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**School policies for preventing smoking among young
people**

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1. EXECUTIVE SUMMARY

The work presented in this thesis is the first attempt to systematically review the effect of an anti-tobacco policy on young people's use of tobacco. In general, there is an high expectation on the efficacy of such measure of environmental prevention, because it is inexpensive and theoretically easily implementable.

The research in this field is dramatically poor. There is a lack of shared definition of what is a School Tobacco Policy (STP), the studies are mainly cross-sectional in type and the components of the policy poorly described.

The narrative and a systematic reviews here presented concluded that the overall evidence of STP's effectiveness is weak, due to a lack of experimental, quasi experimental and longitudinal studies. Notwithstanding, the work highlights promising preventive components of an anti-tobacco policy, to be included in future evaluations and interventions, such as comprehensiveness, consistency and enforcement.

A second goal of the thesis is to study the effect of a national law banning smoking both inside and outside school premises recently introduced in Italy (October 2013). Two surveys designed to bridge this gap are here presented. The recent introduction of an outdoor smoking ban seemed to be not an opportunity to develop specific policies in school setting. The effect of the law on smoking among students and teachers was probably negligible. The work presents some suggestions to develop comprehensive prevention programmes at school level.

2. INTRODUCTION

2.1 Smoking and health: why focus on young people?

Tobacco smoking is an addictive behavior associated with over five million deaths per year. The World Health Organization projects that the number of deaths per year attributable to tobacco smoking will rise to eight million by 2030. Tobacco use is a major preventable cause of morbidity and mortality, killing an average of one person every six seconds, and is responsible for one in ten adult deaths worldwide (WHO 2012). Though the majority of smoking-related deaths are in people aged 35 years or older, the onset of tobacco use occurs primarily in early adolescence, and adolescents are a special target for smoking prevention projects. Trends in youth smoking show a decline during the 1970s and 1980s, and an increase in the 1990s in both the USA and Europe (Warren 2008).

In 2010 the prevalence of Italian adolescents who smoked at least one cigarette a week was 1% at 11 years old, 6% at 13 and 20% at 15. (HBSC 2010) and the ESPAD survey reported that the daily smoking prevalence among Italian fifteens was of 12% in 2014 (EMCDDA 2014). These data suggest focusing prevention programmes during early and middle adolescence.

A younger age of smoking initiation is associated with smoking more cigarettes per day (Everett 1999) and with a lower cumulative probability of quitting (Chen 1998) than in people who start smoking later on in life. Delaying the onset of smoking may affect the likelihood of becoming addicted to nicotine and smoking heavily.

2.2 Risk and protective factors associated with smoking uptake

For several years scientists argue that risk behaviors do not occur in isolation, but in the form of constellations (Jessor 1991): for example there is a positive association between smoking and experimentation with other psychoactive substances (Lewinshon 1999), as well as between the consumption of substances and sexually promiscuity (Pellai 2001). Furthermore, in boys who smoke the presence of other risk behaviour, can be observed such as recklessly

driving, vandalism, theft and frequently breach of the rules (Bonino 1998). The data reported in literature do not indicate that specific risk behaviours necessarily implies also the others, but that there is a rather frequent association. Therefore, a preventive intervention should act on more risk factors and more behaviours simultaneously.

A recent study mainly found that the likelihood of being a current smoker was significantly higher among those young adolescents who were highly influenced by smoker friends, were unaware of the health risks of smoking and who reported a lack of satisfaction about their overall life (Dahlui 2015). An Italian guideline on smoking prevention (Faggiano 2013) tries to summarize in a logical framework the complexity of risk and protective factors implied in smoking uptake and in subsequent smoking dependence (figure 1).

Following a reinterpretation of the social learning theory (Bandura 1977), it was emphasized the role of social pressure in driving healthy as well as unhealthy behaviour. According to this view, teens should start smoking by observing and imitating the behaviour of friends, family members and significant others of their social environment (including teachers). The context contributes to shape beliefs about social norms, and social norms influence what is accepted or disapproved by the group and encourage the individual to smoke or not.

Among peers smoking has the function to maintain the identity of the group, and in some cases not smoking may even lead to forms of isolation and exclusion. The strength of attachment to the group appears the main mechanism that explains the influence exerted by peers on the individual's behaviour. In particular best friends have a greater influence than the broader group (Andrews 2002). If a person is surrounded by smokers, it is likely she/he imitates the behaviour without actively decide.

In addition, teens who have friends, and at least one parent, who smoke tend to overestimate the prevalence of smoking among peers and this leads them to undertake behaviours that they judge prevalent, when in fact they are not (Otten 2009).

2.3 Interventions for smoking prevention

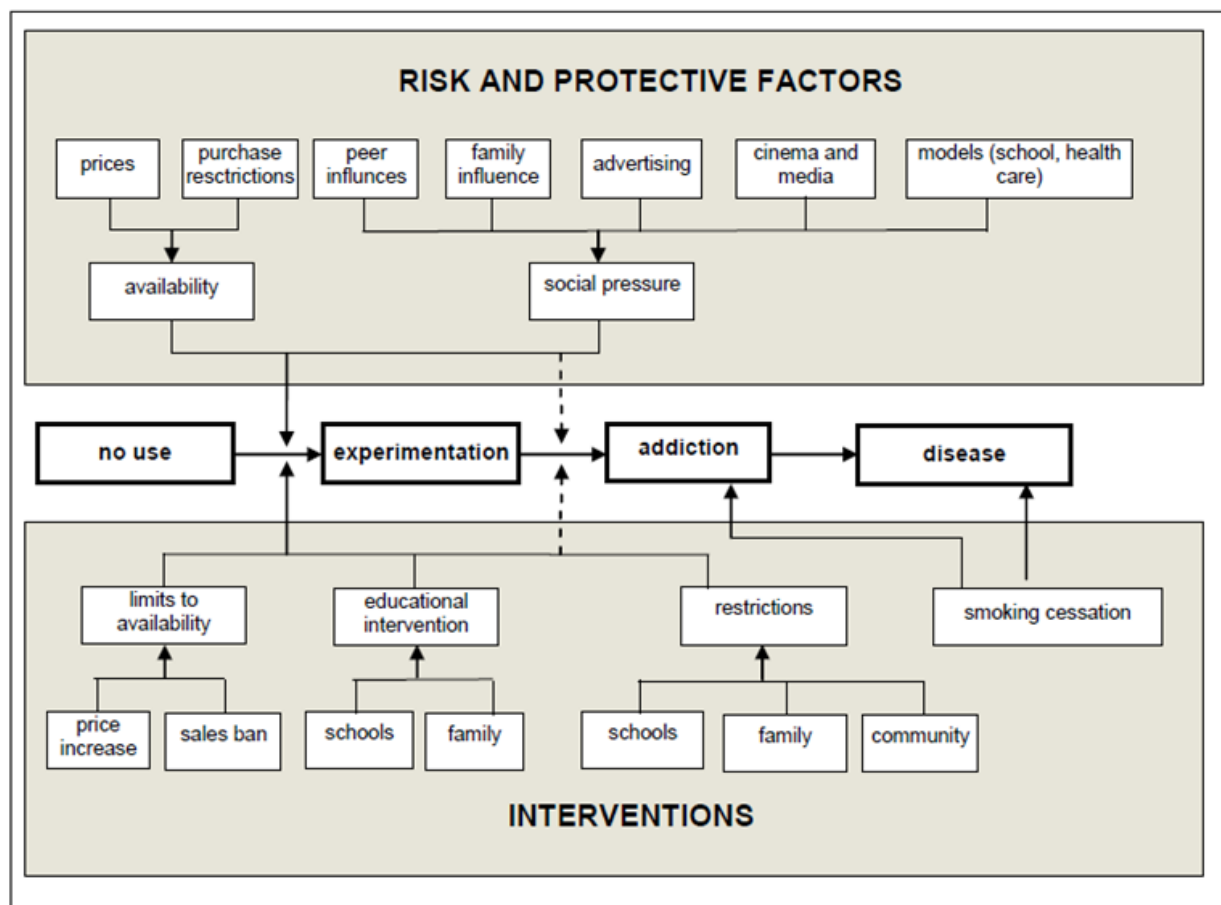
Several interventions are hypothesized to be effective in preventing smoking onset. The literature on the efficacy of smoking prevention interventions is flourished particularly in the last three decades. An overview of prevention interventions (Faggiano 2013) is here briefly summarised (see also figure 1):

- pricing and taxation policies
- composition of tobacco products policies
- labelling policies
- mass-media interventions
- advertising regulation
- sales to minors restrictions
- smoking ban
- family interventions
- school-based interventions
- community interventions

Taking into account the complexity of aspects influencing smoking behaviour it was suggested that a comprehensive smoking prevention strategy has to put in force several interventions affecting several settings (Pierce 2012). This goal could be reached first at all through policies and legislation. This idea drives the work of the WHO Framework Convention on Tobacco Control (FCTC). The FCTC is the first international treaty negotiated under the auspices of the World Health Organization, based on evidence-based strategies, asserting the importance of demand reduction strategies as well as supply issues (WHO 2003).

Despite the implementation of various tobacco control interventions in western Countries (e.g. increased taxation, mass media campaigns, or smoke-free laws for indoor public places and workplaces) the prevalence of tobacco use remains problematic (WHO 2015) and studies continues to focus on what strategies are more effective in preventing smoking and in motivating smokers to quit.

Figure 1. Logical framework of risk and protective factors associated with smoking initiation and possible prevention interventions (Faggiano 2013)



2.4 The focus on school environment

Schools have been considered an ideal site to deliver tobacco prevention programmes since they universally involve youths across a wide age range, including the ages when most young people initiate smoking. Generally school programmes show relatively weak effects in reducing adolescent smoking, and these modest results have been explained by the strong social influence effect in favor of smoking inside and outside school premises (Friend 2011). Early studies suggested the role of peer and parental smoking as moderators of school-based effects (Tyas 1998, Faggiano 2010), and perceived smoking by friends has been found to be a stronger predictor of cigarette use than friends' actual use (Iannotti 1992). Moreover, smoke-free environments may not only reduce teenage smoking, but also exposure to second-hand smoke (Wakefield 2000, Moore 2001). Some authors have therefore stressed the need to address adolescent smoking at the environmental level (Griesbach 2002, Nakamura 2004).

Although smoking bans in school settings are common worldwide, because of their low enforcement adolescents are still frequently exposed to teachers and other pupils smoking during the school day. In a study conducted in 48 Danish schools, three in five students reported that they had seen or knew of teachers smoking outdoors on the school premises; and most of them reported that they had seen or knew of teachers smoking inside the school building (Poulsen 2002). In the same study, teachers smoking outdoors on school premises were significantly associated with students' smoking behavior, while exposure to other pupils smoking outdoors was not. Furthermore, it could be argued that students in a school without anti-tobacco policies would perceive smoking as being acceptable, increasing their risk of taking up the habit.

Teachers who smoke influence in a decisive way the perception of the schools norms about this behavior: the students who see teachers smoking in schools are in fact less favorable to the smoking ban smoke at school (Trinidad 2005).

The school environment itself is therefore a powerful factor able to influence smoking initiation (Murray 1990). When tolerance towards smoking and diffusion of smoking is perceived, then it is likely that teens start smoking in order to look for membership and prestige among their peers (Alexander 2001).

Besides these considerations the importance of schools addressing health promotion and risk factor prevention at the environmental level has become conspicuous in recent years (Bonell 2010) The prevention of tobacco use among youths is a paradigmatic example in this domain. There are several lines of reasoning supporting the environmental perspective in school-based tobacco control. First and foremost, the effectiveness of pedagogic curricula alone in determining changes at the level of the student population is weak (Thomas 2013). This can partly be explained by the fact that young people are often exposed to social contexts where smoking is considered a normative behaviour and tobacco is easily available. Therefore, an environment denormalising smoking may represent a key strategy in prevention (Wilson 2012). Furthermore, classical environmental measures (eg, increasing retail prices, prohibition to sell) provide favorable cost-effectiveness comparisons in real-life situations (DiFranza 1992, Ross 2003) an argument that cannot be ignored in times of rethinking resource allocation in the public sector.

In addition, recent developments indicate the importance of schools as physical environments and therefore implicated in the health protection of students and employees, besides pedagogic and educational tasks (Oliver 2009).

2.5 Data on smoking in Italian schools

In a sample of adults it was reported that 66% of Italian smokers declared to have been influenced by peers and schoolmates (DOXA 2009). This data highlights the importance of social pressure in influencing smoking behavior among young people. Moreover 44.0% of Italian students have seen teachers smoking in the school building during school hours and 56.4% have seen students smoking in the school building during school hours (GYTS 2010). The lack of more recent available data hampers the possibility to know if recent school smoking ban regulation has changed this condition. About prevention programmes it should be noted that 60% of the students stated that during the past school year they had been taught in class about the dangers of smoking or had discussed in class why people of their age smoke (GYTS 2010). These good news must be balanced by the evidence that the majority of prevention interventions, as they were not evaluated, could be potentially ineffective or even harmful (Faggiano 2014). When effective interventions are available, it should be evaluated if they are sufficiently adopted. An evaluated prevention intervention, Unplugged, it was adopted in 2010 only by 27% of secondary schools in Piedmont, a Region where it is supposed to be more widespread (Vigna-Taglianti 2012).

2.6 School Tobacco Policy as prevention intervention

As an intervention, School Tobacco Policy (STP) is intended to inform whether and where pupils can smoke, to set penalties for pupils caught smoking, and to regulate adult smoking in school (Evans-Whipp 2004). The primary objectives of this intervention are to prevent or delay tobacco use by youth, and also to reduce the exposure of employees and students to second-hand smoke.

In many cases the introduction of an STP is combined with other smoking prevention programmes. For example, Ariza (2008) describes a multi-modal intervention, which includes specific lessons for students and strategies to involve adults in smoking cessation programmes. Policies can vary depending on the extent of the ban, teacher and staff training, and the roles and responsibilities of teachers and staff in policy enforcement. Policy can be governed by a central authority at regional or national level rather than locally, and the mandatory nature of a law may moderate its effect on implementation and impact. Other

consequences of STPs have also been observed, e.g. schools which do not accommodate student smoking in a specific area can result in adolescents, sometimes in large groups, leaving school property during school hours to smoke elsewhere (MacBride 2005).

The introduction and enforcement of anti-tobacco policies in schools could in principle be regarded as a very promising preventive strategy. However, there is no consensus or a prevailing view on the definition of a STP or on the effectiveness of such policies. The very concept and content of STPs may be challenging. A formal definition could be taken from the Cambridge Advanced Learner's Dictionary & Thesaurus (Cambridge University Press, Cambridge, UK) as a "*set of ideas or a plan of what to do in particular situations that has been agreed officially by a group of people, a business organisation, a government or a political party*". In a public health framework, policy has been defined as "*a guide to action to change what would otherwise occur, ... a statement of commitment to certain areas of concern*" (Milio 2001). The common key points of these definitions seem to refer to problem-solving and change strategies. However, the peculiar feature of the public health definition above is the emphasis on the role of guide that a policy should have in indicating priorities in areas of concern for the health of the public. It may sound obvious that this general statement would go beyond the healthcare sector, and include other public institutions such as schools that have an indirect function in promoting health (preventing ill health), but schools may face several challenges along this path (Hallfors 2002). Second, the purpose of a STP may not be straightforward: should it be to deter youths from using tobacco in the first place, to be protected from exposure to second-hand smoke or only to secure refrainment from tobacco use on the school premises? Should the concern be for smoking only or for all forms of tobacco use? How far can locally developed rules go from an existing legislation?

Empirical evidence on the effects of introducing or enforcing school anti-tobacco policies has not been systematically reviewed and summarized.

2.7 How School Tobacco Policies might work

From the perspective of social learning theory, the interplay between individual and environment is crucial in developing intentions, expectations and ultimately behaviour (Bandura 1986). Cognitive processes such as perceived health risks or benefits of smoking and perceived availability of tobacco could be involved in smoking behaviour. According to

Eccles and Roeser's ecological perspective (Eccles 1999), peer and adults' smoking habits, influence adolescents' behaviour in combination with other factors. Therefore STPs, implemented as a part of a comprehensive approach, may affect smoking indirectly by influencing beliefs about acceptability (approval or disapproval) of cigarette smoking by adults and by peers (Lipperman-Kreda 2009a). According to identity theory, it has been hypothesized that a strong condemnation of smoking by the school communicates to young people that smoking is an unacceptable part of mainstream identities (Lloyd 1998). A further possibility is that STPs strengthen the connection to school among students and staff, as well as school ethos beyond its regulatory content (Fletcher 2008). An STP can also reduce youth smoking by directly limiting smoking opportunities and access to tobacco (Alesci 2003). Teachers perceiving able to act as role models are an important element of the success of this type of intervention. Galaif (1996) found that teachers will comply with a smoking regulation only if they believe that they can directly affect students' smoking behaviour. If students who smoke perceive that it is acceptable for teachers to smoke in school, they are less likely to adhere to school smoking bans. For this reason Trinidad (2005) argues that encouraging teachers not to smoke on school grounds should be considered as a key component of school-based tobacco prevention programmes. However, conversely smoking bans may encourage teachers to smoke outside school, with the unanticipated result of making teachers who smoke even more visible to students (Wold 2004).

2.8 The Italian legislation on smoking at school

The first school smoking ban in Italy was put in force in 1975 (Law n. 584) and afterwards extended to all public places in 2005 (Law 3/2003). Up to that time smoking legislation was deliberated in order to protect non smokers against passive smoking. In 2013 with the decree law 104 "*Urgent measures in education, universities and research*" (Article 4 "*Protection of health in schools*"), smoking ban was extended to outdoor areas near school buildings with the explicit intention to prevent smoking among young people. The Decree, entered into force on September 2013, prohibiting smoking in school outdoor areas. With the conversion into law (Law 128/2013), from November 2013 the ban was extended to electronic cigarettes. In the same law electronic cigarettes were banned at school and in its premises. The document promotes the introduction of anti-smoking curriculum in schools and establishes economic

penalties for transgressors. This set of regulations virtually support schools in introducing STPs in order to control smoking through environment interventions. Finally it must be here mentioned that in addition to Italy 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 school outdoor areas as well as the indoor areas (O'Dea 2012).

2.9 What we need to advance the research on School Tobacco Policies

Implementing STPs was described as a promising strategy to prevent smoking initiation among adolescents (Bowen 1995). However, it is not yet clear whether this approach is effective. It is unclear whether policies contribute to a reduction of youth smoking only when they are included in a comprehensive tobacco control plan at the school level (Lovato 2010a), or whether a policy constitutes a suitable and cost-effective stand-alone intervention (Reid 1999). A summary of evidence is critical in order to define which STP elements are effective, and which require further research.

Moreover it is necessary to know if, among the possible options to prevent smoking among young people, STP is a strategy adopted by Italian schools.

3. OBJECTIVES OF THE RESEARCH

The objective of the research was to assess the efficacy of policies aiming at preventing smoking initiation among students by regulating smoking in schools and to explore if STPs are adopted in Italian schools. The following questions were therefore addressed:

- Are STPs effective in preventing smoking uptake?
- Which characteristics, if any, increase their impact?
- Can STP be considered an effective stand-alone intervention?
- Is STP a tobacco control strategy adopted in Italian schools?

4. METHODS

4.1 General overview

The work was carried out through 3 steps.

- 1) First at all, through a narrative review it was explored the different definitions of STPs and summarized studies on their effect.
- 2) In the second place it was explored the effectiveness of STPs in reducing tobacco smoke among students through a Cochrane systematic review.
- 3) Finally it was studied the level of adoption of STPs through a national monitoring survey on the impact of outdoor smoking ban in Italian schools and a survey involving principals and teachers of secondary schools of an Italian province.

4.2 Exploring School Tobacco Policies' definitions and effects

In the first review were included articles:

1. published in English in peer reviewed journals;
2. comparing schools with or without an anti-tobacco policy with any study design;
3. reporting at least one measure of effect on tobacco use by students (smoking and/or smokeless tobacco);
4. evaluating the effects of an anti-tobacco policy alone or evaluating policy effects within a multicomponent intervention, provided that it was possible to disentangle the unique policy effect;
5. regarding high schools.

Any definition of STP was accepted, and no time constraints were posed. We also included articles where policy status was derived from the students' perception and not from objective external sources, but these were analysed separately.

The search was conducted independently from 1 September to 30 November 2011 by two reviewers. The following databases were searched: Pub Med, PsychInfo, Eric, Google scholar, Global Health and Web of Science, with keywords: 'policy', 'ban', 'restriction' and

‘environment’ in combination with ‘adolescent’ or ‘student’, ‘school’ and ‘smoking’ in titles, abstracts or keywords.

After each search, double entries were cleared and abstracts reviewed to check for inclusion criteria. When in doubt, two other researchers were requested to read the article in order to assess the presence of inclusion criteria. The data to be extracted and the framework for classification and comparison of policy characteristics were determined collaboratively. Two reviewers independently read each study in detail and checked on agreement.

4.3 Exploring School Tobacco Policies' effectiveness

For the second review it was adopted the method described in the Cochrane Handbook for Systematic Reviews of Interventions (Higgins 2011). It were included cluster-randomised controlled trials (c-RCTs) in which schools or classes were randomised to receive different levels of smoking policy or no intervention. As it was expected to find a limited number of RCTs, if any, the following prospective designs were also eligible: non-randomised controlled trials, interrupted time series and controlled before-after studies. Cross-sectional studies were not formally included. In the absence of higher quality evidence, their findings were described and used to generate hypotheses for future studies.

Types of participants selected were students in primary and secondary schools (10 to 18 years old). As intervention were considered all written policies that regulate tobacco use inside and/or outside the school property. The outcome studied was the smoking prevalence among students, measured by individual self-report. Biochemically validated smoking data, where provided, were used in preference to self-report. In literature young people were classified as smokers or non-smokers in different ways: daily, weekly, monthly, ever, non-smoker, smokeless tobacco user, smoker. Where multiple definitions were provided, it was used the strictest measure given. In studies with multiple follow-up periods, it was used data from the longest follow-up period reported.

4.3.1 Search methods for identification of studies

The search was conducted in May 2014 exploring the following databases:

1. Cochrane Tobacco Addiction Group's Specialised Register
2. Cochrane Central Register of Controlled Trials (CENTRAL)

3. MEDLINE
4. EMBASE
5. PsycINFO
6. ERIC (Educational Resources Information Center)
7. Sociological abstracts (CSA)
8. 'Grey' literature (conference proceedings and unpublished reports) via Google Scholar and dissertation abstracts.
9. Unpublished literature, by searching trial registers (www.clinicaltrials.gov, www.controlled-trials.com, www.clinicaltrialsregister.eu) and contacting researchers and agencies whom are known to have conducted or sponsored relevant research to identify further studies not found and unpublished reports.

The Tobacco Addiction Group Specialized Register contains reports of controlled trials of interventions for smoking cessation or prevention, evaluations of tobacco control policies, identified from regularly updated highly sensitive searches of CENTRAL, MEDLINE, EMBASE, PsycINFO, and the Science Citation Index.

The search strategy for the register used the following topic related terms; (polic* or ban* or restriction* or rule* or environment* or health promoting or smoke-free) AND (school*) in title, abstract or keyword fields. The search strategies for MEDLINE, EMBASE and PsycINFO combined these topic terms with the smoking and tobacco terms and the study design terms used for the Register searches. The full MEDLINE search strategy can be found in **Appendix 1**. Searches of ERIC, Sociological Abstracts and other sources combined topic related and smoking related terms. Cited studies were checked in all studies identified. Language restrictions were not applied.

4.3.2 Data collection and analysis

All search results were imported into an electronic register. Titles and abstracts were classified according to their relevance to the review. Once bibliographic searches were completed, all retrieved records were assembled in a database and processed in order to de-duplicate them (i.e., remove duplicate records). Two reviewers screened all identified studies in the electronic databases.

Articles were rejected if the title or abstract was not pertinent to the topic of the review. Any disagreements were resolved between the two reviewers by referring to the full-text, and by consulting with a third party when necessary. The same reviewers conducted further screening of the full text of the studies that passed the initial screening stage.

Two reviewers independently extracted data from the selected study using a tailored standardised data extraction form including the following elements:

- Country
- School level
- Participants (demographic information)
- Intervention (characteristics of the policy)
- Outcomes, and how they are measured
- Length of follow-up from the introduction of the policy
- Completeness of follow-up
- Definition of smoking

Any discrepancies were resolved through discussion or, if required, through consultation with a third person.

4.3.4 Assessment of risk of bias in included studies

Two reviewers assessed independently risk of bias for each study using the criteria outlined in the Cochrane Handbook for Systematic Reviews of Interventions (Higgins 2011):

- adequate sequence generation;
- adequate allocation concealment;
- blinding of personnel/outcome assessors;
- addressing incomplete outcome data;
- free of selective outcome reporting;
- free of other bias.

For each of these domains, risk of bias was judged High, Low, or Unclear. Any disagreement was resolved by discussion or by involving a third assessor.

4.3.5 Measures of treatment effect

For dichotomous data, we used the risk ratio (RR) to summarize individual trial outcomes $((\text{number of events in intervention condition} / \text{intervention denominator}) / (\text{number of events in control condition} / \text{control denominator}))$ with 95% confidence intervals. For our primary outcome, the RR was calculated using the student population of the school as the denominator $((\text{number of student smokers in intervention condition} / \text{student population in intervention condition}) / (\text{number of student smokers in control condition} / \text{student population in control condition}))$. Where the event measured was students classified as smokers, a risk ratio less

than one indicated that fewer students were smokers in the intervention group than in the control group. For continuous data, we used the mean difference if outcomes were measured in the same way between trials. We used the standardized mean difference to combine trials that measured the same outcome, but use different methods.

4.3.6 Unit of analysis issues

Though in cluster randomised trials we expected the school (or classes) to be the unit of randomisation, we used the individual as the unit of analysis. We reported adjustments for design effect when provided and dealt with any unit of analysis issues using the guidance in the Cochrane Handbook for Systematic Reviews of Interventions (Higgins 2011).

4.3.7 Dealing with missing data

If the proportion of missing data suggested a risk of bias, the study would have been classified accordingly and included in a sensitivity analysis. Participants who have been missing follow-up data for our primary outcome would have been counted as smokers in an intention-to-treat analysis.

4.3.8 Assessment of heterogeneity

The statistical heterogeneity was to be examined using the I² statistic. However, this was not necessary as we included only one study.

4.3.9 Assessment of reporting biases

If we had found sufficient studies, we would have tested publication bias using a funnel plot. The relevance of outcomes had been checked to determine if there was any bias in outcome reporting.

4.3.10 Data synthesis

If we had found sufficient studies we would have carried out summary analyses using RevMan 5.1. We would have used the Mantel-Haenszel fixed-effect model for meta-analyses, combining data where trials examined the same intervention and populations and methods were judged sufficiently similar. Where we had suspected clinical or methodological heterogeneity between studies sufficient to suggest that treatment effects may differ between trials, we would have used a random-effects meta analyses.

4.3.11 Subgroup analysis and investigation of heterogeneity

If relevant studies had been available, we would have conducted subgroup analyses for the following policy characteristics:

- ban extended only to school staff versus extended both to staff and students;
- only indoor area affected by the ban versus ban extended to outdoor area;
- policies enforced by punishment versus policies not enforced by punishment;
- policies as stand-alone interventions versus policies accompanied by educational programmes.

In the presence of substantial heterogeneity, we would have explored the reasons for this, undertaking sensitivity analyses (if there have been sufficient studies to warrant this approach).

4.4 Exploring how School Tobacco Policies are adopted in Italian schools

4.4.1 Monitoring survey on the impact of outdoor smoking ban in Italian schools

In 2014 the Ministry of Health entrusted to the National Centre for Epidemiology, Surveillance and Health Promotion, National Institute of Health, (CNESPS-ISS) the coordination of the “ENFASI scuole project: monitoring the impact of the introduction of outdoor smoking ban in Italian schools (Law n.128/2013)”. The project, developed in collaboration with the Ministry of Education, University and Research (MIUR) and with the involvement of Italian Regional governments, was aimed at collecting information on how such legislation has been incorporated in the school context and to assess its impact after one year (CNESPS ISS 2015).

The project included two objectives:

- to observe tobacco smoking at school,
- to enhance school communication and training initiatives, aimed at disseminating information and raising awareness of the risk linked to smoking.

The study was conducted by the Prevention Department of 40 selected Local Health Authorities in 12 selected Regions. Each Region involved in the study randomly selected, using the sample list of the 2014 Health Behaviour in School-aged Children survey (HBSC 2014):

- .two first-grade secondary schools (middle schools: students aged 11-14 years),

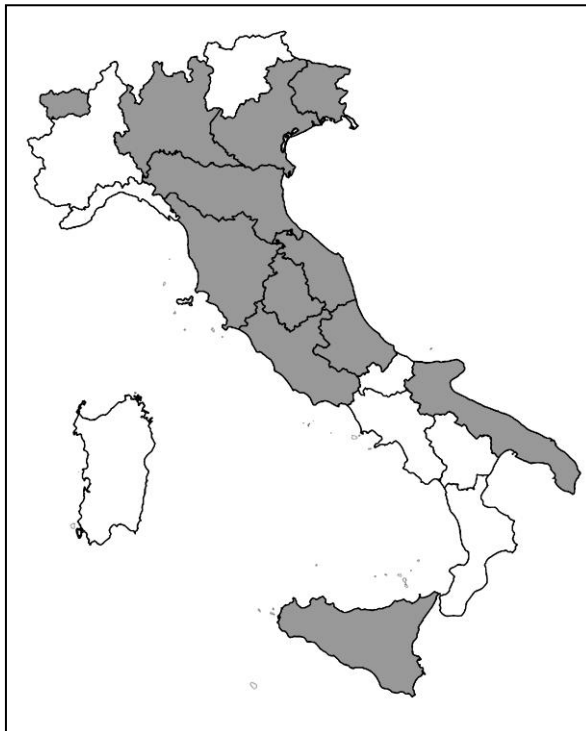
- and four second-grade secondary schools (students aged 14-19 years): two high schools and two vocational or technical secondary schools.

The data were collected through a detection grid by health professionals who visited the schools in order to collect information from direct observation of:

- presence of non-smoking signs in prohibited areas (outdoor and indoor),
- presence of ashtrays, cigarettes butts and cigarette smoke,
- students or school staff that were smoking at school (in school indoor and outdoor areas, and in outdoor areas not pertaining to the school).

In order to gather information on opinions, knowledge and methods of management for the implementation of the new school outdoor ban, it was voluntarily administered a questionnaire to School Principals. The questionnaire could be filled out by school principals themselves or by their representatives or used as a guide to direct interviews by technicians of Local Health Authorities visiting the school.

Figure 2. Italian Regions involved in the monitoring survey on the impact of outdoor smoking ban in Italian schools (CNESPS-ISS 2015)



4.4.2 Survey on the level of adoption of School Tobacco Policies in an Italian province

A survey targeting all the 18 second-grade secondary schools in Province of Novara (373.230 inhabitants) was carried out in January-February 2015. The Province is situated in Piedmont,

a Region not involved in the national monitoring survey mentioned before. During two meetings with school staff three university researchers informed teachers about strategies for smoking prevention at school and delivered a questionnaire to school personnel in charge for health promotion activities (one for each school) in order to explore if specific policies were introduced at school after the extension of smoking ban in external school premises (Law n 128/2013). At a later stage (within one month) personnel who did not attend the two meetings was contacted with a telephone call in order to complete the survey. The questionnaire (see **appendix 2**) was also aimed at exploring:

- school smoking prevention activities implemented in the last year,
- resources to help smokers to quit,
- level of adoption and implementation of new law.

5. RESULTS

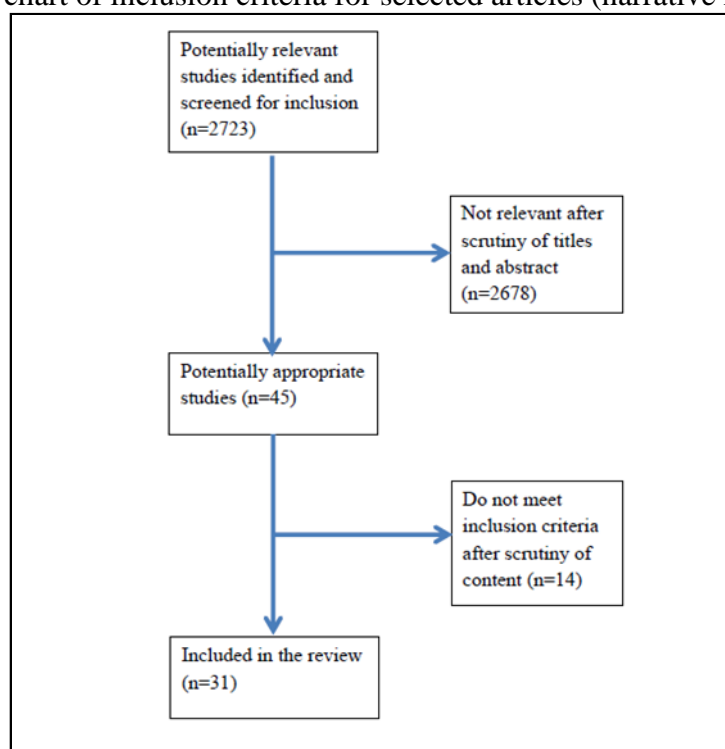
5.1 Exploring School Tobacco Policy Definition and Effect

5.1.1 General overview of the included studies

In total, 31 original studies published between 1989 and 2011 were included in the review (Adams 2009, Barnet 2007, Boris 2009, Darling 2006, Evans-Whipp 2007, Evans-Whipp 2012, Griesbach, 2003, Hamilton 2003, Huang 2010, Kumar 2005, Lipperman-Kreda 2009a, Lipperman-Kreda 2009b, Lovato 2007, Lovato 2010a, Lovato 2010b, Moore 2001, Murnaghan 2007, Murnaghan 2008, Murnaghan 2009, Pentz 1989, Piontek 2008a, Piontek 2008b, Poulin 2007, Reitsma 2004, Sabiston 2009, Sinha 2004b, Wakefield 2000, Watts 2010, Wiium 2011a, Wiium 2011b, Øverland 2010). The flowchart of the search history is displayed in figure 3.

The majority of the studies were based in North America (11 in Canada and 7 in the USA), followed by European countries (n=7) and Australia and New Zealand (n=3). Two studies were based in Asian countries, while one included a comparison between US and Australian data.

Figure 3. Flowchart of inclusion criteria for selected articles (narrative review)



5.1.2 Study design

Without exceptions, the included studies were cross-sectional, comparing concurrent variations in the prevalence or individual probability of tobacco use according to existing school-level policies. Three articles (Murnaghan 2007, Murnaghan 2008, Murnaghan 2009) referred to the same study, employing repeated cross-sectional survey data in order to model changes in smoking prevalence connected to scaled introduction of policy measures. The most recent of these articles reported on a group of students eligible to be followed-up for 3 years (ie, between 10th and 12th grade), but without individual linkage. A few studies reported information on the time the anti-tobacco policy had been in place, or the time of exposure of the study population (Murnaghan 2007, Murnaghan 2008, Murnaghan 2009, Pentz 1989). The majority of the included studies explored the association between school policy and tobacco use by students as exclusive or primary aim. Six studies included other anti-smoking measures, other outcomes, mediation or contextual effects (Evans-Whipp 2007, Griesbach 2002, Lipperman-Kreda 2009a, Piontek 2008a, Piontek 2008b, Wakefield 2000).

5.1.3 Study populations

The student populations were recruited from all kinds of schools in a range of ages from 10 to 21 years, with a preponderance of studies enrolling students between 13 and 16 years.

5.1.4 Dimensions and components of STPs

In all studies, specific STPs were analysed according to a predefined set of components or characteristics, but these differed greatly. Some studies analysed the effect of a single STP component, such as the presence of smoking ban (Sinha 2004b), of STP rules as such (Murnaghan 2007, Poulin 2007) or of specific sanctions (Kumar 2005). However, the majority of the studies adopted a complex descriptive approach of the exposure under study, with policy components differently aggregated into larger dimensions. The most frequently encountered dimensions were:

- comprehensiveness or strength (Adams 2009, Boris 2009 Darling 2006, Evans-Whipp 2007, Moore 2001, Pentz 1989)
- enforcement (Adams 2009, Evans-Whipp 2007, Evans-Whipp 2010, Griesbach 2002, Kumar 2005, Moore 2001 Piontek 2008a, Reitsma 2004, Sabiston 2009, Wakefield 2000, Wium 2011b)
- dissemination,

- communication and participation (Evans-Whipp 2007, Lovato 2007, Piontek 2008a, Sabiston 2009, Wium 2011a) degree of formality (Griesbach 2002, Hamilton 2003, Huang 2010, Moore 2001 Sabiston 2009, Wium 2011a),
- emphasis or orientation (Darling 2006, Evans-Whipp 2007, Evans-Whipp 2010, Pentz 1989).

Studies used different operational definitions for these complex dimensions as well as different measurement scales for the underlying policy components. For instance, in a US study (Adams 2009) policy comprehensiveness was defined according to a multiple-items tool addressing applicability, restrictions, repercussions, programmes, notification and evaluation. In another US study, comprehensiveness was defined as number of components applied in the policy out of four investigated (Pentz 1989). In addition, enforcement could be variably defined through consequences for violation (Evans-Whipp 2007), subjective rating by staff (Evans-Whipp 2010, Griesbach 2002) or subjective rating by students (Lipperman-Kreda 2009a, Wakefield 2000). Conversely, the same policy component (for instance sanctions in cases of rule breaking) could be used as an empirical definition of different policy dimensions, such as enforcement or emphasis (Darling 2006, Hamilton 2003, Pentz 1989, Reitsma 2004). Concerning the modality of assessment of STPs, studies could be divided into 2 groups: 9 studies where the assessment was based exclusively on students' subjective perception of rules and of their enforcement in school (Lipperman-Kreda 2009a, Lipperman-Kreda 2009b, Murnaghan 2009, Piontek 2008a, Poulin 2007, Reitsma 2004, Wakefield 2000, Watts 2010, Øverland 2010) and the remaining 23 where the assessment was performed exclusively or also through interviews or surveys of the school administrators.

5.1.5 Outcome definitions

All studies included some measure of smoking by students, and two studies included measures of smokeless tobacco use (Sinha 2004b, Øverland 2010). Broadly speaking, outcomes related to tobacco use were conceptualised either with reference to lifetime experience (eg, ever smoking) or to current/recent use (eg, current smoking). However, substantial variations could be observed between operational definitions of these two timeframes as well as of behavioural frequency (see **Appendix 3**). For instance, of 25 studies examining current/recent tobacco use as main or secondary outcome about half referred to any use in the past 30 day for the definition of current behaviour, but in 12 studies other definitions were adopted, such as weekly smoking (Murnaghan 2009) having smoked from a cigarette during 2 of the past 30 days (Lovato 2007), or various combinations of self-reported

daily or occasional smoking investigated with different questions (Darling 2006, Watts 2010, Wiium 2011a, Øverland 2010).

Three studies did not allow the direct exploration of smoking outcomes among students. In one study (Evans-Whipp 2007) smoking was assessed in combination with other substances. In another study, the only outcome was perception of smoking by students or teachers in the school area (Griesbach 2002). A third study assessed the locations where smoking occurs (on or off school properties) (Watts 2010). The three studies were retained because of potentially interesting tobacco-specific secondary outcomes.

5.1.6 Smoking bans, permissions and restrictions

The presence or self-report of different levels of smoking bans was investigated in 13 studies, with mixed results. Five of these studies (Griesbach 2002, Lovato 2010b, Piontek 2008a, Sinha 2004b, Watts 2010) suggested a 20% to 60% decreased probability of tobacco use among students in schools with strict bans, supported by three studies that presented an increased risk with more liberal attitudes, especially concerning smoking by teachers (Barnett 2007, Kumar 2005, Øverland 2010). However, other studies failed to detect clear relationships between smoking bans per se and students' behaviour (Boris 2009, Huang 2010, Poulin 2007, Wiium 2011a), while one study suggested an association in the opposite direction (higher likelihood of smoking progression) if the students perceived the presence of strict bans (Wakefield 2000).

5.1.7 Degree of formality

Eight studies investigated the effect of the degree of formality of the adopted policy in relation to students' behaviour, for instance whether the policy was written and/or clearly stated (Griesbach 2002, Hamilton 2003, Huang 2010, Lovato 2010a, Lovato 2010b, Moore 2001, Sabiston 2009, Wiium 2011b). The presence of a written policy with clearly stated rules and goals was associated with lower probability of students smoking or lower perceived smoking in some studies (Griesbach 2002, Lovato 2010a, Lovato 2010b). One study (Moore 2001) investigated the degree of formality together with level of restrictions or bans, and found that strong policy (written, with universal restriction) was associated with lower probability of daily and weekly smoking than a policy that was not written and/or not universal. In one study, written policy dissemination to students was analysed separately from the presence of a formal policy itself (Wiium 2011a). While written dissemination was linked to lower probability of smoking, the opposite association was found between formal policy

and students smoking, but this was no longer observed after adjustment for individual-level variables. However, some studies failed to detect any association between formal or clearly stated school policies and students' behavior (Hamilton 2003, Huang 2010, Sabiston 2009). Similarly, studies where the presence of clearly stated anti-smoking rules was self-reported by students yielded mixed results, as some found associations in the hypothesised direction (Murnaghan 2007, Piontek 2008a, Watts 2010) while others did not (Murnaghan 2009, Reitsma 2004).

5.1.8 Policy comprehensiveness or strength

Comprehensiveness or strength of the policy was analysed in six studies (Adams 2009, Boris 2009, Darling 2006, Evans-Whipp 2007, Moore 2001, Pentz 1989), conceptualised in different ways from complex multidimensional indexes (Adams 2009) to simple statements on target groups included in the bans or restrictions (Evans-Whipp 2007). Studies were largely inconsistent, with some not observing any association between policy comprehensiveness and students' behavior (Adams 2009, Evans-Whipp 2007). Among the studies that found comprehensiveness being associated with lower probability of smoking by students (Moore 2001, Pentz 1989) one investigated degree of formality together with the extent of the smoking restrictions (Moore 2001).

5.1.9 Policy enforcement

Definitions of enforcement employed in the studies were as heterogeneous as those of comprehensiveness, frequently including the perception of smoking in the environment self-reported by staff or students. Other definitions included systems to monitor students' behaviour, sanctions and perceived compliance with the rules. Associations of strict policy enforcement with smoking by students or tobacco use in the anticipated direction of lower smoking rates overall or on school premises were reported in eight studies (Adams 2009, Griesbach 2002, Kumar 2005, Lipperman-Kreda 2009b, Lovato 2010b, Moore 2001, Reitsma 2004, Wakefield 2000). In these studies, the association of smoking with enforcement (indicated by ORs) ranged from 0.39 (0.34 to 0.43) (Reitsma 2004) to 0.89 (0.85 to 0.99) (Wakefield 2000). Other studies also indirectly suggested associations in the same direction, that is, exposure to staff or students smoking and to non-compliance with policy rules was associated with increased likelihood of own smoking (Murnaghan 2009, Piontek 2008a, Sabiston 2009). However, these associations were not always consistent across age groups (Kumar 2000, Reitsma 2004) or types of exposure (eg, to smoking by staff or students) (Moore

2001, Murnaghan 2009). In one study, the proportion of students perceiving strict enforcement predicted smoking prevalence at the general and at the school area level in the hypothesised direction, but individual behaviour in the opposite direction (Lipperman-Kreda 2009b). In another study, field observations of smokers in the school area was associated with higher smoking prevalence, and multiple involvement of school staff in the enforcement with lower smoking prevalence, but strength of enforcement was not associated (Sabiston 2009). In a study addressing individual mediators of school policy effects, it was found that policy enforcement was linked to proximal predictors of adolescent smoking, such as perceived availability, perceived peer norms and perception of risks, in the anticipated direction (Lipperman-Kreda 2009a). Nevertheless, a few studies showed no association between components of policy enforcement and tobacco use by students (Evans-Whipp 2007, Piontek 2008a, Wium 2011), one study showed associations opposite to the expectations (that is, higher probability of students smoking with stricter enforcement) (Lovato 2010a), while one study (Lovato 2007) showed different associations depending on whether enforcement was defined through staff reports (associations mostly in the predicted direction) or student perceptions (inconsistent associations).

A total of 12 studies specifically investigated the presence, the perception and/or the content of sanctions or punishment emphasis in case of rule breaking of the anti-tobacco policy in relation to students' behaviour. Findings were quite mixed, with a majority of either null (Darling 2006, Evans-Whipp 2007, Pentz 1989, Piontek 2008a, Wium 2011a) or counterintuitive reported associations, that is, risk increasing with sanctions (Kumar 2000, Murnaghan 2007, Watts 2010). In one study (Hamilton 2003) schools using only a disciplinary approach had a higher probability of students smoking compared to schools using education and counselling. Of the two studies that reported decreased use with heavier sanctions, one did not present results for smoking separately from those of other substances (Evans-Whipp 2007). The other study found that sanctions that were put in place at school were associated with lower smoking probability, while informing parents showed the opposite association (Wium 2011).

5.1.10 Communication and participation

Six studies examined indicators of policy development, diffusion and communication in relation to students' behaviour. Despite heterogeneity of definitions, findings were in general negative, that is, no associations were detected with the majority of these indicators (Evans-Whipp 2007, Lovato 2007, Lovato 2010b, Piontek 2008a, Sabiston 2009). A few studies have

suggested, however, that some dimensions of policy communication may be important. In one study, developing/overseeing and communicating the school policy was not associated with lower probability of current smoking, but clearly stated purpose and goals was (Lovato 2010b). In another study, a written communication of policy to students and staff and the consistency of anti-smoking messages in the school environment were associated with lower prevalence of smoking and of smoking at school (Wiiium 2011a).

5.1.12 Policy emphasis/orientation

Four studies explored the relation between an overall indicator of policy inspiring principles (emphasis or orientation) and smoking prevalence, in particular whether this indicator was connected to prevention, harm minimisation, cessation, or discipline (Darling 2006, Evans-Whipp 2007, Pentz 1989). Results were not consistent, as in two studies policy emphasis did not make any difference on youth smoking (Darling 2006, Evans-Whipp 2007), while two studies indicated that emphasis on prevention rather than on cessation, and on total abstinence rather than on harm minimisation was associated with lower smoking prevalence (Evans-Whipp 2007, Pentz 1989).

5.1.13 Availability of education or cessation support

Five studies indicated that policies including prevention and education components were associated with lower prevalence of smoking (Hamilton 2003, Huang 2010, Lovato 2010a, Piontek 2008a, Sinha 2004b), but two studies did not detect an association (Lovato 2007, Sabiston 2009). Two studies compared schools including antismoking educational or cessation components programmes, schools introducing policy measures only, or a combination of the two (Murnaghan 2007, Murnaghan 2008). Educational or cessation components were associated with a decreased risk of being an occasional smoker rather than a non-smoker but not of being a regular smoker. However, there was no association with policy alone or a combination of policy and educational programmes. One study found that perceived support from teachers in general was associated with lower probability of students' daily smoking (Wiiium 2011). With regard to cessation, available or mandatory cessation was not associated with smoking in some studies (Piontek 2008a, Piontek 2008b), associated with a lower risk of smoking in one study (Sabiston 2009), and with higher risk of smoking in another study (Lovato 2010b).

5.1.14 Objective assessment of policy versus students' perception

STP variables were exclusively based on students' perception in nine studies (Lipperman-Kreda 2009a, Lipperman-Kreda 2009b, Murnaghan 2009, Piontek 2008a, Poulin 2007, Reitsma 2004, Wakefield 2000, Watts 2010, Øverland 2010). In 5 studies (Evans-Whipp 2007, Lovato 2007, Murnaghan 2007, Sabiston 2009, Wium 2011) policy information was collected from students and from staff, while in the remaining (Hamilton 2003) studies the policy variables were assessed through interviews with staff only. The proportion of studies reporting at least 1 association in the hypothesised direction (ie, STP components associated with lower smoking prevalence) was higher in studies based on student self-reports (7 out of 9) than in studies based on staff reports (11 out of 17). However, the presence of counterintuitive results (eg, the perception of strict rules and sanctions associated with higher smoking prevalence) was more common in studies where policy assessment relied exclusively on student perception. In fact, 6 out of 9 such studies reported at least 1 'counterintuitive' association, compared to 9 of the 17 studies where the policy assessment rested exclusively on staff reports.

5.1.15 Policy effects on tobacco use by students

A summary of policy effects on tobacco use by students by primary or secondary outcomes is reported in **Appendix 4**.

5.1.16 Policy effects on other endpoints

The most commonly investigated secondary outcome concerned students' own tobacco use on the school grounds or while at school, as opposed to overall use (Darling 2006, Lipperman-Kreda 2009b, Lovato 2007, Watts 2010, Wium 2011a). To these should be added a few studies that investigated smoking by students in school as observations performed by others, including the students themselves (Adams 2009, Evans-Whipp 2007, Evans-Whipp 2010). Although referring to the same events these studies are cited separately, because reporting on an undesirable behaviour as involving others implies quite different cognitive and evaluation processes than reporting on the same behaviour as one's own, and the gap due to unreliable reports is likely to increase with policy strength. Both these groups of studies were rather consistent in indicating that clear rules (Watts 2010), a comprehensive ban, consistency of rules (Wium 2011a), strict enforcement (Adams 2009, Evans-Whipp 2007, Evans-Whipp 2010, Lipperman-Kreda 2009b) and availability of education and prevention (Lovato 2007) were associated with lower likelihood of students smoking on the school area. However, one

study conducted only among smokers suggested that the policy characteristics effective in decreasing smoking at school may actually increase smoking outside the school area (Watts 2010).

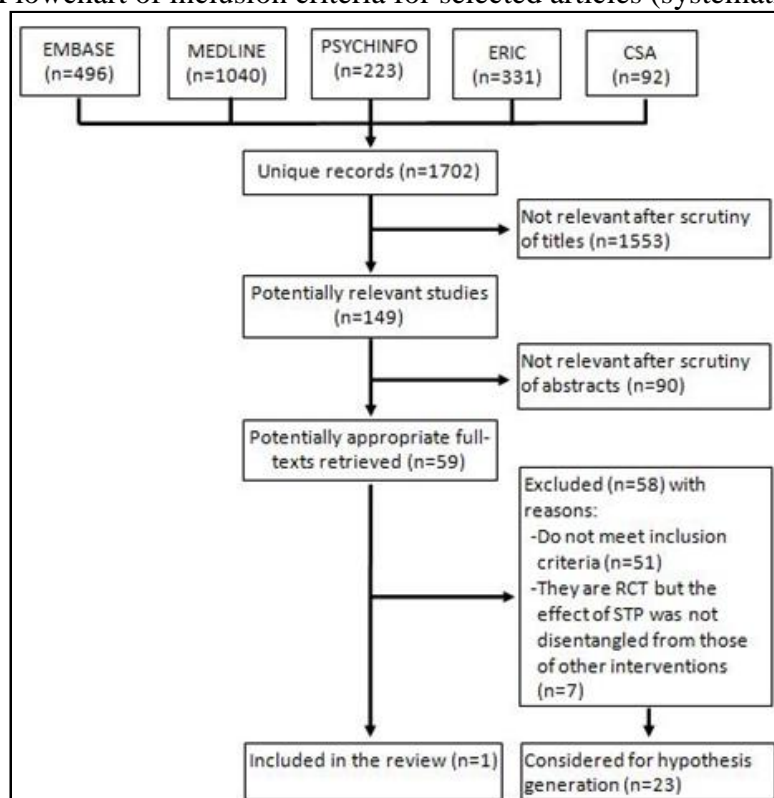
In other studies, a variety of outcomes indirectly linked to tobacco use were explored. These included purchasing tobacco (Darling 2006), knowledge of consequences of smoking (Darling 2006, Hamilton 2003, Lipperman-Kreda 2009a) positive or negative expectations and attitudes about smoking (Hamilton 2003 Kumar 2000, Lipperman-Kreda 2009a, Lipperman-Kreda 2009b), perceived availability of cigarettes in school and frequency of peer smoking (Hamilton 2003, Lipperman-Kreda 2009a) recalling of being taught anti-tobacco curricula (Sinha 2004b) and academic performance in general (Reitsma 2004). Apart from one negative study (Darling 2006) there was a tendency for the remaining studies to report associations in the anticipated direction, that is, aspects of policies were associated with increased awareness of risks (Hamilton 2003, Lipperman-Kreda 2009a), with negative attitudes and intentions (Hamilton 2003, Lipperman-Kreda 2009a, Lipperman-Kreda 2009b), and with decreased perceived availability and frequency of peer smoking (Hamilton 2003, Lipperman-Kreda 2009a). Recalling anti-tobacco curricula was more common in schools with a policy (Sinha 2004b), and poorer academic performance was predicted by perceiving absence of school anti-tobacco rules (Poulin 2007).

5.2 Exploring School Tobacco Policies effectiveness

5.2.1 General overview of the included studies

In order to explore STPs effectiveness a more restrictive study selection was carried out, including only studies measuring the level of implementation of the policy through an examination of written policies as well as policies' characteristics reported by principals/teachers. About study design we were interested in selecting only experimental or quasi-experimental studies. Figure 4 shows the study selection process (up to May 2014). Two review authors independently assessed all the titles and abstracts identified as a result of the comprehensive updated search. Initially 2182 citations were identified in the electronic databases, of which 1702 remained after de-duplication. No ongoing studies were found in trial registers. We excluded 1553 studies after screening the titles and then 90 after reading the abstracts. At the end of selection process we included only one study in the review, which aimed to study the effect of the introduction of smoking policies at school.

Figure 4. Flowchart of inclusion criteria for selected articles (systematic review)



5.2.2 Description of the included study

The included study (Chen 2014) was conducted in 2008 in two Chinese regions and involved two schools in the intervention group and two in the control group. Of a total of 1807

participants aged between 13 and 15 years old, 941 students attended intervention schools and 866 attended control schools. The students were then surveyed a year later about their smoking habits. To assess the frequency of smoking, participants were asked whether they smoked daily, weekly, or were smoking currently. Ever-smoking was defined as having ever used cigarettes, even one or two times. Characteristics of the intervention were: smoking banned inside the school, peer educators trained to encourage smokers to quit, and brochures about health hazards of smoking distributed among students. The study measured changes in students' smoking behaviour, knowledge and attitudes. Table 1 provides further details on participants, interventions, outcomes of the study, and on risk of bias.

Table 1. Characteristics of the included study

Chen 2014		
Methods: Cluster-RCT at level of school		
Participants		
Country: China (Linzhi, Tibet and Guangzhou, Guangdong Province)		
School type: Middle Target group: Grades 6 and 7 (13 - 15 yrs)		
Number of intervention schools: 1 in Linzhi and 1 in Guangzhou		
Number of control schools: 1 in Linzhi and 1 in Guangzhou		
Number of participants: 941 in intervention schools and 866 in control schools		
Interventions		
Start date: 2008 Duration: 1 year		
Comparators: No intervention		
Health Policies in the school: A tobacco control committee headed by the principal was established; regulations on smoking were made at the beginning of the study		
Health Environment in the school: No-smoking signs were placed in the schoolyards. Peer education was conducted to help smokers to quit smoking. Teachers were required not to smoke in front of students.		
Personal Health Skills: Brochures of health hazards of smoking and blackboard newsletter, posters and publicity pictures were disseminated. Smoking-related health education lectures were given. Students participated in smoking cessation-related activities including essay competitions, signing a non-smoking pledge, Additional components: No Tobacco-Day theme activities, self-producing newspaper competition and logo design contests		
Outcomes		
Primary outcomes: Ever smoking, daily smoking, weekly smoking, current smoking		
Secondary outcomes: Smoking-related knowledge and smoking-related attitudes		
Risk of bias		
Bias	Authors' judgment	Support for judgment
Random sequence generation (selection bias)	Unclear risk	No details provided on random sequence generation
Allocation concealment (selection bias)	Unclear risk	No details provided on allocation concealment
Blinding of participants and personnel (performance bias)	High risk	Unlikely that participants could have been adequately blinded
Blinding of outcome assessment (detection bias)	Low risk	Outcomes were self-reported
Incomplete outcome data (attrition bias)	Low risk	Attrition rates were very low; correspondence rate from matched questionnaires between the two surveys was 99.6% in Linzhi and 99.4% in Guangzhou
Selective reporting (reporting bias)	High risk	No protocol available
Selection bias	High risk	Unclear sample procedure and no citation of stratified sampling

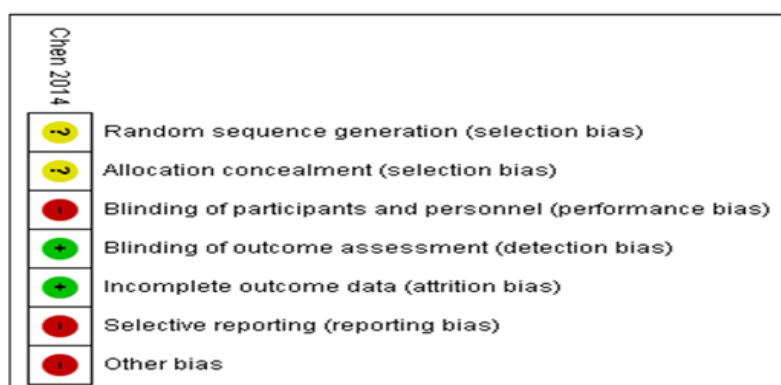
5.2.3 Excluded studies

Among the 58 studies that were excluded, 51 were observational and therefore not eligible. Seven studies were randomised controlled trials (RCTs) (Andersen 2012, Elder 1996, De Vries 2006, Gorini 2014, Hamilton 2005, Schofield 2003, Wen 2010), evaluating multi-modal programmes, but it was not possible to disentangle the effect of STP from those of others interventions, and so they were excluded. Of the 51 observational studies, 27 reported a predictor not suitable for this review (STP not sufficiently specified) or no outcome suitable for the review. Table contained in **appendix 5** provides details of the respective reasons for excluding each study. The remaining 24 studies reported an effect on students' smoking behaviour and information about the policies' characteristics was collected through interviews with school staff. Even if excluded from the review, they were considered useful for hypothesis generation. All but one were cross-sectional studies, while one (Rosendhal 2002) was a cohort study. Twenty-two studies involved middle or secondary schools, and two were conducted in primary schools (Rosendhal 2002, Huang 2010). Information about the study, characteristics of the policy and main results are summarised in the table contained in **appendix 6**.

5.2.4 Risk of bias in the included study

The only study included (Chen 2014), had a small sample size of only 4 schools, a high risk of interclass correlation, a likely absence of blinding, and lack of information to assess the presence of selective reporting. For these reasons the risk of bias of this study was judged to be very high. This assessment is summarised in Figure 5.

Figure 5. Risk of bias summary: review authors' judgements about each risk of bias item for each included study



5.2.5 Effect of the intervention

In the included study (Chen 2014) a school tobacco policy (STP) was not significantly associated with all smoking outcomes studied. There weren't substantial differences in the prevalence of current smokers between intervention and control schools in either of the two regions: risk ratio (RR) 0.98 (95% CI 0.71 to 1.4) and RR 1.35 (95% CI 0.57 to 3.2). The study didn't consider other outcomes of interest for this review.

5.2.6 Studies considered for hypothesis generation

Using data from 24 observational studies, we were interested if specific characteristics of STPs were associated with students smoking behaviour. The characteristics analysed were the following:

- formally-adopted STP vs no policy
- ban extended outdoor school premises vs internal ban
- ban extended to teachers vs teachers' smoking allowed in limited area
- STP including (types of) sanctions for transgressors vs including weak or no sanctions
- STP including assistance to quit for smokers vs STP without assistance
- STP plus prevention components vs STP alone
- STP highly enforced vs weakly or not enforced

The mere adoption of an STP did not seem to affect smoking behaviour. Nine studies measured the effects of a formally-adopted STP on students' smoking. These studies present mixed results, as three studies showed lower prevalence of smoking in schools with STPs, when compared with schools without a formal policy (Lovato 2010b, Moore 2001, Sinha 2004b), while six studies reported no differences (Galán 2012, Hamilton 2003, Huang 2010, Murnaghan 2007, Murnaghan 2008, Rosendhal 2002). We also analysed the effects of five aspects of policy: extent of a smoking ban, inclusion of teachers' smoking, sanctions for transgression, assistance for smoking cessation, and a ban combined with prevention and education activities. Only a few studies reported results to support the effects of these features. With respect to the extent of bans, one study detected a difference in students' smoking prevalence, when comparing schools which prohibited students' smoking on school premises or outdoors, with those which permitted smoking (Piontek 2008b). Three studies found no differences (Barnett 2007, Huang 2010, Pentz 1989); however, of these Pentz (1989) found a difference only in the number of cigarettes smoked. One policy forbidding teachers to

smoke was associated with a decrease in students' daily smoking (Kumar 2005). Prohibition of indoor smoking for teachers was not significantly associated with student smoking, while prohibiting teachers from smoking outdoors was associated only with decreased daily smoking in girls aged 13 years, but not among boys and girls aged 16 years (Barnett 2007). In Boris (2009), Clarke (1994), Piontek (2008b), and Wium (2011a), comprehensive policies prohibiting teachers from smoking, when compared with those allowing them to smoke in restricted areas, were not related to student smoking. Nine studies considered the relationship between sanctions for students found smoking and smoking prevalence. Sanctions cited in the STP were not related to smoking prevalence in the majority of the studies (Darling 2006, Pentz 1989, Piontek 2008b, Wium 2011a). Harsh and remedial penalties (Evans-Whipp 2010), the severity of sanctions (Kumar 2005, Paek 2013), and sanctions put in place at school and informing parents (Wium 2011b) were not associated with adolescent smoking. In one study (Hamilton 2003) counselling and education for students caught smoking appeared to be more effective against student smoking than a disciplinary approach alone. Seven studies considered the effect of assistance with smoking cessation for students. Out of these, only Sabiston (2009) showed a link to a lower probability of smoking. Of the others, five studies did not show a link (Darling 2006, Evans-Whipp 2010, Lovato 2007, Pentz 1989, Piontek 2008b); in fact Pentz (1989) reported a higher number of cigarettes smoked in schools where cessation support was available. Moreover, Lovato (2010a) showed that in schools that mandated cessation programmes students had a higher probability of smoking. Six studies compared the effect of 'STP only' to 'STP with prevention and education components', but did not find an association with reduction of smoking prevalence (Darling 2006, Lovato 2007, Murnaghan 2007, Murnaghan 2008, Pentz 1989, Sabiston 2009). Pentz (1989) reported lower numbers of cigarettes smoked and lower smoking prevalence (although not statistically significant) in schools with smoking ban policies and smoking prevention programmes. Eleven of the considered studies focused particularly on the role of policy enforcement. Four studies showed that policy enforcement was linked to lower rates of smoking (Adams 2009, Kumar 2005, Moore 2001, Sabiston 2009). In one study, the data were in favor of schools adopting policy enforcement, but the effect was no longer statistically significant after adjustment for state, gender, age and family socioeconomic status (Evans-Whipp 2010). The presence of an enforcement officer, but not the strength of the enforcement, was associated with a lower probability of smoking in one study (Lovato 2010a). Smoking prevalence was not related to policy enforcement in two studies (Lovato 2007, Wium 2011b). One study found no difference in smoking prevalence between schools with a high versus a low degree

of monitoring of students' compliance with the policy (Piontek 2008b). In contrast, Lovato (2010b) found that students were more likely to smoke if they attended a school with stronger enforcement of the tobacco policy. Policy enforcement for teachers was not associated with a difference in daily and weekly smoking among students in one study (Moore 2001). Table presented in **appendix 6** shows further details on characteristics, outcomes and results of the considered studies for hypothesis generation, while table presented in **appendix 7** summarizes the effect of policies' characteristics on students' smoking behaviour as reported in the studies.

5.3 Exploring if School Tobacco Policies are adopted in Italian schools

5.3.1 Results of the monitoring survey on the impact of outdoor smoking ban in Italian schools

The adherence to the survey was very high (99%) with a total of 237 visited schools (94% of which were state-owned).

Visited schools were uniformly distributed in:

- middle school (34%),
- high school (35%),
- and technical or vocational schools (31%).

In the indoor areas no-smoking signs were found only in 88% of the schools. In 82% of the schools having no-smoking signs they were visible and in 93% were complete/intact.

Concerning indoor areas, classrooms, gymnasiums and laboratories were found to be smoke free, while in administrative offices, stairs, cafeteria, bar, warehouses and toilets were found cigarette butts and people smoking. In particular in 4% of the toilets students have been seen smoking (table 2).

In the outdoor areas no-smoking signs were found only in 37% of the schools, while students have been seen smoking in 28% of the observations, teachers in 11% and non-teaching staff in 9%. Ashtrays have been seen in 16% of the outdoor school areas and cigarettes butts in the 69%.

In the outdoor areas not pertaining to the schools, students smoking have been seen in 33% of the observations, teachers smoking in 18% and non-teaching staff smoking in 22%. Ashtrays have been seen in 5% of the cases and cigarettes butts in 85%.

Table 2. Presence of ashtrays, cigarette butts and people smoking in specific school areas (237 schools visited) (CNESPS-ISS 2015).

Location	Percentage of school where the location was visited	Students smoking	Teacher smoking	School staff smoking	Presence of ashtrays	Presence of cigarette butts	Smell of smoke
Interior spaces							
Administrative office	97%	1%	1%	0,4%	2%	0	0
Stairs	97%	1%	1%	1%	1%	5%	2%
School staff toilets	92%	-	0	0	0,9%	0,9%	2%
Students toilets	97%	4%	-	-	0	9%	17%
Canteen and bar	40%	0	1%	0			
Stores	82%	0	0	0	0	1%	0
Classrooms, gymnasiums and laboratories	95%	0	0	0	0	0	0
Outdoor spaces							
School outdoor areas (courtyards , interior gardens , parks)	96%	28%	11%	9%	16%	69%	-
Outdoor areas not pertaining to the school (streets , sidewalks , gardens)	98%	33%	18%	22%	95%	85%	-

Eighty-four percent of the School Principals personally filled the questionnaire, only 16% delegated it to a representative. Among respondents, 13% are smokers, 27% are ex-smokers, 60% never smoked.

Sixty-four percent of visited schools did not participate to smoking prevention programmes, even though 95% of schools without any smoking prevention programmes declared willingness to participate in one programme in the future. Eighty-seven percent of visited schools had their own anti-smoking regulations. Most of the schools (66%) shared the school anti-smoking regulations with teachers, students and parents.

In School Principals opinion the smoking ban in the indoor areas is general accepted from the 96% of the people that work and study in the school. This percentage decreases to 50% considering the outdoor areas. With regard to disciplinary measures in case of infringements of the school regulations, both for students and teachers, the penalties were described in 91% of smoking regulations. Only the 35% of School Principals believe that the law is effective in

discouraging young people to initiate to smoke, and the 23% of them consider the law hardly anything effective.

5.3.2 Results of the survey on the level of adoption of School Tobacco Policies in an Italian province

On a total of 18 secondary schools in Province of Novara, 15 of them agreed to adhere to the survey (83,3%). Table 3 summarizes information on the characteristics of the sample and the anti-tobacco activities adopted by the selected schools. The sample represents both high schools and technical/vocational schools. The majority of the schools are public, a data that complies with the normal rate of public/private schools in Italy. Almost half of the schools have adopted some smoking prevention interventions in the last year.

These interventions include:

- conferences
- information activities on cancer prevention
- meeting with a psychologist
- nonspecific activities aimed at promoting self-efficacy

No schools have adopted the Unplugged Curriculum and almost no schools have organized activities to inform smokers about opportunities to be helped to quit. The majority of the schools have communicated the extension of the smoking ban, but only 20% have involved the students in order to strengthen the message about the new regulation. The outdoor smoking ban was integrated in a written document in 60% of the schools. Disciplinary actions for students not complying with the ban were undertaken by the majority of the schools, but no fines were issued for its infringement.

Table 3. School Tobacco Policy survey results: characteristics of the sample and information pertaining anti-smoking activities put in force in the last year

	n/N	%
Respondents	15/18	83%
Type of school		
High School	7/15	47%
Technical School	7/15	47%
Vocational School	2/15	13%
Public/Private Schools		
Public Schools	13/15	87%
Private Schools	2/15	13%
Smoking prevention interventions		
Schools putting in force interventions in the last year	7/15	46%
Grade target of prevention interventions		
8th and 9th grades	3/15	20%
10th, 11th, 12th grades	1/15	7%
All grades	2/15	13%
Unplugged knowledge and adoption		
Do you know Unplugged Curriculum?	2/15	13%
Schools adopting Unplugged Curriculum	0/15	0
Activities to quit smoking		
School organising activities to inform students about resources to quit smoking?	2/15	13%
School organising activities to inform teachers about resources to quit smoking?	0/15	0
Methods to inform students about outdoor smoking ban		
Bulletin	11/15	73%
Billboard	4/15	27%
School magazine	1/15	7%
Other	3/15	20%
Participation		
Activities involving students to communicate outdoor smoking ban to other students and teachers	3/15	20%
Policy characteristics and consequences for infringement		
Written policy	9/15	60%
Any fines in the last year	0/15	0
Any disciplinary actions in the last year	9/15	60%

6. DISCUSSION

The work was aimed at assessing if STP is an effective intervention to prevent smoking initiation among students and to explore what policy's characteristics are associated with this goal. The research was also interested in exploring the use of STPs and the impact of smoking regulation in Italian schools.

For these purposes two systematic reviews were carried out. The first was a narrative review exploring the different definitions of STPs and summarizing studies on their effect. The second was a Cochrane systematic review assessing the effectiveness of policies aiming at preventing smoking initiation among students by regulating smoking in schools.

The study of the impact of smoking regulation in Italian schools was carried out through a national survey based on the observation of smoking indicators in school indoor and outdoor areas. Finally a survey was carried out in an Italian Province in order to assess the level of adoption of STPs.

6.1 Effect of School Tobacco Policies on students

Despite a comprehensive search of the literature evaluating the effectiveness of school policies for preventing smoking among young people, it was not found any evidence of an effect. This is mainly explained by the absence of experimental or quasi-experimental studies except one. The results of the two reviews are limited by the number of studies identified and the low methodological quality of the only one included (Chen 2014) which showed no significant differences for students' smoking behaviours between schools with and without a STP. Furthermore, the study was judged as having high risk of bias. Therefore, the evidence of effectiveness of STP can be classified as 'very low quality' with a high risk of bias.

Smoking bans in school settings are common worldwide, and particularly in Anglo-Saxon countries they are often enforced through comprehensive strategies that include the presence of anti-smoking committees, specific penalties for transgressors and communication activities. Generally STP's characteristics vary between countries and inside the same country, so beside the presence of a smoking ban, it is not clear if some characteristics of activities to enforce the ban are more effective than others.

Given the heterogeneity of the studies included in the present work and the methodological limitations discussed below, questions whether and to what extent an anti-tobacco policy in school can deter youths from taking up or from progressing into tobacco use cannot be answered from the existing literature. Some components of the investigated policies may be regarded as more promising than others, as they showed rather consistent expected associations with less tobacco use by students. For instance, **universal tobacco bans or restrictions, clear rules against tobacco use and consistent enforcement towards students and adults in school** were most often associated with decreased likelihood of smoking or decreased smoking prevalence at the school level. However, whether a policy was written and/or disseminated as a written document did not consistently affect students' behavior beyond its content or strength. Sanctions and strict surveillance measures deserve a particular attention, because their presence and strength were often either not associated at all with student behaviour or associated with an increased likelihood of smoking. In addition, there may be different effects of sanctions depending on contextual characteristics. For instance, countermeasures with emphasis on education seemed to be most often associated with lower smoking prevalence than countermeasures with emphasis on punishment or cessation. In addition, sanctions applied at school seemed to be more effective in deterring smoking than delayed consequences, such as informing parents (Wiium 2011b).

Other characteristics such as extended outdoor bans, assistance to quit smoking, formal adoption of a STP and inclusion of prevention or education activities were not found to be associated with a decreased likelihood of smoking, but should be studied as interacting components. For example, some of the studies suggested that while STPs may be effective in curbing smoking on the school premises, they do little in preventing smoking in general, and may even contribute to increase the frequency of the behaviour outside the school buildings (Watts 2010).

In the absence of longitudinal observations or intervention studies it would be erroneous to dismiss these components as ineffective or counter effective, owing to the possible sources of bias highlighted below.

6.2 Effect of Italian smoking restrictions on smoking at school and on initiatives to control smoking

About the adoption of STPs and the consequences of restrictions on smoking at school in Italy, some insights can be gained by the two surveys analysed in this work. The survey conducted in 2015 in Province of Novara highlights the total lack of a comprehensive strategy on smoking prevention at school level. Even if half of the schools offered some kind of prevention interventions to contrast smoking uptake, these actions are not evaluated with rigorous studies and are not implemented systematically. The Unplugged Curriculum, the only one smoking and drugs prevention intervention evaluated through a Cluster-Randomised Control Trial (Faggiano 2010) available in the Piedmont Region, was not adopted in any school of our sample. Furthermore only few teachers declared to know this programme.

Data suggests that the outdoor smoking ban was adopted by the schools merely as a recent law imposition, without conducting any activity to enforce it and to involve students and teachers in its dissemination (only 20% of the schools has involved students in activities to communicate the ban). Finally no fines were registered in the last year as teachers preferred to put in force traditional disciplinary measure. This last data is not surprising since it is probable that teaching staff prefers to use own methods not involving external agencies such as the police. But it is also probably that the ban was seen as an imposition without understanding the educational purpose of the law.

All these information could suggest that schools seem to wait external drive (interventions offered by associations, or prohibition imposed by law) to put in force smoking prevention activities.

Data from this local study are comparable with the results of ENFASI scuole. The survey reveals that students have been seen smoking in the toilets in 4% of the schools visited and in 28% of the school outdoor areas, where smoke was banned one year before. It is important to consider that in 11% of the visits also teachers have been seen smoking in school outdoor area, a cause of concern considering that smoking is socially influenced by the behaviour of peers and significant adults (Geckova 2002).

Despite the smoking ban, only classrooms, gymnasiums and laboratories were really smoke free indoor areas, while outside the school smoking is widespread and involve both school staff and students.

Considering the interviews realized in the same research, school principals appear to be not confident that the law was effective in discouraging young people to initiate to smoke and some of them considered the law hardly anything effective.

The picture here presented shows a situation in which STPs are only formally adopted while students and school staff continued to smoke in the school area, suggesting that the extension of smoking ban outside schools hasn't been yet accepted appropriately in the school contest. This could be due to a sudden introduction of the law without any possibility for the schools to prepare an appropriate environment to introduce the ban, a different situation than the previous indoor smoking ban (law 3/2003), that was introduced after two years after its announcement. As for previous anti-smoking laws, probably a period of time is needed to assimilate the new rules and encourage a real cultural shift.

It could be questioned that the introduction of STPs could produce conflicts between teachers and students and for this reason smoking in outdoor spaces is tolerated, but researches have highlighted that students are often surprised and concerned that smoking is permitted on school property (Baille 2008, Turner 2004).

Concerning the marginal adoption of STP in Italian schools it could be mentioned from a qualitative research with Dutch teachers how some school environment characteristics (such as large school grounds or no clear demarcation of the school premises) could be of impediment for a correct adoption of this kind of policy. On the other hand some interventions, such as removing ashtrays and billboards are considered as facilitators. Finally, school staff' lack of knowledge about this kind of strategies (i.e., knowledge about what an outdoor school ground smoking ban implies) is a determinant barrier for a proper adoption of STPs (Rozema 2016), so resources could be dedicated to bridge this cultural gap.

Another qualitative research from North Caroline State (that has introduced a 100% Tobacco-Free School Policy in 2001) concluded that the change was achieved after have reached a strong leadership and commitment by key stakeholders (eg, school principals, board members, superintendents) (Goldestein 2013). The policy was reached after recruiting youth and adults for STPs summits, and training to ensure high-level motivation, facilitate leadership skills, and acknowledge leadership roles. Youth were involved in initiating change and in supporting adult efforts for policy change. Youth roles ranged from collecting signatures on petitions, testifying at school board meetings, and educating classmates about smoking cessation. Policymakers were involved in order to facilitate the introduction of STPs by helping to identify champions, to deflect criticism from the school board, and to mobilize coalitions for action. The research concludes that STPs should be firm and enforceable,

include frequent reminders, and be visible to staff, students, and visitors. Finally advocacy appears to be fundamental before and after introducing a smoking ban.

6.3 Limitations due to methodological considerations

6.3.1 Limitations of the reviews

Despite the search limitations, for instance the possibility to have not reached unpublished works, we are confident that the studies included in the review fairly represent the state of art of research in this domain.

It is important to consider that the main conclusion of the systematic review is based only on one randomised controlled trial (RCT) at high risk of bias. This is because the included study did not describe the randomisation method for the schools and did not provide information about allocation concealment, which may introduce significant selection bias. On the other hand the number of dropouts and participants lost at the follow-up were very low. Given the characteristics of the assessed intervention, it is important to note that it was not feasible to blind the participants or the school personnel. The investigators measuring the outcomes could have been blinded, but this was not reported in the included studies. Insufficient details were provided on variables used in the statistical analysis for the adjustment for possible confounders.

We have also analysed some observational studies, which in turn have important limitations. These studies adopted a cross-sectional design, which precluded causal inference but also made them vulnerable to various risks of bias. Inverse causality is a possible explanation for associations of higher tobacco use with policies that are more comprehensive or harsh prohibitions (ie, high tobacco use rates prompt more restrictive measures). In studies in which the exposure to policy was assessed through student self-reports there is the additional possibility that perception of stricter enforcement or other policy characteristics may be influenced by actual behaviour, for instance smokers become more aware than non-smokers of the existence and content of policy rules.

One important issue is the heterogeneity of exposure definition. There is a large variability in policy formats, and this can include several different characteristics, which make comparisons difficult. Only a few studies are based on policy definition in written documents. Policy information obtained by interviewing school principals, school administrators or teachers

might overstate the extent of the STP, and frequently it is not possible to differentiate the contribution of the STP from that of other school interventions. Descriptive terms, like 'enforcement' or 'comprehensiveness', were used in different and incompatible ways, with specific policy characteristics being differently defined. This was true for smoking prevention programmes, availability of cessation support, and the sanctions for violations. The outcome variables were heterogeneous, and the age range between studies was variable. Since age is a major determinant of the prevalence of tobacco use, with a doubling of the initiation rates between early and middle adolescence (DiFranza 2007), discrepancies between studies should always be interpreted with respect to the age distribution. With regard to the analysis methods, some studies did not mention any adjustment for potential confounders (Clarke 1994; Darling 2006; Sinha 2004b; Wiium 2011b) and in general there is a large variability in the factors considered for adjustment.

Finally, contextual effects due to social norms concerning tobacco use may interact with the effects of school policies and also account for conflicting results between studies. Indeed, there was a greater tendency to report favorable effects of a school policy in studies based on surveys conducted up to the year 2000, compared to studies conducted later, suggesting that a possible preventive effect of local policies may be concealed by increasing social disapproval of tobacco use.

6.3.2 Limitations of the surveys

Some limitations should be considered when interpreting the results of the surveys. The primary limitation derived from the cross-sectional methodology of the study design. Because the exposure and outcome are simultaneously assessed, there is no evidence of a temporal relationship between exposure and outcome. If this is true for smoking behavior, we are confident that the extension of the smoking ban had not affected school practices on smoking prevention, as the presence of anti-smoking activities in the school setting reported in the two surveys was very low.

The second important limitation concerning the survey in Province of Novara is due to the sample selection. The study is conducted in a small and not representative province of north-west Italy (inhabitants are only the 0,6% of the Italian population).

A third limitation of this last survey concerns the appropriate selection of respondents among the school staff. The answers about environmental characteristics associated with prevention might vary between different responders in the same organization. Moreover responders might not have been in the position to have all the information about smoking prevention

activities in their schools. In the survey were contacted teachers in charge to monitor school health promotion activities, but a lack of information because of a frequent turnover of this position cannot be excluded. For this reason researchers in Novara survey interviewed personnel in charge for health promotion activities, who are supposed to be in the position to have information about smoking prevention activities.

Concerning the national survey, the methodology consisting in observing and counting the number of people smoking and cigarette butts to explore ban compliance could be questioned, but this is a common method adopted by researchers interested in assessing the impact of smoking bans (Ickes 2015, Lee 2013, Fallin 2012).

6.4 Comparison with other reviews

Some previous related works deserve mention, because their conclusions are generally in line with those of the two reviews or may convey useful information for future studies. A review conducted with the broader goal to identify contextual factors explaining differences in the smoking prevalence between schools (Aveyard 2004) reached the conclusion that policy comprehensiveness, strength and harsher sanctions, but not other aspects of tobacco control, could explain school variation in smoking. A narrative review of the effectiveness of school anti-drug policies (not specifically smoking) concluded that a more comprehensive anti-smoking policy may have some effect in decreasing smoking prevalence, but may also displace the behaviour from school grounds to off school (Evans-Whipp 2004). A nonsystematic review of school contextual effects on pupil behavioural outcomes presented results in the hypothesized direction from three studies, two of which did not include any specific evaluation of STP (Sellstrom 2006). Finally, a fourth systematic review analyzed whole-school programmes aiming at changing school organization, practices and ethos (Fletcher 2008). This analysis suggested that such programmes may lead to decreased use of substances. Research on the effectiveness of STP seems not to have progressed beyond an initial stage, with a distinctive lack of experimental, quasi-experimental and longitudinal studies.

6.5 Areas of primary importance for future research and practice

6.5.1 Exploring the effectiveness of School Tobacco Policies

Prospective studies with a focus on the intervention evaluation should be conducted, preferably with an experimental or quasi experimental design in order to explore the effect of STPs. Primary and secondary outcomes should be clearly identified, by stating: type of tobacco use involved in the policy; timeframe and definition of use; topography of the target behaviour (eg, in school or elsewhere); follow-up time. Policy definition should rest on a small number of well-defined components, allowing the possibility to reproduce and test their effects. At this time, when there is little evidence that the effectiveness of a policy is a function of some particular values of these components, it would be premature to recommend a complete policy template. However, theoretical and empirical considerations suggest that a well-defined policy should target all areas and all subjects in a school, should report a clear description of the consequences for violations, be regularly enforced and widely communicated. Table 4 is an attempt to operationalise the above components. Finally, the context in which a given policy is going to be evaluated should be explicit, in order to allow the study of potential interactions (eg, with campaigns, preventive programmes, legislation).

Table 4. Policy dimensions and components suggested for formal evaluation

Policy dimension	Components
Comprehensiveness	Targets (subjects in school to which the policy applies: students, staff, visitors/guests); type of tobacco to which rules apply (ie, smoking, smokeless); coverage of school premises (restricted areas, inside the school, outdoors); coverage of school activities and time; support of cessation facilities; combination with other smoking prevention programmes; combination with other policies (eg, other substance use)
Degree of formality	Form of statements (whether written or other); approval issued by official school organism/representative
Enforcement	Rules for surveillance; rules for referral of violation episodes; definition of the responsible person for policy evaluation and review; agenda for periodic evaluation and review of the policy
Consequences	Whether the on-site or delayed consequences of violations are defined for each target, such as: referral to principal, to school healthcare, to other healthcare or to parents; fines; suspension from school; other disciplinary (eg, some kind of extra assignment)
Communication	Communication channels identified to inform on the policy, such as: internal meetings of staff and students; meetings including visitors (eg, families); school website; school journal; posters in school premises, newsletters
Level of Implementation	Whether the policy elements are implemented at the national/regional/other local/school level

6.5.2 Monitoring the adoption of School Tobacco policies and their consequences

In order to monitor the use of STPs and their consequences some current periodic surveys such as OKkio alla SALUTE promoted by ISS-CNESPS (Ministero della Salute 2016) could integrate items regarding the same school characteristics that should be better studied in order to advance the research of this kind of policies (see table 4). Furthermore, the monitoring process could contribute to promote the adoption STPs by the schools.

6.5.3 Recommendations for the practice

School managers should be encouraged to adopt STPs along with effective prevention programmes as a comprehensive strategy to control smoking at school. For this reason, STPs and prevention programmes should be disseminated through specific training of school staff

and be used as assessment criteria in the periodic school quality surveys. Moreover, effective school-based programmes could be enriched with components aimed at controlling smoking through environmental interventions at school level. The promotion of best practice exchange between schools could encourage the adoption of these strategies.

International as well as national networks on health promotion, such as the “International Union for Health Promotion and Education” (www.iuhpe.or), “Schools for Health in Europe network” (www.schools-for-health.eu), and “Rete delle scuole che promuovono salute” (www.scuolapromuovesalute.it), could support the dissemination of successful experiences in this field.

The theoretical absences of side effects, together with their limited costs, are elements to be considered when STPs are proposed in school setting. Schools of all levels should adopt written regulations to control smoking. The policy should be shared between teachers and students in order to obtain their compliance. The ban must be extended to all indoor and outdoor areas of relevance of the school, and properly communicated. Attention should be paid to create appropriate control and sanctioning mechanisms indicating the responsible persons for the compliance with the law. Finally, a comprehensive prevention framework integrating effective prevention programmes and STPs, should be disseminated in the form of handbooks or informative website to the schools

6.7 CONCLUSIONS

STPs represent an integral component of a comprehensive tobacco control strategy, but the evidence on their effectiveness is limited.

Some components of an anti-tobacco policy in schools may be effective in deterring young people from initiating or progressing in tobacco use.

Conclusions about evidence of effectiveness should be cautious, owing to the low methodological quality of the studies addressing this question, which remains to be investigated in large, possibly by multicentric studies, employing an experimental or a quasi-experimental design.

Future research in this area must be rigorously designed and evaluated.

The intervention should be accurately and objectively described, in particular the rules of the policy, the persons involved, the penalties for the infringement of rules, and the process of enforcement.

Outcome variables should be standard and validated where possible, and should include process as well as behavioural change data.

Information relating to context (e.g. social, political and cultural factors) should also be collected and factored into the analysis.

Several STP components can play an essential role in contributing to policy effectiveness; the most important ones suggested by this work are:

- degree of formality: form of statements of the policy (whether written or other);
- participants to which the policy applies (students, staff, visitors/guests);
- extent of the ban (in all indoor areas or on external school premises);
- level of enforcement including: rules for surveillance and for referral of smoking ban infringements; definition of the person responsible for policy evaluation and review; agenda for periodic evaluation and policy review;
- sanctions for transgression;
- assistance with smoking cessation;
- combination with prevention and education activities.

Looking at the Italian situation, the extension of smoking ban in outdoor school areas seemed to be not an opportunity to introduce specific policies in the school setting. The presence of smokers in outdoor school areas could be seen as the proof of the low effect of the ban. This

could be due to a sudden introduction of the law, therefore it is probably necessary a longer time span and a focused effort to induce schools to assimilate the new ban. It is here recommended to introduce some specific actions in order to enforce the smoking ban and to monitor its effect on smoking behavior.

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APPENDICES

Appendix 1. MEDLINE search strategy in the systematic review

1 RANDOMIZED-CONTROLLED-TRIAL.pt.
2 CONTROLLED-CLINICAL-TRIAL.pt.
3 CLINICAL-TRIAL.pt.
4 Meta analysis.pt.
5 exp Clinical Trial/
6 Random-Allocation/
7 randomized-controlled trials/
8 double-blind-method/
9 single-blind-method/
10 placebos/
11 Research-Design/
12 ((clin\$ adj5 trial\$) or placebo\$ or random\$).ti,ab.
13 ((singl\$ or doubl\$ or trebl\$ or tripl\$) adj5 (blind\$ or mask\$)).ti,ab.
14 (volunteer\$ or prospectiv\$).ti,ab.
15 exp Follow-Up-Studies/
16 exp Retrospective-Studies/
17 exp Prospective-Studies/
18 exp Evaluation-Studies/ or Program-Evaluation.mp.
19 exp Cross-Sectional-Studies/
20 exp Behavior-therapy/
21 exp Health-Promotion/
22 exp Community-Health-Services/
23 exp Health-Education/
24 exp Health-Behavior/
25 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18
or 19 or 20 or 21 or 22 or 23 or 24
26 smoking cessation.mp. or exp Smoking Cessation/
27 "Tobacco-Use-Cessation"/
28 "Tobacco-Use-Disorder"/
29 Tobacco-Smokeless/
30 exp Tobacco-Smoke-Pollution/
31 exp Tobacco-/
32 exp Nicotine-/ (19782)
33 ((quit\$ or stop\$ or ceas\$ or giv\$) adj5 smoking).ti,ab.
34 exp Smoking/pc, th [Prevention & Control, Therapy]
35 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 [A category smoking terms]
36 exp Smoking/ not 35 [B category smoking terms]
37 1 or 2 or 3 [Likely CT design terms; RCTs, CCTs, Clinical trials]
38 35 and 25 [A category smoking+all design terms]
39 35 and 37 [A category smoking terms+likely CT design terms]
Øverland 2010 (animals not humans).sh. [used with 'not' to exclude animal studies for each
subset]
41 ((26 or 27 or 28 or 29) and REVIEW.pt.) not 38 [Set 4: Core smoking related reviews
only]

42 36 and 25 [B category smoking+all design terms]
 43 (42 and 37) not Øverland 2010 [Set 3: B smoking terms, likely CT design terms, human only]
 44 38 not 39 not Øverland 2010 [Set 2: A smoking terms, not core CT terms, human only]
 45 (35 and 37) not Øverland 2010 [Set 1: A smoking terms, likely CT design terms, human only]
 46 (36 and 25) not Øverland 2010 not 43 [Set 4: B smoking terms, not core CT terms]
 47 (polic* or ban* or restriction* or rule* or environment*).mp.
 48 school*.mp.
 49 47 and 48 [Topic related terms]
 50 45 and 49 [Topic + A smoking terms & core CT terms **SET 1**]
 51 44 and 49 [Topic + A smoking terms & wide design terms **SET 2**]
 52 43 and 49 [Topic + B smoking terms & core CT terms **SET 3**]
 53 46 and 49 [Topic + B smoking terms & wide design terms **SET 4**]

Lines 1 to 24 identify controlled trials and other types of programme evaluations, as used to identify reports of studies for the Tobacco Addiction Group Specialised Register. Lines 26 to 34 identify reports related to smoking and tobacco control. Lines 47 and 48 identify reports relevant to the topic of this review. Sets 1 to 4 will be screened for the review, Sets 1 and 2 are expected to be the most likely to contain relevant reports, and Set 4 to be unlikely to identify any.

Appendix 2. Questionnaire on School Tobacco Policies

1 Grado di scuola

- ☐ Scuola secondaria di primo grado ☐ Scuola secondaria di secondo grado

2 Tipologia della scuola in cui insegna

- ☐ liceo ☐ istituto tecnico ☐ istituto professionale

3 Forma giuridica

- ☐ scuola pubblica ☐ scuola privata o paritaria

4 Sono stati realizzati interventi di prevenzione del tabagismo nel corso dello scorso e dell'attuale anno scolastico?

- ☐ Sì ☐ no

5 Se sì, di che tipo

- ☐ Conferenze
☐ Programma unplugged
☐ Programma di prevenzione extracurriculare (specificare nome _____)
☐ Altro (specificare) _____

6 A che età sono rivolti? _____

7 E' a conoscenza del programma di prevenzione Unplugged?

- ☐ Sì ☐ no

8 Sono state organizzate attività per informare gli studenti sulle risorse per smettere di fumare (es. centro antifumo)?

- ☐ Sì ☐ no

9 Se sì, di che tipo:

- ☐ avviso in circolare
☐ informazione tramite cartelloni
☐ informazione tramite giornalino
☐ altro, specificare _____

10 Sono state organizzate attività per informare gli insegnanti sulle risorse per smettere di fumare presenti sul territorio (es. centro antifumo)?

- ☐ Sì ☐ No

11 Se sì, di che tipo:

- ☐ avviso in circolare
- ☐ informazione tramite cartelloni
- ☐ informazione tramite giornalino
- ☐ altro, specificare _____

Con la legge 8 novembre 2013, n.128 (in G.U. 11/11/2013, n. 264) “Divieto di Fumo per la tutela della salute nelle scuole”, il divieto di fumo nelle scuole è stato esteso alle aree esterne di pertinenza della scuola.

12 Come sono stati informati gli studenti e i professori di questa nuova disposizione?

- ☐ avviso in circolare
- ☐ informazione tramite cartelloni
- ☐ informazione tramite giornalino
- ☐ altro, specificare _____
- ☐ non è stata realizzata nessuna attività informativa

13 Sono stati coinvolti gli studenti in attività specifiche finalizzate a diffondere il divieto?

- ☐ Sì ☐ No

14 Se sì, quali attività sono state realizzate?

15 E' stato scritto un regolamento ad hoc?

- ☐ Sì ☐ No

16 Nel suo istituto sono state comminate delle multe per la trasgressione del divieto da quanto è attiva la legge?

- ☐ Sì ☐ No

17 Se sì, a chi sono state rivolte?

- ☐ Personale docente ☐ Personale non docente ☐ Studenti

18 Oltre, o in alternativa, alla multa sono state previste delle conseguenze per gli studenti che violano il divieto?

- ☐ Provvedimenti disciplinari
- ☐ indicazione a rivolgersi al centro di trattamento del tabagismo
- ☐ Altro

19 La stessa legge, al comma 2, vieta anche l'uso delle sigarette elettroniche:

Nonostante il divieto, ha visto studenti che fumano sigarette elettroniche?

- ☐ nei cortili o nei giardini interni
- ☐ presso balconi, terrazze o scale all'aperto
- ☐ nei servizi igienici
- ☐ presso il marciapiede davanti all'ingresso
- ☐ no

20 Nonostante il divieto, ha visto professori che fumano sigarette elettroniche?

- ☐ nei cortili o nei giardini interni
- ☐ presso balconi, terrazze o scale all'aperto
- ☐ nei servizi igienici
- ☐ presso il marciapiede davanti all'ingresso
- ☐ no

21 Gli interventi di prevenzione che sono stati effettuati trattavano anche i rischi correlati all'uso della sigaretta elettronica?

- ☐ sì ☐ no

Appendix 3. Overview of the 31 studies included in the narrative review- Participants and methods

Ref. #	First author/Publ year	Methods	Participants and setting	Intervention/Exposure (Policy constructs and policy variables)	Primary outcome	Secondary outcomes
10	Adams ML 2009	Cross-sectional	16561 students in grade 7-12 (age 12-17) from Øverland 2010 schools in Illinois (USA)	STP defined through a. enforcement, b. comprehensiveness	Current smoking (any day during the past 30 days)	Students' smoking on school grounds
11	Barnett TA 2007	Cross-sectional	763 students (mean age 13) and 762 students (mean age 16) from Quebec (Canada)	STP assessed reported by administrators and defined as: staff permitted to smoke indoors/ outdoors; students permitted to smoke on school ground	Daily smoking in the past 30 days	Non-daily smoking (less than every day in the past 30 days)
12	Boris NW 2009	Cross-sectional	4469 students in grade 9 (mean age 15.4) and 1041 teachers in HS in Louisiana (USA)	Schools with comprehensive STP (n=4) compared with schools with restriction to use only (n=16)	Daily smoking in the past 30 days	Teachers' smoking; concern for students seeing them smoking; support to STP
13	Darling H 2006	Cross-sectional	2658 students in grade 10 and 12 (mean age 15) from 63 schools in New Zealand	STP components categorized as punishment, cessation, prevention, comprehensiveness. Each group of schools was contrasted with the group of schools not having the specific focus.	Current smoking (both daily and occasional)	School smoking prevalence, purchasing cigarettes, knowledge on health effects
14	Evans-Whipp T J 2007	Cross-sectional from a longitudinal study	1934 students in grade 7 and 9, in Washington state (US) and 1942 in Victoria state (Australia)	STP components analyzed: parents' awareness, communication methods, orientation (harm minimization or abstinence), enforcement	Students reporting being drunk/high at school in the past 12 months	Perception of drinking or smoking on school grounds
15	Evans-Whipp T J 2010	Cross-sectional from a longitudinal study	3466 students in grade 8 and 10 (age 13-15) from 285 schools: 153 in Washington state (US) and 132 in Victoria state (Australia)	STP components reported by principals: comprehensiveness, enforcement, "harsh" or "remedial" response for students violating the policy, orientation (harm minimization or abstinence)	Current smoking (smoking in the past-30 days)	Prevalence of daily and non-daily smoking during the past year. Perception of students smoking in school without consequences
16	Griesbach D 2002	Cross-sectional	1644 students (mean age 15) from 77 schools in Scotland	STP components reported by staff: status: (written, informal or uncertain), restrictions, enforcement.	Students' perceived smoking among students and staff	

17	Hamilton G 2003	Cross-sectional	4697 students in grade 9 (mean age 13.6) from 31 schools in Australia	STP components reported by principals: health committee, written health policy, written drug policy, availability of counseling and education, type of consequences for violation	Ever smoking (definition not reported) Regular smoking (4 or more days in the previous week)	Perceived risk with smoking Negative smoking attitudes Perception of friends smoking
18	Huang H-L 2010	Cross-sectional	2350 students (mean age 10.9) from grade 3 to 6 from 26 schools in south Taiwan	STP components reported by staff: written for students and staff, restrictions for students and staff, anti-tobacco activities or curricula, perceived smoking prevalence	Ever smoking (even a puff)	
19	Kumar R 2005	Cross-sectional	35745 students in grade 8, 10 and 12 (age 13-16) in Michigan (USA)	STP components reported by administrators: monitoring students behavior; severity of consequences after violation, staff allowance to smoke on premises	Daily smoking in the past 30 days	Students' disapproval of cigarette use
20	Lipperman-Kreda S 2009 a	Cross-sectional	17256 students (age 12-18) from 255 MS and HS in Oregon (USA)	Perceived enforcement STP by students	Students' positive expectations; perceived harm, tobacco availability, peer smoking, disapproval	Past 30-days cigarette smoking in general and on the school property
21	Lipperman-Kreda S 2009 b	Cross-sectional	21281 students (age 12-18) from 255 MS and HS in Oregon (USA)	Perceived strict enforcement of STP reported by students	Past 30 days cigarette smoking; daily smoking; heavy smoking (>10 cigs per day)	Smoking on school property; likelihood to accept a cigarette from best friend
22	Lovato CY 2007	Cross-sectional	22318 students in 10-11 grade from 81 schools in Canada	STP reported by administrators: developing, overseeing and communicating; purpose and goals; prohibition; strength of enforcement; characteristics of enforcement; education; assistance to quitting). Students' perception of policy enforcement	Smoking few puffs of a cigarette on ≥ 2 days in the last month	Location of smoking
23	Lovato CY 2010a	Cross-sectional	22681 students from 77 schools (mean age 16) in Canada	STP components reported by administrators: intent and strength, enforcement, tobacco prevention and cessation. Field observation of students	Current smoking, (having smoked at least 100 cigarettes in life and having smoked in the past 30 days)	

				smoking and visibility of tobacco ads.		
24	Lovato CY 2010b	Cross sectional	27892 students in grade 5-9 (age 10-14) from 272 MS and HS in Canada	School policy intent reported in school documents. Enforcement obtained by administrators interviews	As Lovato 2010a	Smoking prevalence at the school level
25	Moore L 2001	Cross-sectional	1375 students (mean age 15) from 55 schools in Wales (UK)	STP components reported by senior staff: written policy and level of extension of the ban, enforcement	Daily and weekly smoking	
26	Murnaghan DA 2007	Repeated cross sectional with comparison on time	3965 students in grade 12 (mean age 17.6) from 10 schools in Canada, surveyed during 3 years	3 conditions: implementation of STP, educational and cessation programmes or combination of the two measured over 3 years. Students' perception of consequences for breaking them	Occasional smoking (less than weekly)	Regular (at least weekly)
27	Murnaghan DA 2008	Repeated cross sectional with comparison on time	4709 students in grade 10 (mean 15) from 10 school in Canada, surveyed during 3 years	Implementation of STP and/ or participation in one of two preventive programmes	Current smoking (less than weekly or weekly)	Student beliefs on policy rules. Interactions with friends smoking and with smoking prevalence in school
28	Murnaghan DA 2009	Repeated cross sectional	1500 students in grade 10-12 exposed to progressive implementation of policy and prevention programmes at different ages in Canada	Students reported: seeing students smoking near school or in school, seeing teachers or staff smoking, presence of clear rules in the school	Weekly smoking in grade 12	Occasional smoking (less than weekly) in grade 12
29	Pentz MA 1989	Cross-sectional	4807 adolescents in grade 7 (mean age 12) in 23 schools in California (USA)	STP components reported by staff: comprehensiveness (nr. of components), prevention emphasis, cessation emphasis, punishment emphasis	Smoking during last week and last 24 hours	Amount of smoking in the last week and in the last 24 hrs (mean nr cigarettes)
30	Piontek D 2008 a	Cross-sectional	3364 students (mean age 14.05, range 10-21) from Øverland 2010 schools in Germany	STP reported by principal or health educator: smoking ban for students, adults or visitors, monitoring students, observance of policy, sanction, availability of smoking cessation, smoking prevention activities. Mediating variables: school engagement,	Current smoking (past 30 days smoking)	Mediation of school effects by variables potentially influenced by school

				attachment to school, risk behaviors, use of substances		
31	Piontek D 2008 b	Cross-sectional	3364 students (age 10-21) from Øverland 2010 schools in Germany	STP reported by students: existence of rules, consequences for students smokers; availability of smoking cessation; enforcement.	Current smoking (past 30 days smoking)	
32	Poulin CC 2007	Cross-sectional	12990 students in grades 7-12 (mean age 14.9) in Canada	Perceived STP from students	Having smoked the first whole cigarette in the year preceding the survey	Academic performance
33	Reitsma AH 2004	Cross-sectional	29888 students in MS (grades 6-8) and HS (grades 9-12) in Canada	Perceived STP from students: sanctions, students seen smoking at or near school, presence of clear rules, consequences for students smoking.	Current smoking (past 30 days smoking)	
34	Sabiston CM 2009	Cross-sectional	24213 students in grade 10 and 11 (mean age 16) in 81 schools in Canada	STP reported by administrators: written policy (intentions); participation and communication; stated goals and purpose; whether all groups in school were prohibited all tobacco; strength of enforcement; prevention education; availability of cessation programmes. Field observation of policy enforcement.	Having smoked a whole cigarette in life and at least one puff in the past 30 days	
35	Sinha DN 2004b	Cross-sectional	6587 students (age 13-15) from 50 State and 50 Federal schools in India	Federal schools having STP contrasted to State schools (no STP)	Lifetime and current any tobacco use, smokeless and smoking	Students being taught curricula on tobacco
36	Wakefield MA 2000	Cross-sectional	17287 students (age 14-17) from 202 schools in USA	Presence of smoking bans and enforcement (if most students comply) self-reported by students	Combination of smoking behavior and intentions categorized into: non susceptible non-smokers; susceptible non-smokers; early experimenters; advanced experimenters; established smokers	Smoking prevalence (past 30-days)
37	Watts AW 2010	Cross-sectional	11881 students ever smokers in grade 7-12 (age 12-17) in Canada	Students perception of STP: clear rule and consequences for breaking rules	Smoking on school grounds	Smoking outside school grounds
	Wiiium N	Cross-	1941 students in	STP reported by	Daily and weekly	Daily smoking

38	2011 a	sectional	grades 210 and 11 (age 11-16) from 45 schools in Wales (UK)	teachers, : policy restriction; formal policy (whether written); staff policy approach (consultative vs. prescriptive); dissemination ;sanctions for students (underline health or underline transgression); consistency between policy, environment and school	smoking	on school premises
39	Wiium N 2011 b	Cross-sectional	1Øverland 20104 students (mean age 15) from 73 schools in Norway	STP reported by students and by teachers: parents informed, parents' disapproval, disciplinary measures, teachers' smoking, teachers' support	Daily smoking	Interactions between school policy and teachers support
Øverland 2010	Øverland S 2010	Cross-sectional	1444 people (age 16-20) from population registries in Norway	Perceived restriction of tobacco use (smoking and smokeless tobacco <i>snus</i>) at own school.	Current use of <i>snus</i> (daily or weekly)	Current use of cigarettes (daily or weekly)

**Appendix 4. Summary of associations between policy measures and students' tobacco use
(narrative review)**

Ref. #	First author	Unit of analysis	Statistical methods	Adjustment for confounders	Associations with primary outcome	Associations with secondary outcomes
10	Adams ML 2009	St	Hierarchical linear model (students - schools)	Gender, grade, ethnicity	Enforcement of STP linked to lower odds of smoking (OR=0.83, 0.70-0.99). Comprehensiveness not associated	Enforcement linked to lower odds of observing students smoking at school (OR=0.49 per unit of score, CI=0.32-0.75). No association with comprehensiveness.
11	Barnett TA 2007	St	Multi-level logistic regression by age groups	Parent and siblings smoking; income, rural-urban area, public or private school	Univariate association of smoking with staff and students smoking outdoors among 13-y old students. Multivariate association only with staff smoking outdoors among 13-y old girls (OR=4.8, 1.1-21.1)	No effect of policy variables on less than daily smoking, in any age or sex category
12	Boris NW 2009	St	Logistic regression and GEE model	None	No differences in students smoking in the two types of schools.	No differences in teachers' smoking; teachers of non-use schools were more aware of policy and more concerned for students seeing staff smoking.
13	Darling H 2006	Sc	Negative binomial regression	None	No association between any policy component or intensity with current smoking	No association between policy and: smoking, school smoking, purchasing cigarettes and health knowledge
14	Evans-Whipp TJ 2007	St	Logistic regression with robust "information sandwich" estimation of SE	State, cohort and recent tobacco use	Use of alcohol and drugs in school negatively associated with perception of emphasis on abstinence in education and policy, on harm minimization, and with expulsion for alcohol violation. Monitoring school area associated with increased risk of drinking at school	Students' perception of smoking in school negatively associated with harsh penalties against drug use (OR=0.52; CI=0.42-0.64) and with drug education based on harm minimization

					(OR=1.38, CI=1.03-1.85)	
15	Evans-Whipp TJ 2010	St	Random effect logistic regression	State, gender, age and family SES	No differential effects of policy dimensions on current smoking (between harm minimization and abstinence policies, and between comprehensive and not comprehensive smoking ban)	No differential effects of policy dimensions on daily smoking. Perception of school smoking negatively associated with strict enforcement of the policy (OR=0.45, CI=0.25-0.82)
16	Griesbach D 2002	Sc	Comparison between proportions (prevalence)	None (univariate analyses)	Written policy associated with lower proportion of pupils seen smoking in the school outdoors area and of teachers smoking in the staff room. Restrictions on students associated with lower proportion reporting students smoking. Total ban associated with lower proportions of pupils reporting staff smoking indoors but higher proportions reporting staff smoking outdoors	
17	Hamilton G 2003	St	Ordinary logistic regression	Gender, socio-economic status, family smoking	Counseling and education rather than discipline consequences associated with lower probability of ever smoking (OR=0.73; CI=0.64-0.84) or regular smoking (OR=0.67; CI=0.53--0.85).	Counseling and education significantly associated in the hypothesized direction with individual predictors of smoking, such as attitudes and perceived risks
18	Huang H-L 2010	St	Multi-level logistic regression with analyses separately by sex	Grade, family and friends smoking, alcohol drinking, betel-quid chewing	Ever smoking elevated for students in schools without anti-tobacco activities or curricula. Among males, perceived smoking in school associated with a 3-folds increased risk of smoking. No association with written policy status or restrictions	

19	Kumar R 2005	St	Multilevel logistic and linear regression	Gender, ethnicity, parental education at the student level. Type of school, size, urban-rural status and survey year at the school level	Monitoring students' behavior negatively associated with current daily smoking in MS, but not in HS. Severity of consequences positively related to smoking in HS, but no longer after adjustments. Staff allowed to smoke positive predictor of smoking, significant among HS students even in adjusted analyses	Monitoring and severity of measures not associated with students' disapproval of smoking. Staff permitted to smoke negatively associated with HS students' disapproval.
20	Lipperman-Kreda S 2009a	St	Mediation analysis through structural equation modeling	Irrelevant	Past 30-days smoking positively predicted by positive social expectancies, perceived smoking by peers, age and early initiation; perceived harm, perceived disapproval and perceived low availability negative predictors	Perceived enforcement of school policy negatively associated with positive expectancies, perceived availability and perceived smoking by peers and positively to perceived harms and personal disapproval
21	Lipperman-Kreda S 2009b	St	Multilevel logistic regression	Age, gender, age at smoking initiation, personal beliefs, social modeling variables at the individual level. School type at the school level.	The highest quartile of proportion perceiving strict rules and strict enforcement was associated with lower prevalence of any smoking (OR=0.62; CI= 0.44-0.89) and of daily smoking (OR=0.46; CI=0.20-0.80) compared to the lowest quartile. At the individual level, such endorsement entailed an increased risk of smoking	Smoking on school property (OR= 0.34; CI=0.19-0.59) and the likelihood of smoking if offered by best friend (OR=0.70; CI=0.52-0.95) was significantly lower in the upper quartile of perceived strict enforcement of the rules
22	Lovato CY 2007	Sc	Analysis of correlation coefficients and differences between means. Multiple	Simultaneous adjustment was made for several policy variables	Smoking prevalence correlated only with perception of smoking prevalence, but not with policy.	Smoking in the school area negatively predicted by prohibition, education and prevention and by students' perception of consequences for rules been broken; positively

			linear regression			predicted by policy purpose and goal, strength and consistency
23	Lovato CY 2010a	St	Multilevel logistic regression	Age and gender	Strong prohibition in written policies associated with lower probability of smoking (OR=0.92; 0.88-0.97). Policy enforcement, enforcement officer and observation of students smoking on school periphery associated with higher probability of smoking. Focus on preventive programmes associated with lower probability of smoking	
24	Lovato CY 2010b	St and Sc	Multilevel logistic regression (student) and negative binomial regression (school prevalence)	Grade and gender	Purpose and goals clearly stated (OR=0.38 CI=0.15-0.95), smoking prohibition, one variable of enforcement (officer) associated with lower probability to be a smoker. Availability of assistance to quit smoking associated with a higher probability of smoking (OR=2.23, CI= 1.12-4.45).	Smoking prevalence lowest for school without own policy. Predictors of smoking prevalence at the school level same as for individual level
25	Moore L 2001	St	Multilevel logistic regression	Age, gender, parents' and friends' smoking, parental expectations, family structure, family affluence score, bond to parents, connection to school	Increasing gradient of daily and of weekly smoking from schools with strong to schools with weak policy and from schools with high to low enforcement for pupils. Enforcement for staff not associated with pupils' smoking	
26	Murnaghan DA 2007	St	Multilevel logistic regression	Gender, wave of data collection and school location	Compared to baseline, students exposed to educational and cessation	No effect of any of the three conditions. Students who believed that breaking the rules would be sanctioned

					programmes less likely to be occasional smokers rather than non-smokers (OR=0.42; 0.18-0.97). Students exposed to STP or the combination of the two did not differ from the reference group.	were at increased risk of being regular rather than occasional smokers (OR=1.48; 1.02-2.15)
27	Murnaghan DA 2008	St	Multilevel logistic regression	Gender, school location, wave of data collection and mutually for school predictors	STP only associated with non-significant decrease of occasional smoking but increase of regular smoking (OR=1.54, CI= 1.04-2.29). Smoking prevention only associated with a significant reduction of occasional (OR=0.57, CI= 0.44-0.75), but not of regular smoking. Presence of both activities not associated with students' smoking. The belief that sanctions will occur if breaking rules associated with lower risk of occasional, but higher risk of regular smoking.	Smoking prevention associated with lower risk for occasional smoking when no close friend smoked, the contrary in presence of friends smoking
28	Murnaghan DA 2009	St	Logistic regression	Age, grade	Seeing teachers and staff smoking near school positively associated with regular smoking (Or=1.78; CI=1.13-2.80) (no effect among females). Among females, seeing students smoking where not allowed associated with risk. Perceiving consequences for breaking the rules associated with increased risk of regular smoking	Seeing students smoking at school linked to higher probability of occasional smoking rather than non-smoking among females.
29	Pentz MA	Sc	Linear and	School-level	Higher number of	Prevention emphasis

	1989		logistic regression is cited in methods	socio-economic status and school environmental support, staff awareness and perceived effectiveness of policy	components and emphasis on prevention rather than cessation associated with lower school smoking prevalence both weekly and last 24 hrs. High punishment emphasis not associated with lower prevalence	associated with lower amount smoking, cessation emphasis with higher amount and punishment emphasis with virtually no difference
30	Piontek D 2008a	St	Multilevel logistic regression	Not school-mediated: parental education and attitudes, parental and sibling smoking, pocket money. School-mediated: academic achievements, attachment to school, smoking attitudes, friends smoking	Complete ban for students and presence of evidence based prevention programmes associated with lower smoking prevalence. Smoking prevalence not affected by smoking restrictions for adults, sanctions, monitoring of students or availability of smoking cessation	No evidence that the two effective policy factors were mediated by individual characteristics that can be influenced by schools (e.g. academic achievements or school attachment)
31	Piontek D 2008b	St	Logistic regression	Sex, type of school, participation in the Bavarian project	Among 10-15 years old, increased risk to be a current smoker with no clear school rules against smoking (OR 1.62; 1.03-2.53). Among 16+ years old, risk increased if students reported seeing teachers smoking on the school premises (OR=1.97; CI 1.18-3.29)	
32	Poulin CC 2007	St	Multilevel logistic regression	Individual level: gender, grade, province of residence, family structure and mother's education. School level: presence of rules and of smoking prevalence in the previous year	Students reporting no smoking rule at school at higher risk of smoking, while unawareness of rules was protective. Smoking prevalence in school highly predictive of smoking initiation	Reporting no smoking rules at school predictive of poorer school performance
33	Reitsma AH 2004	St	Ordinary logistic regression	School size and location, gender, grade	In elementary schools enforcement linked to lower proportion of smokers. In	

					secondary schools stronger rules and stronger enforcement associated with higher probability of smoking	
34	Sabiston CM 2009	St	Multilevel logistic regression	Age, gender, school connectedness, family and friends smoking, perception of smoking in school	Prohibition and availability of cessation, but not prevention education, linked to lower probability of smoking. Several persons and groups in charge of enforcing the policy linked to lower prevalence of smoking. Length of time a policy was in place associated with a 1% increase in smoking probability per year. The observation of smokers in the school area associated with higher probability of smoking.	
35	Sinha DN 2004b	Sc	Comparisons between proportions	None	State schools (no STP) 5-6 times higher prevalence of any tobacco use and smokeless tobacco use than federal schools, 3-4 times higher prevalence of any smoking, and 5-6 times higher prevalence of cigarette smoking	In federal schools the proportion recalling curricula on danger of smoking was 25-30 times higher than in state schools.
36	Wakefield MA 2000	St	Logistic regression with random effects	Sex, grade, smoking adults in the family, siblings smoking	Ban enforcement associated with reduction in the probability to be in a more advanced stage compared to an earlier stage. Presence of ban not associated with behavioral progression	No association of smoking prevalence at the school level with school ban. Prevalence decreased with strong enforcement
37	Watts AW 2010	St	Multilevel logistic regression	Age, gender, school location	Positive predictors of smoking on school grounds: high perceived smoking prevalence at school,	Positive predictors of smoking off school grounds: perceived smoking prevalence, rules against smoking at

					students breaking the rules, students breaking the rules getting into troubles (upper grades). Negative predictor: perceiving clear school rules about smoking	school, compliance with the rules, students breaking the rules, and students breaking the rules fined or getting into troubles
38	Wiiium N 2011a	St	Multilevel logistic regression.	Gender, best friend's smoking, parental smoking, relation to parents, family structure, alienation from school	In multi-variate analyses no association with policy variables after controlling for individual characteristics	Prevalence of smoking in school lower in schools with total ban, with dissemination of policy to students and consistent with their anti-smoking messages. Results from multi-level modeling not statistically significant
39	Wiiium N 2012b	St	Multilevel logistic regression	None reported	Informing parents associated with a non- significant increased risk of being a daily smoker. Disciplinary measures at school associated with lower probability of smoking (borderline significance). Teachers' support associated with lower smoking. Teachers' smoking associated with higher prob. of smoking	No interactions between informing parents and parents smoking or between disciplinary measures at school and teachers support
Øverland 2010	Øverland S 2010	St	Ordinary logistic regression	Age, gender, type of school (vocational or general), region	Prohibition to use <i>snus</i> on the school premises was not associated with use, which was instead predicted by <i>snus</i> being permitted in class (adj OR= 2.3; CI=1.6-3.3) and by allowance to use <i>snus</i> in the school hours (adj. OR=2.5; CI=1.7-3.8)	Predictors of smoking: allowance to smoke outside school or in outdoor areas, students and teachers could smoke together, smoking during school hours not forbidden ((adj. OR=3.4; CI=2.2-5.2)

Legend: Sc= School St=Student MS= Middle School HS= High School STP= School anti-tobacco policy

Appendix 5. Characteristics of excluded studies in the systematic review

Study	Reason for exclusion
Adams 2009	Cross-sectional study; considered for hypothesis generation
Aldinger 2008	Inappropriate outcomes (no association with smoking behaviour)
Andersen 2012	RCT; not possible to isolate the predictor
Ariza 2008	Not possible to isolate the predictor
Baillie 2008	Inappropriate outcomes (no association with smoking behaviour)
Barnett 2007	Cross-sectional study; considered for hypothesis generation
Boris 2009	Cross-sectional study; considered for hypothesis generation
Clarke 1994	Cross-sectional study; considered for hypothesis generation
Darling 2003	Inappropriate outcomes (no association with smoking behaviour)
Darling 2006	Cross-sectional study; considered for hypothesis generation
De Vries 2003	RCT; not possible to isolate the predictor (see De Vries 2006)
De Vries 2006	RCT; not possible to isolate the predictor
Elder 1996	RCT; not possible to isolate the predictor
Evans-Whipp 2007	Inappropriate outcome (students' smoking based on observation)
Evans-Whipp 2010	Cross-sectional study; considered for hypothesis generation
Galán 2012	Cross-sectional study; considered for hypothesis generation
García-Vázquez 2009	Not possible to isolate the predictor
Gorini 2014	RCT; not possible to isolate the predictor
Griesbach 2002	Inappropriate outcome (pupils' perception of teacher and student smoking)

Hamilton 2003	Cross-sectional study; considered for hypothesis generation
Hamilton 2005	RCT; not possible to isolate the predictor
Huang 2010	Cross-sectional study; considered for hypothesis generation
Johnson 2009	Not possible to isolate the predictor
Kumar 2005	Cross-sectional study; considered for hypothesis generation
Labiris 2005	Not possible to isolate the predictor
Lipperman-Kreda 2009a	Inappropriate predictor's measure (policy reported by students)
Lipperman-Kreda 2009b	Inappropriate predictor's measure (policy reported by students)
Lovato 2007	Cross-sectional study; considered for hypothesis generation
Lovato 2010a	Cross-sectional study; considered for hypothesis generation
Lovato 2010b	Cross-sectional study; considered for hypothesis generation
Maes 2003	Inappropriate predictor
Moon 1999	Not possible to isolate the predictor
Moore 2001	Cross-sectional study; considered for hypothesis generation
Murnaghan 2007	Repeated cross-sectional study. Considered for hypothesis generation
Murnaghan 2008	Repeated cross-sectional study. Considered for hypothesis generation
Murnaghan 2009	Not possible to isolate the predictor
Novak 2001	Inappropriate predictor
O'Brien 2010	Inappropriate predictor
Paek 2013	Cross-sectional study; considered for hypothesis generation
Pentz 1989	Cross-sectional study; considered for

	hypothesis generation
Pinilla 2002	Inappropriate predictor's measure (policy reported by students)
Piontek 2008a	Inappropriate predictor's measure (policy reported by students)
Piontek 2008b	Cross-sectional study; considered for hypothesis generation
Poulin 2007	Inappropriate predictor's measure (policy reported by students)
Reitsma 2004	Inappropriate predictor's measure (policy reported by students)
Rosendhal 2002	Cohort study. Considered for hypothesis generation
Roski 1997	Inappropriate outcomes (no association with smoking behaviour)
Sabiston 2009	Cross-sectional study; considered for hypothesis generation
Schofield 2003	RCT; not possible to isolate the predictor
Sinha 2004a	Inappropriate predictor
Sinha 2004b	Cross-sectional study; considered for hypothesis generation
Trinidad 2005	Inappropriate outcomes
Wakefield 2000	Inappropriate predictor's measure (policy reported by students)
Watts 2010	Inappropriate predictor's measure (policy reported by students)
Wen 2010	RCT; not possible to isolate the predictor
Wium 2011a	Cross-sectional study; considered for hypothesis generation
Wium 2011b	Cross-sectional study; considered for hypothesis generation
Wold 2004	Inappropriate outcomes
Østhus 2007	Inappropriate predictor's measure (policy reported by students)
Øverland 2010	Inappropriate predictor's measure (policy reported by students)

Appendix 6. Characteristics of cross-sectional studies

Study	Participants	Characteristics of the policy	Associations with outcomes
Adams 2009	16561 students in grade 7 - 12 (age 12 - 17) attending 20 middle schools and 20 high schools in 24 towns in northern and central Illinois (USA) 2002 - 2005	STP measured with 2 scales: a) Enforcement (beliefs about the relative problem of youth tobacco use at school, level of active enforcement, strategies employed to enforce the policy, staff and student perceptions about the policy, environmental factors that may be related to tobacco use at school such as assessment of closed vs open campus) b) Comprehensiveness (defined as applicability, restrictions, repercussions, programmes, notification, and evaluation of the written policies)	Enforcement linked to lower odds of smoking (OR 0.83, 95% CI: 0.70 to 0.99) but not with comprehensiveness nor with the interaction between comprehensiveness and enforcement
Barnett 2007	763 students (mean age 13) in 50 schools and 762 students (mean age 16) in 57 schools in Quebec (Canada) in 1999. 25 students randomly selected in each school	STP defined as staff permitted to smoke indoors/outdoors; students permitted to smoke on school ground	Policies permitting students to smoke indoors were not associated with daily smoking among either 13 or 16-year-old students. Policies permitting staff to smoke outdoors were significantly associated with daily smoking among 13-year-old students. Multivariate effect limited to staff smoking outdoors among 13 years girls (OR 4.8, 95% CI: 1.1 to 21.1)
Boris 2009	4469 students in grade 9 (mean age 15.4) and 1041 teachers in high schools in Louisiana (USA) in 2004	Comparison between schools prohibiting all tobacco use by anyone on the school campus and at all school events (no-use policy) and schools that allow teachers and other staff to smoke in one 'restricted' area on campus (restricted-use policy)	No differences in students smoking in the 2 types of school
Clarke 1994	26,429 students from grades 7-12 (12 - 18)	All the schools have a smoking policy for students;	Smoking prevalence unrelated to staff and visitor smoking

	years) from 351 secondary schools and 347 teachers in Australia in 1990	differences between school about policies' characteristics for teachers and visitors and presence of smoking signs around the school	policy and presence of smoking signs
Darling 2006	26,580 students in grade 10 and 12 (mean age 15) from 63 schools in New Zealand in 2002	STP focus categorized as punishment (having sanctions for students who were caught smoking), cessation (having a cessation support), prevention (having included prevention guidelines), comprehensiveness (having communicate students to be smoke-free and informed the public about the policy); each group of schools was contrasted with the group of schools not having the specific focus	No association between any policy component or intensity with current smoking
Evans-Whipp 2010	3466 students in grade 8 and 10 (age 13 - 15) from 285 schools: 153 (1777 students) in Washington state (USA) and 132 (1689 students) in Victoria state (Australia) in 2003	STP components: comprehensiveness (teachers and staff covered by smoking policy; in force on school grounds and during school-related activities where students are present; extended to visitors) enforcement (policy rated between 'strictly enforced' and 'not at all strictly') , 'harsh' (expulsion, calling the police and out of school suspension) or 'remedial' (referred to a school counsellor or nurse, recommended to participate in an assistance, education, or cessation programme or required to participate in an assistance, education, or cessation programme) response for students violating the policy, orientation (emphasizing of total abstinence from drug	No differential effects of policy dimensions on current and daily smoking (between harm minimisation and abstinence policies, and between comprehensive and non-comprehensive smoking ban)

		use and emphasizing harm minimisation)	
Galán 2012	9127 students attending 4th year of compulsory secondary education (15 - 16 years) from 203 schools in Spain, 2001 - 2005	Variables taken into account: years before (2001 - 2002) and after (2003, 2004, 2005) the introduction of the law banning smoking at school; characteristics related to the school centre (compliance with the law banning smoking; written reference to smoking control policy in the school regulations; existence of complaints about smoking; undertaking of educational activities regarding smoking prevention)	No differences in smoking prevalence and amount of smoking between the schools that complied with the legislation and those that did not, or with those centres including smoking prevention policies in the school regulation
Hamilton 2003	4697 students in grade 9 (mean age 13.6) from 31 schools in Australia in 1999	STP components: involvement in school health promotion projects, formation of a school health committee, presence of a health policy and a written drug policy, availability of counselling, education, and discipline strategies used to deal with students caught smoking, quit strategies used to support students and staff who smoke	No association with having a health committee and a drug policy. Counseling, education for students caught smoking associated with lower probability of ever smoking (OR 0.73; 95% CI 0.64 to 0.84) or regular smoking (OR 0.67; 95% CI 0.53 to 0.85)
Huang 2010	2350 students from grade 3 - 6 (mean age 10.9) from 26 schools in South Taiwan in 2008	STP components: a) Policy status (written/informal/uncertain policy) b) Smoking restrictions (smoking banned completely on school premises/ permitted in restricted areas] c) Level of enforcement of smoking restrictions (always/not always) d) Health education related to tobacco, participation in smoke-free health promotion events, access to cessation programmes and sanctions	No association with written policy status or restrictions; Ever smoking elevated for students in schools with out anti-tobacco activities or curricula

		imposed on students smoking at school	
Kumar 2005	35,745 students in grade 8, 10 and 12 (age 13-16) in 342 schools of Michigan (USA) in 1999 and 2000	STP components: a) Monitoring of students' compliance b) Severity of consequences when students are caught violating the policy c) School policy regulating tobacco use by staff	Monitoring students' behaviour negatively associated with current daily smoking in middle, but not in high schools. Severity of consequences positively related to smoking in high schools, but no longer after adjustments. Permission for staff to smoke positive predictor of smoking in high schools
Lovato 2007	22,318 students in 10-11 grade (15 - 19 years old) from 81 schools in Canada	STP characteristics derived from a) Written policies coded in developing, overseeing and communicating the policy; purpose and goals; prohibition; strength of enforcement; characteristics of enforcement; tobacco use prevention education and assistance to overcome tobacco addictions b) School administrators' interviews on STP implementation c) students' survey on perception of policy enforcement	Smoking prevalence was only significantly correlated with perception of smoking prevalence, but not with policy. On school property smoking prevalence, but not smoking prevalence related to consistency of enforcement in policy implementation
Lovato 2010a	27,892 students from grade 5 - 9 (age 10 - 14) from 281 elementary and secondary schools (mean age 16) in 10 Canadian provinces in 2004 - 2005	Policy enforcement derived from information about who was involved in policy development, how students were informed, and the nature of enforcement	Purpose and goals clearly stated (OR 0.38; 95% CI 0.15 to 0.95) and presence of an enforcement officer (OR 0.60; 95% CI 0.36 to 0.99) associated with lower probability of being a smoker. Availability of assistance to quit smoking was associated with a higher probability of smoking (OR 2.23; 95% CI 1.12 to 4.45)
Lovato 2010b	24,474 students in 10 - 11 grade (15 - 19 years old) from 82 randomly sampled secondary schools in	School policy intent extracted by examining written documentation on smoking policies. Policy enforcement derived by	Strong prohibition in the written policy was associated with a lower probability of smoking (OR 0.92; 95% CI 0.88 to 0.97). Policy

	5 Canadian provinces (during the 2003 - 2004 school year)	principals' or teachers' interviews. Tobacco control programmes data derived from a survey completed by school administrators	enforcement (OR 1. 20; 95% CI 1.07 to 1.35) and enforcement officer (OR 1.22; 95% CI 1.04 to 1.43) were associated with higher probabilities of smoking. Focus on preventive programmes was associated with a lower probability of smoking (OR 0.87; 95% CI 0.81 to 0.94)
Moore 2001	1375 students in year 11 (aged 15 - 16) from 55 schools in Wales (UK) in 1998	STP coded as: 1. Written policy where pupils and teachers were not allowed to smoke anywhere on the school premises 2. No written policies for pupils and teachers and/or teachers allowed to smoke in restricted areas 3. Either no smoking policy for pupils or for teachers. Level of extension of the ban, enforcement	Weak policy was associated with daily (OR 3.84; 95% CI 1.76 to 8.37) and weekly (OR 2. 55; 95% CI 1.26 to 5.15) smoking. Low enforcement associated with daily (OR 1.41; 95% CI 0.96 to 2.07) and weekly (OR 1.32; 95% CI 0.92 to 1. 91) smoking for pupils. In logistic regression models the associations remained, even after adjustment for individual-level variables. Low enforcement for teachers compared to high enforcement was not associated with pupils' daily (OR 1.03; 95% CI 0.66 to 1.59) or weekly (OR 0.86; 95% CI 0.56 to 1.31) smoking
Murnaghan 2007	3965 students in grade 12 (mean age 17.6) from 10 schools in Canada, surveyed 1999 - 2001	Repeated cross-sectional with comparison time to assess the effect of implementation of smoking prevention programmes and introduction of STP in a school district. Characteristics of STP not reported	Students exposed to educational and cessation programmes less likely to be occasional smokers rather than non-smokers (OR 0. 42; 95% CI 0.18 to 0.97). Students exposed to STP (OR 1. 06; 95% CI 0.67 to 1.68) or the combination of the 2 did not differ from the reference group (OR 0.83; 95% CI 0.61 to 1.12)
Murnaghan 2008	4709 students in grade 10 (age 15 - 16)) from 10 schools in Canada, surveyed 1999 - 2001	Repeated cross-sectional with comparison time to assess the effect of implementation of smoking prevention programmes and introduction of STP in a school district. No report of the	STP only associated with nonsignificant decrease of occasional smoker vs current nonsmokers (OR 0.72; 95% CI 0. 50 to 1.03) and increase of regular smokers vs occasional smokers (OR 1.54; 95% CI

		characteristics of STP	1.04 to 2.29). Smoking prevention only associated with a significant reduction of occasional (OR 0.57; 95% CI 0.44 to 0.75), but not of regular smoking (OR 0.94; 95% CI 0.69 to 1.28). Presence of both activities not associated with students' smoking
Paek 2013	983 students in grades 9 and 12 (age 12 - 19) from 14 schools in Michigan (USA)	STP components: types of prohibiting tobacco products, hours of prohibiting tobacco use, places of prohibiting tobacco use, communication of tobacco policy, person in charge of enforcing tobacco policy, designation of a tobacco-free school zone, anti-smoking communications, tobacco cessation services, actions taken for students who are caught smoking cigarettes, stringency of tobacco policy enforcement	No association with policy variables after controlling for individual characteristics
Pentz 1989	4807 students in grade 7 (mean age 12) in 23 schools in California (USA) in 1986	STP components: comprehensiveness (presence of formal rule about no smoking on school grounds, near school grounds, closed campus policy, formal health education plan for smoking prevention programming, prevention emphasis, cessation emphasis, punishment emphasis, policy enforcement, time in effect, consequences for violation (7 categories increasing in severity), policy on school ground	Higher number of components and emphasis on prevention rather than cessation associated with statistically non-significant lower school smoking prevalence both weekly and in last 24 hrs. High punishment emphasis not associated with lower prevalence. More consistent effect obtained on amounts of smoking rather than on prevalence rates in particular, with high emphasis on prevention and low emphasis on cessation
Piontek 2008b	3364 students (mean age 14.05, range 10 - 21) from Øverland 2010 schools in Germany	STP characteristics investigated: a) Extension of smoking ban for students (in school building, on school grounds, or in immediate	Comprehensive ban for students (OR 0.62; 95% CI 0.42 to 0.92) and presence of evidence-based prevention programmes (OR 0.

		surroundings) b) Extension of smoking ban for adults (teachers, non-teaching staff, school visitors in school buildings) c) Monitoring of students' compliance with the smoking ban (monitored regularly in corridors, rest rooms and on school grounds) d) Sanctions following breaking the smoking rules (different sanction activities) e) Offers of smoking cessation courses f) Smoking prevention activities. Mediating variables: school engagement, attachment to school, risk behaviours, use of substances	62;95%CI0.39to0.99)associated with lower smoking prevalence. Smoking prevalence not affected by smoking restrictions for adults, sanctions, monitoring of students or availability of smoking cessation
Rosendh al 2002	(Cohort study) 2883 children recruited in the 5th grade with follow-up in 6th grade across 213 classes from 91 compulsory schools in Sweden in 1997	STP assessed through questions about formal adoption of a local anti-smoking policy; implementation of a local plan for anti-tobacco education; ongoing pedagogic activities against tobacco; presence of a smoking room for the staff; and availability of smoking cessation programmes for staff or for students	Having formally adopted a STP is not associated with smoking prevalence(OR 1.06; 95% CI 0.80 to 1.41)
Sabiston 2009	24,213 students in grade 10 and 11 (mean age 16) in 81 schools in Canada during 2003 - 2004 school year	STP reported in written policy (intent) and by administrators' interview. characteristics examined were: participation and communication (excellent if students were involved in the development of the policy, group appointed to oversee the policy, communication to students); stated goals and purpose (excellent if all groups in school were	Prohibition (OR 0.83; 95% CI 0.72 to 0.95) and availability of cessation assistance (OR 0.74; 95% CI 0.60 to 0.92), but not prevention education(OR1.23; 95% CI 0.96 to 1.57), linked to lower probability of smoking; length of time a policy was in place associated with a 1% increase in smoking probability per year

		prohibited from all tobacco), strength of enforcement (excellent if verbal and written warnings were delivered to the student and parent/ guardian, and sanctions were based on zero tolerance);characteristic of the enforcement (excellent if more than one person/ group was designated as ensuring policy enforcement, and the policy outlined clear enforcement strategies), prevention education; availability of cessation programmes, time in effect	
Sinha 2004b	6587students(age13-15)from 50 State and 50 Federal schools in India in 2000 - 2001	Federal schools having STP contrasted to State schools (noSTP). STP consists in specific rules and regulations prohibiting use of tobacco and tobacco products on school premises by students, school personnel, parents, and visitors	In State schools there was 5 - 6 times higher prevalence of any tobacco and smokeless tobacco use, 3 - 4 times higher prevalence of any smoking, and 5 - 6 times higher prevalence of cigarette smoking
Wiium 2011a	1941 students in grades 10 and 11 (age 11- 16) from45schools in Wales (UK) in 2001 - 2002	STP characteristics examined: policy restriction; formal policy (whether written); staff policy approach (consultative vs prescriptive); dissemination for pupils and staff; sanctions for students (underline health or underline transgression); consistency between policy, environment and school	No association with policy variables after controlling for individual characteristics. The only statistically significant association found was that pupils at tending schools that did not disseminate pupil smoking policy in a written document had a greater tendency (OR 2.16; 95% CI 1.13 to 4.10) to smoke daily on school premises than those who attended schools that disseminated policy through a written document
Wiium 2011b	1Øverland 20104 students (mean age 15) from 73 schools in Norway	STP characteristics examined the extent to which actions taken by schools (i.e.informing parents of adolescents' violation of the	School enforcement of smoking restrictions was not related to adolescent smoking prevalence (OR 1.29; 95% CI 0.80 to 2.05)

		school tobacco policy, disciplining and counselling adolescents who are caught smoking) changed prevalence	
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Appendix 7. Summary of comparison

Characteristics of the policy	Studies (Refs)	N. participants (country)	Age of participants	Results (*=statistically significant) ORs and RRs need a 95% CI
Formally-adopted STP vs no policy				
Favours policy (3)	Lovato 2010b	24,474 (Canada)	15 - 19 years	OR 0.92* current smoker (last 30 days)
	Moore 2001	1375 (UK)	15 - 16 years	OR 0.26* daily smoker
	Sinha 2004b	6587 (India)	13 - 15 years	OR 0.2* current smoker
		Total: 32,436		
No difference (6)	Galán 2012	9127 (Spain)	15 - 16 years	OR 0.96 current smoker
	Hamilton 2003	4697 (Australia)	13.6 mean age	OR 0.82 regular smoker
	Huang 2010	2350 (Taiwan)	10.9 mean age	No differences (values not reported)
	Murnaghan 2007	3965 (Canada)	17.6 mean age	OR 1.06 occasional smoker
	Murnaghan 2008	4709 (Canada)	15 - 16 years	OR 0.72 occasional smoker
	Rosendhal 2002	2883 (Sweden)	10 - 11 years	RR 1.06 ever smoker
		Total: 27,731		
Ban extended outdoor school premises vs internal ban				
Favours policy (1)	Piontek 2008b	2818 (Germany)	10 - 21 years	OR 0.62* current smoker (last 30 days)
		Total: 2818		
No difference (3)	Barnett 2007	762 (Canada)	13 - 16 years	20.8% (school with outdoor ban) vs 23.6% (school without outdoor ban) daily smoker prevalence
	Huang 2010	2350 (Taiwan)	10.9 mean age	No differences (values not reported)
	Pentz 1989	4807 (USA)	12 - 13 years	4.93% (schools with comprehensive STP) vs 5.60% weekly smoker
		Total: 7919		

Ban extended to teachers vs teachers' smoking allowed in limited area				
Favours policy (2)	Barnett 2007	395 (Canada)	13 mean age	OR 0.2* (staff cannot smoke outdoors) daily smoker among 13 years (girls)
	Kumar 2005	35,745 (USA)	13 - 16 years	OR 1.24 daily smoker in middle schools and OR 0.82 in high schools
		Total: 36,10overland 2010		
No difference (5)	Barnett 2007	1130 (Canada)	13 - 16 years	23.3% (staff can smoke outdoors) vs 22.8% (staff cannot smoke outdoors) daily smokers among 13 years (boys) and 16 years (P = ns)
	Boris 2009	4469 (USA)	15.4 mean age	24.6% (staff cannot smoke) vs. 25.2% (staff can smoke in restricted area) 30-day cigarette smoking prevalence (P = ns)
	Clarke 1994	26,429 (Australia)	12 - 18 years	27.2% (staff not allowed to smoke) vs 30.9% (no restrictions) weekly smokers among grade 11 and 12 (P < 1)
	Piontek 2008b	2818 (Germany)	10 - 21 years	β coefficient -0.06 current smoker
	Wiium 2011a	1941 (UK)	11 - 16 years	16.4% (staff not allowed to smoke) vs 18.6% (restricted area) daily smokers
		Total: 36,787		
STP highly enforced vs weakly or not enforced				
Favours policy (4)	Adams 2009	16,561 (USA)	12 - 17 years	OR 0.83* current smoker (last 30 days)
	Kumar 2005	35,745 (USA)	13 - 16 years	OR 0.81* daily smoker in middle school, OR 1.03 in high school
	Moore 2001	1375 (UK)	15 - 16 years	OR 0.65* daily smoker
	Sabiston 2009	24,213 (Canada)	16 mean age	OR 0.90* current smoker (last 30 days)

		Total: 77,894		
No difference (5)	Evans-Whipp 2010	3466 (USA and Australia)	13 - 15 years	OR 0.78 current smoker (last 30 days)
	Lovato 2007	22,318 (Canada)	15 - 19 years	OR 1.11 smoking prevalence
	Lovato 2010a	27,892 (Canada)	10 - 14 years	RR 1.63 current smoker (last 30 days)
	Piontek 2008b	2818 (Germany)	10 - 21 years	β coefficient 0.25 current smoker
	Wiiium 2011b	1Øverland 20104 (Norway)	16 mean age	OR 1.29 daily smoker
		Total: 57,898		
Favours controls (1)	Lovato 2010b	24,474 Canada	15 - 19 years	OR 1.20* current smoker
		Total: 24,474		
STP including (types of) sanctions for transgressors vs including weak or no sanction				
Favours counselling and education for students vs disciplinary approach only (1)	Hamilton 2003	4697 Australia	13.6 mean age	OR 0.67* regular smoker
		Total: 4697		
No difference (8)	Darling 2006	2658 (New Zealand)	15 mean age	RR 0.89 dailysmoker in school with sanctions included in the policy
	Evans-Whipp 2010	3466 (USA and Australia)	13 - 15 years	OR 0.99 current smoker (last 30 days)
	Kumar 2005	35,745 (USA)	13 - 16 years	OR 0.98 daily smoker in middle school, OR 1.01 in high school
	Paek 2013	983 (USA)	12 - 19 years	β coefficient -0.02 current smoker (last 30 days)
	Pentz 1989	4807 (USA)	12 - 13 years	4.91% weekly smokers in school with high punishment emphasis vs 5.38% in school

				with low punishment emphasis
	Piontek 2008b	2818 (Germany)	10 - 21 years	β coefficient 0.10 current smoker with punishment emphasis
	Wiium 2011a	1941 (UK)	11 - 16 years	18.1% (sanctions tending to health) vs 15.7% (sanctions tending to discipline) daily smokers
	Wiium 2011b	1Øverland 20104 (Norway)	15 years	OR 0.65 daily smoker when pupils were disciplined at school vs other forms, OR 2.90 daily smoker when parents were informed vs other forms
		Total: 53,822		
STP including assistance to quit for smokers vs STP without assistance				
Favours policy (1)	Sabiston 2009	24,213 (Canada)	16 mean age	OR 0.74* current smoker (last 30 days)
		Total: 24,213		
No difference (5)	Darling 2006	2658 (New Zealand)	15 mean age	RR 1.17 daily smoker
	Evans-Whipp 2010	3466 (USA and Australia)	13 - 15 years	OR 1.15 current smoker (last 30 days)
	Lovato 2007	22,318 (Canada)	15 - 19 years	No differences in smoking prevalence
	Pentz 1989	4807 (USA)	12 - 13 years	5.29% (high cessation emphasis) vs 4.72% (low cessation emphasis) weekly smokers
	Piontek 2008b	2818 (Germany)	10 - 21 years	β coefficient 0.32 current smoker when cessation programme is offered
		Total: 36,067		
Favours controls (1)	Lovato 2010a	27,892 Canada	10 - 14 years	RR 2.23* current smoker (last 30 days)
		Total: 27,892		
STP plus prevention components vs STP alone				

No difference (6)	Darling 2006)	2658 (New Zealand)	15 mean age	RR 1.17 daily smoker
	Lovato 2007	22,318 (Canada)	15 - 19 years	No differences in smoking prevalence
	Murnaghan 2007	3965 (Canada)	17.6 mean age	OR 0.83 occasional smoker
	Murnaghan 2008	4709 (Canada)	15 - 16 years	OR 1.54 occasional smoker
	Pentz 1989	4807 (USA)	12 - 13 years	4.31% (high prevention emphasis) vs 5.77% (low prevention emphasis) weekly smokers
	Sabiston 2009	24,213 (Canada)	16 mean age	OR 1.10 current smoker (last 30 days)
		Total: 62,670		

OR: odds ratio

RR: risk ratio