



Meri Paavola

Smoking from Adolescence to Adulthood

A 15-year Follow-up of the North Karelia Youth Project

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Department of Public Health,
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Meri Paavola

SMOKING FROM ADOLESCENCE TO ADULTHOOD

**A 15-YEAR FOLLOW-UP OF THE NORTH KARELIA YOUTH
PROJECT**

ACADEMIC DISSERTATION

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University of Helsinki, for public examination in Small Hall,
University Main Building, on December 16, 2006 at 10 o'clock.*

National Public Health Institute, Helsinki, Finland

and

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Kansanterveyslaitos (KTL)

Mannerheimintie 166

00300 Helsinki

Puh. vaihde (09) 474 41, telefax (09) 4744 8408

Folkhälsoinstitutet

Mannerheimvägen 166

00300 Helsingfors

Tel. växel (09) 474 41, telefax (09) 4744 8408

National Public Health Institute

Mannerheimintie 166

FIN-00300 Helsinki, Finland

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Quidquid agis, prudenter agas et respice finem.
'Mitä teetkin, toimi viisaasti ja ota huomioon lopputulos.'

S u p e r v i s e d b y

Research Professor Erkki Vartiainen, MD, PhD
Department of Health Promotion and Chronic Disease Prevention
National Public Health Institute (KTL)
Helsinki, Finland

R e v i e w e d b y

Professor Arja Rimpelä, MD, PhD, MSc
School of Public Health
University of Tampere
Tampere, Finland

and

Docent Ossi Rahkonen, PhD
Department of Public Health
University of Helsinki
Helsinki, Finland

O p p o n e n t

Professor Lasse Kannas, PhD, MEd
Department of Health Sciences
University of Jyväskylä
Jyväskylä, Finland

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ABSTRACT

Smoking continues to be the largest single preventable cause of premature mortality and morbidity in Finland as well in other industrialized countries worldwide. Smoking is an addictive behaviour which usually starts in adolescence and has effects on health later in life. Therefore it is important to know the predictors for smoking and ways how to prevent it.

The aim of present study was to examine the effects of a smoking prevention program and smoking in general from early adolescence to early adulthood by using longitudinal data. Specifically, the effects of the smoking prevention intervention, predictors of smoking, smoking cessation, and associations of smoking with socioeconomic factors and other health behaviours were assessed.

The data was gathered in connection with the North Karelia Youth Project follow-up study during 15 years. A two-year cardiovascular diseases (CVD) risk factor prevention program was carried out among students from grades seven to nine. The subjects of the study were the participants of the North Karelia Youth Project study from six schools in Eastern Finland. At the baseline in 1978 they were 13-year-olds (n=903) and in the last of the six surveys in 1993 28-year-olds. The parents of the subjects were studied twice, in 1978 and 1980.

A two-year intervention prevented smoking for several years, and the effect was better among those who were non-smokers at the baseline. The continuity of smoking from adolescence to adulthood was strong: most adolescent smokers were still smoking in adulthood. Moreover, approximately half of the 28-year-old smokers had started smoking after the age of 15. Previous smoking status and smoking by friends were the most important predictors of smoking at the age of 28. Parental and sibling smoking were associated weakly to the smoking of the subjects. One third of all adolescent smokers had stopped smoking before the age of 28, averaging at 2.3 % annual decline. The socioeconomic status of the subject and, especially, education were strongly related to smoking, the lower socioeconomic groups smoking the most. Parental socioeconomic status and intergenerational social mobility were not significantly related to the smoking of the subject in adolescence or adulthood. Smoking was associated positively with the use of alcohol and negatively with physical activity from adolescence to adulthood.

The results support the feasibility of a school-based social influence program with a community-based program in smoking prevention among adolescents. Strong continuity of smoking from adolescence to adulthood supports the importance of preventing the onset of smoking in adolescence. It would be useful to continue prevention programs also after the comprehensive school, since so many young start smoking after that. It would likewise be important to develop cessation programs tailor-made for adolescents and young adults. Additionally, the results support the importance of using methods based on social influence in smoking prevention and cessation programs, targeting especially such risk groups as those with low socioeconomic status as well as those with other unhealthy behaviours.

Keywords: smoking, adolescents, longitudinal, intervention, smoking prevention, smoking cessation, socioeconomic status, social mobility, use of alcohol, physical activity

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TIIVISTELMÄ

Tupakointi on suurin yksittäinen ennenaikaisen kuolleisuuden ja sairastavuuden aiheuttaja Suomessa samoin kuin muissa teollistuneissa maissa maailmanlaajuisesti. Tupakointi on riippuvuutta aiheuttava tapa, joka tavallisesti alkaa nuoruudessa ja vaikuttaa terveyteen vasta myöhemmin. Tämän vuoksi on tärkeää tietää tupakointia ennustavia tekijöitä ja keinoja, miten ehkäistä tupakoinnin aloittaminen.

Tutkimuksen tavoitteena oli tutkia tupakoinnin ehkäisyohjelman vaikutuksia sekä tupakointia yleensä nuoruudesta aikuisuuteen pitkittäisaineiston avulla. Erityisesti tarkoituksena oli tutkia tupakoinnin ehkäisyohjelman vaikutuksen lisäksi tupakointia ennustavia tekijöitä, tupakoinnin lopettamista sekä tupakoinnin yhteyttä sosio-ekonomisiin tekijöihin ja muihin terveystapoihin.

Aineisto kerättiin Pohjois-Karjalan nuorisoprojektin seurantatutkimuksen yhteydessä 15 vuoden aikana. Kaksivuotinen sydän- ja verisuonisairauksien riskitekijöiden ehkäisyprojekti toteutettiin yläasteen 7-9 luokilla. Tutkimukseen osallistuneet olivat Pohjois-Karjalan nuorisoprojektin seurantatutkimukseen osallistuneita oppilaita kuudesta koulusta Itä-Suomesta. Alkumittauksessa vuonna 1978 tutkimukseen osallistuneet olivat 13-vuotiaita (n=903) ja viimeisessä kuudesta tutkimuksesta vuonna 1993 28-vuotiaita. Oppilaiden vanhemmat osallistuiivat tutkimukseen vuosina 1978 ja 1980.

Kaksivuotinen Pohjois-Karjalan nuorisoprojekti ehkäisi tupakoinnin aloittamista useita vuosia. Vaikutus oli paras niille, jotka olivat tupakoimattomia alkumittauksessa. Tupakoinnin jatkuvuus nuoruudesta aikuisuuteen oli voimakasta: suurin osa nuorista tupakoijista tupakoi edelleen aikuisena. Kuitenkin noin puolet 28-vuotiaista tupakoijista oli aloittanut 15 ikävuoden jälkeen. Aiempi tupakointi ja tupakoivat ystävät olivat tärkeimmät tupakointia ennustavat tekijät 28-vuotiailla. Vanhempien ja sisarusten tupakoinnin yhteys tutkittavien tupakointiin oli heikko. Kolmasosa tupakoivista nuorista oli lopettanut tupakoinnin 28 ikävuoteen mennessä, keskimäärin 2.3 % vuodessa. Oma sosio-ekonominen asema ja erityisesti koulutus olivat yhteydessä tupakointiin siten, että alimpaan sosiaaliryhmään kuuluvat tupakoivat eniten. Vanhempien sosio-ekonominen asema tai sukupolven välinen sosiaalinen liikkuvuus eivät olleet merkittävästi yhteydessä tutkittavien tupakointiin nuoruudessa tai aikuisuudessa. Tupakoimattomiin verrattuna tupakoivat käyttivät enemmän alkoholia ja harrastivat vähemmän liikuntaa nuoruudesta aikuisuuteen.

Tutkimus osoitti, että jopa pitkän aikavälin tuloksia voidaan saada koulu- ja yhteisöpohjaisella tupakoinnin ehkäisyohjelmalla, minkä vuoksi ko. ohjelmat ovat käyttökelpoisia nuorten tupakoinnin ehkäisemisessä. Koska tupakoinnin jatkuvuus nuoruudesta aikuisuuteen on voimakasta, olisi tärkeää ehkäistä tupakoinnin aloittamista nuoruudessa, mutta myös jatkaa tupakoinnin ehkäisyä peruskoulun jälkeenkin, koska niin moni aloittaa tupakoinnin sen jälkeen. Samalla tulisi kehittää erityisesti nuorille ja nuorille aikuisille tehtyjä tupakoinnin lopettamisohjelmia. Tutkimustulokset tukevat sosiaaliseen vaikuttamiseen perustuvien menetelmien tärkeyttä tupakoinnin ehkäisy- ja lopettamisohjelmissa sekä ohjelmien kohdistamista erityisesti riskiryhmiin kuten niihin, jotka kuuluvat alimpiin sosio-ekonomisiin ryhmiin sekä niihin, joilla on tupakoinnin lisäksi muita epäterveellisiä tapoja.

Avainsanat: tupakointi, nuoret, pitkittäistutkimus, interventio, tupakoinnin ehkäisy, tupakoinnin lopettaminen, sosioekonominen asema, sosiaalinen liikkuvuus, alkoholinkäyttö, liikunta

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LIST OF ORIGINAL ARTICLES

The thesis is based on the following articles which are referred to in the text by their roman numerals.

I

Vartiainen E, Paavola M, McAlister A, Puska P: Fifteen-Year Follow-Up of Smoking Prevention Effects in the North Karelia Youth Project. *American Journal of Public Health* 1998;88:81-85.

II

Paavola M, Vartiainen E, Puska P: Predicting adult smoking: the influence of smoking during adolescence and smoking among friends and family. *Health Education Research* 1996;11:309-315.

III

Paavola M, Vartiainen E, Puska P: Smoking Cessation Between Teenage Years and Adulthood. *Health Education Research* 2001;16:49-57.

IV

Paavola M, Vartiainen E, Haukkala A: Smoking from adolescence to adulthood: The effects of parental and own socioeconomic status. *European Journal of Public Health* 2004;14:417-421.

V

Paavola M, Vartiainen E, Haukkala A: Smoking, Alcohol Use, and Physical Activity: A 13-Year Longitudinal Study Ranging from Adolescence into Adulthood. *Journal of Adolescent Health* 2004;35:238-244.

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ABBREVIATIONS

CI	Confidence Interval
CVD	Cardiovascular Diseases
HBSC	Health Behaviour in School-aged Children
OR	Odds Ratio
SD	Standard Deviation
SES	Socioeconomic Status
SPSS	Statistical Package for the Social Sciences
WHO	World Health Organization

1 INTRODUCTION

Smoking is the most important single preventable cause of premature morbidity and mortality (Ezzati et al., 2002; Murray and Lopez, 1997; USDHHS, 2000). Smoking prevalence is increasing worldwide and it is estimated that the number of deaths attributable to tobacco will increase from 3.0 million in 1990 to 8.4 million in 2020 (Murray and Lopez, 1997). Approximately half of continuing smokers are killed by their habit – a quarter while still in middle age (35-69 years). On average, smokers die ten years younger than non-smokers (Doll et al., 2004).

With the decline in smoking in many industrialized countries, smoking continues to shift from the developed to the developing countries (Shafey et al., 2003). Worldwide, about 50 % of males and 10 % of females are smoking, but there are great variations among nations. Smoking prevalence among 13-15-year-olds ranges from 1 % to 40 % in different countries (Global Youth Tobacco Survey (GYTS) Collaboration Group, 2002).

The decreasing of the smoking rates is largely agreed as an important goal of public health. Globally, WHO Framework Convention on Tobacco Control was developed in response to the globalization of the tobacco epidemic (WHO, 2003). Tobacco control is highly cost-effective (World Bank, 1999). Smoking prevalence can be decreased by a variety of smoking prevention and control efforts. Educational, clinical, regulatory, economic, and comprehensive approaches are widely used and studied.

Smoking is an addictive behaviour that usually starts in adolescence and has effects on health later in life. Prevention policies and interventions targeting on adolescents are essential, because the majority of smokers start this habit in adolescence (USDHHS, 1994). However, recent studies show that surprisingly many smokers start experimenting or regular smoking only in young adulthood (Hammond, 2005; Lantz, 2003). This might be the result of increased efforts of the tobacco industry to target on young adults (Lantz, 2003).

Finland has a long history of tobacco control policy; the Finnish Tobacco Control Act was passed already in 1976 (Puska et al., 1997; Tobacco Network, 2006). It prohibited smoking in most public places, restricted tobacco advertising, and set a 16-year age limit for tobacco purchases. Further revisions of the Act were made in 1995, when, for example, the age limit for tobacco purchases was raised to 18 years, and, in 2000, when environmental tobacco smoke (ETS) was included in the national list of carcinogenic substances. Among Finnish adults, smoking prevalence is nowadays one of the lowest in Europe (Shafey et al., 2003). In 2005, 26 % of 15-64-year-old males and 18 % of females smoked daily (Helakorpi et al., 2005). In general, the smoking trends suggest that the impact of tobacco policy is decreasing smoking initiation in youth (Helakorpi et al., 2004); for example the legislation appears to have decreased purchases from commercial sources to minors (Rimpelä and Rainio, 2004). The proportion of daily smokers among 14-18-year-old adolescents was 22 % in 2005; 22 % of boys and 23 % of the girls were smoking daily (Rimpelä et al., 2005).

The North Karelia Project started in Finland in 1972 with the aim of implementing a comprehensive, community-based program to lower the extremely high levels of heart diseases in the eastern province of Finland (Puska et al., 1995). The North Karelia Project achieved successful results (Vartiainen et al., 1994) and provided a model for numerous similar projects around the world.

The North Karelia *Youth* Project aimed at preventing risk factors of cardiovascular diseases (CVD) among 13-15-year-old adolescents (Vartiainen, 1982). The previous results of the North Karelia Youth Project concerning changes in CVD risk factors have been reported with more details in earlier publications (Pallonen et al., 1982; Puska et al., 1979; Puska et al., 1981; Puska et al., 1982; Vartiain-

nen, 1982; Vartiainen et al., 1990; Vartiainen et al., 1983, 1986; Vartiainen and Puska, 1986; Vartiainen et al., 1982a; Vartiainen et al., 1982b; Vartiainen et al., 1991a, b).

The overall aim of the present study was to examine the effects of the smoking prevention program and smoking in general from early adolescence to early adulthood. The study is based on the longitudinal data on smoking collected in 1978-1993 in connection with the North Karelia Youth Project follow-up study.

2 LITERATURE REVIEW

2.1 SCHOOL-BASED SMOKING PREVENTION PROGRAMS

In the late 1970s it was found that traditional, information-oriented smoking prevention programs in schools had not been successful in preventing or delaying smoking (Thomas, 2002; Thompson, 1978; USDHHS, 1994). Although they extended the knowledge of smoking and its risks, the attitudes or behaviour of the young were not changed by information-based programs (Rundall and Bruvold, 1988). Additionally, it was found out that the strongest predictors of onset were related to social influences such as friends and family smoking (Flay, 1985).

As a result of the above findings, efforts to develop more effective programs were started. These programs have been categorized for example as follows (Thomas, 2002): 1) Social competence approach based on Bandura's social learning theory (Bandura, 1977), 2) Social influence approach developed by Evans et al. (Evans, 1984; Evans et al., 1978), and 3) combination of the two first approaches, so-called Life Skills Training approach. Additionally, the programs can be divided by settings into school-based or school-community-incorporated programs.

Most school interventions have been variations of the social influence approach with different components from other approaches; therefore it is not possible to categorize these interventions unambiguously. In the present literature review the programs have been classified as follows: Social Influence, Life Skills Training, Competitions, Multiple substance prevention, and Community- and school-based approach.

2.1.1 Social Influence approach

Evans and colleagues developed and pioneered the first prevention program the aim of which was to teach students skills to resist social influences to smoke (Evans, 1984; Evans et al., 1978). The approach was based on the following information: 1) health information programs did not prevent students from starting smoking, and 2) the strongest predictors of the onset of smoking are related to social influences. Researchers concluded that adolescents need to learn how to refuse cigarettes and resist social pressure coming from the environment (Evans et al., 1978). First the seventh-grade students were taught to recognize the social influence on smoking. Then they were given information about the immediate physiologic effects of smoking and feedback from the surveys on the actual rates of smoking. Finally, the students were taught and trained a set of skills to deal with social influences to smoke by peers or media. The result of the ten-week investigation was positive: the onset of smoking was significantly lower in the intervention group (10 %) compared to control group (18 %) immediately after the program.

The following studies were carried out in the USA (Flay, 1985); in Stanford (McAlister et al., 1980; Perry et al., 1980; Telch et al., 1982), in Minnesota (Luepker et al., 1983), and in New York (Botvin et al., 1980). These studies were carried out only in one unit, in school or classroom. The results were relatively consistent in reducing the smoking onset by short-term. In later studies the methodology was improved and the studies included several units; these studies were carried out in Washington (Schinke et al., 1985), in Norway (Tell et al., 1984), and in Finland (Vartiainen et al., 1983). The studies published after that aimed at maximizing the internal validity and they included large-scale trials and randomized units.

Waterloo School Smoking Prevention Trial (Flay et al., 1989) in Canada was one of the first randomized trials of a social influence approach. Twenty-two schools with sixth-grade students were randomized to carry out or not a six-session curriculum. The program was successful in preventing the onset of experimental smoking two years. Six years later there were no overall differences between the program and control groups, indicating that the effect was not maintained.

One of the largest studies, being also highly rigorous, is the Hutchinson Smoking Prevention Project in the USA (n=8388). In this study no short- or long-term effect of an intensive eight-year program was found on smoking behaviour (Peterson et al., 2000a). The project ran for 15 years and aimed at assessing the effect of a social influence approach including all essential elements for school-based prevention (Glynn, 1989). The intervention included 65 lessons and lasted from grades three to ten. In the trial the participants were followed up for two years after they had left school. There was no immediate effect on intervention or two years after the program was finished.

A number of studies on the prevention of smoking have been carried out in the USA, but interventions have been evaluated also in Canada (Flay et al., 1989; Renaud et al., 2003), Norway (Josendal et al., 1998; Klepp et al., 1993), Finland (Vartiainen et al., 1983), the Netherlands (Cuijpers et al., 2002; De Vries et al., 1994; Dijkstra et al., 1999), UK (Nutbeam et al., 1993), India (Reddy et al., 2002) and Australia (Shean et al., 1994; Shope et al., 1996) as well as at the European level (de Vries et al., 2005; Hanewinkel and Asshauer, 2004).

Most intervention studies have shown positive short-term effects in the intervention group compared to the control group immediately after the intervention, (Cameron et al., 1999; Elder et al., 1993b; Killen et al., 1989; McAlister et al., 1980; Perry et al., 1980; Shope et al., 1996; Telch et al., 1990), in six months after the intervention (Chou et al., 1998; Ellickson et al., 2003; Josendal et al., 1998; Klepp et al., 1994), in nine months after the intervention (Telch et al., 1982), and in one-year follow-ups (Ausems et al., 2004; Cuijpers et al., 2002; De Vries et al., 1994; Dielman et al., 1985; Murray et al., 1987; Reddy et al., 2002). However, some interventions have failed to show any effect on smoking (Flay et al., 1995; Nutbeam et al., 1993; Peterson et al., 2000b).

In a few studies peer-led sessions have been found more effective compared to teacher-led programs (Luepker et al., 1983; Mellanby et al., 2000; Telch et al., 1990; Tobler, 1986), and booster sessions have proved to prolong the effectiveness (Dijkstra et al., 1999). Additionally, the effectiveness of prevention programs can be improved if the programs are culturally tailored as was the program targeting Hispanic boys (Unger et al., 2004) or the special program for adolescents living in a tobacco-producing region (Noland et al., 1998).

Long-term positive effects have not been very common. First, quite a few studies have followed up the intervention several years. Secondly, the results of most long-term follow-up studies have indicated that the effects of prevention are generally not maintained. Longitudinal studies were not able to show effects after two or three years (Chou et al., 1998; Cuijpers et al., 2002) or five or six years (Ellickson et al., 1993; Flay et al., 1989; Murray et al., 1989), though the results were successful immediately after the program. There are some studies with successful results maintained between two and four years (Dent et al., 1995; Flynn et al., 1997; Hansen et al., 1988; Luepker et al., 1983; Snow et al., 1992); also the effect of the program Know Your Body lasted for six years (Walter et al., 1989). In an Australian study (Shean et al., 1994) the effects of the program lasted for seven years among the females. In a Norwegian study it was found that the intervention group of non-smoking males at the baseline included significantly fewer smokers in a 12-year follow-up (Klepp et al., 1994)

2.1.2 Life Skills Training approach

Life Skills Training (LST) was designed to teach skills for resisting social pressures and, additionally, to teach coping skills such as decision-making and problem-solving (Botvin et al., 1980; Botvin and Kantor, 2000). The LST program consists of 15-20 sessions for seventh-grade students, with additional booster sessions in the eighth and ninth grades (Perry and Kelder, 1992). Life Skills Training was first tested (Botvin et al., 1980) among students from grades eight to ten in New York. The results indicated a positive and significant effect on experimental smoking. The other Life Skills Training study tested the relative efficacy of peer leaders and teachers as program providers (Botvin et al., 1990). The program had an effect on smoking when it was provided by peer leaders and had booster sessions (Botvin et al., 1995). A positive effect on smoking was found immediately after the intervention and still six years after the baseline. Epstein et al. (2000) tested the Life Skills Training approach among students from grades six to nine and found out that general competence (decision-making skills and self-efficacy) predicted higher refusal assertiveness, which predicted less smoking at the two-year follow-up.

The positive results of the Project Towards No Tobacco Use in the USA (Sussman et al., 1993) indicated that intervention in the seventh grade can be effective for at least two years post-program (Dent et al., 1995). The Life Skills Training program in Norway aimed at training the social skills to resist smoking pressure and personal freedom (Josendal et al., 1998). From the different variations, the comprehensive intervention was the most effective in reducing smoking among participants in a three-year follow-up (Josendal et al., 2005). In Austria, Denmark, Luxembourg, and Germany (Hanewinkel and Asshauer, 2004) the aim of a four-month program was to promote social competence and coping skills. The program showed a weak effect on lifetime smoking prevalence and experimental smoking.

The Life Skills Training program has also been tested among specific groups, and especially short-term results of tailor-made programs have been positive. In a study carried out among the Hispanic youth in the USA fewer smokers were found in the intervention group immediately after the program (Botvin et al., 1992); similar results were obtained also among high-risk adolescents in the USA and Norway (Griffin et al., 2003a; Josendal et al., 2005), among the minority of urban black youth in the USA (Botvin et al., 1989), and urban minority girls in the USA (Botvin et al., 1992; Botvin et al., 1999).

To conclude, the results of the Life Skills Training approach are relatively good: different variations of the program among different groups have been found effective in the prevention of smoking, the effect of some of them being maintained even for several years.

2.1.3 Competition-based approach

In programs based on competitions and joint commitments, a group of students make a joint commitment not to smoke for a certain period of time. After this period, the non-smokers are rewarded (Vartiainen et al., 1996; Wiborg and Hanewinkel, 2002). The main idea is that positive reinforcement enhances the probability of producing a desired behaviour.

In the study of the Smokefree Class Competition in Germany (Wiborg and Hanewinkel, 2002) it was found that the effect of competition was especially strong among those of the young who were non-smokers at the baseline, in the seventh grade. In a six-month follow-up after the competition had finished, smoking had increased significantly more in the control groups than in the intervention groups. These results are comparable with those of a Finnish study (Vartiainen et al., 1996). In another study from Germany on Smokefree Class Competition (Schulze et al., 2005) no effect of the competition was found in smoking in an 18-month follow-up. However, in that study immediate effects were not studied, and “drop-outs” were not analysed separately. In a Dutch study (Crone et al., 2003) the results

showed a favourable effect of the competition in short-term, but in the one-year follow-up the effect was weakened being no longer significant. In Norway the competition-based program was also found successful, the results showing lower smoking prevalence among participants, especially among girls (Svoen and Schei, 1999). Hansen (1992) concluded that several successful prevention programs included pledges and other forms of public commitment as part of the program.

2.1.4 Multiple substance prevention approach

Some studies have included an examination of the prevention of multiple substances, such as tobacco, alcohol, and drugs, by teaching skills in general and, especially, skills to resist social pressures (Botvin and Kantor, 2000; Hansen, 1992). The following studies have been carried out in the USA.

The ALERT program (Ellickson et al., 1993) aimed at preventing smoking as well as the use of alcohol and drugs among students from grades seven and eight. In a six-year follow-up it was found that stopping the project also stopped the effects on use. The revised program with booster sessions was carried out later (Ellickson et al., 2003; Orlando et al., 2005a). In a six-month follow-up after the program was finished, there were statistically significantly fewer smokers in the intervention group.

The SHOUT program was carried out during a three-year period for students from grades seven, eight, and nine (Elder et al., 1993a). At the end of the program, the prevalence of smoking was significantly lower among the participants. The program was reintroduced in the 11th grade to half of the students (Eckhardt et al., 1997). The results showed that continued intervention students reported statistically significantly lower smoking rates.

The DARE program has been a largely used drug prevention program among students of grade six (Clayton et al., 1996). The DARE curriculum contains elements of informational, affective, and social influence approaches. The program is delivered by police officers. The results of the follow-up studies (Clayton et al., 1996; Lynam et al., 1999) and meta-analyses (Ennett et al., 1994) have shown no effects (Clayton et al., 1996; Lynam et al., 1999) or only very limited effects (Ennett et al., 1994). The researchers concluded that the effectiveness of the DARE program is lower compared to that seen in programs emphasizing competencies and using interactive teaching strategies.

In the study of Botvin et al. a three-year intervention was started in the seventh grade using a social influence approach combined with Life Skills Training and booster sessions to prevent smoking as well as the use of alcohol and drugs. (Botvin et al., 1995). In the six-year follow-up the strongest effects were seen in those who had received a complete version of the intervention: there were up to 66 % fewer smokers and users of alcohol and 44 % fewer users of drugs in the intervention group compared to the control group.

The multiple substance prevention programs have been more effective to prevent smoking than the use of other substances. This is probably due to the primary focus of the programs which has mostly been on the prevention of smoking (Rundall and Bruvold, 1988). Moreover, there is some evidence about preventing the use of alcohol and drugs at the same time.

2.1.5 Community- and school-based prevention approach

The Midwestern Multicomponent Trial in Southern California was the first reported (Pentz et al., 1989) multi-component community program directed towards delaying the onset of smoking in adolescence. The program implementation included school, booster activities, parents, and mass media components. The results showed that still two years after the program had been finished, smoking among the students in the program schools was significantly lower than in the control group.

The Class of 1989 Study was part of the Minnesota Heart Health program (Perry et al., 1994; Perry and Kelder, 1992) which aimed at preventing cardiovascular diseases in three communities from 1980 to 1993. A five-year health promotion program in schools was combined with a community-wide general population CVD prevention program. The school program was started when the students were in the sixth grade in 1983. The control community did not receive any special intervention. The students in the intervention communities had significantly lower smoking prevalence at each assessment until the 12th grade.

The Child and Adolescent Trial for Cardiovascular Health (CATCH) study was a trial carried out in four states of the USA to examine the effects of the school program with family intervention components and policy interventions (Elder et al., 1996). There was no difference in smoking between the intervention and control groups, but the percentage of schools with a no-smoking policy increased during the three years of the study.

The Stanford Five-City Study in California was a multi-factor cardiovascular disease prevention study (Winkleby et al., 1993). In the schools the smoking prevention program CLASP was carried out by older peers. The six-year community intervention was carried out in two intervention communities. During the 12-year study period, the prevalence of smoking declined in all cities but showed only a little change among the 12-15-year-olds. The declines were not significantly different in the intervention cities compared to the control ones.

A three-year community health promotion project Action Heart with a separate school component was undertaken in two communities in UK (Baxter et al., 1997). However, it was not clearly reported what kind of a health promotion program was carried out in the schools. Lifestyle factors including smoking were measured at the baseline and three years later. There were no significant differences in smoking between the intervention and control groups.

The first randomized experimental evaluation of a community prevention program versus a school-based program was carried out in Oregon (Biglan et al., 2000). Eight pairs of small communities were randomly assigned to receive a school-based Sixteen-program alone or with a community program. The community program included media advocacy, family activities, and reduction of youth access to tobacco. The effects were assessed through five annual surveys of the 12-15-year-old students. The smoking prevalence was lower among the students in the school-community intervention compared to the students in the school intervention still after three years of intervention (Biglan et al., 2000).

The Heart Health Project was implemented during five years in Canada (Renaud et al., 2003). The comprehensive program was targeting children and adults for multiple risk factors in multiple sites. In a controlled, two-year follow-up, the program produced negative, reverse effects on smoking.

The Texas Tobacco Prevention Initiative tested how the intensity of anti-smoking media-campaigns and different types of community programs influence adolescent smoking among students in grade six (Meshack et al., 2004). The main result after a six-month intervention was that the best smoking prevention effects in adolescents were achieved by combining the intensive media campaign with the comprehensive community program. In Vermont, the effects of the combined school and mass media intervention persisted for two years after the intervention in a six-year follow-up (Flynn et al., 1994).

The European Smoking Prevention Framework Approach (ESFA) study performed in six countries tested the effects of a comprehensive smoking prevention approach in a 30-month follow-up (de Vries et al., 2005). The program targeted smoking at four levels: adolescents, schools, parents, and out-of-school setting. The project resulted in a small, but significant, effect: more non-smokers in the control group had become smokers compared to the intervention group. The effect was positive and significant in three countries: Portugal, Spain, and Finland. An opposite effect was found among native

Dutch adolescents. Among the Finnish students the intervention was effective among those successful in their studies but also among students with low school performance (Vartiainen et al., 2004).

Sustainability issues led researchers to embed school-based interventions in community-wide activities (Manske et al., 1997). The results of these studies suggest that a multi-component community program can prevent adolescent smoking for several years (Perry et al., 1994; Sowden et al., 2003; Vartiainen et al., 1986) and combining a school program with mass media (Flynn et al., 1994) or with a community program can have a greater effect on smoking than one of these programs alone (Biglan et al., 2000; Pentz, 1999; Pentz et al., 1989; Sowden et al., 2003). However, there are also studies in which the comprehensive school-community program did not have desired effects on adolescent smoking (Baxter et al., 1997; Elder et al., 1996; Renaud et al., 2003; Winkleby et al., 1993). The data on the effectiveness of school interventions with community participation is still limited.

2.1.6 Meta-analyses and reviews

In a meta-analysis of about 65 studies carried out in the USA (1978-1993) it was counted that psychosocial smoking prevention programs were effective in showing an approximately 10 % relative reduction in smoking behaviour (Hwang et al., 2004). The results of another meta-analysis including studies from the years 1974-1991 suggested that the reduction in smoking may be only 5 % or, under optimal conditions, 20-30 % (Rooney and Murray, 1996). Sussman (1999) concluded that the mean reduction in smoking was 6 % with a range of 0-11 %. Some reviewers have been more positive and estimated that smoking can be reduced on a short-term basis by 35-45 % (Botvin et al., 1998) or by 30-50 % (Skara and Sussman, 2003; Thomas, 2002). Thomas concluded in his review (2002) that in a one-year follow-up, there was 8-15 % more non-smokers in the intervention groups compared to the controls. Wiehe (2005) found hardly any support for the long-term effectiveness of the school programs. Hansen (1992), on the other hand, concluded that approximately half of the outcomes from social influence and comprehensive programs were positive. Bruvold (1993) found out that the strongest effect was produced by the social influence. In one of the latest reviews it is stressed that the school-based programs should be combined with a community approach (Backinger et al., 2003).

As a conclusion of the reviews and meta-analyses, social influence strategies can prevent or delay the onset of smoking in adolescence, but over time the effect tends to decay. Moreover, researchers have given relatively different estimations about the extent of the possible reduction.

2.1.7 Conclusions

Due to large variation in the results, it is not possible to draw clear conclusions of the effectiveness of different smoking prevention approaches. It is also difficult to conclude exactly which elements are the most effective, since the content of the programs differs widely and most interventions are not reported with details in the articles. The difficulty of characterizing interventions may be one reason for conflicting results and conclusions in reviews and meta-analyses. The interventions have differed in the length of the program (from some months to several years), number of the sessions at schools (varying from five to 65), age of the target group (usually 13-15 years), training techniques and content, provider (teacher, peer leader or outsider), and settings (school, community). Programs that were successful in achieving prevention effects tended to have more sessions over a longer time period, though this was not always the case.

The quality of the implementation has not usually been reported or evaluated. The effect of intervention might be influenced, for example, by the personality of the teacher or the relationship between the teacher and students. On the other hand, successful interventions have been carried out under various

implementation conditions, in different times, countries, cultures, and minorities. These diverse characteristics of successful programs support the generalizability of the social influence model. The studies of combined community- and school-based programs have given partly promising results, but the evidence is still quite limited.

2.2 SMOKING FROM ADOLESCENCE TO ADULTHOOD

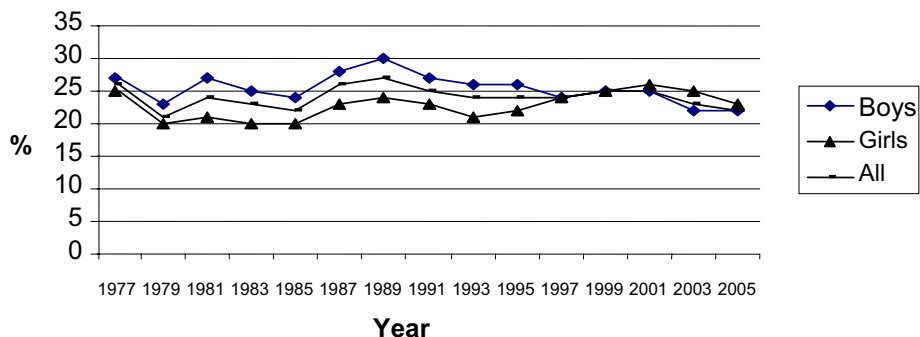
2.2.1 Smoking prevalence

Smoking is widespread among adolescents throughout the world, but there is a great variation among nations (Global Youth Tobacco Survey (GYTS) Collaboration Group, 2002; Godeau et al., 2004). The WHO collaborative cross-national survey Health Behaviour in School-aged Children (HBSC), describes adolescent smoking surveyed across Europe and North America (Godeau et al., 2004). The proportion of adolescents reporting ever having smoked rises significantly with age in all countries: from 15 % for 11-year-olds to 40 % for 13-year-olds, and 62 % for 15-year-olds. Among 15-year-olds who report ever having smoked, the mean age of onset was 12.5 years. Similarly, the rates of weekly smoking increase with age, from 2 % among 11-year olds, to 8 % among 13-year-olds, and 35 % of 15-year-olds. Among 15-year-olds, the smoking rates tend to be higher among girls compared to boys, but boys are more likely to start smoking earlier than girls (Godeau et al., 2004).

In Finland, the proportion of daily smokers among 14-18-year-old adolescents was 26 % in 1977 and 22 % in 2005 (Rimpelä et al., 2005). Boys and girls are quite equally likely to smoke. The rising trend among girls stopped and began to fall after the year of 2000; among boys this happened earlier (Fig. 1). About 80 % of 18-year-old boys and girls have tried tobacco. However, the present-day trend is that experiments with the use of tobacco are started at a later age than before (Rimpelä et al., 2005).

Smoking among Finnish males has decreased since the 1950s (Rimpelä, 1978), whereas smoking among females has remained at the same level since the mid-1980s (Helakorpi et al., 2005). In 2005, 26 % of males and 18 % of females smoked daily (Helakorpi et al., 2005).

Figure 1. Percentage of 14–18-year-old daily smokers in Finland in 1977–2005.



Adolescent Health and Lifestyle Survey (Rimpelä et al. 2005)

2.2.2 Smoking trajectories

It has been shown in several studies that most smokers have started smoking by the age of 18-20 years (Chen and Kandel, 1995; USDHHS, 1994) and there is very little new smoking initiation in late adolescence/young adulthood (Chassin et al., 1996; Pulkkinen and Kallio, 1988). However, recent studies have indicated that a relatively large proportion of smokers start only in young adulthood (Hammond, 2005; Lantz, 2003). In a Canadian study remarkable increases were reported in the proportion and intensity of smoking occurring still after the age of 18 years: one fifth of smokers tried their first cigarette only after the age of 18 years (Hammond, 2005).

Smoking can be defined to develop in the following stages: preparation, trying, experimenting, regular use, and dependence on smoking (Mayhew et al., 2000). It has been shown that the first symptoms of nicotine dependence can appear already within days or weeks of the onset of smoking (Colby et al., 2000; DiFranza et al., 2002). By the age of 15 years, approximately 60 % of adolescents have at least tried smoking (Godeau et al., 2004). Smoking often begins at the age of 13-15 years (Godeau et al., 2004), continues to increase over adolescence, stabilizes in the late adolescence, and slightly declines at the age of the late 20s (Chassin et al., 1996; Chen and Kandel, 1995). Based on the results of the annual survey on Health Behaviour and Health among the Finnish Adult Population, more than half of the 55-64-year-olds, both males and females, ever smoked, had quit smoking during their life course (Helakorpi et al., 2005).

The prevalence rates are dependent both on the country and the year in which the study is undertaken (Godeau et al., 2004). In a Finnish cohort study smoking among girls increased up to the age 17 after which it started to decline (Pulkkinen and Kallio, 1988). Smoking among boys increased up to the age of 20 and started to decline slightly after the age of 23. In another Finnish study among 12-18-year-olds, 85 % of those who smoked daily in the baseline study were classified as established smokers and only 10 % as non-smokers 2,5 years later (Rimpelä, 1980). In an Australian study there was a clear increase in the prevalence of daily smoking in adolescence: from 1 % at the age of 13 to 15 % at the age of 15, and to 31 % at the age of 18 (Stanton et al., 2005; Stanton et al., 1996b; Stanton et al., 1991). Among 18-year-olds who had never smoked up to the age of 15, two thirds had remained non-smokers and 7 % had become daily smokers. In an American cohort study from age 14 to age 23 (Tucker et al., 2003) the number of experimenters who became regular smokers was 19 % between the ages 14 and 16, 16 % between the ages 16 and 18, and 17 % between the ages 18 and 23. In a Scottish study regular smoking more than doubled between the ages 15 (14 %) and 23 (30 %) (West et al., 1999).

Non-smoking in adolescence predicts adult non-smoking, whereas adolescent smoking predicts adult smoking (Chassin et al., 1996; Chen and Kandel, 1995; Mulder et al., 1998). Chassin et al. (1996) found that among those who were smokers at the age of 17, 60 % were adult smokers compared with 10 % adult smokers among those who were non-smokers in adolescence.

The younger one begins to smoke, the more likely he/she is to be a smoker also in adulthood (Chassin et al., 2000). There is a strong continuity between early smoking experimentation and later smoking (Chassin et al., 1990; Fergusson et al., 1995; Godeau et al., 2004). Experimental use has been found to double the risk for adult smoking in relation to no experimentation during adolescence (Chassin et al., 2000). On the other hand, non-smoking periods of different duration are a crucial part in the process of starting the smoking habit (Rimpelä, 1980).

By using longitudinal data researchers have developed smoking trajectories (Table 1) to discover differences in smoking patterns (Abroms et al., 2005; Audrain-McGovern et al., 2004; Chassin et al., 2000; Juon et al., 2002; Karp et al., 2005; Soldz and Cui, 2002; Stanton et al., 2004; White et al., 2002). It is of importance to distinguish various subgroups of adolescent smoking patterns over time as well as different predictors for more specific targeting of prevention activities. The number of different trajectories

has varied from three (White et al., 2002) to six (Stanton et al., 2004). For example, Chassin (2000) defined five smoking trajectories from the age 11 to that of 31 as follows: non-smokers (60 %), early stable smokers (12 %), late stable smokers (16 %), experimenters (6 %), and quitters (5 %).

Among adolescents, the “late stable group” was similar to “non-smokers” but different from the “early stable group” (Chassin et al., 2000). The key difference between the “experimenters” and the “regular smokers” was that the “experimenters” had a more conventional profile; they, for example were given parental support and they showed better school performance (Audrain-McGovern et al., 2004; Chassin et al., 2000; Juon et al., 2002). The “early initiating smokers” were those most likely to have behavioural problems across the life course (Juon et al., 2002). Poor school performance (Karp et al., 2005; White et al., 2002) and having smoking friends (Abroms et al., 2005) predicted higher smoking. Stanton et al. (2004) did not find association between the use of alcohol and different smoking trajectories.

In a study of Soldz non-smokers tended to have the least increase in risk factors, whereas intermediate risk factor trends were seen among the quitters (Soldz, 2005). Early age in initiation was associated with heavier smoking in adolescence and adulthood (Chassin et al., 2000).

Table 1. Longitudinal studies about smoking trajectories.

Reference	Follow-up (years)	Age (years)	N	Country	Trajectory groups
Abroms et al., 2005	3	12–15	1320	USA	- Never-smoker (41 %) - Intender (33 %) - Delayed escalator (9 %) - Early experimenter (14 %) - Early user (3 %)
Audrain-McGovern et al., 2003	3	15–18	968	USA	- Never-smoker (45 %) - Experimenter (23 %) - Earlier adopter (8 %) - Later adopter (24 %)
Chassin et al., 2000	13	14–27	8556	USA	- Non-smoker (61 %) - Early stable smoker (12 %) - Late stable smoker (16 %) - Experimenter (6 %) - Quitter (5 %)
Juon et al., 2002	26	6–32	1242	USA	- Non-smoker (37 %) - Former smoker (13 %) - Late adopter (26 %) - Early adopter (24 %)
Karp et al., 2005	2	13–15	369, all smokers	Canada	- Low-intensity smoker (72 %) - Slow escalator (11 %) - Moderate escalator (11 %) - Rapid escalator (6 %)
Soldz et al., 2002	7	12–15	852	USA	- Non-smoker (66 %) - Experimenter (6 %) - Early escalator (9 %) - Late escalator (9 %) - Continuous smoker (6 %) - Quitter (4 %)
Stanton et al., 2004	9	9–18	845	New Zealand	- Non-smoker (64 %) - Early rapid escalator (4 %) - Late rapid escalator (14 %) - Late moderate escalator (5 %) - Late slow escalator (4 %) - Stable puffers (5 %) - Late slow escalators (4 %)
White et al., 2002	18	12–30	374	USA	- Non/experimental smoker (40 %) - Heavy/regular (41 %) - Occasional/maturing out (19 %)

As a summary, heterogeneity was seen in all trajectory studies: those who start smoking early and continue smoking can be differentiated from those who quit smoking as well as from those who start smoking at a later age. Risk factors for a higher smoking stage tend to include similar risk factors as for being a smoker, though the effect of the risk factors becomes stronger with the increasing smoking stage.

2.2.3 Smoking cessation

Most young smokers would like to quit and have tried it, but have failed in doing so (Breslau and Peterson, 1996; Burt and Peterson, 1998; Dappen et al., 1996; Dozois et al., 1995; Gillespie et al., 1995; Global Youth Tobacco Survey (GYTS) Collaboration Group, 2002; Helakorpi et al., 2005; Hines, 1996; Lamkin et al., 1998; Stanton et al., 1996b; Townsend et al., 1991; Tuakli et al., 1990; Tucker et al., 2005). Smoking shows the least decline in young adulthood (Chassin et al., 2000). Smoking prevalence starts to decline slightly around the age of 25 when a higher proportion of smokers stop than start smoking (Chassin et al., 2000; Chen and Kandel, 1995).

The proportion of the group of quitters is quite small (Chassin et al., 2000; Pulkkinen and Kallio, 1988). The annual quitting rate has been found to be approximately 3 % in adolescence (Burt and Peterson, 1998) or in young adulthood (Stanton et al., 1996b). In a study from New Zealand experimental smokers stopped at an average rate of 11 % per year (Stanton et al., 1996b). Subjects who have become regular smokers at the youngest ages (Breslau and Peterson, 1996; Burt and Peterson, 1998; Chassin et al., 1996; Ellickson et al., 2001) and who have smoked more (Rose et al., 1996; Sussman et al., 1998; Zhu et al., 1999) are less likely to quit. Engels et al. (1998) found that adolescents who had a positive attitude towards smoking and a lower self-efficacy were less likely to quit three years later.

Tucker et al. (2005) found that between the ages of 23 and 29, 76 % of smokers attempted to quit and 26 % quit for six months or longer. In the Framingham Heart Study (Hubert et al., 1987) one third of smoking males quit during the ages of 20 and 29. Chen et al. (1995) found that from the age of 29 to that of 35, 6.2 % of males and 8.7 % of females had quit smoking. In a Canadian study, a total of 65 % of young adult smokers had attempted to quit smoking within the last two years (Hammond, 2005).

Smoking cessation is more rare among those who have smoking friends (Burt and Peterson, 1998; Chen et al., 2001; Ellickson et al., 2001; Ershler et al., 1989; Rose et al., 1996; Sussman et al., 1998), smokers in the same household (Chandola et al., 2004; Sussman et al., 1998), smoking parents (Chandola et al., 2004; Chassin et al., 1996) or a smoking mother (Zhu et al., 1999). Being married (Rose et al., 1996), being married with a non-smoker (Chen et al., 2001), living with a non-smoker (Tucker et al., 2005) or with an ex-smoker (Monden et al., 2003) increased the likelihood of quitting. Parenthood was not related to smoking cessation in the studies carried out among 25-31-year-old (Chen et al., 2001) and 24-32-year-old Americans (Rose et al., 1996).

In some studies females have been less successful in quitting compared to males (Burt and Peterson, 1998; Weden et al., 2006), or the situation has been vice versa (Patton et al., 1998), or there have not been significant gender differences (Breslau and Peterson, 1996; Chen et al., 2001; Zhu et al., 1999). Females seem to be more likely than males to make quitting attempts, but there are no differences in the success of these attempts (Rose et al., 1996). Cessation rates have been found to be lower among those who are unemployed (Rose et al., 1996; Weden et al., 2006) and less educated (Breslau and Peterson, 1996; Broms et al., 2004; Chassin et al., 1996; Isohanni et al., 2001; Rose et al., 1996). Additionally, persons from lower social classes (Siahpush et al., 2005), non-married, and those who lacked social support were less likely to quit (Chandola et al., 2004). In a Finnish twin study it was found that the indicators of SES were important predictors of smoking cessation even if the previous smoking status was adjusted (Broms et al., 2004).

Chandola et al. (2004) found that the strongest predictor for smoking cessation was the degree of nicotine dependence. A majority of young smokers experience withdrawal symptoms during abstinence (McNeill, 1991). Nicotine addiction among adolescents follows fundamentally the same process as among adults, resulting in a large majority in withdrawal symptoms and failed attempts to quit (Colby et al., 2000; USDHHS, 1994). In a study by Breslau and Peterson nicotine-dependent smokers were 40 % less likely to quit successfully than non-dependent smokers (Breslau and Peterson, 1996). Moreover, Amos et al. (2005) found that perceived barriers to quitting among adolescents were related to habitual and social aspects of dependence, such as smoking by friends and the smoking culture. As a summary, the success at adolescent smoking cessation seems to be greatly influenced by the social environment and addiction of smoking.

There is only limited evidence about the efficacy of smoking cessation interventions among adolescents and no evidence about the long-term effectiveness (Garrison et al., 2003; McDonald et al., 2003; Sussman et al., 1999). This could be partly explained by the fact that only a few smoking cessation programs have been rigorously evaluated and reported. Various theoretical approaches have been used in the interventions and they tend to produce a higher quitting rate than natural quitting (Sussman et al., 1999). However, some school-based cessation programs which have proved effective, have been reported: 1) immediately after the eight-session classroom curriculum (Adelman et al., 2001), 2) in a three-month follow-up of the eight-session cessation clinic (Sussman et al., 2001), and 3) in a five-month follow-up of a ten-session program for small groups (Dino et al., 2001; Horn et al., 2004).

2.3 PSYCHOSOCIAL FACTORS RELATED TO SMOKING

Psychosocial factors influence the process of the onset of smoking and can be defined as environmental, behavioural, personal, and socio-demographic factors (Tyas and Pederson, 1998; USDHHS, 1994). This classification is used in the present review. The environmental factors are external and include the availability of cigarettes, the acceptability of smoking, and the smoking of others, e.g. parents, siblings, and friends. Behavioural factors include, for example, other health behaviours, skills to resist pressures to smoke, and previous smoking. Personal factors comprise self-image, self-esteem, and personality, and socio-demographic factors age, gender, marital status, and socioeconomic status.

2.3.1 Environmental factors

The social learning theory focuses on learning that occurs within a social context (Bandura, 1977). According to the theory, behaviour, perceptions, and environment interact to influence one another. People learn (e.g. smoking) from one another, by, for example, observing, imitating, and modelling.

The influence of parental smoking has been examined in several studies, and partly with inconsistent outcomes. The increased risk of adolescent smoking with parental smoking has been found in a number of longitudinal studies (Andrews et al., 2002; Barman et al., 2004; Bricker et al., 2006; Derzon and Lipsey, 1999; Droomers et al., 2005; Engels et al., 2004; Fagan et al., 2005; Fergusson et al., 1995; Flay et al., 1998; Flay et al., 1989; Harakeh et al., 2004; Jackson, 1998; Johnson et al., 2002; Kestilä et al., 2006; Li et al., 2002; O'Loughlin et al., 1998; Patton et al., 1998; Peterson et al., 2005; Vink et al., 2003). However, in some of the studies parental smoking was not found as predictor for the smoking of the children (Distefan et al., 1998; Juon et al., 2002; McNeill et al., 1989; West et al., 1999; White et al., 2000) or parental smoking was found to influence smoking experimentation but not later smoking (Fergusson et al., 1995). The effect of the smoking of the mother or the father has also been studied separately. The effect of the smoking of both parents (O'Loughlin et al., 1998; Vink et al., 2003), as well as that of only the mother (Griffin et al., 1999; Oygard et al., 1995) or the father (Droomers et al., 2005), have been significant. Some studies have reported that parental smoking is more significant

for girls than for boys (Oygaard et al., 1995; White et al., 2002). Vink et al. (2003) concluded that the same-sex smoking family members influenced smoking behaviour more than the opposite-sex family members. Peterson et al. (2005) found in a nine-year follow-up study that having one smoking parent increased the risk of children to become daily smokers compared to families where neither of the parents smokes. The risk was not dependent on the gender of the parent or child.

Lack of parental support (McNeill et al., 1989) has been found to be a risk factor for adolescent smoking (Tucker et al., 2003; van den Bree et al., 2004). On the other hand, a close relationship with the parents (Distefan et al., 1998; Harakeh et al., 2004), a warm attitude of the parents towards their children (White et al., 2000), and parental supervision (Reimers et al., 1990) have been protective factors against smoking. A Dutch study concluded that the good quality of the parent-child relationship including good communication and trust affected adolescent smoking behaviour indirectly, while parental smoking behaviour had a direct effect on it (Harakeh et al., 2004).

There are fewer studies on the predictive effects of the smoking of siblings than that of the parents. The findings of sibling smoking are quite consistent so that sibling smoking is a predictive factor especially for initiating smoking in adolescence (Bricker et al., 2006; Elder et al., 1996; Flay et al., 1989; Johnson et al., 2002; O'Loughlin et al., 1998; Rajan et al., 2003; West et al., 1999; Vink et al., 2003). Moreover, in a Norwegian study (Oygaard et al., 1995) no predictive sibling effect on daily smoking was found in a ten-year follow-up.

Several studies have given consistent evidence of the association between the smoking by friends and adolescent smoking (Avenevoli and Merikangas, 2003; Bertrand and Abernathy, 1993; Conrad et al., 1992; Tyas and Pederson, 1998). Longitudinal studies have proved that this relation also remains predictive (Bricker et al., 2005; Derzon and Lipsey, 1999; Distefan et al., 1998; Droomers et al., 2005; Duncan et al., 1995; Elder et al., 1996; Fergusson et al., 1995; Flay et al., 1998; Flay et al., 1989; Griffin et al., 1999; Hoffman et al., 2006; Johnson et al., 2002; Karp et al., 2005; O'Loughlin et al., 1998; Oygaard et al., 1995; Schofield et al., 2003; Stanton and Silva, 1992; Tucker et al., 2003). Peer pressure and smoking by friends are often presented as major reasons for the onset of adolescent smoking. The link may be mediated by personal factors and it appears to be most potent in the earlier stages of smoking (Chassin et al., 1990). Adolescents themselves also report, that peer pressure is the most important reason to start smoking (Kannas, 1983; Tossavainen, 1988). Engels et al. (2004) suggested that parental smoking affects the selection of new friends: In particular, adolescents with smoking parents are most likely to become affiliated with smoking friends. The results of the European Smoking Prevention Framework Approach (ESFA) study support the selection paradigm suggesting that adolescents choose friends with a similar smoking behaviour (de Vries et al., 2006).

In a nine-year follow-up study the probability that the smoking of a close friend influenced an adolescent to make the first experimentation with smoking was 38 % (Bricker et al., 2005), while that of a smoking parent was 32 % (Bricker et al., 2006) and that of a smoking sibling 29 % (Bricker et al., 2006). O'Loughlin et al. (1998) found that the effect of parental smoking on continued smoking was not significant after the smoking by friends was controlled.

2.3.2 Behavioural factors

The problem-behaviour theory focuses on the role of problem behaviours which are interrelated and tend to cumulate (Jessor and Jessor, 1977). Problem behaviours can often be referred to as health risk behaviours, such as smoking, use of alcohol, sexual intercourse etc. in adolescence. The theory suggests that a variety of behaviours typically initiated during adolescence have similar aetiological factors. Several studies have supported this theory (Duncan et al., 1995; Tucker et al., 2003; Turbin et al., 2000).

Health behaviours have been found to be accumulated both in adolescence and in adulthood (Burke et al., 1997; Fisher et al., 1991; Laaksonen et al., 2002; Raitakari et al., 1995; Rimpelä, 1980; Schuit et al., 2002; Wiefferink et al., 2006). Smoking has had a central role concerning the association with other health behaviours (de Bourdeaudhuij and van Oost, 1999; Koivusilta et al., 2003; Laaksonen, 2002). Additionally, Wang et al. (2001) found that the adolescents who had been engaged in physical fights and drunk-driving were more likely to be smokers than those who did not exhibit these risk-behaviours. Especially the association between smoking and the use of alcohol is very strong, already in adolescence (Bien and Burge, 1990; Burke et al., 1997; de Bourdeaudhuij and van Oost, 1999; Jackson et al., 2002; Pohjanpää, 1997; Rahkonen, 1994; Rimpelä, 1980; Tossavainen, 1988; Turbin et al., 2000; Wang, 2001; Wiefferink et al., 2006). Smoking has been found to be negatively associated with physical activity (Aarnio et al., 2002; Burke et al., 1997; Osler et al., 2001; Raitakari et al., 1995; Steptoe et al., 1997), but the use of alcohol and physical activity are not significantly associated (Aarnio et al., 2002; Steptoe et al., 1997).

Smoking and the use of alcohol increase over adolescence and young adulthood (Duncan et al., 1995; Jackson et al., 2002), whereas physical activity mostly decreases over time (Audrain-McGovern et al., 2003; Kelder et al., 1994; Telama and Yang, 2000). Typically, smoking, use of alcohol, and leisure-time physical activity are all more common among males than among females (Steptoe et al., 1997).

In longitudinal studies earlier behaviour has predicted the same behaviour to continue also later on (Gillander Gadin and Hammarstrom, 2002; Kelder et al., 1994). Previous smoking has been one of the strongest predictors of later smoking (Chassin et al., 1996; Derzon and Lipsey, 1999; Fagan et al., 2005; Fergusson et al., 1995; Flay et al., 1989; Higgins and Conner, 2003; Jackson and Dickinson, 2004; Patton et al., 1998; Pederson and Lefcoe, 1987; Pietilä et al., 1995; Schofield et al., 2003). Smoking has been found to be a very persistent behaviour (Chen and Kandel, 1995; Mulder et al., 1998). The greater stability of smoking compared to other health behaviours may reflect the addictive nature of the smoking habit (Chassin et al., 1996). Earlier behaviour is a predictive factor also in physical activity (Garcia et al., 1998; Gillander Gadin and Hammarstrom, 2002; Pietilä et al., 1995; Telama et al., 2005; Yang et al., 1999) and in the use of alcohol (Gillander Gadin and Hammarstrom, 2002; Mulder et al., 1998; Pulkkinen, 1982).

It has been found that the use of alcohol predicts smoking (Griffin et al., 1999; Jackson et al., 2002), but also smoking can predict the use of alcohol (Lewinsohn et al., 1999). In the studies of Orlando et al. and Pohjanpää it was found that while it is common during adolescence to drink but not to smoke, it is unusual to smoke and not to drink (Orlando et al., 2005b; Pohjanpää, 1997). Duncan et al. found that most adolescents try alcohol first, the next substance being cigarettes (Duncan et al., 1995). In an Australian cohort study from the age of nine to that of 18, the use of alcohol did not predict the patterns of smoking and smoking did not conform to the patterns of later use of alcohol (Stanton et al., 2004). In a seven-year follow-up study smoking predicted the use of alcohol, physical inactivity, and dietary behaviour among Finnish adults (Laaksonen et al., 2002). Similar social, environmental, and individual factors seem to predict both smoking and the use of alcohol (Duncan et al., 1995; Griffin et al., 2003b).

It has been found that in adolescence physical activity predicts non-smoking in adolescence (Audrain-McGovern et al., 2003) and non-smoking physical activity (Yang et al., 1999). Childhood smoking predicted low physical activity among Danish females in a 13-year follow-up from adolescence to adulthood (Osler et al., 2001). In general, physical activity seems to be a more unique factor in contrast to smoking and use of alcohol, which are more clearly connected to each other (de Bourdeaudhuij and van Oost, 1999).

2.3.3 Personal factors

Risk-taking (Flay et al., 1998) and rebelliousness are personal factors found to predict smoking from childhood to adolescence (Burt et al., 2000; Conrad et al., 1992). Additionally, high novelty-seeking, depressive symptoms (Audrain-McGovern et al., 2004), inattentiveness (Barman et al., 2004), susceptibility (Jackson, 1998), aggressiveness and/or shyness (Conrad et al., 1992; Juon et al., 2002; Pulkkinen, 1982), and lower levels of refusal skills (Conrad et al., 1992; Flay et al., 1998; Li et al., 2002) are associated with smoking. In one study, a high risk of smoking was predicted by lower intelligence scores (Droomers et al., 2005). In a Dutch study it was found that “high extraversion” and “low emotional stability” predicted the onset of smoking (Harakeh et al., 2006). The findings concerning the association between smoking and self-esteem have been inconsistent (Conrad et al., 1992), partly because the definition of self-esteem has varied greatly between the studies. Moreover, Glenninning et al. (1999) suggest that there is no simple, direct relationship between self-esteem and smoking behaviour in youth.

2.3.4 Sociodemographic factors

The WHO tobacco epidemic model (Lopez et al., 1994) suggests that there are four major stages in the use of tobacco, but also differences between countries. Stage 1 is characterised by a low smoking prevalence, and smoking is mainly a habit of males in higher socioeconomic groups. Countries in stage 2 show increases in smoking up to a prevalence of 50 % in males and growing increases in the smoking of females, smoking being similar in the different socioeconomic groups. In stage 3 the peak is seen in male smoking, which, however, starts to decrease due to quitting, especially in the highest socioeconomic groups. Among females the peak follows a few years later. The final stage 4 is marked by a decline in smoking both in males and females, and smoking seems mainly to be the habit in the lower socioeconomic groups. This model proved to be a useful framework among young people as well, in a study comparing smoking patterns among university students from 23 countries (Steptoe et al., 2002). Moreover, nowadays the gender differences in smoking among adolescents and young adults in Western Europe are relatively small (Godeau et al., 2004; Steptoe et al., 1995). More details of smoking in different age- and gender-groups have been presented earlier (2.2.1).

The socioeconomic differences of smoking in adulthood are well known: smoking is more prevalent in the lower socioeconomic groups compared to the higher ones, the differences being large and increasing especially in Northern Europe (Cavelaars et al., 2000; Huisman et al., 2005a). The socioeconomic status (SES) is most often measured by education, occupation or income (Chen et al., 2002; Conrad et al., 1992) and all these factors have been found to be related to smoking (Cavelaars et al., 2000; Huisman et al., 2005b; Laaksonen et al., 2005).

Socioeconomic differences in smoking exist already in adolescence (Chen et al., 2002), measured by the parental SES (Cavelaars et al., 2000; Chassin et al., 1992; Karvonen and Rimpelä, 1996; Soteriades and DiFranza, 2003; Tyas and Pederson, 1998), but the association has not been found significant in all studies (Friestad and Klepp, 2006; Pärna et al., 2003; Rimpelä, 1980; Tuinstra et al., 1998). Several studies have reported a positive relationship between smoking and low school performance

(Conrad et al., 1992) or smoking and a low educational level in adolescence (Karvonen and Rimpelä, 1996; Rahkonen, 1994; Vereecken et al., 2004). The students who are not doing well at school (Audrain-McGovern et al., 2004; Flay et al., 1998; Griffin et al., 1999; Karp et al., 2005; Reimers et al., 1990; Rimpelä, 1980; Tucker et al., 2003; van den Bree et al., 2004; Vartiainen et al., 2004; White et al., 2002) or have low academic orientation (Chassin et al., 1992; Tucker et al., 2003; van den Bree et al., 2004) are more likely to smoke. For example, in a Finnish ESFA-study among 15-year-olds, there were almost 60 % smokers among those with low school performance compared to 10 % smokers among those who were doing well at school (Vartiainen et al., 2004). School performance in adolescence is associated with later educational achievements (Isohanni et al., 2001; Koivusilta et al., 2003). The SES of the parents and that of their offspring are in correlation (Glendinning et al., 1994; Huurre et al., 2003; Wannamethee et al., 1996; Vereecken et al., 2004).

Longitudinal studies have demonstrated a relationship between the parental SES and adult offspring smoking (Conrad et al., 1992; Droomers et al., 2005; Fagan et al., 2005; Huurre et al., 2003; Kellam and Anthony, 1998; Power and Matthews, 1997; Voorhees et al., 2002), but in some other studies the relationship has not been found (Blane et al., 1996; Friestad and Klepp, 2006; Greenlund et al., 1995; Oygard et al., 1995; van de Mheen et al., 1998). The achieved adult SES has been found a more important factor than the parental SES in smoking. (Huurre et al., 2003; Jefferis et al., 2004; Karvonen et al., 1999; Power et al., 2005; Wannamethee et al., 1996). In some studies the childhood SES was associated only with female smoking (Brunner et al., 1999; Glendinning et al., 1994; Jefferis et al., 2004; Power et al., 2005). Soteriades et al. (2003) concluded that parental smoking is a mediator between the parental SES and adolescent smoking. On the other hand, smoking in adolescence has been found to be a strong predictor of the educational career (Flay et al., 1989; Koivusilta et al., 2003), especially if smoking continues to adulthood (Isohanni et al., 2001; White et al., 2002).

The social mobility model hypothesizes that intergenerational SES mobility across the life course has an impact on adult health or health behaviour (Power et al., 1991). Mobility indicates the movement between the original (parental) SES in childhood and the achieved (own) SES in adulthood. In Finland, downward mobility was found to be relatively rare when measured by the differences between the occupational groups of the father and of the subject in 1986 (Rahkonen et al., 1997). Some studies have also reported that smoking is most common among downwardly mobile and least common among upwardly mobile persons (Glendinning et al., 1994; Karvonen et al., 1999; Srole and Fischer, 1973). However, the movement effect itself has not been significantly related to smoking (Hart et al., 1998; Karvonen et al., 1999; Pulkki et al., 2003a). Young people who transferred from one SES group to another tend to behave according to the achieved SES groups (Karvonen et al., 1999).

Besides age, gender, and SES, the differences in smoking may also be based on the family structure and marital status. The results of an HBSC- study in seven European countries (Griesbach et al., 2003) showed that there was a strong, independent association between the family structure and adolescent smoking: smoking prevalence among the 15-year-olds was the lowest among adolescents in intact families and the highest among adolescents in step-families. In general, adolescents from other than nuclear families are smoking more (Kestilä et al., 2006; Orlando et al., 2005b; Rahkonen et al., 2005; Rimpelä, 1980; Tucker et al., 2003). Additionally, the marital status of the person is associated with smoking: divorced people usually smoke more than singles, who, in turn, smoke more than married people (Helakorpi et al., 2005; Laaksonen, 2002).

3 AIMS OF THE STUDY

The overall aim of the present study was to examine the effects of the smoking prevention program and smoking in general from early adolescence to early adulthood by using longitudinal data.

The specific aims of the study were the following:

1. To evaluate the long-term effects of a school- and community-based smoking prevention program (I).
2. To describe the development of the smoking status from adolescence to adulthood: how smoking in adolescence predicts smoking in adulthood and how smoking among the family and friends of the adolescent predicts smoking in adulthood (II).
3. To assess the rate of smoking cessation from adolescence to adulthood and to find out how socioeconomic factors, other health behaviours, and smoking in the family and among friends are associated with cessation (III).
4. To examine the effect of parental socioeconomic status, a person's own socioeconomic status, and social mobility upon the development of smoking from adolescence to adulthood (IV).
5. To study the associations between smoking, use of alcohol, and physical activity, and to assess how health behaviours predict changes in other health behaviours from adolescence to adulthood (V).

4 MATERIALS AND METHODS

4.1 STUDY DESIGN AND PARTICIPANTS

A two-year cardiovascular risk factor prevention program, the North Karelia Youth Project, was started in 1978 among students from the seventh grade (age 13 years) and concluded when the same students were in the ninth grade (age 15 years) in autumn 1980. The project was carried out at four schools in the province of North Karelia, Finland. Two control schools were chosen from another county. The aim of the project was to prevent the main cardiovascular risk factors among adolescents. A social influence approach was used in the smoking prevention part of the program, and the program was particularly based on teaching skills to resist social influences which promote smoking. In North Karelia, a community-based smoking cessation program for adults was also carried out.

The study began with a pretest survey in 1978. After that, five follow-up surveys were carried out in 1980, 1981, 1982, 1986, and the last survey in 1993, when the subjects were 28 years old (Table 2).

Table 2. *Participation rate in different surveys.*

	N	Participated % of original sample
Original Sample	903	100
At school in autumn 1978 (7th grade)		
o questionnaire and risk factor survey	897	99
o questionnaire to fathers	729	
o questionnaire to mothers	839	
At school in autumn 1980 (9th grade)		
o questionnaire and risk factor survey	851	94
o questionnaire to fathers	720	
o questionnaire to mothers	834	
At school in spring 1981 (9th grade)		
o questionnaire	752	83
By mail, in autumn 1982		
o questionnaire	788	87
By mail, in autumn 1986		
o questionnaire	657	73
By mail, in autumn 1993		
o questionnaire	640	71

The study was designed to test the efficacy of a school-based intervention. Three pairs of matched schools were chosen for the study (Table 3). Two schools (one urban, one rural) were selected from another province in Eastern Finland as controls, and the intervention program was carried out in four North Karelian schools (two urban, two rural). For each matched pair, one school was chosen from the province capital (Joensuu, Kuopio) and the other from a rural community (Ilomantsi, Juuka, Nilsiä). The schools were upper-level comprehensive schools (junior high schools). Comprehensive schooling is compulsory for all Finnish citizens and covers the entire age group.

Table 3. *Three school pairs of the North Karelia Youth Project Study.*

"Karsikon yläaste", Joensuu (urban) "Ilomantsin yläaste", Ilomants (rural)	Health-educator-led intervention + peer leaders	10 sessions
"Keskustan yläaste", Joensuu (urban) "Juuan yläaste", Juuka (rural)	Teacher-led intervention + peer leaders	5 sessions
"Puijonlaakson yläaste", Kuopio (urban) "Nilsian yläaste", Nilsia (rural)	Control schools	

The aim of the smoking prevention program was to prevent smoking by teaching students skills of resisting social pressures associated with smoking. During the intervention, ten sessions were held in the health educator-led intervention schools. In the teacher-led intervention, five sessions covered the main elements of the program. In addition, the program used 14- and 15-year-old peer leaders of both sexes as the primary agents for delivering the non-smoking message in the classroom. Peer leaders were given approximately ten hours of training by the project team.

The anti-smoking sessions included three main topics. The first topic aimed at making the students aware of the reasons for smoking behaviour, such as tobacco advertising and social pressures to start smoking. The second topic introduced the health hazards of smoking, and the third taught the students skills necessary to resist various pressures to begin smoking. The students were asked to write and act out situations that might lead to smoking; then they tried to find solutions other than starting to smoke.

Between 1978 and 1980 the six schools had a combined enrollment of 903 students who continued from the seventh to the ninth grade. The participation rates of the pretest survey (autumn 1978) and the post-test survey (autumn 1980) were 897 students (99 %) and 851 students (94 %), respectively. These two surveys included a self-administered questionnaire and a cardiovascular risk factor examination at school. The permission for the study was requested from the school authorities and headmasters. In addition, the parents were asked to give a permission for their children to participate in the survey. All the parents gave their approval for the study. The survey was carried out by specially trained project nurses. The answers given by the adolescents in the questionnaire were confidential and not forwarded to the teachers or parents. More technical details of the study have been published earlier (Puska et al., 1979; Vartiainen, 1982). The students filled in the questionnaire at school in the spring of 1981, and postal surveys were done in the autumn of 1982 and 1986. The new addresses of those who had moved to another area were obtained from the National Population Register based on the social security number of the subject. The questionnaires were sent to the home addresses, and the subjects were asked to complete and return them in an enclosed envelope. In the most recent survey (1993–94) the subjects were asked to complete the questionnaire at home and to participate in a cardiovascular risk factor examination carried out by a trained project nurse at a health centre.

In 1978, six students were absent from school, but none of them had refused to participate. In 1980 only those students who were still at the same school and participated in both 1978 and 1980 surveys were included (n=851). In the last survey for the 28-year-olds the participation rate was 71 %. The other participation rates are presented in Table 2. The questionnaires for the parents included two parts; one for the mother and the other for the father to fill in. All the families filled in at least one part of the parent questionnaires (the mother's or father's part). Almost all of the non-responding parents had either divorced or died.

The response rate was sustained at a high level, being 71 % in the last follow-up in 1993. In the original sample 51 % were boys and 49 % girls. In the last survey the drop-out rate was slightly higher among the males: 49 % of the participants were males and 51 % females. The difference in smoking

between the participants and drop-outs (in the 1993 survey) was analysed at the age of 15: there was no statistically significant difference in the smoking status.

Additionally, the difference between the participants and drop-outs in the prevalence of the use of alcohol and physical activity was studied by cross-tabulating the behaviours of the participants and drop-outs at the age of 15. Again, there were no significant differences in the prevalence of the three behaviours.

4.2 STUDY VARIABLES

The questionnaires included several different variables only few of which are used in this study. If information on the variable was missing, the participants were excluded from the analyses (if there is no other notice).

4.2.1 Smoking

In all six surveys, the self-reported *smoking status* was determined by asking the following question: Do you smoke now? The response choices were: 1) not at all, 2) less than once a month, 3) once or twice a month, 4) from one to two times per week, and 5) daily. Categories 2), 3), and 4) were regarded as occasional smokers. In most analyses the smoking status was dichotomized as non-smoking (less than weekly, categories 1)-3)) and smoking (at least weekly, categories 4) and 5)). The term “all smokers” indicates the categories 2)-5).

The smoking status of the fathers and mothers was asked in the 1978 and 1980 surveys by the following question: When have you last smoked? 1) yesterday or today, 2) two days – one month ago, 3) one month – six months ago, 4) six months – one year ago, 5) more than one year ago, and 6) I have never smoked regularly. The categories included 39 %, 3 %, 1 %, 1 %, 26 %, and 30 % of the answers from the fathers and 14 %, 2 %, 1 %, 1 %, 4 %, and 78 % of the answers of the mothers. In most analyses, the smoking status of the father and mother in 1980 was used by dichotomizing it as smoking (category 1)) and non-smoking (categories 2) -6)).

Smoking cessation was the topic of the Study III. The students who were daily smokers at the age of 15 (in 1980) and non-smokers at the age of 28 (in 1993) were defined as “quitters”. The quitting rates between the ages of 15 and 21 (in 1986) and those of 21 and 28 were defined in the same manner. When the association between background variables and cessation was analysed, the quitters were the subjects who were at least occasional smokers at the age of 15 and non-smokers at the age of 28. (III)

Lifetime cigarette consumption was obtained by multiplying the number of cigarettes per day by the number of days between the surveys. Missing data points in the different surveys were replaced by the smoking status in the preceding survey. The analysis that ignored the missing data and the one that used only the data of the subjects with no missing data yielded similar results. (I)

4.2.2 Use of alcohol

The use of alcohol was determined at the age of 15 (in 1980), 21 (in 1986) and 28 (in 1993) by using the same question: How often do you use alcohol? The response choices were: 1) not at all, 2) less than once a month, 3) about from one to three times per month, 4) once a week, 5) twice a week, and 6) daily. For some analyses the use of alcohol was dichotomized by “not at all” and all the other categories 2)-6) as “alcohol use”. (V)

4.2.3 Physical activity

Physical activity was measured by leisure time physical activity in 1980, 1986, and 1993, when the subjects were 15, 21, and 28 years old. It was inquired in the following manner: How often do you do leisure time physical activity (at least 30 minutes) so that you get out of breath? The response choices were: 1) a few times a year, 2) from one to three times per month, 3) once a week, 4) from two to three times a week, and 5) daily. (V)

4.2.4 Socioeconomic status

The socioeconomic status of both the subjects and their parents was measured by self-reported education, occupation, and income: in the parental questionnaire in 1978 or 1980 and in the subject questionnaire in 1986 (age 21) or 1993 (age 28). (IV)

The length of the education of the subjects was asked in 1993 (age 28) and *the length of parental education* in 1978 by an open question “How many years have you been at school or studied full-time?”. Both variables were measured by the years of education and classified into three groups so that there were approximately one third of the subjects in each group. The average length of education had increased by five years between two generations: it was, on average, nine years among both fathers and mothers, 14 years among their daughters, and 13 years among their sons. *The education of the subjects* was categorized as follows: low (11 years or less), middle (12-15 years) and high (16 years or more). For some analyses, the years of education were used as a continuous variable. *Parental education* was defined as one variable by summarizing the years of education of the father and mother, and the groups were categorized as follows: low (15 years or less), middle (16-18 years), and high (19 years or more). If only the father or mother had answered the question, the education was classified only according to the paternal or maternal education group: low (seven years or less), middle (from eight to nine years) and high (ten years or more).

The educational level of the subject was asked in 1986 (age 21) by a structured question “What is your education?”, in which the choices were: 1) comprehensive school, 2) vocational school, 3) senior high school, 4) college, and 5) university. The answers for the categories were 9 %, 34 %, 20 %, 24 %, and 13 %, respectively.

Social mobility was assessed as the difference between the years of education of the subjects and parents (defined above), which were categorized as “low”, “medium”, and “high”. If the subjects were more educated than their parents, they were socially upwardly mobile, those less educated were downwardly mobile, and the rest of the subjects were regarded as a stable group. For example, if parental education belonged to the “low” category and their offspring education to the “middle” category, the subjects were socially upwardly mobile.

The occupation of the father and mother was asked in 1980 by a question with the following choices: 1) non-professional worker, 2) professional worker, 3) official or employee, 4) official or employee in a leading position 5) farmer (field size less than ten hectares), 6) farmer (field size more than ten hectares), 7) other enterpriser, and 8) something else. The categories included 3 %, 32 %, 16 %, 13 %, 11 %, 11 %, 11 %, and 3 % of the answers of the fathers, and 7 %, 38 %, 22 %, 3 %, 12 %, 9 %, 3 %, and 6 % of the answers of mothers. Out of these choices three categories were created: 1) - 2) as “blue-collar”, 3) - 4) as “white-collar”, and 5) - 6) “farmers”.

The income of the father and mother was asked in 1978 by a question with six choices of the gross amount of money earned in one month, the first category being the lowest income. The categories included 10 %, 17 %, 32 %, 20 %, 10 %, and 11 % of the income of the fathers and 22 %, 32 %, 35 %, 8 %, 2 %, and 1 % of that of the mothers. The three lowest categories of the fathers were combined as

“low income” and the three highest categories as “high income”. “Low income” of the mothers included the two lowest categories and “high income” the four highest income categories.

The occupation of the subject was asked in 1993 (age 28) by a standardized question with eight choices: 1) upper white-collar worker, 2) lower white-collar worker, 3) blue-collar worker, 4) farmer, 5) enterpriser, 6) pensioner, 7) student, 8) something else. Upper (10 %) and lower (21 %) level white-collar were combined as one group, and the blue-collar group (45 %) was taken as it was. The remaining categories (farmers 4 %, enterprisers 6 %, students 8 %, pensioners 1 %, and others 5 %) were not included in the analyses due to the small size of the groups.

The income of the subjects was asked in 1993 (age 28) by a question with six choices, the first being the lowest income. The categories included 15 %, 28 %, 41 %, 16 %, 0 % and 0 % of the answers. The two lowest income categories were combined as “low income” group, and the remaining four categories as “high income” group.

4.3 STATISTICAL METHODS

The analyses were conducted by using SPSS-X statistical software.

The associations between the categorical variables were analysed by using cross-tabulation and Chi-square tests.

For analysing the smoking prevention effect, both the individual and the school were used as the unit of analyses. At the individual level, the Chi-square test was used for proportions comparing the intervention programs at each study point. The analyses of variance were used on the school level and for assessing lifetime cigarette consumption. (I)

The logistic regression analysis was used to assess: the association between smoking in adolescence and smoking among friends and family, the association between smoking in adulthood and smoking in adolescence and smoking among friends and family. (II)

A logistic regression analysis was used to assess the independent effect of parental education, education of the subject, and smoking of the father and mother on the risk of weekly smoking of the subject. The effect of social mobility was tested by studying if the interaction between the parental education and the education of the subject improved the model after the main effects of these variables. (IV)

The percentages, means, and standard deviations were calculated for health behaviours, and Student's t-tests were used to test the differences in the mean values between the genders. The linear association between the health behaviours was examined with pair-wise correlations. The method used by Steiger was used to examine the equality of the correlations between the different health behaviours and between the genders (Steiger, 1980). A linear regression model was used to analyse whether the previous behaviours predicted smoking, use of alcohol or physical activity which were then treated as continuous variables. (V)

5 RESULTS

The results summarized in this chapter are mainly based on the five original articles (appendices). The results not published in the articles are the following: 1) in Table 5, “Weekly Smoking by the Level of Education”, and 2) in the text, the association between school performance and smoking (5.3).

5.1 INTERVENTION (I)

Immediately after the program was finished at the schools in 1980, there were one third fewer smokers in both intervention groups compared to the control group (Table 4). In the six-month and two-year follow-ups after the program, the overall smoking prevalence increased, but a significant difference between the intervention groups and the control group still existed. At the eight-year follow-up when the subjects were 21-year-olds, there were significantly fewer smokers in the schools with teacher-led programs compared to the control group.

In the 15-year follow-up when the subjects were 28-year-olds, there were no more significant differences in smoking between the intervention and control schools: There were 34.6 % smokers in the health-educator-led intervention group, 34.3 % in the teacher-led intervention group, and 42.8 % in the control group (Table 4).

Among the students who were non-smokers at the baseline, significantly fewer students at the intervention schools compared to the control schools started to smoke until the age of 21 (Study I, Table 3). Still at the latest follow-up, at the age of 28, the difference in the smoking onset between the intervention and control schools remained statistically significant, when all smokers were taken into the analysis: 30.8 % in the health-educator led program, 29.3 % in the teacher-led program, and 41.2 % in the control schools ($p=0.026$). These results were obtained with individuals as the analytic unit. The confirmation was made on the school level so that the mean for each school population was taken as the analytic unit. The preventive effect remained significant among the baseline non-smokers: the mean prevalence of all smokers was 30 % and 41 % in the intervention and control groups, respectively ($F=11.7$, $p=0.027$).

Table 4. Percentages of smokers at the baseline (1978) and in five follow-up surveys by smoking level in three groups.

	Health educator-led program	Teacher-led program	Control schools	P
1978 (Age 13)				
All Smokers	15.0	13.2	8.4	.047
At least 1-2 times/month	9.6	6.4	4.7	.073
At least 1-2 times/week	5.8	4.6	2.2	.095
Daily	3.1	2.5	1.1	.266
n	293	280	274	
1980 (Age 15)				
All Smokers	25.3	24.5	34.8	.011
At least 1-2 times/month	20.5	19.1	29.3	.008
At least 1-2 times/week	18.8	16.3	26.4	.009
Daily	15.4	10.3	21.2	.003
n	293	282	272	
1981 (Age 16)				
All Smokers	30.0	30.0	40.7	.014
At least 1-2 times/month	22.8	22.8	33.9	.005
At least 1-2 times/week	19.2	20.4	29.8	.009
Daily	17.2	17.2	23.8	.010
n	250	250	248	
1982 (Age 17)				
All Smokers	33.6	30.7	44.4	.003
At least 1-2 times/month	26.5	26.1	37.8	.004
At least 1-2 times/week	23.9	22.6	32.0	.029
Daily	20.1	18.4	28.2	.016
n	268	261	259	
1986 (Age 21)				
All Smokers	42.2	35.2	50.0	.008
At least 1-2 times/month	39.2	30.2	43.4	.173
At least 1-2 times/week	34.9	26.1	38.5	.022
Daily	31.0	22.6	33.6	.035
n	232	199	226	
1993 (Age 28)				
All Smokers	34.6	34.3	42.8	.115
At least 1-2 times/month	33.2	31.0	37.4	.356
At least 1-2 times/week	29.8	28.1	31.1	.793
Daily	32.5	32.8	34.7	.713
n	208	210	222	

* Chi-square test across the three groups

The mean lifetime cigarette consumption of the 28-year-olds was obtained by multiplying the number of cigarettes per day by the number of days between the surveys. In the last follow-up, the cumulative cigarette consumption was 22 % lower in the intervention group compared to the control groups ($p=.017$) if missing data points were replaced by the smoking status in the preceding survey; 25 % lower ($p=.014$) if missing data points were ignored, and 27 % lower ($p=.050$) if only data for the subjects who participated in all surveys were used in the analyses (Fig. 2). The preventive effect was slightly better among the males (27 % lower) than among the females (24 % lower).

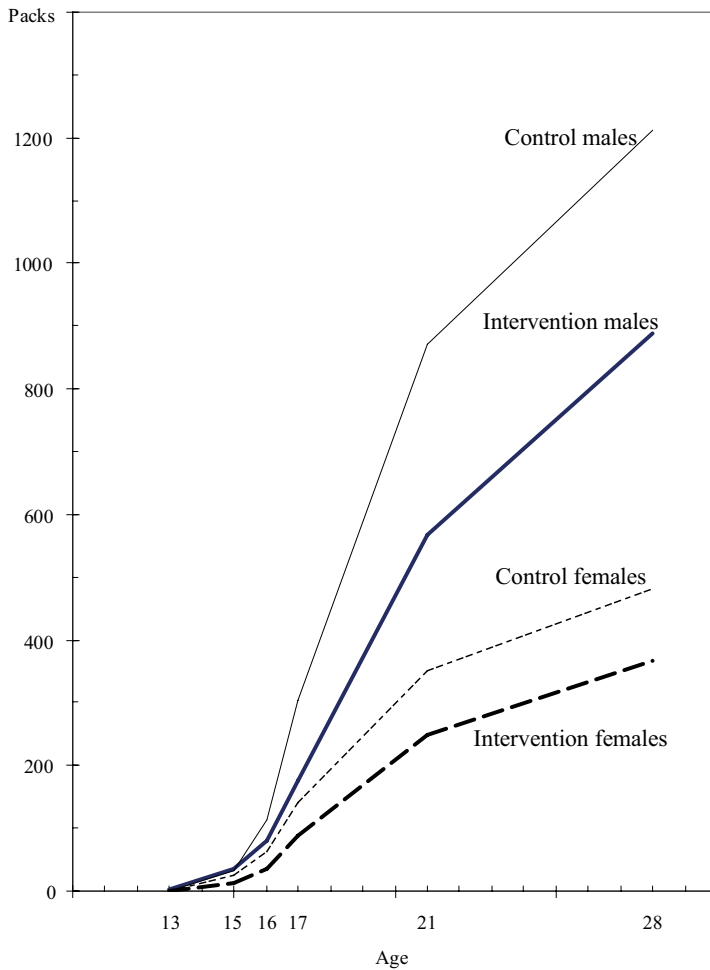
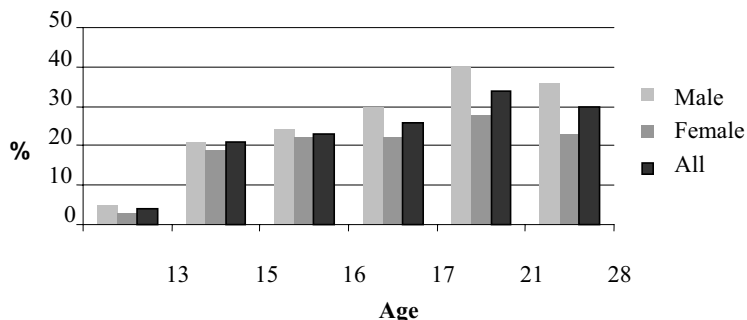


Figure 2. *Cumulative lifetime cigarette smoking, in packs, among male and female students in intervention and control schools.*

5.2 SMOKING STATUS FROM ADOLESCENCE TO ADULTHOOD (II, III)

The smoking status was studied at six occasions during 15 years, the subjects being 13-, 15-, 16-, 17-, 21-, and 28-year-olds. Weekly smokers are presented in Figure 3. Smoking was the least prevalent among the 13-year-olds and the most prevalent among the 21-year-olds. Smoking prevalence increased most sharply between 13 and 15 years of age.

Figure 3. Weekly smokers (%) from age 13 to 28 (1978-1993) by gender.



When smoking was dichotomized as non-smoking (less than weekly) and smoking (at least weekly), 21 % of the 15-year-olds and 30 % of the 28-year-olds were smokers. Approximately two thirds (64 %) of the smokers at the age of 15 were smokers also at the age of 28 (Fig. 4.). Almost half of the 28-year-old smokers (45 %) were smokers at the age of 15 and slightly more than half (55 %) had started after that age (Fig. 5). One third (35 %) of the 15-year-old smokers had quit smoking until the age of 28: one fourth (26 %) of the daily smokers and approximately half (46 %) of the occasional smokers had quit. The average cessation rate was 2.3 % annually: 4.1 % between the ages 15 and 21 and 2.4 % between the ages 21 and 28. Only 7 % of the 28-year-old smokers thought that they would still be smokers in the coming five years.

Males smoked at every point more than females. The greatest gender difference in smoking was at the age of 28, when 36 % of the males and 23 % of the females reported to be at least weekly smokers. Also the continuity of smoking was stronger among males. Compared to females, more males had started smoking after the age 15.

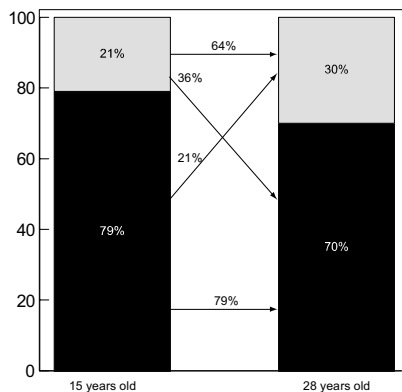


Figure 4. Weekly smoking (%) in adulthood by smoking in adolescence.

Hatched bars = Smoking, Solid bars = Non-smoking

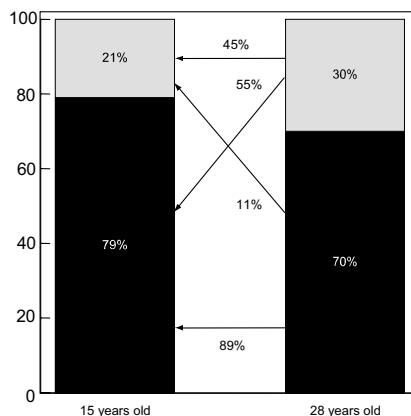


Figure 5. Weekly smoking (%) in adolescence by smoking in adulthood.
 Hatched bars = Smoking, Solid bars = Non-smoking

There was a significant difference in quitting between the genders: 27 % of the weekly smoking males had quit before the age of 28 and 43 % of the weekly smoking females, respectively. Occasional smokers, especially females, quit more often than daily smokers.

The association between smoking and smoking by others in social environment was assessed by logistic regression. At the age of 15, smoking by friends (OR=34.16) was the most important factor (Study II, Table III). Additionally, in girls both the smoking of brothers (OR=2.95) and that of sisters (OR=3.10) were significantly associated with smoking, whereas among boys the smoking of sisters (OR=2.46) and that of fathers (OR=2.38) had a significant association with smoking. The best predictor for smoking at the age of 28 was previous smoking at the age of 15 (OR=3.15) (Study II, Table IV). Smoking by friends (OR=2.08) and by a brother (OR=2.35) in adolescence predicted smoking at the age of 28, when the analysis included both genders.

The cessation rate between the ages of 15 and 28 was lower among the subjects whose spouse smoked daily (21 %) compared to those whose spouse was a non-smoker (47 %). The smoking status of the best friend was significantly associated with cessation: 20 % had quit if the best friend was a smoker and 52 % if the best friend was not a smoker. Neither smoking among fellow workers nor daily exposure to passive smoking were significantly associated with smoking cessation. Smoking cessation was most common among married subjects, but having children was not significantly related to cessation.

5.3 SOCIOECONOMIC STATUS (IV, III)

The smoking of the subjects from the age of 13 to that of 28 was not, for the most part, related to the parental socioeconomic status measured by education, occupation or income. Only at the age of 15 and 16 the children of the blue-collar parents smoked significantly more compared to those of the white-collar or farmer families.

The educational level of the subject measured at the age of 21 (in 1986) was strongly related to smoking at all survey times (Table 5). For example, 63 % of those who had only a compulsory comprehensive education were smokers at the age of 28 in contrast to 12 % of those who had university-level education. Similarly, the subjects, who had the longest education at the age of 28, had smoked the

least in all the surveys. At the age of 28, 42 % of the subjects belonging to the lowest educational group (11 years or less) were smokers compared to 15 % of those who had the highest education (16 years or more). The differences in the occupational groups were also large: at the age of 28, 18 % of the white-collar subjects compared to 40 % of the blue-collar ones were smokers. Those who were unemployed at the age of 28, had smoked more than the employed ones from early adolescence. There were no significant differences in smoking by the income groups.

Table 5. Prevalence of weekly smoking from 1978 to 1993 according to SES of the subject measured in 1986 or 1993 (percentage of non-smokers is not presented in the Table).

Year	1978	1980	1981	1982	1986	1993
Age	13	15	16	17	21	28
N	847	848	748	799	679	640
Smoking/ All	4	20	23	26	34	30
Years of education (n=639) *)						
Low (11 years or less)	7	31	35	38	47	42
Middle (12-15 years)	4	19	20	20	31	28
High (16 years or more)	0	10	13	16	17	15
p	0.002	<0.001	<0.001	<0.001	<0.001	<0.001
Occupation (n=483) *)						
Blue-collar	5	26	29	31	40	40
White-collar	2	14	15	19	27	18
p	0.085	0.001	0.001	0.005	0.004	<0.001
Income (n=588) *)						
Low	4	24	27	31	36	34
High	4	19	22	21	31	26
p	0.984	0.135	0.213	0.010	0.184	0.065
Employment (n=509) *)						
Unemployed	6	32	34	39	44	50
Employed	3	18	20	22	30	28
p	0.254	0.001	0.003	<0.001	0.014	<0.001
Level of Education (n=672) **)						
Comprehensive	10	43	44	54	60	63
Vocational	5	22	24	32	41	32
Upper secondary school	1	16	19	22	32	29
College	3	12	16	17	25	19
University	1	6	11	8	15	12
p	0.007	<0.001	<0.001	<0.001	<0.001	<0.001

Difference in smoking in different SES groups was tested by Chi-square cross-sectional analysis

*) asked in 1993 (age 28) survey

**) asked in 1986 (age 21) survey

The students were categorized in three groups based on their school performance at the age of 13: poor (32 %), medium (37 %), and good (31 %). By cross-tabulating the school performance at the age of 13 with smoking at the ages of 13, 15, and 28, significant differences were found in weekly smok-

ing between the poor, medium, and good performance groups: 8 %, 4 %, and 1 % at the age of 13 ($p=0.001$), 30 %, 21 %, and 10 % at the age of 15 ($p<0.001$), and 38 %, 32 %, and 20 % at the age of 28 ($p<0.001$), respectively.

The cessation rate between the ages of 15 and 28 was significantly higher among the employed (36 %) compared to the unemployed (15 %), and among the white-collar workers (52 %) compared to the blue-collar workers (29 %). There were no significant differences between the educational or income groups in smoking cessation.

Social mobility was measured as the difference between the categories of the years of education of the subjects and the parents (Study IV, Table 3). Approximately half of the subjects were in the same educational group as their parents (socially stable), one third were in a lower group (downwardly mobile), and one fifth in a higher group (upwardly mobile).

The highest smoking prevalence (52 %) was in the group where the education of the subject was the lowest and had decreased two categories from parental education (Study IV, Table 4). Similarly, the least smokers (8 %) were among those whose education was in the highest category and had risen two categories higher than the education of their parents. The effect of mobility with smoking was tested by logistic regression (Table 6). The risk of smoking at the age of 28 was significantly smaller in the middle ($OR=0.48$) and high ($OR=0.21$) education groups compared to the lowest education group which was the reference group. Parental education was not significantly associated with the smoking of the children, and the interaction of the education of the subject and that of the parents was not significant. This proves that the mobility itself was not associated with smoking. The smoking of the mother, but not that of the father, was related to the smoking the children at the age of 28.

Table 6. *Odd ratios using logistic regression model of weekly smoking at the age of 28 for the education of the subject, parental education, and parental smoking. Low education is the reference group.*

		OR	95 % CI	P
Education of the subject	Low	1		
	Middle	0.48	0.32–0.74	0.001
	High	0.21	0.12–0.35	0.000
Parental education	Low	1		
	Middle	0.83	0.53–1.30	0.42
	High	1.46	0.91–2.35	0.12
Smoking of the father	Yes	1.06	0.73–1.55	0.75
Smoking of the mother	Yes	2.04	1.26–3.29	0.004

In 1980, the smoking prevalence (at least monthly) among the mothers was 16 %, and there were no socioeconomic differences. Among the fathers, the smoking prevalence was 42 %, and smoking was significantly more prevalent in the lower socioeconomic groups measured by occupation, education or income.

5.4 SMOKING, USE OF ALCOHOL, AND PHYSICAL ACTIVITY (V)

The prevalence of the use of alcohol increased over time, and at the age of 28 even 90 % of the subjects used alcohol. The prevalence of leisure time physical activity did not change over time as much as the prevalence of smoking and the use of alcohol (Study V, Table 2).

In the cross-sectional analysis smoking correlated significantly with the use of alcohol at the ages of 15, 21, and 28 years, the correlations being $r = .53$, $r = .35$, and $r = .24$, respectively. Physical activity was negatively and significantly correlated with smoking at each three study point the smokers having less leisure time for physical activity ($r = -.12$, $r = -.18$, $r = -.18$). The use of alcohol and physical activity correlated negatively and significantly at the age of 21 ($r = -.16$). (Study V, Table 3).

At the age of 28, smoking correlated significantly with earlier smoking at the age of 15 ($r = .42$) and 21 ($r = .69$). Smoking was also significantly related to earlier use of alcohol at the age of 15 ($r = .29$) and 21 ($r = .24$). The use of alcohol at the age of 28 was associated with earlier use of alcohol at the age of 15 ($r = .24$) and 21 ($r = .43$) and with earlier smoking at the ages of 15 and 21 ($r = .16$ and $r = .20$). Physical activity correlated positively with earlier physical activity ($r = .20$ and $r = .36$) and negatively with earlier smoking ($r = -.17$) and use of alcohol ($r = -.11$) at the age of 21. (Study V, Table 3).

In the linear regression model smoking, use of alcohol, and physical activity were independent variables at the age of 15, and the same behaviours were dependent variables at the ages of 21 and 28 (Table 7). Smoking and the use of alcohol in adolescence predicted smoking at the ages of 21 and 28; the model explained approximately 18 % of the variance in both periods. The use of alcohol was mainly predicted by earlier use of alcohol, and the model explained 6.8 % and 6.5 % of the variance. Physical activity was predicted by earlier physical activity; the model explained 5.1 % and 4.7 % of the variance.

The result that the use of alcohol of the adolescents predicted adult smoking was examined in more detail by cross-tabulating "use of alcohol in adolescence" by "smoking in adulthood" separately for non-smoking and smoking adolescents. The results show that 27 % of the non-smoking adolescents who used alcohol and 18 % of these adolescents who did not use alcohol at the age of 15 years started to smoke by the age of 28 years. The difference was statistically significant, tested by the Chi-square test ($p = .028$).

At the age of 15 there were no gender differences in smoking or in the use of alcohol among girls and boys, but at the ages of 21 and 28 the use of alcohol and smoking were more common among males compared to females. There were no differences between the genders in leisure time physical activity. Neither were the correlations between smoking, use of alcohol, and physical activity statistically significantly different between the genders. The smoking cessation rate between the ages of 15 and 28 was significantly lower among those who consumed more alcohol and had less leisure-time physical activity at the age of 28.

Table 7. Linear regression models for smoking, use of alcohol, and leisure time physical activity at the ages of 21 and 28 years predicted by behaviours at the age of 15 years.

DEPENDENT VARIABLES						
INDEPENDENT VARIABLES	Smoking, age 21			Smoking, age 28		
	B	Beta	p	B	Beta	p
Constant	1.30		<.001	0.91		<.001
Smoking, age 15	0.46	0.37	<.001	0.43	0.37	<.001
Use of alcohol, age 15	0.20	0.09	0.034	0.19	0.09	0.045
Physical activity, age 15	-0.13	-0.07	0.057	-0.04	-0.02	0.516
R ²	0.188			0.183		
INDEPENDENT VARIABLES	Use of alcohol, age 21			Use of alcohol, age 28		
	B	Beta	p	B	Beta	p
Constant	1.51		<.001	1.63		<.001
Smoking, age 15	-0.03	-0.04	0.334	0.04	0.05	0.261
Use of alcohol, age 15	0.37	0.28	<.001	0.33	0.21	<.001
Physical activity, age 15	-0.01	-0.01	0.900	0.10	0.08	0.045
R ²	0.068			0.065		
INDEPENDENT VARIABLES	Physical activity, age 21			Physical activity, age 28		
	B	Beta	p	B	Beta	p
Constant	1.73		<.001	2.07		<.001
Smoking, age 15	-0.03	-0.04	0.415	-0.01	-0.02	0.688
Use of alcohol, age 15	-0.04	-0.03	0.575	-0.07	-0.06	0.219
Physical activity, age 15	0.25	0.22	<.001	0.20	0.20	<.001
R ²	0.051			0.047		

B = Regression Coefficient, Beta = Standardized Coefficient

6 DISCUSSION

6.1 MAIN FINDINGS

The school- and community-based smoking prevention program, the North Karelia Youth Project, prevented or delayed the onset of smoking for several years. The preventive effect was better among the subjects who were non-smokers at the baseline. The mean lifetime cigarette consumption at the age of 28 was 22 % lower among those who participated in the intervention.

Smoking prevalence increased most between the ages of 13 and 15. The continuity of the smoking status from adolescence to adulthood was strong: most adolescent smokers were still smoking in adulthood. On the other hand, approximately half of the smokers at the age of 28 had started after the age of 15. The previous smoking status and smoking by friends were the most important predictors of smoking. Parental and sibling smoking were not so clearly associated.

A quarter of the daily smokers and half of the occasional smokers at the age of 15 had quit by the age of 28. One third of all adolescent smokers had quit before the age of 28, averaging at 2.3 % annual decline. The cessation was greater among the females, those who were occasional smokers, belonged to a higher social class, had fewer smoking family members, and had a healthier lifestyle.

The socioeconomic status and, particularly, the education of the subject were strongly related to smoking, the lower socioeconomic groups smoking the most. The parental socioeconomic status or inter-generational social mobility were not significantly related to the smoking of the subject in adolescence or adulthood.

Smoking was positively associated with the use of alcohol and negatively with physical activity from adolescence to adulthood. The best predictors for smoking, use of alcohol, and leisure-time physical activity were the same behaviours measured before, but smoking was the most constant. The use of alcohol in adolescence predicted smoking in adulthood, but smoking did not predict the use of alcohol.

6.2 DISCUSSION OF THE FINDINGS

6.2.1 Intervention

The North Karelia Youth Project prevented the onset of smoking for several years. The positive results of the school- and community-based intervention are supporting the importance of this kind of an approach in the field of smoking prevention.

Similar results have been reported in other studies: School programs based on a social influence approach combined with a community program with supportive parental, media, and community components have shown the most sustained effects on adolescents smoking (Biglan et al., 2000; Pentz, 1999; Perry et al., 1994; Sowden et al., 2003), even though the evidence is contradictory.

The intervention was most effective in delaying the onset among the non-smokers, and the effect was still seen at the age of 28. Also other studies have reported that the programs are most effective among non-smokers (Flay, 1985; Thomas, 2002). This supports the idea that the critical starting period for smoking prevention programs should be in early adolescence which is the most common time to experiment and start smoking.

At the age of 28, lifetime exposure to smoking was significantly lower in the intervention group than in the control group. The decrease in smoking prevalence would result in significant decreases in mortality, morbidity, and public health costs associated with treatment, insurance, and work days lost. Smoking prevention programs have been estimated highly cost-effective (Wang et al., 2001): The delayed onset of smoking reduces total lifetime exposure associated with an improved prognosis for quitting and a lower incidence of mortality and morbidity.

There were no great differences in the effects of the teacher-led and health educator-led programs. Trained peer leaders were used in both programs. Therefore it seems that the program would be effective also in a normal school setting. Mostly the teacher is the best person to carry out teaching at school, as the teacher knows the students and how to approach them. Therefore smoking prevention should be part of the school curriculum, of which the school staff has the main responsibility. However, the number of schools in this study was too small to permit definite conclusions to be drawn of the level of effectiveness of these two different programs.

The best results of smoking prevention programs used at schools have been achieved with the psychosocial programs such as the social influence approach, though the variation in the results is large. There is some evidence that the prevention effect can last for several years, but mostly the effect has disappeared relatively quickly. Surgeon General's report concluded (USDHHS, 1994) that the approaches based on the socio-psychological models are modestly effective across a variety of settings, times, and populations. However, some serious questions have been raised lately regarding the effectiveness of the social influence model, e.g. rigorously evaluated Hutchinson intervention in which no effect was found after eight years of intervention (Peterson et al., 2000a). It is also possible that selected significant results have been reported in the literature more frequently than non-significant findings.

It is a challenge to develop tailor-made programs taking into account also the environmental contexts and changing cultures. One option is to develop the programs further basing them on competitions and positive reinforcement. Then the social pressure coming from peers is turned upside down, to a pressure for non-smoking. Additionally, a public commitment of adolescents not to smoke shows to others that smoking is neither prevalent nor acceptable. This is important, since adolescents typically overestimate the prevalence of smoking among peers and this normative belief is associated with a higher risk of smoking (Olds et al., 2005). Therefore it is of importance that schools would adopt and implement prevention programs in a feasible way. It is not worth planning complicated and demanding programs if schools and teachers are not motivated or able to carry them out. The training of teachers is therefore an essential part of the prevention programs. However, to gain lasting prevention effects, it seems to be necessary to have ongoing prevention activities throughout young adulthood.

6.2.2 Onset of Smoking

Smoking prevalence increased strongly during the upper level of the comprehensive school from the seventh to ninth grade, between the ages of 13 and 15. This finding is consistent with other studies (Godeau et al., 2004) indicating that smoking prevention should be started on the seventh grade at the latest.

Most adolescent smokers were still smoking in adulthood. Previous smoking strongly predicted later regular smoking. Other studies constantly support these findings (Chassin et al., 1996; Chen and Kandel, 1995; Mulder et al., 1998). Adolescent smokers are likely to become adult smokers, partly because nicotine addiction occurs already during adolescence (Colby et al., 2000; DiFranza et al., 2002). The social environment also influences the smoking behaviour from adolescence to adulthood. Additionally, the negative health impacts of smoking may not appear until later ages and therefore do not motivate cessation.

Approximately half of the adult smokers had started smoking after the age of 15. There has been a widespread assumption that the smoking status is established by the age of 18. However, recent studies from the USA and Canada have not supported this assumption, but suggest that there have lately been clear changes in the smoking patterns among young adults, as nowadays relatively many start smoking only after the age of 18 (Hammond, 2005; Lantz, 2003). The findings of the present study might be in accordance with these results, even though surveys around the age of 18 were not included in this study. However, the present results indicate that it is important to continue smoking prevention efforts also after the comprehensive school, not only in adolescence, but also in young adulthood.

In the present study there were no great differences in smoking between the genders in adolescence, but in adulthood the males were smoking more than the females. Females stopped smoking more often, and the onset of smoking was not as common after the comprehensive school compared to the males. Nowadays there are no remarkable gender differences in smoking among Finnish adolescents (Rimpelä et al., 2005). In more than half of the countries participating in the HBSC study girls were more likely, or as likely as boys, to be smokers at the age of 15 (Godeau et al., 2004). Among Finnish adults gender differences in smoking exist, but the differences have been diminished in younger cohorts (Helakorpi et al., 2005). In Finland as well as in most other countries in Western Europe the educational differences in smoking are nowadays larger than the differences between the genders (Cavelaars et al., 2000; Helakorpi et al., 2005).

The influence of smoking by friends on the smoking of the subject was remarkable, especially in adolescence. This association has also been found in a large number of other studies. Smoking by friends in adolescence had a significant association with the smoking of the subject in adulthood, the finding being supported also by a number of other studies (Tyas and Pederson, 1998; USDHHS, 1994).

In the present study the smoking of siblings was associated with that of the subject in adolescence. Smoking by sisters was related to smoking in adolescence and smoking by brothers to smoking in adulthood when both genders were included in the analysis. The weakness of this study was that it did not inquire whether the siblings were younger or older than the subjects. Probably the older siblings would have had a stronger influence on smoking than the younger ones. However, most other studies agree that smoking by siblings influences adolescent smoking (Rajan et al., 2003; Vink et al., 2003).

Parental smoking was a relatively weak risk factor in the smoking of the subject in adolescence, especially compared to smoking by peers. Additionally, parental smoking in adolescence did not predict smoking in adulthood. The results of other studies concerning the association between parental smoking and offspring smoking vary: In some studies parental smoking is associated with adolescent smoking (Bricker et al., 2006; Fagan et al., 2005; Peterson et al., 2005; Tossavainen, 1988), while in others this association does not exist (McNeill et al., 1989; West et al., 1999; White et al., 2000). In addition to the effect of the parental model, it may also be easier for the children of smoking parents to experiment smoking due to easy access to cigarettes. On the other hand, the parents themselves may have tried to quit, and the young have seen how difficult it can be and therefore do not even start smoking. Most studies, however, agree that friends have a greater influence than parents on adolescent smoking (Bricker et al., 2006; Distefan et al., 1998). Adolescence is a time when the influence of friends becomes more important. It has been discussed that parental smoking has probably indirect effects on adolescent smoking, mediated by other factors, such as peer smoking (de Vries et al., 2006; Engels et al., 2004; Fergusson et al., 1995). Consequently, those adolescents who have smoking parents would more probably choose smoking friends compared to those whose parents are non-smokers.

6.2.3 Smoking Cessation

One fourth of the 15-year-old daily smokers and half of the occasional smokers had quit by the age of 28. Other longitudinal studies have indicated similar kinds of trends, even though there are no other studies from exactly the same period. However, a “smoker” is difficult to define especially in adolescence, when the non-smoking periods of different duration are part of the process of smoking. Similarly, there are different phases in the cessation process, and the limitation of this study is that the smoking status has mostly been studied by comparing only two study points.

The present results support the finding that heavier smokers and those who have smoked relatively longer are less likely to quit (Sussman et al., 1998). The annual quitting rate was 2.3 %, which has also been quite the same in other studies (Burt et al., 2000; Stanton et al., 1996a). In some analyses of this study, the definition “occasional smoker” included also those who smoked less than monthly. Naturally, smoking cessation is more probable among occasional smokers compared to those who smoke more often. The stability of smoking and difficulties in quitting reflect the addictive nature of smoking. However, in the present study only 7 % of the 28-year-old smokers thought that they would still be smokers in five years. The cessation programs are greatly needed for adolescents and young adults, since most of the young are willing to quit. At present only a few successful cessation programs for adolescents have been developed and evaluated (Garrison et al., 2003; McDonald et al., 2003; Sussman et al., 1999).

The social environment seems to be an important factor: The cessation rate was higher among those whose friends or family members were non-smokers. As the onset of smoking, also the cessation of smoking is influenced by the social environment. Those who were married had more likely quit. Support or lack of support from others seems to play a crucial role in quitting smoking. Monden et al. (2003) found that a partner who is an ex-smoker increased the chance of cessation compared to a partner who had never smoked or one who still smokes. Successful quitting seems to be an encouraging model for a smoking spouse.

The cessation rate was higher among the females compared to the males, but also opposite results have been obtained in some other studies. Pregnancy or plans for pregnancy might influence quitting among females. On the other hand, having children was not associated with smoking cessation in this study, and the result is consistent with a few other studies (Rose et al., 1996; Tucker et al., 2005). It has been speculated that having children might increase stress and thus hinder cessation. Smokers may also have children earlier than non-smokers. For example, smoking prevalence among young American mothers was higher compared to females of the same age without children (Gillmore et al., 2006).

Smoking cessation was related to other health behaviours: the subjects who consumed less alcohol and those who had more leisure time physical activity were more likely to quit. This finding is supported by other studies, which have shown an association between smoking cessation and a healthier lifestyle (Lewinsohn et al., 1999; Osler et al., 1999)

6.2.4 Socioeconomic status

The socioeconomic status in adolescence was measured with the parental socioeconomic status. The parental SES was mostly not significantly associated with the smoking of the subject in adolescence or in adulthood. Other studies have documented similar results (Friestad and Klepp, 2006; Pärna et al., 2003; Tuinstra et al., 1998), but there are also studies where a significant association has been found between the parental SES and offspring smoking (Cavelaars et al., 2000; Karvonen and Rimpelä, 1996; Tyas and Pederson, 1998). The socioeconomic status in adolescence was also measured by

school performance at the age of 13, and this indicator was strongly associated with smoking from adolescence to adulthood: Those who had the lowest school performance or the lowest education smoked the most from early adolescence to adulthood. The result is in line with other studies (Audrain-McGovern et al., 2004; Conrad et al., 1992) as well as with a Finnish study, in which smoking differences based on school performance among the 13-15-year-olds measured in 1998-2001 were even larger (Vartiainen et al., 2004).

The socioeconomic status of the subject in adulthood was strongly related to smoking, the lower SES groups measured by education or occupation smoking the most. The result is in line with most corresponding studies (Cavelaars et al., 2000; Laaksonen et al., 2005). On the other hand, those subjects who were most educated in adulthood, had smoked the least also in adolescence. It has been discussed that a health-compromising lifestyle in adolescence could be an important mechanism from which educational health differences originate (Koivusilta et al., 1998). However, it is relatively difficult to interpret smoking as a directly causal mechanism for low education. The phenomenon may be explained by other factors, such as personality, environmental factors, and overall lifestyle. In general, the smoking status reflects a complex interaction between personality, environment, and culture which probably also influences the education and other socioeconomic factors.

Social mobility measured by the relative difference between parental education and the education of the subject was not significantly associated with smoking. It seems that people adopt smoking behaviour prevalent in the SES group where they end up. However, there was a tendency for the upwardly mobile subjects to smoke less and the downwardly mobile subjects to smoke more compared to the stable subjects. Other studies on social mobility and smoking have reported similar results (Hart et al., 1998; Karvonen et al., 1999; Pulkki et al., 2003b). In the present study parental education was related to the education of the subject, even if the average level and length of education had increased between the two generations. Moreover, the association between the parental socioeconomic status and smoking exists at least partly, as the adult socioeconomic status is dependent on childhood socioeconomic origins. Whatever the mechanism is, the role of education seems to be highly important in the process of smoking.

There were no significant differences in smoking cessation between the educational groups in adulthood. Several other studies report opposite results. On the other hand, the white-collar workers showed a higher cessation rate compared to the blue-collar workers and so did the employed subjects compared to the unemployed. Smokers in high socioeconomic groups are usually more likely to be in social environments where smoking is not encouraged and thus have more pressure for cessation.

In several European countries educational differences in smoking are larger among younger generations (Cavelaars et al., 2000). The differences between the educational groups in smoking have increased (Giskes et al., 2005), also in Finland (Laaksonen et al., 1999; Rahkonen et al., 1995). In terms of the WHO model on the cigarette epidemic (Lopez et al., 1994), Finnish adults and probably also adolescents are quite close to the stage IV of the model, in which smoking prevalence is slowly declining, but socioeconomic differences in smoking prevalence persist and may still widen. High smoking prevalence among low SES groups is an important determinant for health inequalities. It has been assumed that socioeconomic differences among people suffering from diseases related to smoking will increase (Cavelaars et al., 2000; Giskes et al., 2005), and, therefore, reducing smoking among lower educated subgroups should be a priority in policies aiming at reducing inequalities in health in Europe (Huisman et al., 2005a). Smoking prevention is essential particularly among adolescents with low school performance. Additionally, cessation efforts should be tailored especially for young adults in lower SES groups.

6.2.5 Smoking related to use of alcohol and physical activity

The present study followed two health-compromising behaviours, smoking and use of alcohol, and one health-enhancing behaviour, physical activity, at the ages of 15, 21, and 28. Smoking prevalence increased until the age of 21, the prevalence of the use of alcohol increased until the age of 28, and physical activity did not change much over time. The best predictors for smoking, use of alcohol, and physical activity in adulthood were the same behaviours as measured in adolescence. The prevalence of smoking and use of alcohol was higher among males. The continuity of smoking was the strongest longitudinal behaviour. All these results are well in accordance with most other studies.

Smoking and the use of alcohol were clearly associated with each other from adolescence to adulthood, though later the correlation became weaker. A large number of other studies support this association (Bien and Burge, 1990; Pohjanpää, 1997; Wang, 2001). The use of alcohol in adolescence predicted smoking in adulthood, but smoking did not predict the use of alcohol. In other words, adolescents who used alcohol were more likely to start smoking later. Smoking and the use of alcohol belong, at least partly, to a certain type of lifestyle in adolescence. Substance use can be related to willingness to transit to adult society. Later on, smoking and the use of alcohol may belong to similar social situations. It has been found that both smoking and the use of alcohol in adolescence fit in the Problem Behaviour Theory (Jessor and Jessor, 1977), since both are associated with a set of problem behaviours rather than with health-related behaviours (Turbin et al., 2000). In present study at the age of 28, even 90 % of the subjects reported to use alcohol. However, mostly the use of alcohol in adulthood does not indicate problem behaviour, as it often does in early adolescence.

Physical activity was associated stronger with smoking than with the use of alcohol, the non-smokers having more leisure-time physical activity. These findings show that common risk-behaviours are connected already in adolescence and in young adulthood. The present results confirm the results of other studies (de Bourdeaudhuij and van Oost, 1999; Koivusilta et al., 2003; Laaksonen, 2002) stressing the central role of smoking in association with other health behaviours; according to these studies smoking seems to be a strong indicator of a broader lifestyle. The association between physical activity and smoking may be confounded by several other factors, such as the socioeconomic status. Moreover, preventing smoking might lead to a healthier lifestyle in general.

In the lately renewed basis for the comprehensive school curriculum in Finland, health education is an independent subject starting from the seventh grade. Within the health promotion sector, there are several different and competitive subjects to be covered during the lessons, and the health education curriculum is at risk of becoming overfull. The results of the present study show that some of the health issues, at least smoking and the use of alcohol, could be treated together out of lifestyle perspective. A similar approach has been supported by previous studies (Aaro, 1995; Kannas, 1983; Pohjanpää, 1997; Wiefferink et al., 2006).

6.3 METHODOLOGICAL CONSIDERATIONS

The present longitudinal, 15-year follow-up study from 1978 to 1993 is one of the longest among the analogous studies in the literature. Due to the longitudinal design of the study, it was possible to determine the order of the events and to analyse the predictors. However, the longitudinal method does not provide proof of causation, as many intervening things cannot be controlled.

The surveys during the 15 years were not carried out on a regular basis; there were even a seven-year gap between the last two surveys. Additionally, several of the analyses are based only on three observation points with relatively limited questionnaires. However, the questions about smoking were ex-

actly the same for the subjects in all the surveys. Also many other items were asked in the similar manner in the different surveys.

The study sample was relatively small, especially for studying factors associated with items, such as quitting smoking and social mobility. In many cases the statistical power of the study was not large enough to study gender differences. The study sample was originally from Eastern Finland, and therefore the results are not fully representative nationally. On the other hand, Finland is a country with a relatively homogenous population, and the prevalence of health behaviours examined in this study are approximately the same in the different parts of Finland. Therefore it is very likely that most results could be generalized to cover also the rest of the country and even other industrialized countries. The determinants of adolescent smoking – e.g. peer influence – are quite universal, roughly the same even in China (Zhang et al., 2000).

The response rate was good, being 94 % after the school intervention at the age of 15 years, and 71 % in the last survey, when the participants were 28 years old. There were no significant gender differences between the participants and drop-outs. The present study cohort was not selected on the basis of smoking or other health behaviours, as there were no significant differences between the participants and drop-outs in smoking, use of alcohol or physical activity measured at the age of 15. The result is somewhat surprising, because the response rate is often lower among those who smoke and have other non- healthy behaviours (Hill et al., 1997). On the other hand, the lifestyle of the drop-outs might have changed remarkably during the follow-up period from adolescence to adulthood: if a person was not smoking or using alcohol at the age of 15, he/she can be a smoker or heavy drinker at the age of 28. It is likely that current alcoholics or heavy drinkers did not answer in the latest survey.

The present study was originally designed to test the effects of intervention. However, later on, many other aspects were included in the studies. It is possible that, for example, associations between smoking and background variables are different among the subjects in the intervention and control schools. However, the small size of the study sample rejected the possibilities to test this properly.

The data used in this study was collected from self-administered questionnaires filled at school (1978, 1980, and 1981) and at home (1982, 1986, and 1993). At school the children filled in the questionnaire under the supervision of the project nurse or teacher. All replies were kept strictly confidential.

The study was based on standardized questions in self-administered questionnaires. The validity of self-reports has often been questioned, especially with issues such as smoking and use of alcohol. In order to improve accuracy, biochemical assessment can be used, though self-reports of smoking are accurate in most studies (Patrick et al., 1994). In Finland, the validity of self-reported smoking seems to be high, and most of the few self-reported non-smokers who have cotinine in their serum have it only on low or moderate levels (Vartiainen et al., 2002). In a longitudinal study in Liverpool, which followed children from the ages of four and five years to the ages of 14-15 years, it was found that younger children tend to over-report their smoking behaviour, whereas older children under-report it (Mair et al., 2006). Rimpelä (1980) found out that among Finnish adolescents the responses of the age of the first experience of smoking and the age of starting smoking were unreliable in repeated inquiries: the older the youngsters were at the time of the study, the higher was the reported age at the first smoking experience or the starting of smoking.

The smoking status was self-reported by using the same standardized questions in all six surveys. In the 1978 and 1980 surveys, serum thiocyanate was measured from all serum samples of the children. In 1980, 12 boys and four girls reported smoking more rarely than daily, but had 95 $\mu\text{mol/l}$ or more serum thiocyanate (Vartiainen, 1982), which shows that they did probably not tell the whole truth about their smoking status. However, the low number of such cases indicates that the self-reported data is reasonably valid. The validity of the self-reported smoking status was not tested in the follow-

ing four surveys. Increased social unacceptability of smoking, tobacco control legislation, and media attention mostly in negative light concerning smoking might have led to underreporting among the subjects in the latest surveys. It is possible that some smokers deny their smoking habit, especially in this kind of a health-related survey where respondents tend to report answers they think are expected from them. Self-reported smoking of parents was also asked in the questionnaires which were filled at home in 1978 and 1980. At that time smoking among females was relatively rare, and it is possible that cultural unacceptability of smoking made mothers to underreport their smoking, especially as the questionnaire was related to the school of their children.

The same situation as with self-reported smoking exists with self-reported use of alcohol, which may be underestimated. In Finland, a great difference has been found in the use of alcohol when the survey-based estimates are compared to the sale statistics (Simpura et al., 1995). Although this difference is diminishing over time, it can be assumed that also the use of alcohol is underreported in the present study.

Physical activity was measured by the question asking only leisure-time physical activity; work-based physical activity, for example, was not taken into account. Measuring leisure-time physical activity has been an established way to describe physical activity also in several other studies. It describes voluntary physical activity, which is based on a self-made decision and is probably more connected with a healthy lifestyle in general than is, for example, work-based physical activity.

The SES of origin was defined on the basis of the parental questionnaires, in which the most commonly used measures, such as occupation, education, income, and employment, were asked from the parents themselves. The validity of these variables in the present study is much better compared to some other studies, where children have been asked about the socioeconomic status of their parents. The SES of the subjects in adulthood was measured by using the same questions, which assured the comparability between parental SES. This was crucial especially in studying the changes in the socioeconomic status. Social mobility was defined by the relative changes in the parental education compared to the education of the children. The problem in measuring "social mobility" was that it was not possible for the subjects already in the highest group to move higher or for those in the lowest group to move lower. Education has been estimated to be the strongest and most consistent indicator in measuring the relationship between the SES measures and cardiovascular risk factors, such as smoking (Winkleby et al., 1992). In this study, income was not a very useful indicator to measure the SES of the subject, as many of the subjects belonged to only one of the six categories. The classification of income in the questionnaire failed.

Several variables in the present study using larger scales were dichotomised for comparability and different analyses. When categories are combined, some information is always lost. Additionally, the cut-off points can be chosen differently. For example, the length of education has increased between two generations; therefore parental education and the education of the subject had different cut-off points. Both were classified into three groups with approximately one third of the subjects in each group. It was also found that the trends of the results of smoking were quite the same regardless of how smokers and non-smokers were defined (at least daily /weekly /monthly smokers).

There is a danger in the studies with a relatively small sample to make a so-called Type II error by rejecting the real effect, since there is not enough statistical power to make the effect significant. For example, in this study the association of smoking and social mobility could have become significant if the sample size would have been bigger. In the field of public health, the Type II error might lead to a situation where interventions are not implemented if the Type II error proves it is not worth doing anything. However, in this study, it was not the case.

7 CONCLUSIONS

1. In the present study, the prevention effect of the program on the onset of smoking lasted several years. Therefore the results support the feasibility of a school-based social influence program with a community-based program in smoking prevention among adolescents.
2. Strong continuity of smoking from adolescence to adulthood supports the importance of preventing the onset of smoking in adolescence. Additionally, it is worthwhile to continue prevention programs also after the comprehensive school, since so many young start smoking after that. At the same time it is important to develop cessation programs tailor-made for adolescents and young adults.
3. The smoking of significant others and social influence are important factors both for the onset of smoking and for smoking cessation. Therefore it is feasible to use methods based on social influence and social support in smoking prevention and cessation programs.
4. Low socioeconomic status is strongly related with smoking from adolescence to adulthood. In addition, smoking is associated with other unhealthy behaviours such as physical inactivity and, especially, use of alcohol. The results support the importance of targeting smoking prevention and cessation programs on risk groups such as those with poor school performance and low socioeconomic status as well as those with other unhealthy behaviours.

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