared to the implementation of the smoking ban. After implementation of the ban, smoking behaviour on school grounds had disappeared, indicating that the ban was implemented at those schools. It seems that smoking has shifted from the school ground to the surrounding area.

To evaluate these results some points need to be considered. First, the time between the first and the second measurement was six months. This period might be too short to observe significant effects of an outdoor school ground smoking ban, as the ban was relatively recently implemented. Second, results show that implementation of an outdoor smoking ban is feasible. However, it is known that the enforcement of smoking bans after implementation is challenging and adherence is not always optimal [28-30], which might be another explanation why no positive results for the smoking ban have been found. Third, since in the present study no smoking behaviour was observed on the school ground but was observed off school grounds at schools with a ban, smoking behaviour of adolescents might have relocated, e.g. to a student's or friend's home, on the street, or in hospitality venues. A recent study of Rozema et al. [unpublished] supports this rationale. In this study school directors reported that students left the school ground to smoke their cigarettes. Future research should investigate effectiveness of a school ground smoking ban when it is prohibited to leave school grounds, as 'the problem of smoking' might be transferred off school grounds. The probability of transferral of smoking off school grounds is supported by the only study showing effectiveness of an outdoor smoking ban on smoking prevalence among adolescents, as in this study smoking was not only banned on school grounds, but also banned on the immediate surroundings of the school [19].

Nevertheless, given that an outdoor smoking ban decreases students' exposure to smoking, and less exposure is related to less smoking initiation [31], more time than six months may be needed before an outdoor smoking ban is effective in reducing smoking behaviour of adolescents. Indeed, the longer the smoke-free policies are in place, the greater the impact on smoking behaviour [32, 33]. Therefore, future research should examine long-term results and, in addition, effects should be evaluated at schools without and with a comprehensive ban (i.e., banning both smoking on school grounds and the immediate surroundings of the school). The predictors of smoking behaviour on the long term might be affected by a non-smoking policy, being the social norm in schools; this also needs to be evaluated.

Limitations and strengths

In the present study, no school level variables were included in the analyses (apart from smoking policy). Future research should investigate school level confounders (e.g. health education programs, enforcement of the ban) in more detail, as this might influence smoking behaviour. Nevertheless, the present study showed that differences between schools in smoking prevalence were mainly explained by individual characteristics/differences between the students (i.e., attitude, subjective norm and perceived behavioural control) and not by smoking policy (having an outdoor ban or not) of the schools. Furthermore, self-reported data were used in this study, increasing the risk of underreporting of smoking [34]. Nevertheless, despite the fact that several students only completed T0 or T1, a strength of this study is that our sample appears to be representative. For example, compared to the Dutch population of adolescents, the age of onset in our study was 13.1 vs. 12.9 years, 20% vs. 23% students smoked at least once, and 3.8% vs. 3% were regular smokers [4]. Thus, missings were probably random, which can be attributed to our large-scale data collection, as it is difficult to question the same students due to absence, grade changes, repetition of school years. Moreover, we were dependent on the participation of the teachers, since they had to ask their students to fill out the questionnaire in the class. Furthermore, validity of the results was not threatened as the drop-out rate of the schools was one. Overall, despite some limitations, to our knowledge this is the first study to evaluate outdoor school ground smoking bans in a school setting, using a quasi-experimental design, as was requested in literature [17, 18].

Conclusion

This study indicates that implementation of an outdoor smoking ban is feasible, but no evidence is found that an outdoor smoking ban influences smoking behaviour on the short-term. This study shows that, during adolescence, individual characteristics are important predictors of smoking behaviour, indicating that an outdoor smoking ban alone will not be enough to change smoking behaviour. Nevertheless, a longer follow-up period than 6 months is required to examine results on the long term. Furthermore, future research should investigate the relationship between degree of enforcement and effectiveness in more detail and where smoking still takes place. Additionally, differences between schools with and without a comprehensive ban and effectiveness when it is prohibited to leave school grounds should be studied, as smoking behaviour might be transferred off school grounds.

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CHAPTER 6

Impact of an outdoor smoking ban at secondary schools on cigarettes, e-cigarettes and water pipe use among adolescents: an 18-month follow-up

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ABSTRACT

Introduction: The effectiveness of outdoor smoking bans on smoking behaviour among adolescents remains inconclusive. This study evaluates the long-term impact of outdoor school ground smoking bans among adolescents at secondary schools on the use of conventional cigarettes, e-cigarettes (with/without nicotine) and water pipes. *Methods:* Outdoor school ground smoking bans at 19 Dutch secondary schools were evaluated using a quasi-experimental design. Data on 7,733 adolescents were obtained at baseline, and at 6 and 18-month follow-up. The impact of outdoor school ground smoking bans on five outcome variables (i.e., ever use of conventional cigarettes, smoking onset, ever use of e-cigarette with nicotine, e-cigarette without nicotine, and water pipe) was measured. Multilevel logistic regression analysis was used due to the nested structure of the data (i.e., time, individual, school). At schools with a ban, implementation fidelity was checked. *Results:* At schools where a ban was implemented, at 18-month follow-up more adolescents had started smoking compared to the control condition. For smoking prevalence, no effect of implementation of the ban was found for e-cigarettes with/without nicotine, and water pipe use. Implementation fidelity was sufficient. *Conclusions:* No long-term effects were found of an outdoor smoking ban on smoking prevalence, e-cigarettes and water pipe use, except for smoking onset. The ban might cause a reversal effect when schools encounter difficulties with its enforcement or when adolescents still see others smoking. Additional research is required with a longer follow-up than 18 months, as effectiveness of outdoor smoking bans remains equivocal.

BACKGROUND

Smoking continues to be a major cause of illness and death worldwide. In Europe it is one of the main public health problems, since Europe has some of the highest prevalence of tobacco use among adolescents compared to other World Health Organization regions [1]. For example, the average percentage of 15-16 year old European adolescents who have smoked in the last 30 days is 21%, and 10% smokes every day [2]. Because tobacco use mainly starts during adolescence, and because adolescents are extremely sensitive to the addictive substance nicotine [3], protecting youth against the dangers of tobacco use has high priority.

Alternative tobacco products, i.e., electronic cigarettes with nicotine, electronic cigarettes without nicotine (also known as 'shisha-pens') and water pipes (also known as 'shisha' or 'hookah'), have become increasingly popular among adolescents. In fact there is an upward trend in adolescent use of e-cigarettes: rates of ever use have doubled or tripled in recent years [4]. For example, ever use of e-cigarettes use by Dutch adolescents aged 12-16 years is 34% (e-cigarettes with/without nicotine have not been measured separately), which is even higher than the ever use of conventional smoking, i.e. 23%. Use of a water pipe use is also popular, i.e., 23% of the adolescents have used water pipes [5].

There are several concerns related to the use of alternative tobacco products. First, these products could undermine years of efforts to 'denormalize' smoking [6]. Denormalization of smoking behaviour is considered an important population strategy to make non-smoking the generally accepted norm and to prevent deviant behaviour, i.e., smoking [7]. Second, there is strong evidence that smoking e-cigarettes/e-cigarettes without nicotine and water pipe act as a 'stepping stone' to smoking conventional cigarettes [8-12]. Third, although the level of toxicants is higher in conventional cigarettes, e-cigarette vapors contain toxic substances [13, 14] and smoking just one puff of an e-cigarette without nicotine can cause irritation of the airways [15]. Also, water pipe smoking is associated with several negative health outcomes, e.g. increase of heart rate, blood pressure, or even lung cancer and carbon monoxide poisoning [16, 17]. In view of these concerns, tobacco control policies aiming to prevent smoking onset should focus not only on conventional cigarettes, but also on alternative tobacco products.

A possible strategy to prevent or reduce smoking behaviour of adolescents is to prohibit smoking at schools, due to the mandatory attendance of adolescents. Whereas, internationally, indoor bans are more or less the norm [18], the importance of implementation of outdoor smoking bans at schools is becoming increasingly apparent [19]. In the Netherlands, until now, 53% of all secondary schools has implemented an outdoor smoking ban [20]. Guidelines established by the Dutch Lung Foundation for an outdoor smoking ban are: 1) the ban should apply to the entire location/site, 2) the ban should apply to everyone (i.e., students, staff and visitors), and 3) the ban should be clearly displayed i.e., by signs and/or in the school regulations [21].

Studies on whether or not outdoor smoking bans at secondary schools are effective in reducing smoking behaviour remain inconclusive. For example, one study showed the effectiveness

on smoking prevalence when schools banned smoking outdoors on the school grounds [22], whereas other studies found no effects of (outdoor) school ground smoking bans [23-27]. Additionally, those studies have methodological shortcomings. For example, most of the studies used a cross-sectional design [23-26], were performed outside Europe [23-25, 27], and only one study included a second data point after one year [22]. There is a need for quasi-experimental studies to investigate the impact of an outdoor smoking ban on smoking behaviour [28, 29].

Given the concerns regarding the use of alternative tobacco products and the conflicting results of studies, the impact of an outdoor smoking ban on both conventional cigarettes *and* alternative tobacco products needs to be investigated using a quasi-experimental design. Therefore, this study aims to evaluate the long-term impact of an outdoor school ground smoking ban at secondary schools (i.e., 18-month follow-up) in a large representative cohort of Dutch adolescents.

METHODS

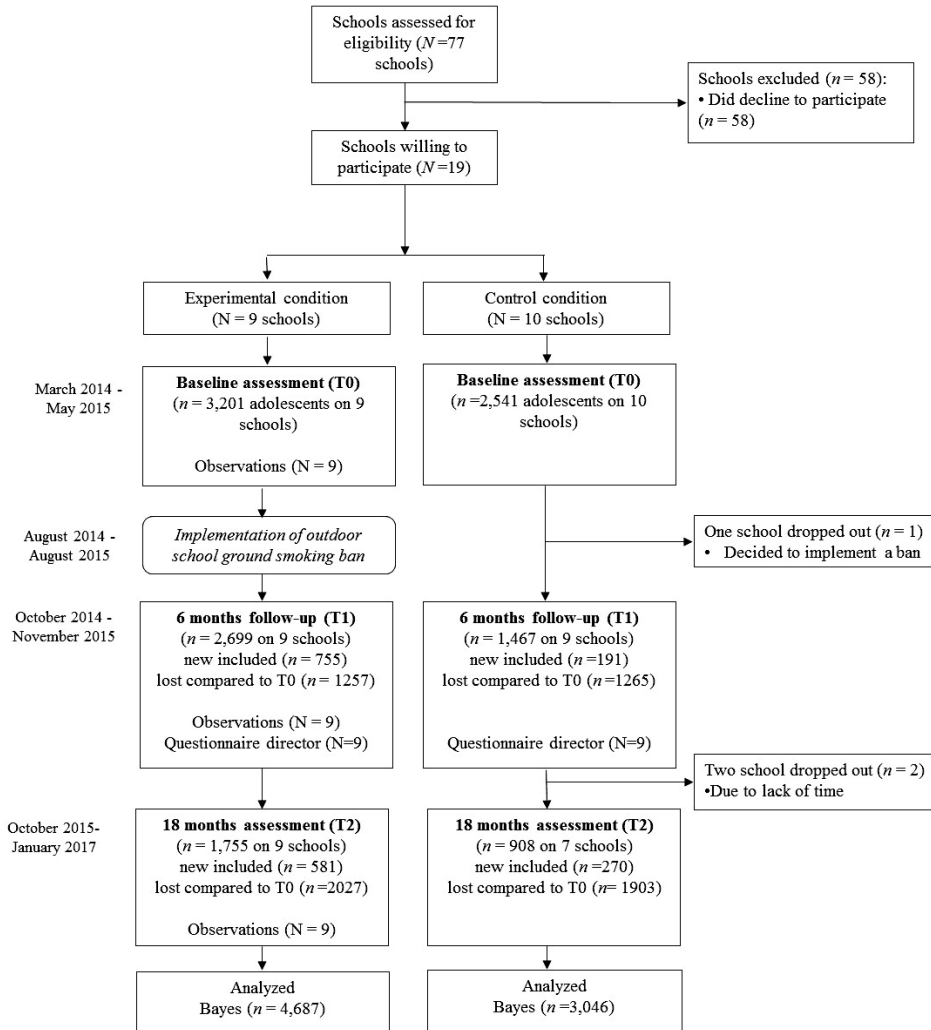
Procedure and participants

To evaluate the effect of an outdoor school ground smoking ban on conventional and alternative smoking behavior of adolescents, a quasi-experimental design was used including: i) schools which decided to implement an outdoor school ground smoking ban (i.e., classified to the experimental condition, $n = 9$) and ii) schools which did not want to implement an outdoor school ground smoking ban (classified to the control condition, $n = 10$).

For 919 Dutch secondary schools, the smoking policy, and whether or not the schools had the intention to implement an outdoor smoking ban, was known from a national monitor questionnaire [30]. In total, 77 schools were randomly contacted by telephone and asked whether they would participate, taking their current smoking policy into account. Participating schools ($n=19$) did not differ substantially from the non-participating schools ($n=58$) in school size ($p = .87$), education type ($p = .30$) and urbanity ($p = .21$). The most common reason for non-participation was lack of time.

Questionnaire data of the adolescents of the participating schools were collected at baseline, and at 6 and 18-month follow-up (T0, T1 and T2, respectively); Figure 1 shows the flow of participants.

Figure 1 Flow chart showing the inclusion of participants



At all waves, adolescent questionnaires were administered at school online, or on paper (online: 84% at baseline; 66% at 6 months; 57% at 18 months, and on paper respectively 16%; 34%; 43%). The questionnaires were completed under supervision of a teacher. At 8 schools in the experimental condition, implementation took place between T0 and T1 during the new school year, in August 2014 and in August 2015. One school implemented the ban in February 2015 (after the school vacation). The schools in the control condition only filled out the questionnaires and did not implement a school ground smoking ban during the study period. During the study, 3 schools in the control condition dropped out. At baseline 1 control school dropped out, as this school wanted to implement an outdoor smoking ban ($n=669$). At 18-month follow-up, 2 additional schools in the control condition

dropped out due to lack of time (n=472). Moreover, in the Netherlands, because the lowest level of education ends at the 10th grade, students in the 9th grade at T0 had already left school at the 18-month follow-up, i.e., in the experimental condition n=913 students and in the control condition n=450 students dropped out. Furthermore, other missings might be due to dependence on the participation of the teachers, as they had to ask their students to fill out the questionnaire in the classroom.

The study was approved by the Psychological Ethics Committee of Tilburg University (EC-2014.19). Active informed consent was obtained from all participants included in the study. Beforehand, passive informed consent was asked by the parents of the students and they were informed about the research because students were of minority age (<18 years). In total, a small group of parents (n=30) refused study participation of their child at T0. The questionnaire was not administered to these students.

Implementation fidelity of the ban

In the experimental condition, it was checked whether the school *had* actually implemented an outdoor ban. That is, at T1, school directors were asked what their current smoking policy was for conventional smoking and e-cigarettes. At all waves, implementation fidelity was also measured at the individual level, by asking adolescents about the current smoking policy of their school.

To double check implementation fidelity, unnoticed observations were performed at all waves in the experimental condition, by counting the number of smokers (i.e., students and staff) on and off the school grounds during a coffee or lunch break. Additionally, at all waves, it was observed whether or not the school had placed non-smoking signs on the school grounds. Furthermore, in the control condition, it was checked that the school had *not* implemented an outdoor ban, by asking the school directors at T1, and adolescents at all waves, what the current smoking policy of the school was.

Measures

Conventional cigarettes

The smoking status of conventional cigarettes of adolescents was assessed at each wave. Adolescents were asked to report (using a 5-point scale) which stage of smoking applied to them. Response categories ranged from 1 'Never smoked', 2 'Smoked only once or twice', 3 'Smokes occasionally, but not every day', 4 'Smoked in the past/Ex-smokers', and 5 'Smokes every day'. Adolescents who 'never smoked a cigarette' were coded as 'Never user; and 'who at least smoked once or twice a cigarette', 'who smokes occasionally, but not every day', 'who smoked in the past', and 'daily smokers' were coded as 'Ever user'. If adolescents reported smoking at T0 or T1 they were also defined as 'ever user' in the following measurement waves, even though they indicated that they had never smoked (T1:75 and T2:79 of all adolescents). Based on smoking status, we differentiated between *smoking prevalence* and *smoking onset*.

For *smoking prevalence* 'never users' were compared with 'ever users'. For *smoking onset*,

only adolescents who were never user at their first measurement (due to missings this could also be T1) were included in the analyses ($n=5,734$) and the development of smoking over time was examined.

Alternative tobacco products (e-cigarettes with/without nicotine and water pipe).

Adolescents were asked the following question ‘How old were you when you used this substance/device for the first time?’, with answer categories ‘I never used this substance/device’, ‘11 years or younger’, ‘12 years’, ‘13 years’, ‘14 years’, ‘15 years’, ‘16 years’, ‘17 years’, ‘18 years’, ‘19 years’ and ‘20 years or older’ for i) e-cigarettes with nicotine, ii) e-cigarettes without nicotine (i.e., shisha-pen) and iii) water pipe. Adolescents saying ‘I never used this substance/device’ were classified as ‘Never user’ and students filled out an age at which they used the substance for the first time were classified as ‘Ever user’.

Sociodemographics

The following sociodemographic variables were included: sex (boys vs. girls), age (in years at T0), migration background (native vs. migrant descent), grade (7th, 8th, 9th and 10th), and education level at T0 (low, average, middle or high). Participants with one or both parents born in a country other than the country of residence were defined as ‘migrant descent’. Furthermore, ‘low education’ refers to schools specialized in students with learning difficulties and pre-vocational secondary education. ‘Average education’ refers to lower general secondary education, ‘middle education’ refers to higher general secondary education, and ‘high education’ refers to pre-university education. In the Netherlands, at primary schools all children are testes and based on this test score, education level of secondary school is determined.

Smoking policy variables to assess implementation

Current smoking policy of students and staff for conventional cigarettes and for e-cigarettes was measured among the school directors at T1. The questions were ‘It is allowed for students to smoke...’, ‘It is allowed for staff to smoke...’, and ‘It is allowed to smoke e-cigarettes...’, with the answering categories 1 ‘Everywhere on and off the school grounds’, 2 ‘Everywhere on the school grounds’, 3 ‘Only on a specific place on the school grounds’, 4 ‘Just outside the fence off the school grounds’, 5 ‘Only on a specific place off the school grounds’, 6 ‘Everywhere off the school grounds’, 7 ‘Nowhere on and off the school grounds’. An extra answer category was added to the questions regarding the smoking policy of staff and of e-cigarettes, respectively: 8 ‘Only on a specific place in the school building’ and 8 ‘The school does not have a specific policy regarding electronic cigarettes’.

Current smoking policy was also measured by asking all students at all three waves ‘What is the current smoking policy of your school?’ with the answering categories 1 ‘It is allowed to smoke everywhere on the school grounds’, 2 ‘It is only allowed to smoke at a specific place on the school grounds’, 3 ‘It is not allowed to smoke on the school grounds’, 4 ‘The school does not have a school ground’.

Statistical Analysis

Using the SPSS package, independent sample *t* tests (for continuous outcome variables) and chi-square tests (for categorical outcome variables) were used to compare participants' characteristics between the experimental and control condition. Attrition analysis to check for differences between participants that dropped out and completers only (i.e., filled out all 3 waves) were conducted using logistic analysis.

Due to the hierarchical structure of the data with 7,733 adolescents being nested within 19 schools, and 3 observations per adolescent, a multilevel analysis in Mplus 7.3 was conducted [31] with three levels (i.e., time, individual, school), to investigate the effect of an outdoor school ground smoking ban on smoking prevalence ('never use' versus 'ever use'), smoking onset ('never use' at first time measurement versus 'ever use' at either T1 or T2), smoking e-cigarette with nicotine, e-cigarette without nicotine and water pipe ('never use' versus 'ever use'). For the multilevel analyses, the dataset was rearranged from a one-person, one-record dataset ($n = 7,733$ person-level dataset) to a one-person, multiple-period dataset ($nobs = 12,571$ person-period dataset).

Per outcome variable, a multivariate model was used. Sociodemographic differences (i.e., sex, grade, migration background and education level) between the experimental and control condition were corrected for. Since grade and age are nested, only grade was entered in the model. Also corrected for was the influence of sociodemographics on the development of smoking or alternative tobacco product use over time (i.e. correction for the possible different influence of time on smoking/alternative tobacco products for sex, grade, migration background and education level). To test the school policy effect, the condition variable (experimental/ control condition), time (T0, T1, T2), and an interaction between time and condition (time*condition), were entered. Time was added to correct for previous substance use. Random intercepts were added to account for clustered data of individuals within schools, and for repeated measurements within respondent. Variables were centered by subtracting the grand mean or group mean from each variable. Within-subject variables were group mean centered (i.e., time) and between-subject and between-school variables were grand mean centered (i.e., sex, migration background, grade, educational level, and condition).

For categorical three-level analyses, the Bayes estimator was used [32]. We first used the default option in Mplus to converge the model. A second run of a double amount of a fixed number of iterations was used to test the stability of convergence of each model (for specific number of iterations per model see Table 3,4). If a model did not converge by default, the amount of iterations was manually increased until the model converged. Convergence was further verified through diagnostic plots following the recommendations of Muthén [33]. All models showed stable results

Missing values were handled by Bayes, as Bayes is a full-information estimator [34]. Intra-class correlations (ICCs) on school level were calculated to examine the similarity of adolescents from the same school [35].

RESULTS

Figure 1 shows the flow of participants. Overall, 5,742 adolescents (74%) participated at baseline, 4,166 (54%) at T1, and 2,663 (34%) at T2. Attrition analysis comparing adolescents that participated at one or two of the waves, compared to adolescents who participated in all three waves (i.e., completers only), showed that girls were more likely to drop out than boys (OR = 1.22, 95% CI = 1.06-1.40, $p \leq .01$). Furthermore, less likely to drop out were migrant adolescents compared to native adolescents (OR = .54, 95% CI = .44-66, $p \leq .01$), smokers compared to non-smokers (OR = .77, 95% CI = .63-.94, $p \leq .01$), higher grades compared to lower grades (OR = .42, 95% CI = .38-.46, $p \leq .01$), and higher educated adolescents compared to lower educated adolescents (OR = .85, 95% CI = .79-.92, $p \leq .01$).

Table 1 shows the characteristics of the adolescents by condition. Significant differences were found between the experimental and control condition for sex, age, grade, educational level and migration background. Therefore, further analyses were controlled for these sociodemographic differences between both conditions. Table 2 shows the number (and percentages) of never user and ever user for smoking onset, smoking prevalence, e-cigarette use (with/without nicotine) and water pipe use.

Table 1. Characteristics of adolescents in the experimental and control condition#.

| | Experimental condition (E) | Control condition (C) | Significant difference between E and C* |
|------------------------------|---------------------------------------|----------------------------------|--|
| | (n=4,687) | (n=3,046) | |
| Sex | | | $\chi^2 = 10.985 (1), p = .001$ |
| Boy | 2,355 (50.7) | 1,647 (54.5) | |
| Girl | 2,293 (49.3) | 1,373 (45.5) | |
| Migration background | | | $\chi^2 = 40.53 (1), p < .001$ |
| Native | 3,815 (83.5) | 2,317 (77.6) | |
| Migrant descent ¹ | 755 (16.5) | 668 (22.4) | |
| Age in years (mean (SD)) | 13.9 (1.06) | 13.5 (1.10) | $t(5623) = -15.763, p < .001$ |
| Education level * | | | $\chi^2 = 1087.36 (3), p < .001$ |
| Low | 1,557 (49.2) | 283 (11.3) | |
| Average | 979 (31.0) | 891 (35.7) | |
| Middle | 297 (9.4) | 763 (30.6) | |
| High | 329 (10.4) | 559 (22.4) | |
| Grade | | | $\chi^2 = 172.47 (5), p < .001$ |
| 7 th | 1,003 (21.5) | 839 (27.7) | |
| 8 th | 1,351(29.0) | 933 (30.8) | |
| 9 th | 1,707 (36.6) | 1,116 (36.8) | |
| 10 th | 566 (12.1) | 118 (3.9) | |
| 11 th | 12 (0.3) | 8 (0.3) | |
| 12 th | 21 (0.5) | 18 (0.6) | |

#Values are numbers (percentages) unless stated otherwise. * χ^2 categorical; t -test continuous. *Education: low education refers to schools specialized in students with learning difficulties and pre-vocational secondary education, average education refers to lower general secondary education, middle education refers to higher general secondary education, and high education refers to pre-university education. ¹ Migrant descent = one or both parents born in a country other than the Netherlands.

Multilevel analysis

Tables 3 and 4 present the results of the implementation of outdoor school ground smoking bans on smoking prevalence, smoking onset, and use of alternative tobacco products. Significant results of sociodemographic on smoking prevalence, e-cigarette use with/without nicotine and water pipe use were in line with expectations: girls used less than boys, other ethnicity than Dutch used more than Dutch adolescents, higher grades used more than lower grades and higher education used less than lower education levels. For smoking prevalence, smoking onset and e-cigarettes with nicotine an increase over time was found. For implementation of school smoking policies only significant results were found for smoking onset (time * condition). This means that students at schools which implemented outdoor school ground smoking bans, had a higher probability to start smoking over time compared to the control condition ($\beta = 1.42$, 95% *BCI** = .21 - 2.96; *Bayesian Credibility Interval). For smoking prevalence and e-cigarettes with/without nicotine, and water pipe use, no interaction effects (time*condition) were found.

Variance components showed that the variation between individuals and schools was significant in all models. Variance for the intercept and slope of individual level indicated a variation between individuals in initial use and use over time. For school level, variation between the schools in initial use and use over time developed differently. The Intra-class correlations (ICCs) to determine the effects of school clustering were between .06 and .16, indicating that 6-16% of the variance could be explained by a school effect (Table 3 and Table 4).

Table 2. Smoking behavior (% of ever users) at baseline (T0), and at 6-month (T1) and 18-month follow-up (T2) measurements.

| | Total sample | Experimental condition 'ever users' | Control condition 'ever users' | Total 'ever users' |
|-------------------------------------|---------------------|--|---------------------------------------|---------------------------|
| <i>Smoking prevalence</i> | <i>n</i> | <i>n (%)</i> | <i>n (%)</i> | <i>n (%)</i> |
| T0 | 5,695 | 745 (23.4) | 485 (19.3) | 1,230 (15.9) |
| T1 | 4,690 | 1,120 (37.6) | 655 (38.2) | 1,775 (37.8) |
| T2 | 4,020 | 1,547 (59.6) | 771 (54.2) | 2,318 (57.7) |
| <i>Smoking onset</i> | | | | |
| T0 | 4,465 | - | - | - |
| T1 | 2,347 | 132 (6.7) | 84 (7.4) | 216 (7.0) |
| T2 | 1,473 | 279 (21.0) | 122 (15.8) | 401 (19.1) |
| <i>E-cigarette with nicotine</i> | | | | |
| T0 | 5,517 | 481 (15.6) | 260 (10.7) | 741 (13.4) |
| T1 | 4,069 | 402 (15.3) | 208 (14.5) | 610 (15.0) |
| T2 | 2,568 | 346 (20.5) | 142 (16.1) | 488 (16.3) |
| <i>E-cigarette without nicotine</i> | | | | |
| T0 | 5,514 | 921 (29.8) | 654 (26.9) | 1,575 (28.6) |
| T1 | 4,061 | 846 (32.2) | 414 (28.9) | 1,260 (31.0) |
| T2 | 2,559 | 580 (34.5) | 251 (28.6) | 831 (32.5) |
| <i>Water pipe</i> | | | | |
| T0 | 5,517 | 725 (23.4) | 455 (18.8) | 1,180 (21.4) |
| T1 | 4,066 | 673 (25.6) | 266 (18.5) | 939 (23.1) |
| T2 | 2,561 | 560 (33.3) | 191 (21.7) | 751 (29.3) |

Table 3. Multivariate Bayes analyses of the implementation of the outdoor school ground smoking ban on 'ever use' of smoking prevalence ($n=5,546$) and smoking onset ($n=4,365$) controlling for sex, migration background, grade and education level.

| | Smoking prevalence | | | Smoking onset | | |
|---|---|--------------------|------------------------------------|---|--------------------|------------------------------------|
| | Median Estimate (posterior SD) [†] | One-tailed p-value | Bayesian 95% Credibility Interval* | Median Estimate (posterior SD) [†] | One-tailed p-value | Bayesian 95% Credibility Interval* |
| <i>Regression</i> | | | | | | |
| Intercept | -6.40 (1.76) | .001 | -9.72 - -2.79* | -9.20 (1.49) | .000 | -12.12 - -6.37* |
| <i>coefficients</i> | | | | | | |
| Sex | -2.56 (.70) | .000 | -4.05 - -1.27* | -0.06 (.41) | .44 | -0.92 -.74 |
| Migration background | 2.24 (.91) | .005 | .54 - 4.11* | -.66 (.63) | .14 | -1.95 -.53 |
| Grade | 5.89 (.72) | .000 | 4.69 - 7.48* | .048 (.26) | .43 | -.49 -.54 |
| Educational level | -4.20 (.71) | .000 | -5.77 - -3.00* | -.20 (.33) | .26 | -.90 -.42 |
| Time | 3.64 (1.15) | .000 | 1.85 - 6.24* | 2.90 (1.26) | .000 | 1.00 - 5.82* |
| Condition | -2.80 (1.75) | .06 | -6.22 -.68 | -1.24 (1.31) | .15 | -4.18 -.99 |
| Condition*time | .52 (.57) | .17 | -0.58 - 1.66 | 1.42 (.70) | .01 | .21 - 2.96* |
| <i>Variance</i> | | | | | | |
| Intercept variance individual level | 331.74 (86.68) | .000 | 213.79 - 547.02* | 39.15 (13.09) | .000 | 17.40 - 69.44* |
| <i>components</i> | | | | | | |
| Slope variance individual level | .14 (.20) | .000 | .004 - 0.75* | .15 (.23) | .000 | .01 - .83* |
| Intercept variance school level | 41.39 (34.91) | .000 | 15.50 - 143.52* | 7.31 (8.11) | .000 | 2.09 - 30.38* |
| Slope variance school level | 1.26 (1.03) | .000 | .44 - 4.19* | .47 (.94) | .000 | .11 - 3.28* |
| Covariance between school level intercept and slope | 5.15 (5.12) | .005 | 1.03 - 19.92* | -1.08 (2.48) | .17 | -7.94 - 1.21 |
| <i>Fit index</i> | | | | | | |
| School ICC | .11 | | | .16 | | |
| Iterations ~ | 419,300 | | | 757,600 | | |

Note: Sex: 1= boy 2 = girl, Migration background: 0=Dutch 1=other, Condition: 0 = control, 1 = experimental, Time: 1, 2, 3; * = significant 2-tailed p -value (significant = bold), ICC = Intra-class correlations, [†] Probit coefficient, ~ Model converged if Potential Scale Reduction (PSR) value was below 1.1.

Table 4. Multivariate Bayes analyses of the implementation of the outdoor school ground smoking ban on 'ever use' of *e-cigarettes with nicotine* ($n = 5,407$), *e-cigarettes without nicotine* ($n = 5,404$), and *water pipe use* ($n = 5,405$) controlling for sex, migration background, grade and education level.

| | E-cigarettes with nicotine | | | | E-cigarettes without nicotine | | | | Waterpipe | | | |
|---|---|--------------------|--------------------------------|---------------------------|---|----------------------|--------------------------------|---------------------------|---|-----------------------|--------------------------------|---------------------------|
| | Median Estimate (posterior SD) ⁺ | One-tailed p-value | Bayesian Credibility Interval* | 95% Credibility Interval* | Median Estimate (posterior SD) ⁺ | One-tailed p-value | Bayesian Credibility Interval* | 95% Credibility Interval* | Median Estimate (posterior SD) ⁺ | One-tailed p-value | Bayesian Credibility Interval* | 95% Credibility Interval* |
| <i>Regression coefficients</i> | | | | | | | | | | | | |
| Intercept | -2.06 (.39) | .000 | -2.86 - -1.35* | -0.06 (0.31) | .43 | .70 - .54 | -1.11 - -.77* | -2.64 (.42) | .000 | -3.50 - -1.86* | | |
| Sex | -.93 (.12) | .000 | -1.17 - -.70* | -.94 (0.09) | .000 | -1.11 - -.77* | -.93 (.13) | .000 | -1.19 - -.69* | | | |
| Migration Background | .33 (.14) | .007 | .07 - .60* | .27 (.13) | .02 | .02 - .51* | .75 (.17) | .000 | .43 - 1.11* | | | |
| Grade | .66 (.08) | .000 | .51 - .82* | .48 (.06) | .000 | .37 - .61* | 1.15 (.11) | .000 | .94 - 1.36* | | | |
| Educational level | -.036 (.08) | .000 | -.51 - -.21* | -.45 (.06) | .000 | -.57 - -.33* | -.57 (0.10) | .000 | -.77 - -.40* | | | |
| Time | 1.09 (.26) | .000 | .59 - 1.61* | .40 (.24) | .05 | -.06 - .89 | .20 (.25) | .21 | -.31 - .70 | | | |
| Condition | -.19 (.41) | .31 | -1.01 - 0.59 | -.03 (.32) | .46 | -.67 - .59 | .32 (.39) | .20 | -.43 - 1.10 | | | |
| Condition*time | -.42 (.23) | .03 | -.88 - .02 | -.15 (.20) | .24 | -.55 - .26 | .20 (.25) | .21 | -.30 - .69 | | | |
| <i>Variance</i> | | | | | | | | | | | | |
| Intercept variance individual level | 5.42 (.83) | .000 | 3.77 - 6.81* | 5.34 (.54) | .000 | 4.43 - 6.61* | 9.08 (1.41) | .000 | 6.52 - 11.98* | | | |
| <i>components</i> | | | | | | | | | | | | |
| Slope variance individual level | .49 (.17) | .000 | .24 - .89* | .44 (.12) | .000 | .20 - .67* | .58 (.22) | .000 | .19 - 1.04* | | | |
| Intercept variance school level | .64 (.31) | .000 | .31 - 1.48* | .37 (.19) | .000 | .17 - .88* | .55 (.29) | .000 | .25 - 1.36* | | | |
| Slope variance school level | .13 (.07) | .000 | .06 - .32* | .12 (.06) | .000 | .06 - .27* | .15 (.08) | .000 | .07 - .38* | | | |
| Covariance between school level intercept and slope | -.002 (0.12) | .49 | -.23 - .25 | .004 (.07) | .47 | -.13 - .15 | -.04 (.11) | .33 | -.29 - .15 | | | |
| <i>Fit index</i> | | | | | | | | | | | | |
| School ICC | .11 | | | .06 | | | .06 | | | | | |
| Iterations ~ | 13,000 | | 5,700 | | 4,800 | | | | | | | |

Note. Sex: 1 = boy 2 = girl, Migration background: 0 = Dutch 1 = other, Condition: 0 = control, 1 = experimental, Time: 1, 2, 3; * = significant 2 tailed p-value (significant = bold), ICC = Intra-class correlations, ⁺ Probit coefficient, [~] Model converged if Potential Scale Reduction (PSR) value was below 1.1.

Implementation fidelity of the ban

On school level, all school directors in the experimental condition reported that they *had* implemented the ban (n=9), and in the control condition they confirmed that they had *not* implemented the ban (n=9). In the experimental condition, schools differed in their implementation form, i.e., 5 schools implemented the ban on the school grounds only for students, and 4 schools implemented the ban on the school grounds for both students and staff. One school in the experimental condition reported that they did not have a specific policy regarding e-cigarettes, the remaining 8 schools reported that the outdoor smoking ban also applied to e-cigarettes.

Implementation fidelity was also measured at individual level, by asking the adolescents about the current smoking policy of their school at all waves. At baseline, in both the experimental (4.3%) and control condition (5.8%), only a small percentage of the students reported that it was prohibited to smoke on the school grounds. After implementation (6-month follow-up) this had increased to 81.6% in the experimental condition vs. 7.4% in the control condition. At 18-month follow-up, the results were similar to those found at T1: 72.7% of the students reported that it was prohibited to smoke on the school grounds in the experimental condition vs. 10.2% in the control condition.

The observations in the experimental condition demonstrated that, at baseline, at 8 of the 9 schools the adolescents smoked on the school grounds (89%). After implementation (T1), no smoking adolescents were observed at all 9 school grounds (0%). At 18-month follow-up, at 2 schools (22%) smoking behaviour was observed on the school grounds (i.e., at one school smoking students were observed, and at the other school both smoking students and staff were observed). In contrast, students smoking cigarettes were more often seen off the school grounds after implementation: at T0 at 4 schools smoking students were seen off the school grounds (44%) vs. 8 at T1 (89%) and 7 at T2 (78%). Furthermore, 4 schools (44%) placed signs at their school grounds at T1 and this had increased to 5 schools (56%) at T2.

DISCUSSION

This is the first study to evaluate the long-term impact of an outdoor school ground smoking ban at secondary schools on the use of conventional cigarettes and of alternative tobacco products among adolescents. Results show that schools with and without an outdoor ban at 18-month follow-up did not significantly differ on smoking prevalence, use of e-cigarettes (with/without nicotine) and water pipe among adolescents. Except for smoking onset a significant effect was found. At the schools that had implemented outdoor school ground smoking bans, more adolescents started smoking.

The international evidence regarding the effectiveness of outdoor smoking bans remains equivocal and, in line with another study, an outdoor smoking ban might not always protect adolescents from taking up smoking [27]. Nevertheless, whether or not school smoking policies are effective, depends on whether: i) the policy is strictly enforced and sanctioned, ii) adolescents do not feel the pressure to smoke, and iii) anti-smoking beliefs are internalized so that non-smoking becomes the generally accepted norm [36]. All these points are important when interpreting the results of the present study.

First, although all schools in the experimental condition implemented the ban, the schools might have encountered difficulties with enforcement or differentiated in the level of enforcement (e.g. strict vs. non-strict), which might explain the absence of positive results (i.e., a reduction in smoking behaviour). Also, enforcement is challenging after implementation of a smoking ban and adherence is often far from optimal [37-39]. During adolescence, a ban (which is a forced choice) might threaten self-autonomy and can backfire, and might even exacerbate deviant behaviour, e.g. smoking [40]. Jancey et al. [40] also reported other reasons for noncompliance of smoking bans: e.g. reluctance to leave the school grounds, smoking necessity, unintentional noncompliance through confusion of school boundaries, or avoiding detection (e.g. going to places where one is unlikely to be observed). In general, future research using a quasi-experimental design should also focus on the enforcement and sanctions related to bans at schools.

Second, adolescents still saw others smoking during school hours, since most schools in the experimental condition tolerated smoking off the school grounds. As a result, adolescents might have felt pressure to conform to other smoking behaviour [36]. Actual smoking might have shifted to, for example, off the school grounds. Observational data of the present study and our previous study support this: i.e. more smoking students were observed near the school grounds after implementation [41]. Additionally, at baseline in both conditions, 40% of the adolescents reported that they smoked outside the school grounds; however, this percentage increased to 47% in the control condition, and to 57% in the experimental condition at 18-month follow-up. In fact, the only study which showed the effectiveness of outdoor smoking bans concerned schools that prohibited smoking on the school grounds *and* in the immediate surroundings of the school [22]. School tobacco policies might cause a reversal effect when adolescents find easily accessible alternative locations to smoke off the school grounds [36], and when the anti-normative behavior of adolescents is salient at the entrance of the school.

Finally, although implementation of smoke-free environments (such as outdoor school ground smoking bans) contributes to non-smoking as the generally accepted norm [19] and to reduced exposure to second-hand smoke [42], 18 months might be too short a period to find positive results in behaviour change. Adolescents might not yet have internalized anti-smoking beliefs. Changing a norm is a gradual process that takes time [43]. For example, in the Netherlands, after implementation of the smoking ban in hospitality venues, there was much resistance and compliance/acceptance was only about 50% in 2010 and increased to 90% only after 5 years [44]. Therefore, a follow-up period longer than 18 months is needed, as the impact of outdoor smoking bans might have a delayed effect. Future studies could compare the control schools with schools that have had an outdoor smoking ban for a considerable number of years, e.g. ≥ 5 years. Additionally, schools using a bottom-up approach during implementation (i.e., consulting key stakeholders), should be compared with schools using a top-down approach (i.e., no consultation of key stakeholders), as this might increase support for the ban and consequently might influence impact of the ban.

Schools might consider to prohibit smoking anywhere on the school grounds, and apply the ban to all types of tobacco products (including alternative tobacco products), thereby strengthening non-smoking as the norm. An integral approach, i.e., integration of outdoor smoking bans in different environments, might be a precondition to more effectively influence the non-smoking norm. For example, to be effective, smoking bans should be implemented not only at schools, but also at other places such as at adolescents' home [45], playgrounds [46], or other locations where adolescents spend regular time, e.g. sport grounds or beaches/public swimming pools. Indeed, it is reported that smoking norms at home seem to predict the effect of school smoking restrictions [47]. Moreover, bans should be extended with other interventions/policies often found to be effective in reducing adolescents' smoking, such as school programs focusing on social influences and competence [48], or other effective tobacco control policies aiming to reduce smoking behaviour among adolescents, e.g. increasing price/tax [49].

Strengths and limitations

A strength of this study is its quasi-experimental design. Moreover, the effectiveness of outdoor smoking bans on the use of alternative tobacco products among adolescents was investigated for the first time; this is valuable due to the clear link between alternative tobacco products and the uptake of conventional cigarettes [8-12]. Additionally, few studies have distinguished between e-cigarettes with nicotine and without nicotine, which is indicated as a research priority [4].

The present study also has some limitations. First, the schools were not randomized and we had therefore no influence on which school implemented the smoking policy and which did not. This led to differences in sociodemographics (i.e., sex, grade, migration background and education level) between conditions. However, we controlled for differences in sociodemographics between the experimental and control condition. Second, although there was a substantial amount of missing data, these missings were probably random, since the prevalence rates of tobacco products were similar to those of a representative Dutch study among adolescents [5]. Third, self-reported data were used,

increasing the risk of underreporting of smoking [50]. Nevertheless, confidentiality was assured during the study, which is effective in increasing the reliability of self-reported data of smoking behaviour [51]. Fourth, the schools differed somewhat in implementation forms; however, there was insufficient power to divide the experimental condition into different groups. Internationally, more research including more schools is needed to investigate different guidelines/definitions of outdoor smoking bans and which implementation form is the best.

Conclusion

An outdoor smoking ban did not appear to affect smoking prevalence and use of e-cigarettes (with/without nicotine) and water pipe after 18 months. Except for smoking onset a significant effect was found. At the schools that had implemented outdoor school ground smoking bans, more adolescents started smoking. To prevent relocation of smoking, schools might strictly enforce the ban and apply the ban not only on school grounds but also in the immediate surrounding off the school grounds; or schools might aim to prevent students leaving the school grounds during school hours. Additional long-term studies are required to determine the longer-term effects on both conventional smoking and use of alternative tobacco products, taking into account the different implementation forms. Overall, schools might consider to prohibit smoking anywhere on the school grounds, and apply the ban to all kind of tobacco products, thereby strengthening non-smoking as the norm and decreasing exposure to second-hand smoke.

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CHAPTER 7

General discussion

The work presented in this thesis aimed to identify important determinants during the i) adoption, ii) actual implementation and iii) sustainability stage of an outdoor school ground smoking ban. Additionally, the impact of an outdoor school ground smoking ban on adolescents smoking behaviour and the use of alternative tobacco products were investigated.

Part I Implementation of an outdoor smoking ban

The first part of this thesis provides insight into important determinants during the adoption, implementation and sustainability stages of an outdoor school ground smoking ban. That is, *Chapter 2* describes what factors hinder secondary schools from adopting an outdoor smoking ban, by presenting the barriers and facilitators as perceived by the various key stakeholders (i.e., directors, non-teaching staff, teaching staff, parents, and students) in schools *without* an outdoor smoking ban. Collaboration, communication and the involvement of important stakeholders during an early stage of the process facilitates adoption. According to stakeholders, lack of knowledge about an outdoor smoking ban hinders adoption and can be solved by providing the schools with adequate information about the concept and how to implement the ban, e.g. by means of media messages and/or educational presentations. Furthermore, the results highlight the importance of legislation for outdoor smoking bans in school settings, as this might facilitate adoption for schools that experience extra barriers to initiate an outdoor smoking ban without formal legislation.

Chapter 3 evaluates the stage after adoption, by identifying important factors related to the implementation process at secondary schools. At 20 schools (out of 24 schools), implementation succeeded; the directors of four schools reported that they were unable to implement the ban as scheduled. Postponing implementation was rooted in the decision-making process (e.g. failing to agree on what to do with staff who smoke) and environmental factors (e.g. no clear demarcation of the school grounds). Furthermore, at four of the 20 schools where implementation succeeded, smoking students were observed on the school grounds. At four other schools, smoking staff were observed on the school grounds, albeit out of sight of the students. This study showed that, although implementation is feasible, there are challenges, including low adherence from students and dealing with staff who smoke (i.e., whether or not to exclude staff from the ban). During implementation, amongst others the following items were perceived as important: realizing the enforcement, achieving consistency between decision-makers regarding the rules for smoking staff, and a clearly structured school ground with appropriate fences.

Chapter 4 describes the post-implementation period of secondary schools *with* an outdoor smoking ban. It was shown that the level of sustainability was high at schools with an outdoor smoking ban ($n=438$), with a higher score for small schools compared to large schools. Neither the type of education nor the year of implementation were associated with sustainability. Results show that schools are able to maintain and routinize an outdoor smoking ban. Once implemented, the ban usually becomes 'normal practice', which is promising for future implementation of outdoor tobacco control initiatives. According to the directors it is important that the staff is involved to strengthen sustainability, as they function as role models, share responsibility for the enforcement, and have good

relationships with students. Furthermore, the directors stated that communication and collaboration with all stakeholders strengthens sustainability.

Part II Impact of an outdoor smoking ban

The second part evaluates the impact of an outdoor school ground smoking ban on adolescents' smoking behaviour of traditional cigarettes and alternative tobacco products. *Chapter 5* presents the short-term results of an outdoor school ground smoking ban at secondary schools on adolescents' smoking behaviour, taking individual characteristics into account. No evidence was found for the effectiveness of an outdoor smoking ban on the smoking behaviour of adolescents. On the short-term, individual characteristics (i.e., attitude, subjective norm, and perceived behavioural control) were more important predictors of smoking behaviour.

Chapter 6 describes the long-term impact (i.e., the 18-month follow-up) of an outdoor school ground smoking ban at secondary schools on the use of conventional cigarettes, e-cigarettes (with and without nicotine) and water pipe among adolescents. No long-term effects were found of an outdoor smoking ban on smoking traditional cigarettes, e-cigarettes and water pipe use, with the exception of smoking onset. At schools where a ban was implemented, at 18-months follow-up more adolescents had started smoking compared to the control condition.

Part I Reflections on the implementation of an outdoor smoking ban

The results of this thesis show that several factors play a role during the adoption, implementation and sustainability stages of an innovation process, i.e., an outdoor school ground smoking ban. Some determinants play a role in all stages and others during only one or two stages. Since the framework developed by Fleuren et al. [1] summarizes several models of the processes of change in a clear and convenient way, we used this framework to interpret our results. Therefore, all influential factors mentioned by stakeholders were divided into the four categories established by Fleuren et al., i.e., i) socio-political, ii) school, iii) individual factors, and iv) factors related to the intervention itself (i.e., smoking ban) [1]. However, during the implementation (chapter 3) and sustainability (chapter 4) stages no specific individual factors were reported by stakeholders. Therefore, in these two studies the factors were divided into three categories (socio-political, school, and factors related to the smoking ban). An overview of all important factors found in the three studies are presented in Table 1. Below, we discuss only those factors most frequently mentioned in all the stages.

Table 1. Summary of the findings based on the model of Fleuren et al., 2004 [1].

| Categories | Important factors | Stages | | |
|-----------------|----------------------|----------|----------------|----------------|
| | | Adoption | Implementation | Sustainability |
| Socio-political | Legislation | ± | | + |
| | Social environment | + | ± | ± |
| School | (School) Policy | ± | ± | + |
| | Decision process | ± | ± | |
| | Enforcement | ± | ± | ± |
| | Resources | ± | - | |
| | Education level | | - | + |
| | Program 'champion' | | - | |
| | School culture | | + | + |
| | Communication | + | + | ± |
| | Collaboration | + | + | + |
| | Workforce conditions | - | | |
| | Physical environment | ± | ± | ± |
| Individual | Support | ± | | |
| | Knowledge | - | | |
| | Target group | - | | |
| Smoking ban | Guidelines | ± | ± | ± |
| | Evidence | + | | |
| | Side-effects | - | ± | - |

± perceived as both a barrier and facilitator, - perceived barrier, + perceived facilitator

Socio-political characteristics

In the socio-political category it was found that both during the adoption stage (i.e., when schools are acquiring/processing information and deciding about the outdoor ban) and the sustainability stage (when schools are trying to routinize the policy in their school), all kinds of legislation discouraging tobacco use among adolescents (including outdoor smoking bans) were important factors. For example, during adoption, some of the stakeholders would only adopt an outdoor smoking ban when policymakers introduce legislation (i.e., when it is made a 'forced choice' by policymakers). However, it should be taken into account that, even though such legislation can be introduced, schools may still encounter barriers/problems, e.g. what to do when confronted with resistance, or when smoking shifts off the school grounds (i.e., side-effects during implementation and sustainability). Nevertheless, whether or not policymakers enact legislation targeting youth, the success of an intervention often depends on feasibility, realizing the enforcement, and/or on public acceptance. Public acceptance tends to be higher for low intrusive interventions and when they target the behaviour of others [2]. Therefore, based on the work in this thesis and on earlier studies, acceptance of legislation targeting tobacco use of youth will probably be high, since stakeholders themselves stated their preference for legislation [3]. This is promising for the Dutch legislation on outdoor smoking bans, which will be implemented in 2020 at educational institutes [4].

Furthermore, the social environment was mentioned as an important factor during all stages. Smoking parents and/or smokers in the student's peer group are perceived as a difficult obstacle. Often, there is no consensus between smoking parents and the school regarding the smoking ban according to stakeholders. Moreover, the smoking status of the parents and friends often predicts smoking onset of adolescents [5]. Since parents play a crucial role in adolescents' engagement in smoking, the pedagogic role of parents might be enhanced, since anti-smoking parenting strategies decrease adolescents' engagement in smoking [6, 7]. In summary, the social environment should be taken into account during all stages of a ban, and (as far as possible) schools and parents should communicate and collaborate with each other.

School characteristics

At the school level, communication and collaboration are reported as important factors that positively influence all three stages. Communication (i.e., informing and educating) and collaboration (i.e., within the school, with other schools, or with external organizations) is generally perceived as important during all stages, as also found previously [8]. Stakeholders need to be involved during an early stage of the process, since involvement of several stakeholders results in community ownership which, in turn, is important for the level of sustainability [9]. Especially involving and consulting smokers (students *and* staff) themselves is likely to be important to overcome resistance.

Difficulties with enforcement in all stages was mentioned by stakeholders. Our findings corroborate previous studies, showing that the enforcement of a smoking ban is challenging and that noncompliance is common practice [10-12]. Strict enforcement is recommended to deal with noncompliance [13-15]. Moreover, a recent study suggests that a smoking ban at schools might backfire if not strictly enforced [16]. Therefore, enforcement, including sanctions when violating the policy, warrant attention during all the stages.

Another important factor mentioned in all stages is the school policy. For example, schools often struggle with the decision as to whether or not to prohibit students from leaving the school grounds during school time. If students are prohibited from leaving the school grounds, problems may arise as the smokers are then unable to smoke. However, according to the stakeholders, this would simplify the enforcement. Nevertheless, a recent review showed that when adolescents find alternative locations, smoking in sight of other adolescents (e.g. just outside the school gate) might cause a reversal effect of the smoking policy [16] and should therefore be avoided. Another school policy is to employ a tailored stepwise approach, making implementation a less drastic change. Schools should allow ample lead time to prepare implementation so that stakeholders can gradually grow accustomed to the outdoor ban. This also allows schools to communicate the policy to parents, staff and other important stakeholders.

Environmental factors are also mentioned as important in all three stages. A large school ground and no clear demarcation (e.g. no fences) is reported to be a barrier in all stages, and a clearly structured school ground as a facilitator; this is because a clearly demarcated school ground with

fences simplifies the enforcement. Indeed, one of the reasons for noncompliance is unintentional noncompliance, i.e., students may not be aware of, or were confused about the boundaries of the school ground [13, 17].

Individual characteristics

Lack of support (e.g. of smokers, parents), is identified as a main barrier on the individual level during adoption. There is a need for support of smoking staff, smoking students, parents and residents.

Involving all stakeholders (both non-smokers and smokers) is essential to enhance support.

Smoking ban characteristics

Another important item in the category of smoking ban factors, are the actual guidelines of the outdoor smoking ban. Schools often have problems about what to do with the second guideline regarding smoking staff: should they apply the ban to students *and* staff, or only prohibit smoking for students on the school grounds and let staff smoke (out of sight of students) on the school grounds. However, staff function as a role model [18], and exemptions to smoking bans are counterproductive and can undermine a smoking ban [19].

Another important factor in this category are the expected negative side-effects during adoption and the actual side-effects during implementation and sustainability (e.g. noncompliance, disturbance in the neighbourhood). Less side-effects were reported during the implementation and sustainability stages than expected during the adoption stage. Moreover, during implementation, some positive side-effects were reported (e.g. contrary to what was expected, some students stopped smoking, less students left the school grounds to smoke, and there was less resistance than anticipated). Nevertheless, some expected side-effects during adoption also occurred after implementation, e.g. some students left the school grounds and disappeared from sight, resulting in 'hangout spots' near the school gate. Furthermore, according to stakeholders, leaving the school grounds increased drug use and nuisance in the neighbourhood. Several side-effects might be resolved by prohibiting students from leaving the school grounds during school hours, since several negative side-effects are related to leaving the school grounds. Although this might present some difficulties regarding enforcement in some schools (as smokers are then unable to smoke), it also might facilitate the enforcement (rules are clear and can be strictly enforced). Moreover, allowing adolescents to leave the school grounds is known to be a contra-mechanism, decreasing the effectiveness of a smoking policy [16].

In general, when interpreting the results, it should be noted that the number of Dutch secondary schools with an outdoor smoking ban increased from 26% in 2012 to 53% in 2016, after which the number of schools with an outdoor smoking ban stagnated [20-24]. According to Rogers [25], there are five types of adopters which are: i) innovators (2.5%), ii) early adopters (13.5%), iii) early majority (34%), iv) late majority (34%), and v) laggards (16%). Data collection for our three studies described above, took place in 2014 and 2016 (respectively, 48% and 53% schools *with* an outdoor smoking ban). This might indicate that the schools included in our adoption study (i.e., schools *without*

an ban) were 'late majority' or 'laggards', and schools included in the implementation and sustainability study (i.e., schools *with* an ban) were 'innovators', 'early adopters' or 'early majority'. This should be taken into consideration when interpreting the present results.

With this in mind, as well as the fact that stakeholders in the adoption stage mentioned legislation to be a facilitator, it seems that schools which did not yet adopt an outdoor ban (i.e., late majorities and laggards) need a 'forced choice' by introducing legislation [26]. In contrast, schools that had already implemented the outdoor ban (i.e., innovators, early adopters and early majority) did not need a forced choice by law, as they had already implemented the ban. Stakeholders in the sustainability stage reported that, although sustainability was high, other kinds of legislation aiming to reduce smoking among adolescents would help sustain the ban, thereby helping non-smoking to become the norm.

With respect to the guidelines, based on the present findings we can make two recommendations. First, all guidelines should be strictly enforced and carry sanctions; moreover, no exemptions should be made to any of the guidelines, as this works counterproductively. Moreover, because the staff function as role models, non-smoking staff is essential or (if no other options are available) the staff should smoke out of sight of the students. Second, if possible, do not allow students to leave the school grounds during school hours; this may reduce negative side-effects and reduce counterproductive effects, since when allowed to leave the school grounds, students might find alternative locations at which to smoke.

Finally, the findings emerging from our studies show that implementation is feasible; however, some schools deferred implementation and returned to the adoption stage. These findings are in line with the model of Fleuren [1], which states that innovation processes are iterative and dynamic. This implies that, at each stage, the desired change may not occur resulting in, for example, schools staying in the same stage, or relapsing to a previous stage.

Part II Reflections on the impact of an outdoor smoking ban

International literature with respect to the impact of outdoor smoking bans remains equivocal, and an outdoor smoking ban might not always protect adolescents from smoking onset [27]. Nevertheless, a recent review provides insights which can be applied when interpreting the results of our studies in Part II [16]. The authors of this review stated that the effectiveness of school smoking policies depends on: i) how strictly the ban is enforced, ii) whether or not adolescents see others smoking and therefore also feel pressure to smoke, and iii) whether or not adolescents internalize anti-smoking beliefs affecting non-smoking as the generally accepted norm [16].

First, when there is high likelihood of sanctions, the risk of starting or continuing smoking might decrease [16]. In Part I, we showed that schools encounter difficulties with the enforcement during implementation, often leading to noncompliance. Since the ban is a forced choice for adolescents, it might threaten their autonomy and exacerbate deviant behaviour, such as smoking [17], and therefore result in noncompliance. Other groups also reported that adherence is often far from optimal after

implementation of a smoking policy [10-12]. In order to be effective, schools should attempt to enforce the ban as strictly as possible [16].

Second, when adolescents still see others smoking, e.g. other students off/on the school grounds, they might feel pressure to conform to their peers' smoking behaviour [16]. In fact, the only study which showed the effectiveness of outdoor smoking bans concerned schools that prohibited smoking on the school grounds *and* in the immediate surroundings of the school [28]. As smoking onset might have been shifted away from the school grounds, it might be important to also prohibit smoking in the immediate vicinity, or prohibit students from leaving the school grounds during school hours. Thus, it is essential that adolescents do not see others smoking; especially smoking staff should be unseen, since they function as role models [18].

Third, 18 months might be a too short period to yield positive results. Non-smoking might not yet be the norm, as adolescents might not have internalized anti-smoking beliefs to a sufficient extent. A longer follow-up period is probably needed to reveal effects, as the ban might have a delayed effect and changing a social norm (e.g. towards non-smoking) generally takes a considerable period of time [29]. This is in line with the Population Model of Tobacco Control, which states that the process of the impact of tobacco control policies is slow and can be described as a 'flywheel in motion': 1) when the social norm towards smoking becomes less tolerant, 2) social support for the measures increases, 3) followed by political support for the measures, 4) next, tobacco control policies are implemented and 5) tobacco consumption decreases, which contributes again to 1) less tolerance towards smoking [30]. Based on the Population Model of Tobacco Control, legislation for outdoor smoking bans, which will be implemented at Dutch educational institutes in 2020 [4], will probably positively influence the impact of outdoor smoking bans and the social norm.

Another point to consider when interpreting the results is that Part I demonstrated that sustainability was high at schools with an outdoor smoking ban, irrespective of the year of implementation. The sustainability level of schools in the experimental condition (i.e., where schools implemented the outdoor ban) at 18-months follow-up (Part II) seemed to be lower. For example, whereas at 6-months follow-up at zero schools smoking students were observed on the school grounds, at 18-months follow-up this had increased to two of the nine schools (22%). Additionally, at 6-months follow-up, 81.6% of the students reported that their school had an outdoor smoking ban, and at 18-months follow-up this percentage had decreased to 72.7%. This decrease could be due, for example, to the fact that i) the school stops communicating the policy (too early) in the sustainability stage, ii) the school lacks adequate enforcement, or iii) the school size plays a role. This last item is important since Part I also showed that smaller schools have a higher level of sustainability, and the experimental condition included mainly large schools (i.e., 5 of the 9 schools had more than 1000 students). Moreover, the two schools where smoking students were observed on the school grounds at 18-month follow-up were both large schools (i.e., schools with over 1000 students) where enforcement is more difficult compared to smaller schools. Nevertheless, it is important that all schools (especially large ones) try to keep the level of sustainability high, as sustainability can never be taken for granted [31].

Furthermore, adolescents have the following five risk factors to start vaping and/or smoking: i) genetic vulnerability, ii) personality traits, iii) intention and susceptibility to use nicotine, iv) parents and friends who smoke, and v) weak anti-smoking policies [32]. Not only should strong tobacco control policies (e.g. outdoor smoking bans) be implemented, but the remaining four risk factors should also be taken into account when aiming to reduce the smoking behaviour of adolescents. This corroborates with findings of our short-term results, where individual characteristics were identified as important predictors of smoking behaviour. Bans should be extended with other comprehensive, community-wide interventions discouraging tobacco use, taking into account all the risk factors. For example, mass media campaigns (i.e., providing information) to convince parents of the importance of a complete smoking ban at home (i.e., no-one in the household should be allowed to smoke anywhere in the house [7]), implementation of effective tax policies [33] (i.e., facilitating choices by disincentives), and legislation for outdoor smoking bans (i.e., forcing a choice), should be combined.

Overall, schools should set an example by not allowing/facilitating smoking anywhere (i.e., not in buildings, on school grounds, or in the immediate surroundings of the school) to strengthen non-smoking as a norm. Furthermore, alternative tobacco products should also be banned everywhere and should be incorporated into guidelines/legislation to enhance non-smoking as the norm. This is important since the rates of the use of alternative smoking products are high among adolescents. Additionally, knowledge on the harm/dangers of use of alternative tobacco products is increasing and there is strong evidence that smoking alternative products act as a 'stepping stone' to conventional smoking [34-38]. Nevertheless, it should be taken into account that the remaining Dutch schools without an outdoor smoking ban are defined by Rogers as 'late majority/laggards' [25], and that these schools need help from other schools (e.g. best practices), parents, health professionals and policymakers, in deterring smoking among adolescents.

Methodological considerations

The studies in Part I offer more in-depth understanding of which conditions foster and hinder adoption, implementation and sustainability. Moreover, the three studies presented here were the first ones to make an explicit distinction between the different stages during the process of implementing an outdoor school ground smoking ban. However, when interpreting the results of Part I some methodological considerations need to be taken into account. *First*, because smoking prevalence was not measured in all the stages, it was not possible to evaluate differences in important factors between schools with a low or high percentage of smokers. It might be easier for schools to adopt, implement and sustain an outdoor ban when smoking prevalence is low. *Second*, social desirability bias might have occurred among the directors in the sustainability study, as they may have been inclined to project a favourable image of their school. In the (actual) implementation study, no social desirability bias seems to be present, since the directors openly acknowledged that it was impossible to introduce the smoking ban as scheduled. *Third*, both in the implementation and sustainability study, only the directors were interviewed and their opinions/views may not necessarily reflect those of the other key stakeholders. Future research could investigate the views of other key stakeholders (e.g. staff and parents) in more detail. Nevertheless, due to their prominent role during the different implementation stages, the

directors are relevant persons to interview.

When interpreting the results of Part II, some methodological considerations also need to be taken into account. *First*, schools were not randomized, and outdoor smoking bans were evaluated in a setting/country where several other tobacco control policies have already been implemented. During recruitment of the schools, it was easier to find schools for the experimental condition than for the control condition. This might be because the schools in the control condition were probably late majorities and laggards (as defined by Rogers), and might have felt threatened by the (results of the) research. Nevertheless, the 19 schools participating in the experimental condition (i.e., with an outdoor ban) and in the control condition (i.e., without an outdoor ban) did not differ from the schools that refused to participate in the study regarding school size, education level and urbanization. However, the schools in the experimental group differed slightly from those in the control condition. For example, the schools in the experimental condition generally contained more smokers and the education level was significantly lower compared to schools in the control conditions; that is why, in the analyses, we controlled for differences in socio-demographic variables between the experimental and control condition. *Second*, schools in the control condition did not implement an outdoor smoking ban. However, we did not measure whether they changed their smoking policy (e.g. smoking is permitted everywhere on the school grounds, changed to only permitted in specific zones on the school grounds) or initiated other tobacco control activities at their schools discouraging tobacco use, such as educational programs in the class. However, other tobacco control activities might also have been implemented in the experimental condition. Moreover, the pre-intervention condition was unknown in all of the participating schools. Future research should take into account the tobacco control activities at all schools. *Third*, self-reported data were used in the study; this may increase the risk of underreporting/overreporting the smoking behaviour of the students, due to recall bias or social desirability [39]. However, self-report data on smoking behaviour is generally reliable when confidentiality is assured [40]. *Fourth*, there were a substantial number of missings in our study, which can be attributed to our dependency on the teacher's willingness to allow the questionnaires to be filled out in their student groups. Nevertheless, missings were probably random since the smoking prevalence rates of students in Part II were similar to those of an earlier representative Dutch study among adolescents [41].

Nevertheless, this is the first study to explicitly investigate outdoor smoking bans at secondary schools using a quasi-experimental design. Moreover, it is the first time that outdoor smoking bans are investigated with conventional smoking *and* the use of alternative tobacco products as outcome variables. In addition, it is often difficult to find schools with lower vocational education that are willing to participate in this type of study. In this thesis it is a strength that the participation rate of schools with a low education level was relatively high, i.e., schools with different education levels were present in all our studies and not one education level was missing. Furthermore, the drop-out rates of the schools were low, i.e., zero in Part I, and only three schools dropped-out in Part II. Additionally, it is important to measure whether an intervention actually has been implemented. Therefore, implementation fidelity was checked at all schools which implemented the ban both in Part I (chapter 3) and Part II.

Recommendations for future research

Based on the results of the studies in this thesis, some recommendations can be made for future research. *First*, more studies are needed (using a quasi-experimental design) to determine the longer-term effects of an outdoor smoking ban, including several school level confounders (e.g. level of enforcement and health policies). Additionally, this thesis clearly shows that schools differ in their form of implementation, e.g. not all schools implement the ban for everyone and everywhere, and some did not place clear signs regarding the ban. Displacement of smokers (also of smoking staff) and creating a smoke-zone off the school grounds is likely to send a normative message that smoking is still acceptable. This might lead to relocation of the smoking behaviour, since adolescents might feel pressure to conform to the smoking behaviour of others [16]. A complete ban on students and staff on the school grounds *and* the immediate surrounding, sends the strongest normative message compared to a ban for students only, or allowing smoking off the school grounds. Future research should include a greater number of schools to ensure sufficient statistical power, and to investigate different implementation forms in more detail and examine which form proves to be the most effective. Moreover, tobacco points-of-sale (i.e., availability of cigarettes) in close proximity to schools (with and without a ban) should be measured, as this might also be related to adolescents' smoking behaviour.

Additionally, in the Netherlands, 78% of primary education schools has an outdoor smoking ban [23]. The relatively high percentage at primary education schools is probably because these children (aged 4-12 years) do not yet smoke; nevertheless, at 22% of these schools it is still allowed for staff to smoke. However, secondary schools might learn from primary schools. For example, 78% of Dutch primary schools managed to prohibit staff from smoking on the school grounds compared to 19% in the secondary schools (i.e., 53% of the secondary schools prohibited smoking only for students [23], and 19% for both students and staff [42]). Future research should be aimed at the question: what makes it easier for primary schools to prohibit staff from smoking and what can secondary schools learn from them?

Second, other outcome variables (besides smoking onset, smoking prevalence, and the use of alternative tobacco products) should also be evaluated. For example, since individual characteristics are identified as important predictors for smoking behaviour on the short term, future research should evaluate whether these predictors (attitude, social norm, perceived behavioural control) might be affected by the outdoor smoking ban. Furthermore, it should be investigated to what extent adolescents internalize non-smoking beliefs after implementation of an outdoor smoking ban.

Third, although we interviewed the school directors, due to a lack of time we did not take leadership styles into account. However, type of leadership is associated with a greater success of smoke-free initiatives. For example, a clear, consistent and visible leadership was shown to increase the success of smoke-free policies [15]. Future research should take this into account and could compare directors of schools using a bottom-up approach (i.e., directors consult students, staff and parents, and make a shared decision regarding the outdoor smoking ban), with directors who use a top-down approach (i.e., no consultation with key stakeholders). This might be valuable, since stakeholders

mentioned communication, collaboration and a bottom-up approach as facilitators. Moreover, a bottom-up approach provides a voice for adolescents themselves in the decision-making process, which might result in more ownership of the smoking policy, and might promote support and internalization of non-smoking beliefs.

Lastly, in a broader perspective, future research should consider integration of different policy strategies to reduce adolescents' smoking behaviour. For example, in a relatively short period of time, the prevalence of adolescents' smoking rates in Iceland has decreased sharply [43]. Researchers attribute this success to the combination of i) legislation (a forced choice), ii) offering alternatives/leisure activities like sports by giving each child 300 euro (positive incentives), and iii) creating social awareness, e.g. by parental monitoring (meaning that parents track their children's whereabouts and activities [44]), and providing parents with relevant information and advice. Indeed, parental monitoring is a strong protective factor against adolescent smoking [45]. For example, adolescents are less likely to smoke when they have parental supervision five or more times a week, compared to adolescents who are home alone two or more days a week [46]. Moreover, it was also found that leisure activities, such as playing a team sport, also works as an important protective factor for smoking. However, it should be noted that street-oriented leisure activities (such as going to a skate park) were associated with an increased risk of smoking [47].

Nevertheless, the combination of informing and involving the social environment (i.e., parental monitoring), facilitating choices or providing help in selecting choices by giving incentives to make another behaviour attractive (i.e., leisure activities such as sporting instead of smoking) and forcing choices (i.e., age-to-sale laws and ban on advertising) seems to be very successful. Moreover, in Iceland, this plan was developed bottom-up in consultation with politicians, policymakers, parents and teachers. In the context of outdoor smoking bans, the ban (i.e., a forced choice by schools) might have reduced smoking behaviour when it was combined with the other two elements, i.e., parental monitoring and leisure activities, such as sports. Although Iceland differs from other countries in that it is relatively isolated, has a small population, and has less inequalities in social economic status, future research should examine whether the 'Iceland model' also works in other contexts (e.g. in the Netherlands), since combining the three elements seems to be very successful.

Recommendations for practice

Findings from this thesis might be used in practice to improve the adoption, implementation and sustainability of outdoor smoking bans at secondary schools. First, Part I showed that schools *without a ban* (47%), defined by Rogers as late majorities and laggards [25], are generally the larger Dutch schools (i.e., schools which perceive difficulties with sustaining a ban). Policymakers and health professionals should bear in mind that these schools might experience more difficulties in the three stages (i.e., adoption, implementation and sustainability) and thus need more support. Dutch legislation for outdoor smoking bans, which will be implemented in 2020 at all educational institutes [4], might be a good trigger for these 47% schools to adopt the ban and gradually progress towards implementation. Nevertheless, although this thesis shows that implementation is feasible, these schools will probably

face various challenges during implementation, which will warrant extra attention. Support is needed in realizing the enforcement (e.g. knowledge-sharing of best practices of other schools), clear guidelines should be provided (e.g. by policymakers), and a clearly structured school ground with appropriate fences should (if possible) be realized (e.g. financed by municipalities).

Furthermore, the results of this thesis might be used in other educational institutes to help adopt, implement and sustain outdoor smoking bans, as the percentages are worrisome (78% of primary education schools and only 4% of senior secondary vocational schools has an outdoor smoking ban [23]). These primary schools should focus on their smoking staff and ensure that they stop smoking if possible or smoke off the school grounds (out of sight). The percentage at senior secondary vocational education schools is probably lower because these schools have older students (with a lower education level) with higher smoking rates. It is important to establish which stage these schools are in, i.e., dissemination or adoption. Next, depending on their stage, it is necessary to communicate guidelines, involve stakeholders and use a step-wise approach developed bottom-up. These schools should take into account the barriers and enhance the facilitators identified in Part I of this thesis. For example, prior to implementation, schools should develop solutions to address potential problems, e.g. strict enforcement to prevent noncompliance, prohibit students leaving the school grounds to prevent negative side-effects, and involving stakeholders during an early stage of the process to prevent general resistance. The fact that once schools have an outdoor smoking ban, it is generally experienced as 'normal practice' irrespectively of level of education, should be communicated to the senior secondary vocational education schools as this might stimulate them.

Apart from helping schools, our results can also be used in other settings to improve smoke-free environment initiatives, such as smoke-free sports grounds, playgrounds and terraces. Although some differences exist between schools and sport fields/playgrounds/terraces (e.g. school attendance is mandatory) there are many similarities, such as lack of support from the smokers and the difficulty of organizing the enforcement. For example, strict enforcement should also be realized at sport grounds e.g. by coaches or volunteers, stakeholders should be involved and a clear demarcation of the sport ground is needed.

Furthermore, parents play a crucial role in adolescents' engagement in smoking and should therefore be involved in anti-smoking tobacco control policies. For example, schools/health professionals could advise parents to implement non-smoking house rules and keep cigarettes out of the home (i.e., reducing the availability of cigarettes) [7] and/or stimulate more parental monitoring and guidance.

Policymakers could disseminate knowledge via mass media/awareness campaigns. Moreover, leisure activities might be facilitated to a greater extent by schools/health professionals and policymakers. For example, schools might provide sport activities during or after school hours, and policymakers might give positive incentives (e.g. by providing money for sport clubs) for each child, or facilitate sports in schools. Policymakers should also continue to implement effective interventions/policies to reduce adolescents' smoking, such as increasing the price of tobacco products and the related taxes [32].

Conclusion

This thesis showed that implementation of an outdoor school ground smoking ban is feasible. However, schools/organizations implementing smoke-free environments, should take into account the barriers and enhance the facilitators during adoption, implementation and sustainability. Moreover, although this thesis does not show a direct effect on smoking prevalence, an outdoor smoking ban at least protects (non-smoking) adolescents and staff at secondary schools from exposure to second-hand smoke, and contributes to gradually making non-smoking the accepted norm.

Additional research with a quasi-experimental design is required for a period longer than 18 months, to investigate how strictly the enforcement has been realized, whether smoking behaviour has moved off the school grounds, to what extent adolescents have internalized non-smoking beliefs, and the role of different leadership styles of directors.

Nevertheless, schools should not facilitate smoking anywhere (i.e., not in buildings, school grounds and not in the immediate surroundings of the school) to strengthen non-smoking as a norm. Moreover, all stakeholders need to be involved during an early stage of the process and once implemented, all schools should strictly enforce the ban. No exemptions should be made for staff or for alternative tobacco products, in order to convey the strongest normative message. If possible, schools should not allow students to leave the school grounds during school hours, thereby reducing the negative and counterproductive effects.

Policymakers should be aware of and pay extra attention to the schools without a ban, as these late majorities/laggards will probably experience more difficulties during implementation and sustainability. Once schools have an outdoor smoking ban it is generally experienced as 'normal practice'; this should be communicated to the schools without a ban, as these successful examples might stimulate them. Overall, implementation processes take time; schools should be aware of this and allow ample lead time. In a broader context, organizations, health professionals and policymakers should continue to implement tobacco control activities (e.g. by increasing taxes), enhance parental strategies (e.g. nonsmoking rules at home; parental monitoring), and initiate additional smoke-free environments (e.g. in cars, at home, in playgrounds) in order to strengthen nonsmoking as the norm.

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Summary

Nederlandse samenvatting

Dankwoord

List of publications

About the author

SUMMARY

The tobacco 'epidemic' has caused a burden of mortality and morbidity worldwide. The tobacco epidemic is most advanced in European countries compared to other countries worldwide. Since smoking initiation often takes place during adolescence and since children spend considerable (mandatory) time at schools, many children can be targeted by making school grounds smoke-free. Currently, in the Netherlands, legislation prohibits smoking *in* school buildings; however, on the school grounds it is up to the schools themselves to decide whether or not to prohibit smoking. To stimulate implementation of outdoor smoking bans at secondary schools, the Dutch Lung Foundation developed the following guidelines: i) the ban applies everywhere (i.e., the entire school location/site), ii) the ban applies to everyone (i.e., students, staff and visitors), and iii) the ban should be clearly displayed (i.e., by signs and/or in the school regulations). The number of secondary schools with an outdoor smoking ban increased between 2012 and 2015, but stagnated since 2016: 26% of secondary schools had an outdoor smoking ban in 2012, 34% in 2013, 48% in 2014, 53% in 2015, and then remained at 53% in 2016. The question then arises: why do not all Dutch schools adopt an outdoor smoking ban? Additionally, when schools have decided to adopt an outdoor ban, what is the best way to proceed with implementation? Also, once schools do have a ban, is it easy or difficult to sustain that ban? A better understanding of factors playing a role in these different stages might help to further increase adoption, implementation and the sustainability of outdoor smoking bans at educational institutes. The first aim of this thesis was to identify important determinants during the i) adoption, ii) actual implementation and iii) sustainability stage of an outdoor school ground smoking ban at secondary schools. Moreover, since the impact of outdoor smoking bans remains equivocal, the second aim was to investigate the impact of an outdoor school ground smoking ban on adolescents smoking behaviour and the use of alternative tobacco products.

Part I

Chapter 2 describes which factors hinder secondary schools from adopting an outdoor smoking ban, by presenting the perceived barriers and facilitators at schools *without* an outdoor smoking ban. Semi-structured interviews were held with various key stakeholders (i.e., directors, non-teaching staff, teaching staff, parents, and students). Collaboration, communication and the involvement of important stakeholders during an early stage of the process facilitates adoption. Furthermore, the interviewees highlight the importance of legislation for outdoor smoking bans in school settings which might be a good trigger for the 47% of the schools which do not have yet a ban.

Chapter 3 evaluates the stage after adoption, by identifying important factors related to the implementation process at secondary schools. Therefore, semi-structured interviews were held with 24 school directors. This study showed that, although implementation is feasible, there are challenges, including low adherence from students and dealing with staff who smoke (i.e., whether or not to exclude staff from the ban). At 20 schools (out of 24 schools), implementation succeeded; the directors of 4 schools reported that they were unable to implement the ban as scheduled. Postponing implementation

was rooted in the decision-making process (e.g. failing to agree on what to do with staff who smoke) and environmental factors (e.g. no clear demarcation of the school grounds). During implementation, amongst others the following items were perceived as important: realizing the enforcement, achieving consistency between decision-makers regarding the rules for smoking staff, and a clearly structured school ground with appropriate fences. Overall, implementation processes take time; schools should be aware of this and allow ample lead time, involving all stakeholders during the process to enhance support.

Chapter 4 describes the post-implementation period of secondary schools *with* an outdoor smoking ban. An online survey among school directors was conducted to measure level of sustainability ($n=438$) and semi-structured interviews were held to measure the perceived barriers and facilitators ($n=15$). It was shown that the level of sustainability was high, with a higher score for small schools compared to large schools. According to the directors it is important that the staff is involved to strengthen sustainability, as they function as role models, share responsibility for the enforcement, and have good relationships with students. These findings are promising for Dutch legislation on outdoor smoking bans, which will be implemented in 2020 at educational institutes. This study demonstrates that schools are able to maintain and routinize an outdoor smoking ban and once implemented, the ban usually becomes 'normal practice'.

Part II

Chapter 5 presents the short-term results (i.e., 6 months) of an outdoor school ground smoking ban at secondary schools on adolescents' smoking behaviour, taking individual characteristics into account. Our quasi-experimental study showed no evidence for the effectiveness of an outdoor smoking ban on the smoking behaviour of adolescents. On the short-term, individual characteristics (i.e., attitude, subjective norm, and perceived behavioural control) were more important predictors of smoking behaviour.

Chapter 6 describes the long-term impact (i.e., the 18-month follow-up) of an outdoor school ground smoking ban at secondary schools on the use of conventional cigarettes, e-cigarettes (with and without nicotine) and water pipe among adolescents. Our quasi-experimental study showed no long-term effects of an outdoor smoking ban on smoking traditional cigarettes, e-cigarettes and water pipe use, with the exception of smoking onset. At schools where a ban was implemented, at 18-months follow-up more adolescents had started smoking compared to adolescents at schools in the control condition.

This is the first study to explicitly investigate outdoor smoking bans at secondary schools. Moreover, the first three studies presented here were the first ones to make an explicit distinction between the different stages during the process of implementing an outdoor school ground smoking ban. Additionally, it is the first time that outdoor smoking bans are investigated with conventional smoking *and* the use of alternative tobacco products as outcome variables. This thesis showed that implementation of an outdoor school ground smoking ban is feasible, however schools should take

into account the barriers and enhance the facilitators during the process, like allow ample lead time to prepare implementation, involving and communication with important stakeholders, and realizing the enforcement. Although this thesis does not show a direct effect on smoking prevalence, an outdoor smoking ban at least protects (non-smoking) adolescents and staff at secondary schools from exposure to second-hand smoke.

Additional research with a quasi-experimental design is required for a period longer than 18 months, to investigate how strictly the enforcement has been realized, whether smoking behaviour has moved off the school grounds, and to what extent adolescents have internalized non-smoking beliefs.

In order to convey the strongest normative message, schools should not facilitate smoking anywhere (i.e., not in buildings, school grounds and not in the immediate surroundings of the school), and no exemptions should be made for staff or for alternative tobacco products. All schools should strictly enforce the ban. If possible, schools should not allow students to leave the school grounds during school hours, or not allowing smoking in the immediate surroundings of the school. Moreover, all stakeholders (e.g. students, smoking staff) need to be involved during an early stage of the process.

Schools included in the implementation and sustainability study (i.e., schools *with* a ban) are 'innovators', 'early adopters' or 'early majority'. However schools included in our adoption study (i.e., schools *without* a ban) were 'late majority' or 'laggards'. Policymakers should be aware of and pay extra attention to the schools without a ban, as these late majorities/laggards will probably experience more difficulties during implementation and sustainability. Extra support and guidance might help schools during the implementation process. Schools should be aware of the time required for the whole implementation processes and allow ample lead time to create support among (smoking) staff and students. Once schools have an outdoor smoking ban it is generally experienced as 'normal practice'; this should be communicated to the schools without a ban, as these successful examples might stimulate them.

Legislation for outdoor smoking bans is not enough to reduce smoking rates. Next to legislation for outdoor smoking bans, organizations, health professionals and policymakers should continue to implement tobacco control activities (e.g. by increasing taxes), enhance parental strategies (e.g. nonsmoking rules at home; parental monitoring), and initiate additional smoke-free environments where children spend considerable time (e.g. sport grounds, playgrounds, swimming pools, in cars and/or at home), in order to strengthen nonsmoking as the norm which is necessary to achieve a smoke free generation.

NEDERLANDSE SAMENVATTING

Dutch summary

Roken zorgt jaarlijks voor veel ziekte en sterfte. Voornamelijk in Europese landen is de rookprevalentie zorgwekkend hoog vergeleken met andere landen in de wereld. Aangezien jongeren vaak beginnen met roken in de adolescentie, en zij vanwege de leerplicht veel tijd doorbrengen op scholen, kunnen rookvrije schoolomgevingen een mogelijke bijdrage leveren om het roken bij jongeren te reduceren. In Nederland is het bij wet verboden om te roken *in* schoolgebouwen, maar het is aan scholen zelf om te bepalen of ze een rookvrij schoolterrein invoeren. Om scholen te ondersteunen bij het invoeren van een rookvrij schoolterrein zijn er drie richtlijnen opgesteld door het Longfonds: i) het verbod geldt voor het gehele terrein (dus overall), ii) het geldt voor iedereen (waaronder leerlingen, personeel en bezoekers) en iii) het verbod is zichtbaar aangegeven (bijvoorbeeld opgenomen in het schoolreglement en/of met borden). Het aantal scholen dat een rookvrij schoolterrein in Nederland heeft ingevoerd is gestegen tussen 2012 en 2015, maar stagneert sinds 2016: van 26% in 2012, 34% in 2013, 48% in 2014, tot 53% in 2015 en 2016. Een belangrijke vraag is wat 47% van de scholen weerhoudt van het adopteren en invoeren van een rookvrij schoolterrein? Onderzoek naar de adoptie, en daarop aansluitend, de implementatie en borging van rookvrije schoolterreinen, levert kennis op die bruikbaar is voor scholen die nog twijfelen over de invoering, of vraagtekens hebben bij de borging van het beleid. Het eerste deel van dit proefschrift beschrijft de factoren die tijdens de adoptie-, implementatie- en borgingsfase van een rookvrij schoolterrein op middelbare scholen van belang zijn. Aangezien er tot nu toe in onderzoek nog geen duidelijkheid is ontstaan of een rookvrij schoolterrein effectief is, wordt in het tweede deel van dit proefschrift ingegaan op de effecten van een rookvrij schoolterrein op het rookgedrag van jongeren van traditionele sigaretten en alternatieve tabaksproducten.

Deel I

Hoofdstuk 2 beschrijft wat scholen zonder een rookvrij schoolterrein belemmert om een rookvrij schoolterrein in te voeren en welke factoren het adoptieproces kunnen faciliteren. Semigestructureerde interviews zijn afgenomen bij schooldirecties, niet-onderwijzend personeel, onderwijzend personeel, ouders en leerlingen. Samenwerking, communicatie en het betrekken van belangrijke stakeholders (bijvoorbeeld ouders, schoolpersoneel, leerlingen) in een vroeg stadium werkt bevorderlijk voor het adopteren van een rookvrij schoolterrein. Daarnaast waren de geïnterviewden van mening dat wetgeving een steun in de rug kan zijn voor scholen die nog niet op eigen initiatief een rookvrij schoolterrein hebben ingesteld.

Hoofdstuk 3 beschrijft hoe het proces van implementatie verloopt bij scholen die een rookvrij schoolterrein gaan invoeren. Daarvoor zijn semigestructureerde interviews afgenomen bij 24 schooldirecties. Deze studie laat zien dat implementatie haalbaar is, maar scholen hebben te maken met verschillende uitdagingen tijdens de invoering, zoals het realiseren van de handhaving en het naleven van alle drie de richtlijnen. In vier van de vierentwintig scholen is het niet gelukt om het rookvrije schoolterrein in te voeren zoals vooraf gepland. Dit had vooral te maken met het besluitvormingsproces

(scholen hebben vooral moeite met de richtlijn ‘het verbod geldt voor iedereen’, en komen er soms niet met elkaar uit of ze de regel ook moeten laten gelden voor het rokende personeel) en omgevingsfactoren (wanneer de school bijvoorbeeld geen duidelijk afgebakend terrein heeft). Belangrijke factoren bij de implementatie zijn het realiseren van de handhaving, het eens worden over de regels rondom rokende personeelsleden en een duidelijk afgebakend terrein met hekken. Ten slotte, implementatie kost tijd, en scholen zouden het beleid zorgvuldig en met voldoende voorbereidingstijd moeten communiceren met alle betrokkenen, zodat draagvlak ontstaat.

Hoofdstuk 4 toetst de mate van borging van scholen die al een rookvrij schoolterrein hebben (d.m.v. een online survey bij 438 directeuren), en beschrijft welke factoren het borgingsproces belemmeren dan wel faciliteren (d.m.v. semigestructureerde interviews bij 15 directeuren). Het blijkt dat scholen met een rookvrij schoolterrein er goed in slagen het rookvrije schoolterrein te borgen en dat deze borging succesvoller is bij kleine scholen in vergelijking met grote scholen. Volgens de geïnterviewde directeuren dienen scholen hun personeelsleden goed te betrekken in het borgingsproces aangezien ze een voorbeeldfunctie hebben, goede onderlinge relaties hebben met leerlingen en zorg dragen voor de handhaving van het beleid. Deze informatie laat zien dat de aankomende wetgeving voor rookvrije schoolterreinen, die vanaf 2020 wordt ingevoerd voor onderwijsinstellingen, als kansrijk en haalbaar kan worden beschouwd. Dit onderzoek laat zien dat scholen in staat zijn om een rookvrij schoolterrein te borgen, en dat het rookvrije beleid, eenmaal geïmplementeerd, als een normale zaak wordt gezien.

Deel II

Hoofdstuk 5 beschrijft de korte-termijn resultaten (6 maanden) van een rookvrij schoolterrein op het rookgedrag van jongeren, rekening houdend met individuele kenmerken. Op basis van een quasi-experimenteel onderzoeksdesign blijkt dat een rookvrij schoolterrein op de korte termijn geen effecten heeft op het rookgedrag van jongeren. Individuele kenmerken (attitude, subjectieve norm en waargenomen gedragscontrole) lijken op de korte termijn belangrijkere voorspellers van rookgedrag.

Hoofdstuk 6 beschrijft de lange-termijn resultaten (18 maanden) van een rookvrij schoolterrein op traditioneel rookgedrag en het roken van alternatieve tabaksproducten (elektronische sigaret, shisha-pen en de waterpijp) onder jongeren. Het quasi-experimentele onderzoek geeft geen aanwijzingen dat een rookvrij schoolterrein, over een periode van 18 maanden, invloed heeft op zowel de rookprevalentie van traditionele sigaretten als op het gebruik van alternatieve tabaksproducten. Echter, bij scholen waar een rookvrij schoolterrein is ingevoerd, zijn in vergelijking met scholen zonder een rookvrij schoolterrein, meer jongeren begonnen met roken.

Dit is het eerste onderzoek in Nederland naar rookvrije schoolterreinen op middelbare scholen. Tot dusver is er geen onderzoek gedaan dat kijkt naar de verschillende fasen in het gehele proces van het adopteren, invoeren en continueren van een rookvrij schoolterrein, noch naar de effectiviteit ervan op het gebruik van traditionele sigaretten en alternatieve tabaksproducten. Dit proefschrift toont aan dat implementatie van een rookvrij schoolterrein haalbaar is, maar dat er belemmerende en bevorderde factoren zijn waar scholen rekening mee dienen te houden, zoals het nemen van voldoende

voorbereidingstijd, het betrekken van en goed communiceren met belangrijke stakeholders, en het realiseren van de handhaving. Hoewel dit proefschrift niet aantoont dat een rookvrij schoolterrein kan beschermen tegen het beginnen met roken, beschermt een rookvrij schoolterrein in ieder geval tegen de blootstelling van jongeren aan rook van derden.

Aanvullend quasi-experimenteel onderzoek is nodig over een langere periode dan 18 maanden om te bestuderen in hoeverre het beleid strikt gehandhaafd wordt bij scholen, of het roken zich verplaatst naar buiten de schoolterreinen en in hoeverre de norm niet-roken is geïnternaliseerd bij jongeren.

Scholen kunnen bijdragen aan het creëren van niet-roken als de norm, door roken nergens meer te faciliteren (niet in gebouwen, niet op het terrein, maar ook niet (net) buiten het terrein), en geen uitzonderingen te maken (voor zowel het rokende personeel als alternatieve tabaksproducten). Verder zou het beleid strikt gehandhaafd moeten worden. Indien mogelijk zouden scholen hun leerlingen niet moeten toestaan het schoolterrein te verlaten gedurende schooltijd of te roken in de verblijfsgebieden rondom het schoolterrein. Tijdens het gehele proces dienen belangrijke stakeholders (bv leerlingen, rokende docenten) te worden betrokken.

Scholen die er reeds in geslaagd zijn een rookvrij schoolterrein in te voeren behoren tot de zogeheten 'innovators', 'early adopters' of 'early majority' van vernieuwingsprocessen. Scholen die tot nu toe geen initiatief hebben genomen in het doorvoeren van een rookvrij schoolterrein behoren tot de 'late majority' of de 'laggards', en zijn over het algemeen grote scholen met veel leerlingen, zo blijkt uit ons onderzoek. Deze scholen zullen daarom waarschijnlijk meer moeite hebben met het implementeren en borgen van het rookvrije beleid. Bij de invoering van de nieuwe rookwetgeving in 2020 moeten beleidsmakers zich hiervan bewust zijn. Extra begeleiding en tijd kunnen deze scholen ondersteunen bij het hele implementatieproces. Op tijd starten, kan eveneens helpen om tot voldoende draagvlak onder (rokend) personeel en leerlingen te komen. Voor deze scholen is het van belang vooraf te beseffen dat als scholen eenmaal een rookvrij schoolterrein hebben ingevoerd, dit al gauw als een 'normale zaak' wordt gezien. Deze kennis over '*best practices*' kan breder dan tot nu toe gecommuniceerd worden naar scholen die nog geen rookvrij schoolterrein hebben, zodat zij zich aangemoedigd voelen door de ervaringen elders.

Van belang is ook te beseffen dat wetgeving alleen niet voldoende is. Een integrale aanpak van maatregelen zou gestimuleerd moeten worden, om het (beginnen met) roken door jongeren verder terug te dringen. Naast de aankomende wetgeving voor rookvrije schoolterreinen, blijven aanvullende maatregelen nodig zoals het verhogen van accijns op tabaksproducten, het betrekken van de ouders in het ontmoedigen van tabaksgebruik van hun kinderen, en het creëren van rookvrije omgevingen op andere plekken waar jongeren veel tijd doorbrengen, bijvoorbeeld rookvrije sportterreinen, speeltuinen, zwembaden, auto's en/of thuis. Een integrale aanpak zal bijdragen aan het creëren van niet-roken als de sociale norm, welke noodzakelijk is voor een rookvrije generatie.

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Andrea Rozema was born on the 18th of May 1989 in Groningen (the Netherlands). After completing her secondary education at Willem Lodewijk Gymnasium in 2007, she started Psychology studies at the University of Groningen where she obtained her Bachelor's degree in 2011. In 2011, Andrea started the master Social Psychology and wrote her Master's thesis at the Department Social Psychology, Environmental Psychology; this thesis dealt with the effects of subgroups on norm adherence. Andrea graduated in 2012. Then, she remained working at the Department Social Psychology on projects related to Health and Illness. In September 2013 Andrea started her PhD project on outdoor school ground smoking bans at Tranzo Scientific Center for Care and Welfare at Tilburg University, which she completed in September 2017. Andrea currently works as a postdoctoral researcher at Tranzo Scientific Center for Care and Welfare at Tilburg University, to disseminate the results of her thesis to key stakeholders in preparation for the legislation of outdoor smoking bans which will be implemented in 2020 in the Netherlands. Additionally Andrea is working at the Dutch Cancer Society as a policy officer working on prevention programs.

