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## Does a smoking prevention program in elementary schools prepare children for secondary school?

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### ABSTRACT

**Introduction.** A smoking prevention program was developed to prepare children in elementary school for secondary school. This study assessed the effects on smoking in secondary school.

**Methods.** In 2002, 121 schools in The Netherlands were randomly assigned to the intervention or control group. The intervention group received 3 lessons in 5th grade of elementary school and a second 3 lessons in 6th grade. The control group received “usual care”. Students completed 5 questionnaires: before and after the lessons in 5th and 6th grade and in the first class of secondary school. At baseline, 3173 students completed the questionnaire; 57% completed all questionnaires.

**Results.** The program had limited effect at the end of elementary school. One year later in secondary school significant effects on behavioral determinants and smoking were found. The intervention group had a higher intention not to smoke ( $\beta = 0.13$ , 95% confidence interval = 0.01–0.24) and started to smoke less often than the control group (odds ratio = 0.59, 95% confidence interval = 0.35–0.99); smoking increased from 2.5% to 3.6% in the intervention group and from 3.2% to 6.5% in the control group. Girls showed the largest differences in smoking between intervention and control condition.

**Conclusions.** A prevention program in elementary school seems to be effective in preventing smoking.

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### Introduction

Young children are often negative about smoking: they think it is unhealthy and stinks. This attitude explains why only 2% of the Dutch children aged 10–12 years smoke (STIVORO, 2008). Due to factors like smoking behavior of peers and parents, social pressure to smoke, and non-smoking policies (Bidstrup et al., 2009; Bernat et al., 2008), this aversion to smoking diminishes rather quickly. It results in 23% smokers among 14-year olds and 44% among 18-year olds (STIVORO, 2008). Gervais et al. (2006) suggest that a person's first puff presents the beginning of a rapid process that leads to symptoms of nicotine dependence and escalating cigarette use. Moreover, adolescents who are stable users of tobacco at the age of 12 show greater weekly cigarette consumption and are more likely to become nicotine-dependent (Riggs et al., 2007).

The transition to high school is a period in which students are very vulnerable to factors that lead to smoking (Côté et al., 2004). This

emphasizes the importance to prepare 10-to 12-year-old children before they are most apparently facing the temptation to experiment with tobacco. In a review on the efficacy of non-smoking interventions (NHS, 1999), the authors also state that an important addition to present intervention practice would be to start interventions at an earlier age, before attitudes and beliefs about smoking are being formed. Starting an education program in elementary school could therefore be an effective instrument in the prevention of smoking onset in adolescence.

Flay (2009) performed a critical review of several reviews on the effects of school programs on prevention of tobacco use. There were some clear directions on what types of programs are most effective. They were summarized as follows: (1) interactive delivery methods; (2) the use of the social influence model; (3) including components on norms, commitment not to use, and intentions not to use; (4) adding community components; (5) including the use of peer leaders rather than relying totally on adult providers; (6) including training and practice in the use of refusal and other life skills. Based on this knowledge, STIVORO, the Dutch expert center on tobacco control, developed an education program called “But I don't smoke”, which was especially targeted at children in elementary school. Here we

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describe the effects of this program by investigating the following questions:

1. What are the immediate effects of the smoking prevention program in elementary school on children's self-reported social influences, attitudes, self-efficacy, intentions towards non-smoking, and smoking behavior?
2. Do these effects sustain after the transition from primary to secondary school?

## Methods

The study design is a cluster randomized controlled trial.

**Recruitment and participants:** in 2002, 121 Dutch elementary schools at the level of 5th grade participated in the study. They were recruited in five community health center regions.

**Sample size:** a power calculation indicated that 1400 students were needed in both the intervention and the control group to find a difference of 5% in smoking increase: a power of 80%, alpha of 0.05, and an intra-class correlation of 0.075.

**Cluster randomization:** we ranked the schools by community health center region. Within each region, the schools were randomly assigned to either the intervention or the control group. This was done by asking an independent person to toss a coin. In total 121 schools participated in the study representing 151 classes.

During the study, the control schools provided any smoking prevention program that they would normally give to their students (usual treatment). The researchers trained experimental and control schools in the same way regarding their tasks in the evaluation.

### The intervention

The intervention consisted of six lessons of 1 hour each, and it was based on the evidence on the effectiveness of education programs on smoking prevention (Flay, 2009; Hwang et al., 2004; Thomas and Perera, 2006; Cuijpers, 2002).

Lessons 1 to 3 were provided in 5th grade of elementary school and were directed at increasing knowledge on the consequences of smoking, forming an attitude towards (non-)smoking, and expressing the intention not to smoke. Intervention methods used were developing a school smoking project, interviewing parents, discussing attitudes towards smoking, and advising/encouraging making a non-smoking deal with their parents. Lessons 4 to 6 were provided in 6th grade and were aimed at providing insight into the factors that influence attitudes towards smoking, teaching skills to express one's opinion, planning how to react to social pressure, and strengthening the intention not to smoke. Showing a video followed by classroom discussion, developing campaign materials, role-playing, and handing the non-smoking certificate were important activities in 6th grade. The teachers delivered the intervention. They were trained on the ins and outs of the program by someone from the community health center.

**Data collection:** a questionnaire was administered immediately before and after the lessons in fifth grade and the lessons in sixth grade. Teachers decided when to deliver the lessons that school year. The control schools completed the questionnaires each school year within 6 weeks; teachers could decide themselves when this period started. This period of 6 weeks corresponded to the period in which the intervention group completed the pre-test questionnaire, gave the lessons, and completed the post-test questionnaire.

The last questionnaire in first grade of secondary school could not be completed in the classroom because children from elementary school had moved to different secondary schools. Therefore, the questionnaire was sent to the home address of the children.

Parents were asked permission for their child participating in the study, for sending their child a (postal) mail in the first grade of

secondary school, and for asking the school for their address at the end of elementary school. The completed questionnaires were anonymously entered in the database, and addresses were destroyed after ending the study.

### Questionnaire

The questionnaire was based on the Theory of Planned Behavior (Ajzen, 1991) and the Social Cognitive Theory (Bandura, 1986). The questionnaire was largely based on a questionnaire used in a previous study (Aussems, 2003).

### Attitude

Disadvantages of smoking, 10 items ( $\alpha$  (Cronbach's alpha) = 0.80) ranging from "negative" (1) to "very positive towards non-smoking" (4).

Advantages of smoking, 5 items ( $\alpha$  = 0.63) ranging from "negative" (1) to "very positive towards non-smoking" (4).

Social advantages of smoking, 3 items ( $\alpha$  = 0.80) ranging from "very negative" (−3) to "very positive towards non smoking" (+3).

Long term physical consequences, 2 items ( $\alpha$  = 0.76).

### Social influence

Smoking behavior "nuclear network", 4 items ranging from "smoking" (−1) and "not smoking" (0), of student's father, mother, brother/sister, and teacher. Smoking behavior "diffuse network", 2 items ranging from "almost all are smokers" (−4) to "almost none are smokers" (0), measuring the number of smoking friends and peers.

Present social norms, 6 items ranging from "very negative" (−3) to "very positive towards non-smoking" (3), measuring the perceived beliefs of student's father, mother, brother/sister, friends, peers, and teacher. This score was weighted by the student's motivation to comply, referring to how much the student care about the opinion of these persons about smoking: range from "not at all" (1) to "very much" (5).

Future social norms (age of 16), comparable to the indices for "present social norm" except that it refers to the social norms towards non-smoking at the age of 16.

Social pressure by offering cigarettes. Seven items ranging from very often (−4) to never (0), measuring the perceived pressure by offering cigarettes by parents, brothers/sisters, friends, peers, older boys and girls, and teachers. This score was weighted by the student's motivation to comply: range from "not at all" (1) to "very much" (5).

Social pressure by encouraging smoking. Seven items ranging from often encouraged (−2) to often discouraged (2), referring to the perceived pressure by encouraging to smoke. This score was also weighted by the student's motivation to comply.

Self-efficacy, 8 items ( $\alpha$  = 0.88) ranging from "very uncertain" (−3) to "very certain" (3), each referring to the student's expectations regarding refraining from smoking in different situations.

Intention to smoke was measured by one item ranging from "definitely do" (−3) to "definitely do not intent to smoke next year".

Smoking was categorized as (1) non-current smokers: students who never smoked, non-smokers (only smoked once), and quitters, and (2) current smokers: students who experimented with smoking or who smoked weekly or daily.

In each measurement, students were asked about smoking policies at school and at home.

Background characteristics were asked: ethnicity of the adolescents and of their mothers and fathers, work and educational level of mother and father, religion, age, and gender of the adolescent.

**Statistical methods:** we employed multilevel techniques to account for the clustering effect among students in classes (Rasbash et al., 2009). We used the statistical packages SPSS 16.0 and MIWin

to effectuate the analyses. We compared the intervention and control groups in terms of the change in determinants of smoking and of the change in the proportion of smokers using linear and logistic regression techniques. We compared before and immediately after the lessons in fifth grade, after the lessons in sixth grade, and 1 year after the lessons in sixth grade. The analyses were adjusted for background characteristics and behavioral determinants on which the intervention and control group significantly differed at baseline. Intention-to-treat analyses were conducted to assess potential bias due to selective non-response. Effect sizes were calculated for the significant intervention effects on behavioral determinants at the last measurement (effect size = Beta/standard deviation of mean). Stratified analyses were conducted to assess

whether the effects differed for gender, educational level, or socioeconomic status.

## Results

### Sample characteristics and attrition

In total 3173 students completed the baseline measurement; 1756 in the intervention group and 1417 in the control group. In the last group of elementary school, the response was 77%. In secondary school, 57% of the students completed the questionnaires of all five measurements. The non-response rate did not differ between intervention and control group (Fig. 1). The analyses were limited

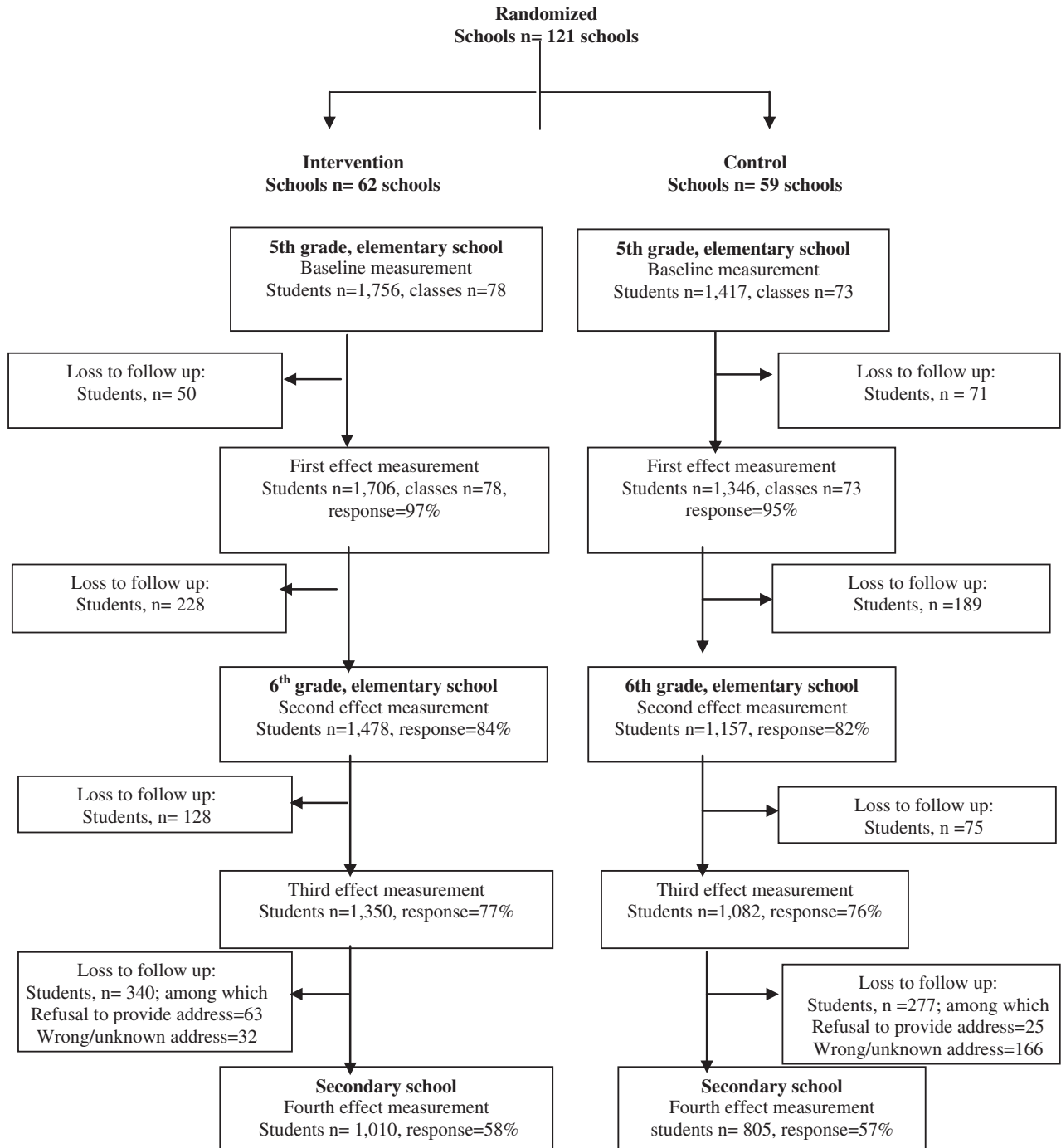


Fig. 1. Participant flow and follow-up.

to the students who completed all questionnaires. Multivariate analyses showed that students who dropped out were more likely to be male, to have parents who were immigrants from a non-industrialized country, to not know the work situation of their parents, to have another religion than being a Christian, and to be older. They also had a lower intention to refrain from smoking and they more often had a mother who smoked. The variables associated with the non-response were the same in the intervention and control group. Reasons for non-response were not completing a questionnaire at each measurement, not being able to match the questionnaire to a questionnaire completed in previous measurements, refusal to provide home address or wrong or unknown home address, and missing data on the primary outcome measure.

### Differences at baseline

The intervention group more often had a Christian religion, more often had parents with a higher education level, and more often attended a higher level secondary school than the control group (Table 1). There were no significant differences between the two groups in baseline behavioral determinants of smoking. Additional analyses showed that at baseline paternal smoking was significantly more prevalent in the control condition and smoking by the teacher in the intervention condition (however, smoking by the teacher did not differ between groups in the following school years). The analyses were adjusted for these differences.

At baseline smoking was more often allowed and lessons on smoking were less often provided in the intervention schools. In secondary school, intervention students more often reported that their parents promised them a reward if they did not start smoking and the control students more often reported having had lessons on smoking that year (Table 2).

**Table 1**  
Background variables, among students of 121 schools in The Netherlands in the period of 2002 to 2005.

|                                      | Intervention group <sup>a</sup><br>n = 1010, % | Control group <sup>a</sup><br>n = 805, % | P      |
|--------------------------------------|------------------------------------------------|------------------------------------------|--------|
| Gender                               |                                                |                                          | ns     |
| Boy                                  | 47                                             | 47                                       |        |
| Girl                                 | 53                                             | 53                                       |        |
| Age of the students at baseline      |                                                |                                          | ns     |
| <10 years or younger                 | 60                                             | 57                                       |        |
| 11 years                             | 38                                             | 38                                       |        |
| 12 years                             | 3                                              | 5                                        |        |
| Work situation of parents            |                                                |                                          | ns     |
| Both working                         | 60                                             | 57                                       |        |
| One working                          | 29                                             | 34                                       |        |
| No one working                       | 10                                             | 9                                        |        |
| Ethnicity                            |                                                |                                          | ns     |
| Industrialized                       | 93                                             | 90                                       |        |
| Non-industrialized                   | 7                                              | 10                                       |        |
| Religion                             |                                                |                                          | <0.01  |
| Christian                            | 37                                             | 31                                       |        |
| Other religion                       | 5                                              | 8                                        |        |
| No religion                          | 58                                             | 61                                       |        |
| Education of parents                 |                                                |                                          | <0.05  |
| Lower education                      | 14                                             | 15                                       |        |
| Average education                    | 29                                             | 30                                       |        |
| Higher education                     | 35                                             | 28                                       |        |
| Do not know                          | 23                                             | 27                                       |        |
| School level students in high school |                                                |                                          | <0.001 |
| Lower high school                    | 37                                             | 48                                       |        |
| Average high school                  | 47                                             | 37                                       |        |
| Higher high school                   | 12                                             | 9                                        |        |
| Unknown                              | 4                                              | 6                                        |        |

ns = Not statistically significant ( $p \geq 0.05$ ).

<sup>a</sup> Students who completed all five measurements.

### Effects during elementary school

In total 47% of students in the intervention group received all activities in 5th grade and 31% received all activities in 6th grade. The activity that was less often provided was planning how to react to social pressure towards smoking.

After the lessons in fifth grade, intervention students perceived more short-term and long-term disadvantages of smoking than control students. The control group perceived fewer advantages than the intervention group. Next, the students in the intervention group more often expected that their nuclear social network did not smoke and that their network would not approve if they would smoke. The significant effects found after the lessons in fifth grade disappeared in sixth grade. After the lessons in fifth and sixth grade, the intervention group still perceived more advantages of smoking than the control group. There were no significant differences on the other determinants of smoking behavior (Tables 3 and 4).

### Effects in secondary school

In secondary school in particular, social pressure to smoke and perceived prevalence of smoking in the diffuse and nuclear network increased in both the intervention and the control group. These social influence determinants increased, however, significantly less in the intervention group. The intervention group had also more positive attitudes towards non-smoking, had a higher intention not to smoke, and smoked less often than the control group (Tables 3 and 4). To assess the potential effect of selective dropout, we conducted an “intention-to-treat” analysis on the basis of the assumption that drop outs did not change their smoking since their last measurement, last observation carried forward. This did not change the effect (OR = 0.67, 95% confidence interval (95% CI) = 0.47–0.97).

Stratified analyses showed that the effects on intention and smoking behavior were only significant in girls. The intervention girls were significantly less inclined to start smoking ( $B = 0.21$ , 95% CI = 0.04–0.37) and to smoke (OR = 0.44, 95% CI = 0.24–0.81) than the control girls in secondary school. There were no differences for parental socio-economic status or educational level of the student.

### Behavioral determinants

To assess mediating effects, we also analyzed the relationship between the change in the behavioral determinants, in intention not to smoke, and in smoking behavior. An increased self-efficacy in refraining from smoking ( $B = 0.17$ , 95% CI = 0.12–0.21), an increased awareness of both disadvantages (0.50, 95% CI = 0.37–0.63) as advantages of smoking (0.19, 95% CI = 0.08–0.29), a decrease in the social pressure to smoke (0.12, 95% CI = 0.06–0.18), and in the perception of smoking behavior in diffuse (0.25, 95% CI = 0.13–0.37) and nuclear network (0.35, 95% CI = 0.05–0.65) were associated with an increased intention to refrain from smoking.

Smoking in secondary school was related to a decrease in the intention to refrain from smoking (OR = 0.59, 95% CI = 0.49–0.71) and in the perceived disadvantages of smoking (OR = 0.28, 95% CI = 0.16–0.49) and to an increase in perceived smoking in the diffuse network (OR = 0.45, 95% CI = 0.30–0.67).

### Discussion

The objective of this study was to assess the immediate and longer term effects of an education program to prevent the onset of smoking in the transition phase between elementary and secondary school. The education program seemed to have limited effect during elementary school. Midway the first class of secondary school, the children in the intervention group, however, indicated that they

**Table 2**

Prevalence of perceived non-smoking policies at school and at home in students of 121 schools in The Netherlands in the period of 2002 to 2005.

|                                                                       | T0   |      | T1   |      | T2   |      | T3   |      | T4   |      |
|-----------------------------------------------------------------------|------|------|------|------|------|------|------|------|------|------|
|                                                                       | I    | C    | I    | C    | I    | C    | I    | C    | I    | C    |
|                                                                       | %    | %    | %    | %    | %    | %    | %    | %    | %    | %    |
| <i>Home policies</i>                                                  |      |      |      |      |      |      |      |      |      |      |
| Reward promised by parents when not smoking                           |      |      |      | ***  |      | ***  |      | ***  |      | ***  |
| Yes                                                                   | 39.1 | 39.5 | 50.4 | 37.0 | 51.9 | 37.2 | 53.5 | 39.4 | 49.2 | 36.9 |
| No                                                                    | 60.9 | 60.5 | 49.6 | 63.0 | 48.1 | 62.8 | 46.5 | 60.6 | 50.8 | 63.9 |
| Discussing smoking with parents                                       |      |      |      | ***  |      | ***  |      | ***  |      | **   |
| Never                                                                 | 19.2 | 22.3 | 15.7 | 24.4 | 11.7 | 19.9 | 10.4 | 17.6 | 10.6 | 14.5 |
| Once                                                                  | 22.2 | 23.1 | 17.1 | 18.8 | 18.5 | 18.4 | 16.4 | 20.7 | 12.6 | 15.5 |
| More than once                                                        | 58.6 | 54.6 | 67.3 | 56.8 | 69.8 | 61.6 | 73.2 | 61.6 | 76.9 | 70.0 |
| Allowing smoking at home                                              |      |      |      |      |      |      |      |      |      |      |
| Yes                                                                   | 51.5 | 52.0 | 52.6 | 53.2 | 51.9 | 53.3 | 49.3 | 50.8 | 45.8 | 46.5 |
| No                                                                    | 41.7 | 41.9 | 42.4 | 41.3 | 43.3 | 42.0 | 46.1 | 44.8 | 51.5 | 49.8 |
| Do not know                                                           | 6.8  | 6.0  | 5.0  | 5.5  | 4.7  | 4.7  | 4.7  | 4.3  | 2.7  | 3.6  |
| Easy access to cigarettes at home                                     |      |      |      |      |      |      |      | *    |      | *    |
| Yes                                                                   | 17.1 | 20.7 | 20.6 | 21.6 | 22.0 | *    | 23.4 | 26.0 | 25.0 | 27.4 |
| No                                                                    | 69.9 | 66.9 | 67.3 | 67.0 | 68.5 | 24.6 | 69.0 | 63.6 | 67.6 | 62.5 |
| Do not know                                                           | 13.0 | 12.4 | 12.1 | 11.4 | 9.5  | 63.0 | 7.6  | 10.4 | 7.1  | 10.0 |
| <i>School policies</i>                                                |      |      |      |      |      |      |      |      |      |      |
| Lesson on smoking at school this school year or preceding school year | &    | *    | #    | ***  | &    | ***  | #    | ***  | #    | **   |
| Yes                                                                   | 10.8 | 12.2 | 96.4 | 44.7 | 95.1 | 65.2 | 94.8 | 55.4 | 34.9 | 40.9 |
| No                                                                    | 73.6 | 67.4 | 1.8  | 37.0 | 1.0  | 18.9 | 2.6  | 30.2 | 60.5 | 52.5 |
| Do not know                                                           | 15.5 | 20.5 | 1.8  | 18.4 | 3.9  | 15.8 | 2.6  | 14.4 | 4.6  | 6.6  |
| Allowing smoking at school                                            |      | ***  |      | ***  |      |      |      |      |      |      |
| Yes                                                                   | 24.0 | 11.8 | 27.1 | 18.1 | 24.6 | 22.2 | 25.8 | 22.9 | 69.8 | 69.0 |
| No                                                                    | 58.2 | 69.5 | 58.8 | 67.7 | 62.7 | 64.9 | 66.5 | 67.3 | 24.7 | 25.7 |
| Do not know                                                           | 17.8 | 18.7 | 14.1 | 14.3 | 12.7 | 12.9 | 7.7  | 9.8  | 5.6  | 5.4  |
| Possibility to buy cigarettes vicinity school                         |      | ***  |      | **   |      | ***  |      | ***  |      |      |
| Yes                                                                   | 41.0 | 47.9 | 48.6 | 54.3 | 50.7 | 60.9 | 52.7 | 61.9 | 46.4 | 49.6 |
| No                                                                    | 46.4 | 35.8 | 39.3 | 31.3 | 38.5 | 29.4 | 36.2 | 27.9 | 28.1 | 26.8 |
| Do not know                                                           | 12.6 | 16.3 | 12.0 | 14.4 | 10.8 | 9.7  | 11.1 | 10.1 | 25.6 | 23.6 |

Difference between intervention and control group: \* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$ .

&amp;,\*Question refers to lessons that school year (#) or lessons in preceding school year (&amp;).

I = intervention group,  $n = 1010$ ; C = control group,  $n = 805$ .

experienced less social pressure and had more positive attitudes towards non-smoking than the students in the control group. But above all they had a higher intention not to smoke and they less often smoked than the students in the control group, particularly the girls.

A possible explanation for this seemingly delayed effect is that, in elementary school, students both in the intervention and in the

control group were still against smoking. Just a few children smoked or experimented with smoking; both groups scored high on the determinants towards non-smoking, causing only limited changes in these determinants. These results also partly confirm the results of Côté et al. (2006), who found no effect on smoking behavior 2 and 8 months after an intervention in elementary school. In their study,

**Table 3**Linear regression to assess the effect of the education program on the behavioral determinants of smoking among students of 121 schools in The Netherlands in the period 2002 to 2005.<sup>a</sup>

|                                                      | Elementary school<br>$n = 1815$                |                                                | Secondary school<br>$n = 1815$              |             |
|------------------------------------------------------|------------------------------------------------|------------------------------------------------|---------------------------------------------|-------------|
|                                                      | After first 3 lessons in 5th grade             | After all 6 lessons in 6th grade               | Secondary school                            |             |
| Effect on: <sup>b</sup>                              | T1 versus T0<br>B (95% CI) <sup>c</sup>        | T3 versus T0<br>B (95% CI) <sup>c</sup>        | T4 versus T0<br>B (95% CI) <sup>c</sup>     | Effect size |
| Attitudes                                            |                                                |                                                |                                             |             |
| Short term disadvantages of smoking                  | <b><math>I = 0.07</math> (0.03 to 0.11)</b>    | $I = 0.03$ (−0.01 to 0.09)                     | <b><math>I = 0.07</math> (0.02 to 0.12)</b> | 0.14        |
| Advantages of smoking                                | <b><math>I = -0.07</math> (−0.12 to −0.02)</b> | <b><math>I = -0.09</math> (−0.14 to −0.03)</b> | $I = -0.01$ (−0.07 to 0.04)                 |             |
| Social consequences of smoking                       | $I = 0.02$ (−0.12 to 0.16)                     | $I = -0.06$ (−0.22 to 0.11)                    | $I = 0.06$ (−0.08 to 0.19)                  |             |
| Long term health consequences                        | <b><math>I = 0.21</math> (0.10 to 0.31)</b>    | $I = 0.11$ (−0.03 to 0.25)                     | $I = 0.05$ (−0.05 to 0.15)                  |             |
| Social influence                                     |                                                |                                                |                                             |             |
| Smoking nuclear network                              | $I = -0.01$ (−0.01 to 0.02)                    | $I = 0.01$ (−0.03 to 0.05)                     | $I = 0.02$ (−0.00 to 0.04)                  |             |
| Smoking diffuse network                              | $I = 0.01$ (−0.02 to 0.04)                     | $I = 0.01$ (−0.02 to 0.04)                     | $I = 0.06$ (−0.00 to 0.12)                  |             |
| Social norm now                                      | <b><math>I = 0.41</math> (0.14 to 0.69)</b>    | $I = -0.02$ (−0.36 to 0.31)                    | $I = 0.16$ (−0.09 to 0.41)                  |             |
| Social norm at the age of 16                         | <b><math>I = 0.45</math> (0.15 to 0.75)</b>    | $I = 0.00$ (−0.35 to 0.36)                     | $I = 0.07$ (−0.18 to 0.32)                  |             |
| Social pressure: being encouraged/dissuaded to smoke | $I = 0.29$ (−0.05 to 0.64)                     | $I = 0.09$ (−0.28 to 0.45)                     | <b><math>I = 0.32</math> (0.04 to 0.60)</b> | 0.11        |
| Social pressure: being offered a cigarette           | $I = -0.01$ (−0.10 to 0.08)                    | $I = -0.01$ (−0.08 to 0.06)                    | <b><math>I = 0.09</math> (0.01 to 0.17)</b> | 0.10        |
| Self efficacy                                        | $I = 0.10$ (−0.03 to 0.23)                     | $I = -0.02$ (−0.12 to 0.08)                    | $I = 0.07$ (−0.02 to 0.17)                  |             |
| Intention                                            | $I = 0.02$ (−0.07 to 0.12)                     | $I = -0.10$ (−0.26 to 0.06)                    | <b><math>I = 0.13</math> (0.01 to 0.24)</b> | 0.10        |

In bold: significant differences between intervention and control group.

<sup>a</sup> Separate linear regression analyses for each behavioral determinant: the behavioral determinant at each post measurement is the dependent variable. The behavioral determinant at baseline, the intervention condition, parental smoking behavior, and background characteristics on which groups differed at baseline are independent variables.<sup>b</sup> A positive B means a more positive score on a determinant towards non-smoking in the intervention group compared to the control group.<sup>c</sup> Control group is the reference group.

**Table 4**Effect of the education program on smoking onset among students in 121 schools in The Netherlands, in the period 2002 to 2005 ( $n = 1815$ ).

|                                    | 5th grade<br>Elementary school                                      |          | 6th grade<br>Elementary school                                             |          | Secondary school                                                     |
|------------------------------------|---------------------------------------------------------------------|----------|----------------------------------------------------------------------------|----------|----------------------------------------------------------------------|
|                                    | T0<br>%n                                                            | T1<br>%n | T2<br>%n                                                                   | T3<br>%n | T4<br>%n                                                             |
| Current smokers prevalence         |                                                                     |          |                                                                            |          |                                                                      |
| Intervention group, $n = 1010$     | 2.5                                                                 | 3.4      | 3.4                                                                        | 3.4      | 3.6                                                                  |
| Girls                              | 1.3                                                                 | 2.7      | 2.9                                                                        | 2.6      | 3.4                                                                  |
| Boys                               | 3.8                                                                 | 4.1      | 4.1                                                                        | 4.3      | 3.8                                                                  |
| Control group, $n = 805$           | 3.2                                                                 | 3.2      | 3.0                                                                        | 3.7      | 6.5                                                                  |
| Girls                              | 2.6                                                                 | 3.2      | 1.7                                                                        | 2.9      | 7.6                                                                  |
| Boys                               | 3.8                                                                 | 3.3      | 4.5                                                                        | 4.6      | 5.3                                                                  |
|                                    | After 3 lessons 5th grade;<br>T1 versus T0 OR (95% CI) <sup>a</sup> |          | After all 6 lessons in 6th grade;<br>T3 versus T0 OR (95% CI) <sup>a</sup> |          | One year after the lessons;<br>T4 versus T0 OR (95% CI) <sup>a</sup> |
| OR of being a current smoker       |                                                                     |          |                                                                            |          |                                                                      |
| Intervention group                 | 2.01 (0.93–4.33)                                                    |          | 1.32 (0.66–2.62)                                                           |          | 0.59 (0.35–0.99) <sup>b</sup>                                        |
| Control group (reference category) | 1                                                                   |          | 1                                                                          |          | 1                                                                    |

<sup>a</sup> Adjusted for smoking and parental smoking at baseline and differences in background characteristics.<sup>b</sup> Significant difference.

however, shortly after the intervention, more behavioral determinants changed than in our study. We observed a change in behavioral determinants and in behavior only in secondary school. In secondary school, intervention students perceived less social pressure to smoke than the control students. Social pressure was associated with a change in intention suggesting that the intervention accomplished exactly what it was supposed to do: preparing children for secondary school.

One question is whether the transition to a different school instead of the intervention is responsible for the difference between the intervention and control students. Other findings indicated, among others, that students are more likely susceptible to smoking if they have two or more close friends who smoke, attend a school with a relatively high smoking rate among the older students or a school with less (endorsed) smoking restrictions (Leatherdale et al., 2006; Wakefield et al., 2000). If a larger part of the control students went to schools with a higher smoking rate, this change in school instead of the intervention might have caused the difference in smoking. Although we could not verify this school transition effect properly, we do not think that the effect of the transition to secondary school differs for intervention or control students. First, in each participating region, we have randomized schools to the intervention or control group, meaning that an important part of the students in both conditions went to the same regional secondary schools. Secondly, there were no important differences in perceived non-smoking policies between the intervention and control group.

The largest effect of the intervention is found in girls. Other studies already have shown that there are gender differences in smoking uptake in adolescence and that smoking is more prevalent in girls than in boys (Rodham et al., 2005; de Vries et al., 2003). Moreover, Mercken et al. (2010) found that particularly girls are influenced to smoke by their peers concluding that an intervention preparing girls to resist peer pressure might be more effective in girls than in boys. This might explain the larger effect of the present intervention among girls.

#### Methodological considerations

The schools were randomly assigned to the intervention and control group in order to reduce the chance of selection bias. In spite of the randomization procedure, differences between the groups at baseline were found. Chance confounding, due to randomization at school level, may explain these differences, so we adjusted for this in our analysis. Loss to follow-up was somewhat selective but seemed to

have a limited effect on the results, while there were no significant differences in smoking behavior between the non-response of intervention and control condition. Moreover, intention-to-treat analyses by carrying the last observation of smoking behavior forward did not have different effects on smoking behavior. The response rate also did not differ between groups. Therefore, it is highly unlikely that selective response has affected the impact of the intervention.

All measurements were self-reports, meaning that information bias could have occurred, especially in the intervention group. A way of avoiding information bias would be to use biological objective measures like cotinine assays. This could be done by collecting hair samples, which are very stable over long time. Cotinine in hair represents, however, total tobacco smoke exposure and is influenced by second hand smoke. Furthermore, most children of this age do not smoke daily. This makes cotinine measurements very unstable; cotinine can only be detected if smoking or passive smoking occurs in the preceding 2 days (Carey and Abrams, 1988; Seersholm et al., 1999).

#### Implications

The fact that we found an effect a year after the education program had finished is important, because often interventions have a short-term effect (Crone et al., 2003; Thomas and Perera, 2006). Debatable is whether this effect sustains when students get older. Studies, for example, indicated that effects of interventions on smoking prevention often do not last till the age of 18 (Wiehe et al., 2005; Chassin et al., 2000). The effect of the interventions disintegrate quickly if no revision activities (booster session) are provided (Skare and Sussman, 2003; Dijkstra et al., 1999). More studies, including longitudinal studies, should shed more light on this discussion.

#### Conflict of interest statement

The authors declare that there is no conflict of interest.

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## Appendix A. Supplementary data

Supplementary data to this article can be found online at [doi:10.1016/j.ypmed.2010.11.003](https://doi.org/10.1016/j.ypmed.2010.11.003).

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