

Satu Helakorpi

# Impact of Tobacco Control Policy on Smoking and Exposure to Environmental Tobacco Smoke

Publications of the National Public Health Institute  15/2008

Department of Health Promotion  
and Chronic Disease Prevention  
National Public Health Institute, Helsinki, Finland  
*and*  
Department of Public Health  
University of Helsinki, Finland

Helsinki, Finland 2008

**Satu Helakorpi**

**IMPACT OF TOBACCO CONTROL POLICY  
ON SMOKING AND  
EXPOSURE TO ENVIRONMENTAL  
TOBACCO SMOKE**

**ACADEMIC DISSERTATION**

*To be presented with the permission of the Faculty of Medicine,  
University of Helsinki, for public examination in the Auditorium of the Arppeanum  
Building of the University of Helsinki, Snellmaninkatu 3, on June 6, 2008,  
at 12 o'clock noon.*

Department of Health Promotion and Chronic Disease Prevention

National Public Health Institute, Helsinki, Finland

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Department of Public Health, University of Helsinki, Finland

Helsinki 2008

## **Publications of the National Public Health Institute KTL A15 / 2008**

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Telephone +358 9 474 41, telefax +358 9 4744 8408

ISBN 978-951-740-823-3

ISSN 0359-3584

ISBN 978-951-740-824-0 (pdf)

ISSN 1458-6290 (pdf)

Yliopistopaino

Helsinki 2008

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Satu Helakorpi, Impact of Tobacco Control Policy on Smoking and Exposure to Environmental Tobacco Smoke

Publications of the National Public Health Institute, A15/2008, 73 Pages

ISBN 978-951-740-823-3; 978-951-740-824-0 (pdf-version)

ISSN 0359-3584; 1458-6290 (pdf-version)

<http://www.ktl.fi/portal/4043>

## **ABSTRACT**

Tobacco smoking is a major cause of premature death in industrialised countries, being a risk factor for a number of diseases, e.g. cardiovascular diseases, chronic obstructive pulmonary disease, and cancer. Variation in smoking prevalence in a population over time results from three processes: smoking initiation rate, cessation rate, and the succession of birth cohorts with different smoking histories. The first two processes are influenced by prevailing factors, including legislation, knowledge of the health consequences of smoking, the price of tobacco products, and the general acceptability of smoking. The third process reflects the past, being the sum outcome of smoking initiation and cessation processes completed so far, and manifesting in the proportion of never-smokers, former smokers, and current smokers in a birth cohort at a given time.

In Finland two major stages of tobacco control policy have been applied to reduce tobacco smoking in Finland: the national Tobacco Control Act of 1976 (TCA), supplemented by a total ban on advertising in 1978, and the environmental tobacco smoke amendment of the TCA in 1995 (TCAA). In 2000 TCAA was also extended to cover restaurants and bars, and the environmental tobacco smoke was defined as a carcinogenic substance. In 2006 the second amendment of the TCA concerned restaurants. Since June 2007 smoking has been totally banned in nearly all restaurants and bars. In 2009 they all will be smoke-free.

The aim of the present study was to evaluate the impact of the Finnish tobacco control measures for reduction of smoking. First, the trends and patterns in ever smoking among adult Finns in 1978–2001 as well as the associations of trends with the Tobacco Control Act in 1976 were examined. Secondly, the impact of the 1976 TCA on the proportion of ever daily smokers in different socioeconomic groups was studied. Thirdly, the impact of the 1995 TCAA on recent trends in the prevalence of daily smoking was evaluated by gender and employment status. Fourthly, the trends of exposure to environmental tobacco smoke (ETS) at workplaces and homes were investigated.

The study is based on data of the 'Health Behaviour among the Finnish Adult Population' surveys. Independent, annual cross-sectional postal surveys have been carried out by Finland's National Public Health Institute (KTL) since 1978. A random sample (sample size about 5000) of the Finnish population aged 15–64 years has been drawn from the National Population Register. The average, albeit declining, response rate has been 74%.

Among Finnish men smoking initiation declined from earlier to later cohorts, whereas among women it increased in successive birth cohorts born before 1956. The lasting differences between birth cohorts as regards ever daily smoking reflected well the impact of measures to reduce smoking in Finland in 1976. Smoking initiation in the birth cohorts (born in 1961 or later) which were in critical age as regards the risk of smoking initiation when the TCA came into force was less common than could be expected according to the trends seen in the earlier birth cohorts.

Marked socioeconomic differences were found in smoking in the different birth cohorts. Smoking was more prevalent in the lower socioeconomic groups than in the higher ones, and the differences were larger in the later birth cohorts compared to the earlier ones. The differences between the birth cohorts in ever daily smoking were compatible with the hypothetical impact of the TCA in almost all socioeconomic groups, except farmers. Among men the 1976 TCA appears to have had the greatest impact on white-collar employees. Among women the effect of the act was highly significant in all socioeconomic groups. However, female smoking prevalence continues to show wide socioeconomic disparities.

Daily smoking decreased among employees after the 1995 TCAA, supporting the hypothesis of the lowering impact of the amendment on daily smoking due to increased smoking cessation. No parallel change in daily smoking was found in the population without direct exposure to ETS legislation (farmers, students, housewives, pensioners or unemployed). Exposure to ETS decreased markedly among non-smokers at work after the 1995 TCAA.

The 1976 TCA and the 1995 TCAA were useful in controlling smoking initiation and cessation, but their impact was not equal across the population groups. The results of this study strongly suggested that tobacco control policies markedly contribute to the decrease in smoking and in exposure to environmental tobacco smoke.

Keywords: smoking, smoking initiation, smoking cessation, passive smoking, tobacco control policy

Satu Helakorpi, Tupakkapoliittisten toimenpiteiden vaikutus tupakointiin ja ympäristön tupakansavulle altistumiseen

Kansanterveyslaitoksen julkaisuja, A15/2008, 73 sivua

ISBN 978-951-740-823-3; 978-951-740-824-0 (pdf-versio)

ISSN 0359-3584; 1458-6290 (pdf-versio)

<http://www.ktl.fi/portal/4043>

## TIIVISTELMÄ

Tupakointi on tärkein yksittäinen syy ennenaikaiseen kuolleisuuteen teollistuneissa maissa. Se on sydän- ja verisuonisairauksien riskitekijä ja aiheuttaa mm. hengityselinten sairauksia sekä keuhkosityöpää. Tupakoinnin yleisyys väestössä tietyllä hetkellä on tulosta kolmesta prosessista: tupakoinnin aloittamisesta, tupakoinnin lopettamisesta ja perättäisten syntymävuosikohorttien erilaisista tupakointihistorioista. Kahteen ensimmäiseen prosessiin vaikuttavat vallitseva lainsäädäntö, senhetkinen tietämys tupakoinnin terveyshaitoista, tupakkatuotteiden hinta ja tupakoinnin hyväksyttävyyys yhteiskunnassa. Viimeinen prosessi heijastelee menneisyyttä. Se on tulosta tupakoinnin aloittamis- ja lopettamisprosesseista ja ilmenee jokaiselle syntymävuosikohortille ominaisena ei- koskaan tupakoineiden, aiemmin tupakoineiden ja sen hetkisten tupakoivien osuuksina.

Suomessa säädettiin vuonna 1976 tupakkalaki, joka oli yksi Euroopan tiukimmista ja sitä täydennettiin vuonna 1978 totaalilla mainontakiellolla. Lakia uudistettiin vuonna 1995 lisäyksillä, joiden tavoitteena oli suojella työntekijöitä ympäristön tupakansavulta. Vuonna 2000 uudistukset laajenivat koskemaan myös ravintoloita ja ympäristön tupakansavu määriteltiin karsinogeeniksi. Vuoden 2006 toinen laajennus koski ravintoloita. Kesäkuun alusta vuonna 2007 jokseenkin kaikki ravintolat ja muut ravitsemusliikkeet tulivat savuttomiksi. Täydellinen savuttomuus ravintoloissa toteutuu kesäkuussa 2009.

Tutkimuksen tavoitteena oli arvioida tupakkapoliittisten toimenpiteiden, erityisesti vuoden 1976 tupakkalain ja sitä täydentävän vuoden 1995 tupakkalain uudistusten, vaikutuksia tupakoinnin aloittamiseen, päivittäin tupakointiin sekä ympäristön tupakansavulle altistumiseen. Tupakoinnin yleisyydessä tapahtuneita muutoksia tarkasteltiin sukupuolen, syntymävuosikohortin ja sosioekonomisen aseman mukaan.

Tutkimusaineistona oli 'Suomalaisen aikuisväestön terveystutkimus (AVTK)' -aineisto. AVTK- tutkimus on vuosittain keväisin toteutettu postikyselytutkimus 15–64-vuotiaille suomalaisille (otoskoko noin 5000) vuodesta 1978 alkaen. Vastausaktiivisuus on ollut keskimäärin 74 prosenttia.



Miehillä yleinen kehityssuunta oli joskus päivittäin tupakoineiden osuuden väheneminen kohortti kohortilta, kun taas naisilla tupakointi lisääntyi kohortti kohortilta ennen vuotta 1956 syntyneissä kohorteissa. Niissä kohorteissa, jotka olivat kaikkein herkimmissä tupakoinnin aloittamisiässä vuoden 1976 tupakkalain tullessa voimaan – 1960-luvulla tai myöhemmin syntyneillä – tupakoinnin aloittaminen oli vähäisempää kuin aiempien syntymävuosikohorttien perusteella laaditun trendiennusteen mukaan oli odotettavissa.

Sosioekonomisten ryhmien väliset erot joskus päivittäin tupakoineiden osuudessa eri syntymävuosikohorteissa olivat suuret. Tupakointi oli yleisempää alemmissa sosioekonomisissa ryhmissä, ja ryhmien väliset erot olivat suuremmat nuoremmassa kohorteissa. Tupakoinnin yleisyyden erot eri kohorteissa tukivat hypoteesia vuoden 1976 tupakkalain vaikutuksesta tupakoinnin vähenemiseen jokseenkin kaikissa sosioekonomisissa ryhmissä. Vuoden 1960 jälkeen syntyneissä kohorteissa tupakoinnin aloittaminen oli harvinaisempaa kuin trendiennusteen perusteella olisi voinut odottaa kaikissa muissa sosioekonomisissa ryhmissä paitsi maanviljelijöillä. Miehillä tupakkalain vaikutus oli suurin toimihenkilömiehillä. Naisilla taas tupakkalain vaikutus oli suuri kaikissa sosioekonomisissa ryhmissä, mutta suuret erot naisten tupakoinnin yleisyydessä eri ryhmissä säilyivät edelleen.

Päivittäin tupakointi väheni väestössä työssä olleiden keskuudessa vuoden 1995 tupakkalain jälkeen tupakoinnin lopettamisen lisääntyessä. Niissä väestöryhmissä, jotka eivät olleet tupakkalain vaikutuspiirissä (maanviljelijät, opiskelijat, kotirouvat, -isät, eläkeläiset ja työttömät) vastaavaa vähentymistä päivittäistupakoinnin yleisyydessä ei tapahtunut. Tupakoimattomien altistuminen ympäristön tupakansavulle väheni työpaikoilla vuoden 1995 tupakkalain voimaantulon jälkeen.

Tutkimustulosten mukaan tupakoinnin vähentämiseksi laadituilla laeilla (vuoden 1976 tupakkalaki ja sitä täydentävän vuoden 1995 tupakkalain uudistukset) ja niihin liittyvillä toimenpiteillä oli mahdollista vähentää tupakoinnin aloittamista sekä lisätä tupakoinnin lopettamista sekä vähentää ympäristön tupakansavulle altistumista. Tupakkalakien vaikutus ei kuitenkaan ollut yhtä voimakas eri sosioekonomisissa ryhmissä.

Asiasanat: tupakointi, tupakoinnin aloittaminen, tupakoinnin lopettaminen, passiivinen tupakointi, tupakkapolitiikka

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## **ABBREVIATIONS**

CI	confidence interval
ETS	environmental tobacco smoke
FCTC	Framework Convention on Tobacco Control
GDP	gross domestic product
NGOs	non-government organisations
OR	odds ratio
SES	socioeconomic status
TCA	Tobacco Control Act of 1976
TCAA	Tobacco Control Act Amendment in 1995
TCS	Tobacco Control Scale
WHO	World Health Organization



## LIST OF ORIGINAL PUBLICATIONS

This thesis is based on the following original articles referred to in the text by their Roman numerals:

- I** Helakorpi S, Martelin T, Torppa J, Patja K, Vartiainen E, Uutela A. Did Finland's Tobacco Control Act of 1976 have an impact on ever smoking? An examination based on male and female cohort trends. *Journal of Epidemiology and Community Health* 2004; 58 (8): 649–654.
- II** Helakorpi S, Martelin T, Torppa J, Vartiainen E, Uutela A, Patja K. Impact of the 1976 Tobacco Control Act in Finland on the proportion of ever daily smokers by socioeconomic status. *Preventive Medicine* 2008; 46 (4): 340–345.
- III** Helakorpi S, Martelin T, Torppa J, Patja K, Kiiskinen U, Vartiainen E, Uutela A. Did the Tobacco Control Act Amendment in 1995 affect daily smoking in Finland? Effects of a restrictive workplace smoking policy. *Journal of Public Health (Oxford Journals)* 2007; doi: 10.1093/pubmed/fdm051
- IV** Jousilahti P, Helakorpi S. Prevalence of exposure to environmental tobacco smoke at work and at home - 15-year trends in Finland. *Scandinavian Journal of Work, Environment & Health* 2002; 28 (suppl 2):16–20.

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# 1 INTRODUCTION

Tobacco smoking is a main cause of premature deaths in industrialised countries, being a risk factor, e.g., for cardiovascular diseases, chronic obstructive pulmonary disease and cancer (e.g. Phillips, et al. 1996). Harmful effects of smoking began to impact into public awareness in the late 1950s, following the publication of the first large-scale epidemiological studies on the association of lung cancer with smoking (Surgeon General's Report 1964). In the mid-1980s several studies were published in which environmental tobacco smoke (ETS) had been proved dangerous also to those involuntarily exposed to tobacco smoke (Adlkofer, et al. 1989).

Currently, tobacco is the leading cause of death in the world (Frieden and Bloomberg 2007). While smoking prevalence has decreased in developed countries, there have been large increases in smoking in the developing countries. It has been estimated that worldwide four million deaths are attributable to tobacco each year, but with current trends the number may rise to about ten million deaths per year by the 2030s (Peto and Lopez 2002).

In Europe the smoking rates have declined during the last 40 years considerably. In Finland tobacco consumption is currently among the lowest in Europe. The prevalence of daily smoking in the Finnish population was 23 per cent at the beginning of the 2000s. In Norway, for example, the corresponding prevalence was 30 per cent, in Denmark 28 per cent, in Sweden 19 per cent, in Spain 32 per cent, and in Germany 36 per cent. (WHO 2003) Although in Sweden the smoking prevalence among men is low (17 per cent) compared to other European countries (WHO 2003), there is a high consumption rate of smokeless tobacco. In 2005, 23 per cent of adult Swedish men used snuff (CAN 2008). In Finland male smoking has markedly diminished, and female smoking has remained at the level reached in the mid-1980s. However, the development in smoking has not been equally positive in all socioeconomic groups. Differences in smoking between educational groups favouring those in higher positions have increased among men and women especially since the mid-1980s. These trends have continued up to the present days. (Helakorpi, et al. 2007b, Rahkonen, et al. 1995.)

Smoking has been suggested to be among the major determinants of social inequalities in health (Huisman, et al. 2005a, Mackenbach, et al. 2004). Therefore reducing differences in smoking would be one means to reduce socioeconomic differences in health, which is also one of the targets in the Finnish health policy (Government Resolution on the Health 2015 Public Health Programme 2001).



Finland has a long history in tobacco control. Measures to reduce smoking in Finland were initiated more than four decades ago. In 1964 the National Board of Health published the first relevant national report, modelled on the US Surgeon General's report. In 1966 the Finnish Tobacco Committee proposed a restriction of cigarette advertising and smoking in public places. In 1969 the tobacco producers/wholesalers voluntarily stopped the television commercials of tobacco products and all such commercials were afterwards banned in 1970. The Second Tobacco Committee for pre-legislative work was nominated in 1972, and the resulting wide-ranging Finnish Tobacco Control Act (TCA) was passed at the Parliament in 1976. Amendment of TCA (Tobacco Control Act Amendment, TCAA) was implemented in 1995. The main aim of the TCAA was to protect people from environmental tobacco smoke (ETS) at work and in public places. In 2000 ETS was classified as a carcinogen, and the TCAA required restaurants to reserve at least half of the area as smoke-free. In 2007, due to the second amendment of the TCA concerning restaurants, nearly all restaurants, bars, pubs, and cafes became smoke-free in Finland. The total smoking prohibition in restaurants and bars will take place in June 2009 (Finlex 2008).

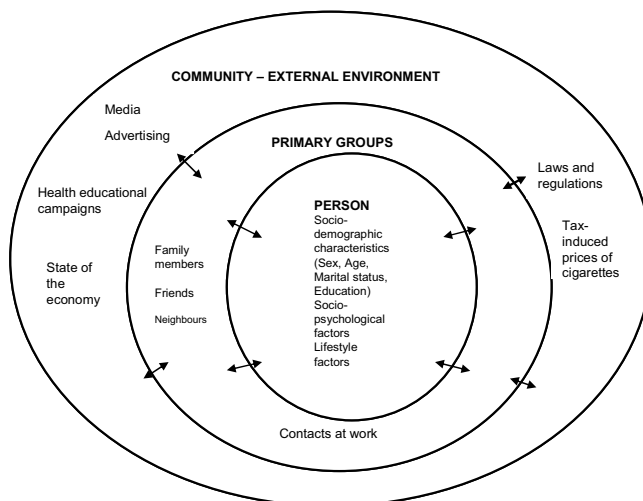
What kind of effects the above-mentioned tobacco control measures have produced, is a question that has - up to the present day - been only modestly answered. In previous Finnish studies the populations have consisted of employees at 8–10 workplaces located in Helsinki metropolitan area (Heloma 2003). Also exposure to ETS among workers in different types of restaurants has been studied in 1999–2004 (Johnsson, et al. 2003, Johnsson, et al. 2006). Some studies have been focused on adolescents, and the effects of the 1976 and 1995 tobacco sales bans on tobacco purchase of minors have been evaluated (Rimpelä and Rainio 2004).

In the present study the impact of the Finnish Tobacco Control Act of 1976 and its amendment in 1995 on smoking and exposure to environmental tobacco smoke are evaluated on the basis of a strong study design with a long sequence of large and nationally representative samples.

## 2 REVIEW OF THE LITERATURE

### 2.1 Smoking behaviour

Smoking behaviour can be seen rooted in e.g. biological, social, environmental, historical, and cultural contexts (Altman 1990). Dedobbeleer and colleagues (2004) have used a model where both individual and societal factors related to smoking behaviour were described. Smoking behaviour has been seen as a function of the surrounding context. Intrapersonal factors are nested within primary groups (interpersonal relationships with e.g. family members, friends, and co-workers), the community, and the external environment. (Dedobbeleer, et al. 2004.) (Fig. 1.)



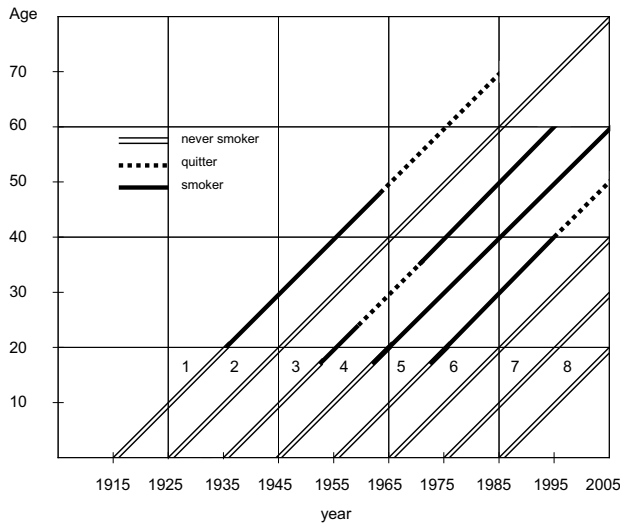
**Figure 1.** *The society and health model on smoking, modified from Figure 2 in Dedobbeleer, et al. 2004.*

The fluctuation of smoking prevalence in a population over time can be seen as a result from three processes: changes in the initiation and cessation rates of smoking, and the process of succession of birth cohorts with different smoking histories. The first two processes are influenced by the current factors, such as legislation, knowledge of the health consequences of smoking, the economic climate, relative costs of tobacco products, and the general acceptability of smoking. The third process reflects the past and can be seen as the net result of the smoking initiation

and cessation processes completed so far, and manifested in the proportion of never-smokers, former smokers, and current smokers in a birth cohort at a given time.

Smoking trajectories of individuals can be described in Lexis diagram, with the calendar year on an x-axis and the age on a y-axis. For example, the fictitious person No. 1 was born in 1915, started smoking in 1935 at the age of 20, and quit smoking in 1965 at the age of 50; the fictitious person No. 4 was born in 1945 and started smoking in 1962 at the age of 17; individuals 2, 6, and 7 are never-smokers (Fig. 2). The smoking status of a birth cohort at a specific point of time is a product of these individual smoking trajectories. The proportion of ever smokers in a birth cohort gives information of the history of smoking initiation among the members in this birth cohort (Martelin 1984). The initiation of smoking can be a consequence of various factors including individual and communal explanatory factors, e.g. the smoking status of friends and parents, and socioeconomic status (e.g. Koivusilta 2000, Madden, et al. 2004). On the other hand, tobacco contains nicotine that is recognized as an addictive substance (Benowitz 1988). The essential role of nicotine in sustaining smoking behaviour has become more broadly accepted only in the past decade (Jarvis 2004). The first symptoms of nicotine dependence can emerge within days or weeks of the initiation of even intermittent smoking (e.g. DiFranza, et al. 2002). Intrapersonal and interpersonal factors that contribute to the sustaining of smoking involve a complicated interaction between unpleasant and rewarding influences of nicotine as well as environmental factors such as approval of a peer group.

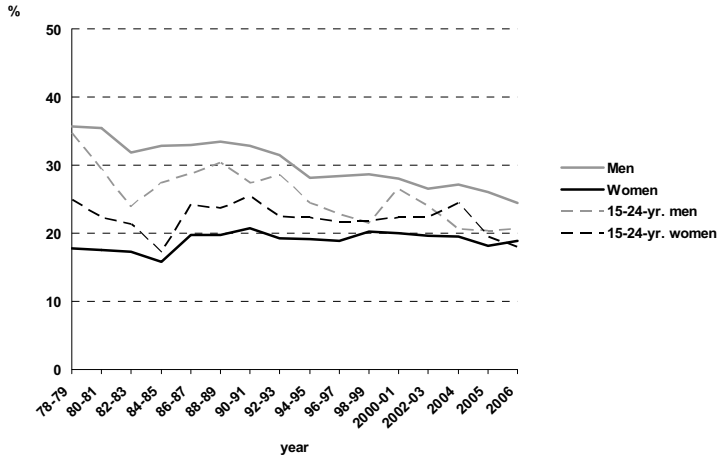
The population changes in smoking prevalence may arise either from a periodical change or from disparate developments in successive birth cohorts. Rates of smoking initiation may vary, leading to persistent disparities in the proportion of ever-smokers between the birth cohorts. In Finland nearly all ever daily smokers have started smoking before the age of 21 years (Paavola, et al. 2001) and hardly any after that age. Consequently, among persons older than 25 years, the variation in the rates of daily smoking is primarily accounted for by smoking cessation.



**Figure 2.** *Examples of individual smoking trajectories (1–8) in Lexis diagram. (modified from Figure 1 in Martelin 1984, p. 15)*

## 2.2 Smoking prevalence and its time trends

In the 1920s, cigarette consumption among the Finnish males was one of the highest in the world, significantly above that of other Nordic countries. A good supply of tobacco products was guaranteed by many cigarette factories from the 19th century onwards. In the 1950s the smoking prevalence of the Finnish adult male population was estimated to be around 70% (Martelin 1984). From this very high level the prevalence declined to about 45% in 1965–70. In contrast, Finnish women smoked very rarely, until smoking initiation began to increase among young women in the 1960s and 1970s. At the beginning of the 1960s the prevalence of female smoking was estimated to be about 13% (Rimpelä 1978). While male smoking declined from 36% to 24% in the period from 1978 to 2006, female smoking increased slightly from 17% to 19% (Helakorpi, et al. 2007a). The gender differences in smoking prevalence have thus decreased (Helakorpi, et al. 2007a, Rahkonen, et al. 1992). (Fig. 3.)



**Figure 3.** *Proportion of daily smokers among 15–64-year-olds and 15–24-year-olds in Finland 1978–2006 (%). (Source: Helakorpi et al. 2007a)*

In many Northern, Southern, and Western European countries smoking among men has decreased, whereas female smoking has even increased in some of these countries. In addition, in the countries where female smoking has decreased the decline has been less marked than in male smoking, for example in Sweden and in the Netherlands. Thus the difference in smoking prevalence between men and women in European countries has become less pronounced in recent years. (Graham 1996, Molarius, et al. 2001, WHO 2003) From Central and Eastern European countries there are not as much data available on smoking as from Northern, Southern, and Western countries, but it has been suggested that smoking has not generally declined in these countries and in some countries it has even increased - both among men and women e.g. in Lithuania (Helasoja, et al. 2006, Molarius, et al. 2001, Puska, et al. 2003).

Considering the persistent disparities between the Finnish birth cohorts, the peak proportion of ever-regular male smokers has been located in the cohorts born in 1911–25. This has been suggested to result partly from the war conditions in the 1940s. Most men were in active service during the Second World War and their food allowances included also cigarettes, which in the stressful war conditions led into increased smoking initiation. The first female cohorts to adopt smoking more widely – presumably because of the changing female gender role in the 1960s - appear to be those born during World War II (in 1941-45) (Laaksonen, et al. 1999, Martelin 1984, Rimpelä 1978).

## 2.3 Smoking in socioeconomic groups

Changes in smoking can be seen as a form analogous to an epidemic with four stages and a diffusion of innovations (Lopez 1995, Lopez, et al. 1994, Pampel 2005, Rogers 1995). During early stages, smoking is mostly taken up among men in high socioeconomic groups. During the middle stages of the process it spreads throughout the rest of the population, and in the third stage male smoking is most prevalent. Thereafter, however, smoking starts to decrease due to cessation, especially in the highest socioeconomic groups. In female smoking the peak follows a few years later. During the last stage of the process - as smoking has proved to be a transient innovation - it starts to decline slowly in both genders, remaining high among the lower socioeconomic groups. It has been suggested that almost all of the northern European countries were in this last stage at the end of the 1980s or in the early 1990s and that Finland reached the end of the third stage in the early 1990s (Cavelaars, et al. 2000) and was at this same stage at the beginning of the 2000s (Giskes, et al. 2005). Particularly in northern European countries the difference in smoking prevalence between the socioeconomic groups is wide. Those in the most advantaged groups smoke less than those representing a lower socioeconomic status. On the contrary, in southern Europe higher educated women smoke more. Also among men a similar north-south pattern is often found but it is less clear than among women (Cavelaars, et al. 2000). Nevertheless, at present people with a low socioeconomic status are more likely to smoke than those in high socioeconomic groups in most countries in Europe (Cavelaars, et al. 2000, Giskes, et al. 2005, Huisman, et al. 2005b).

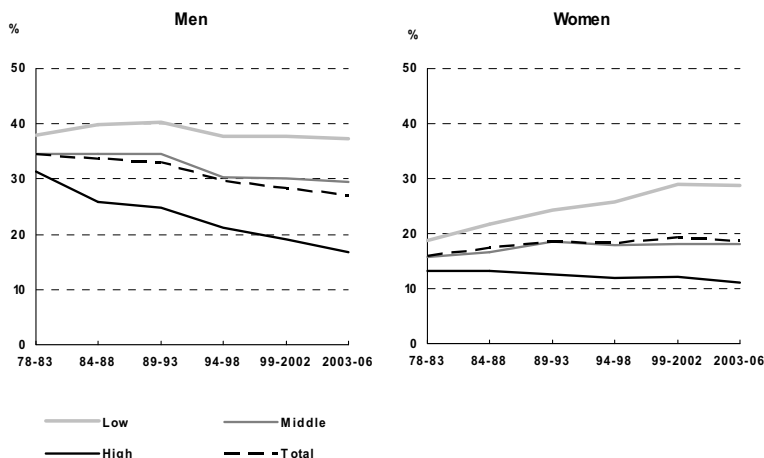
It has been argued that so-called hardcore smoking – defined as less than a day without cigarettes in the past five years; no attempt to quit in the past year; no desire to quit; and no intention to quit – would become proportionally more common, though overall smoking declines. According to a British study, hardcore smokers tend to be older than non-hardcore smokers, more dependent on nicotine, and from more deprived socioeconomic status (Jarvis, et al. 2003). Earlier studies have shown that a lower probability to quit smoking as well as a higher probability to initiate smoking have both an association with a lower socioeconomic status (e.g. Jefferis, et al. 2004, Kestilä, et al. 2006, Paavola, et al. 2004, Paavola, et al. 2001).

In a Finnish study among the employees of the City of Helsinki (Laaksonen, et al. 2005), socioeconomic differences in smoking were examined by several indicators of the socioeconomic position: structural (education and occupational status), material (household income and housing tenure), and perceived (economic difficulties and economic satisfaction) dimensions. According to the study, smoking was associated with the dimensions of socioeconomic disadvantage. Among

municipally employed middle-aged women and men living in Helsinki, women and men who had severe economic difficulties smoked twice as often as those with no economic difficulties (Rahkonen, et al. 2005). Smoking has had positive associations with other unhealthy behaviours (Koivusilta, et al. 2003, Laaksonen 2002). In a study among the Finnish population, smoking, vegetable use, and physical activity were the most important health behaviours explaining the relative educational level differences in all mortality outcomes when seven health behaviours covering dietary habits, smoking, and physical activity were considered (Laaksonen, et al. 2008).

A British study based on the General Household Surveys reported widening social class inequalities in smoking prevalence between successive birth cohorts at the same age, and within cohorts at increasing ages, suggesting that lower social classes were increasingly more likely to initiate smoking and less likely to quit (Evandrou and Falkingham 2002). The study by Martelin clearly indicates that smoking has been more common among Finnish men with a low educational level and among manual workers in practically every male cohort born in 1911 or later. On the contrary, in the oldest female birth cohorts smoking was more common among the higher educated and non-manual workers, whereas among women born in the late 1930s or later a reverse of the trend occurred (Martelin 1984). In Finland smoking differences across the educational groups have been widening among men and women, especially since the mid-1980s (Helakorpi, et al. 2007b, Rahkonen, et al. 1995) (Fig. 4).

Various explanations for the socioeconomic differences in smoking have been suggested. These include reference to e.g. variation in cultural factors, knowledge, material resources, psychosocial stress, and poor material conditions (Jarvis and Wardle 1999, Stronks, et al. 1997). Socioeconomic differences in smoking have also been explained by arguments that the high socioeconomic status groups would be more severely harmed by unhealthy behaviour. Since these groups have greater potential for good health, they also have the most to lose from unhealthy lifestyles (Blaxter 1990, Pampel and Rogers 2004). Blaxter argues that with good social circumstances healthy lifestyles improve well-being but with bad social circumstances healthy lifestyles make only a little difference (Blaxter 1990). Cognitive factors should also be considered. In a British study lower socioeconomic status was associated with lower health consciousness, strong beliefs in the importance of chance in health, diminished cognitive future orientation, and lower life expectancy. All the above factors were also associated with unhealthy behavioural choices (Wardle and Steptoe 2003).



**Figure 4.** *Age-standardised proportion of 25–64-year-old daily smokers by educational group and gender in 1978–2006 (%). (Source: Helakorpi et al. 2007b)*

## 2.4 Exposure to environmental tobacco smoke

People are exposed to environmental tobacco smoke (ETS) when they inhale tobacco smoke originating from the smoking of other people. During the past three decades, definitive evidence has been accumulated that ETS causes serious diseases and shortens the life span. ETS has been causally linked to harmful health effects on non-smokers such as lung cancer, coronary heart disease, asthma, and other respiratory symptoms as well as premature death (Adlkofer, et al. 1989, Boffetta 2002, Repace and Lowrey 1993, Surgeon General 2006, Vineis, et al. 2005). There is no risk-free level of exposure to ETS (also called secondhand smoke or passive smoking): even small amounts of ETS can be harmful to the health. A smoke-free environment is the only way to fully protect non-smokers from the dangers of exposure on environmental tobacco smoke (Surgeon General 2006).

According to the results of the European Community Respiratory Health Survey, exposure to ETS was common in Europe in 1990–1994. However, the prevalence of exposure varied between different countries. The highest prevalence of passive smoking at workplace was in southern Europe. In Spain and Italy, 30–50% of workers were exposed to tobacco smoke at work. The lowest prevalence of exposure was in Sweden (2.5–10%). (Janson, et al. 2001.)

ETS is a widespread and serious health hazard both in workplaces and at home. In a recent study it has been estimated that 617 employed people in the United Kingdom



die each year owing to secondhand smoke at work, including 54 worker deaths in the hospitality industry each year. ETS at home might account annually for another 2700 deaths in the age group of 20–64-year-olds and 8000 deaths among people older than 64 years in the UK (Jamrozik 2005). It has been estimated that the mortality due to exposure to passive smoking at work in Finland was 0.9% of the total mortality of the Finnish population in the relevant disease and age categories in 1996. Still about 8% of the workforce was passive smokers in 1998–2000 (Nurminen and Jaakkola 2001). Previous studies have shown that environmental tobacco smoke was a significant occupational health hazard especially for hospitality industry workers (Siegel 1993). According to a recent study, exposure to ETS among workers in the hospitality industry, and also among customers, was not reduced in the studied establishments in Finland during a period from 1999 to 2004 (Johnsson, et al. 2006).

## **2.5 Tobacco control measures**

The tobacco control policy has applied a variety of strategies to reduce smoking in the population, including influencing the behaviour of current or potential smokers and limiting smoking environments. According to the World Health Organisation (WHO 2007), the measures of a comprehensive tobacco control policy include: 1) fiscal policy: increasing the prices of all tobacco products faster than the prevailing inflation and using part of the resulting revenue to fund tobacco control efforts, 2) information policy: banning tobacco advertising and promotion, precluding effective health warnings on all tobacco products; investing in counter-advertising and health education, 3) ETS protection: protecting people from exposure to ETS by establishing smoke-free public places, 4) regulation of the contents of tobacco products, and 5) provision of tobacco dependence treatment.

Tobacco control acts and regulations can include all the above-mentioned elements and can function as the most important tools in tobacco control. In addition, demand reduction interventions have been found as the most effective tools by the World Bank. The following means have been mentioned: 1) higher cigarette taxes, 2) banning all cigarette advertising and promotion, 3) restricting smoking in public places, 4) requiring strong warning labels and messages on all tobacco product packaging, 5) better consumer information including public information campaigns, media coverage, and publishing findings in research, and 6) increasing access to cessation services for those who want to quit smoking (World Bank 2003). In 2003, the member countries of the World Health Organization (WHO) adopted an historic tobacco control treaty, the Framework Convention on Tobacco Control (FCTC). In 2007 a total of 145 countries have ratified this treaty (Koh, et al. 2007).

### 2.5.1 Tobacco control in Europe

Since the mid-1970s, measures to reduce tobacco smoking have been gradually introduced in Europe. In a study examining tobacco control measures in six western-European countries in 1985–2000, Sweden and Finland reported the most comprehensive policies for tobacco advertising at all time points, whereas tobacco advertising was least restrictive in the Netherlands and Germany. In 1985–2000 the United Kingdom, the Netherlands, and Germany reported no workplace restrictions, whereas in Sweden, Finland, and Spain legislation became more comprehensive over time. (Giskes, et al. 2007) The restrictive smoking policy in all indoor public places is currently being introduced or contemplated in several countries in Europe.

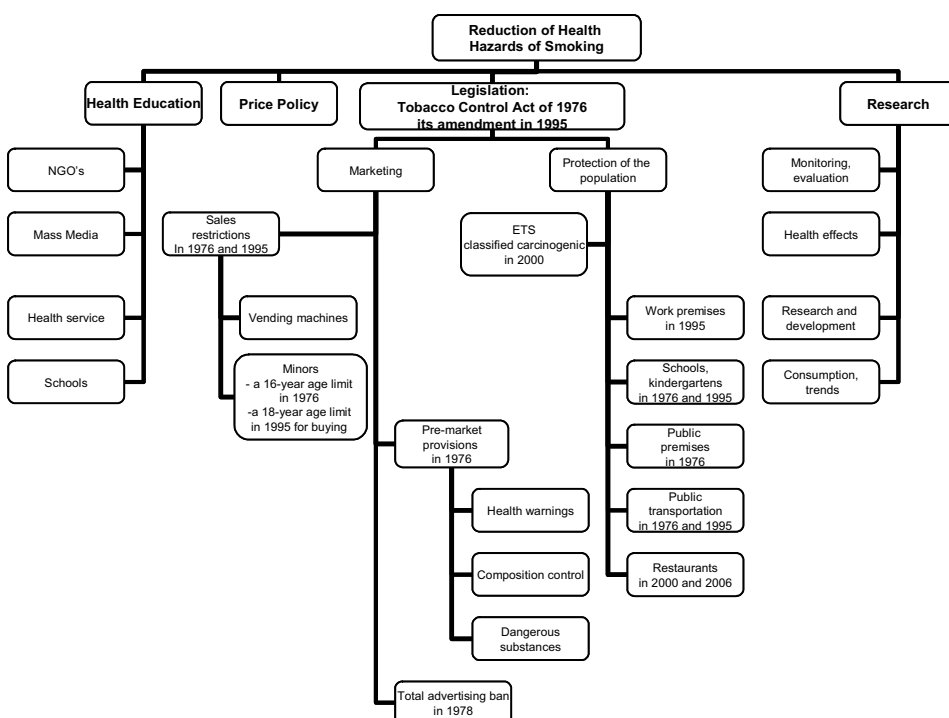
According to the WHO report in 2002, tobacco consumption had decreased in countries that had implemented comprehensive and sustained policies according to the WHO FCTC, such as setting cigarette taxes above the inflation and imposing tough curbs on advertising and promotion (WHO 2002).

The WHO FCTC calls for legislation to reduce or eliminate ETS. In 2004, Ireland implemented comprehensive smoke-free legislation in all workplaces including restaurants and pubs. Several other countries (e.g. Italy, Norway, and Sweden) also recognized the health dangers of ETS and prohibited smoking in most workplaces including restaurants and bars. (Koh, et al. 2007, WHO FCTC 2008.)

Joossens and Raw have assessed the strength of tobacco control at country level in 30 European countries using the Tobacco Control Scale (TCS) (Joossens and Raw 2006). The scale is based on six measures found favourable in comprehensive tobacco control programs according to the World Bank (World Bank 2003). Based on the TCS, European countries were ranked by their total score on the scale. Ireland, United Kingdom, Norway, and Iceland were on the top of the ranking list. Sweden was the sixth and Finland the seventh on the list. Lithuania, Spain, Austria, Latvia, Romania, and Luxembourg were countries with the lowest scores. All countries had some low scores regarding the tobacco control measures. Norway and Iceland, for example, had low scores for treatment to help smokers in cessation, while the United Kingdom and Lithuania had the lowest score on public-place smoking bans. In the UK the new English law prohibiting smoking in workplaces, implemented in 2007, changed this. Ireland increased its total score significantly due to its smoke-free legislation. Finland had the lowest scores in spending funds to public information campaigns and in public place bans (the latter having changed from June 2007 onwards). (Joossens and Raw 2006.)

## 2.5.2 Tobacco Control in Finland

The comprehensive Finnish tobacco control policy has included legislation, price policy, health promotion activities (health education), and research. Figure 5 presents a description of the national tobacco control measures in Finland during the past three decades (modified from Leppo and Puska 2003). Since the end of the 1970s, important programs have been carried out by many NGOs (non-government organizations, e.g. Cancer Society, Finnish Heart Association, Finnish Lung Disease Association, and Folkhälsan). In addition, health services have implemented various smoking cessation programs. In the 1980s various tobacco cessation programs were carried out (e.g. TV programmes and Quit and Win campaigns) (Korhonen, et al. 1992, Leppo and Puska 2003). Prevention programs were initiated in the North Karelia project in 1972. The aim of the project was to reduce the high rates of cardiovascular morbidity and mortality. Smoking was one of the three main target risk factors of the project (Puska, et al. 1995).



**Figure 5.** *Tobacco Control Policy in Finland since 1975. Modified from a Figure in Leppo and Puska 2003.*

In 1978 a school- and community-based smoking prevention program was started with seventh-grade students in North-Karelia (Vartiainen, et al. 1998). Gradually the North Karelia project spread nationwide. Since 1989, Action on Smoking and Health (ASH) in Finland has supported health-oriented tobacco policy. Systems of monitoring smoking habits were established soon after the implementation of the 1976 TCA. Since 1978, the National Public Health Institute has annually monitored the health behaviour of the adult population (aged 15–64 years) through postal surveys (Health Behaviour Monitoring among the Finnish Adult Population 2007, Helakorpi, et al. 2007a). This monitoring system has been an important instrument to follow the effects of the tobacco control acts on smoking and exposure to ETS among the working-age population. On the other hand, the effects of the tobacco control policy on the tobacco use and purchase of adolescents and as well as on tobacco control at schools have been monitored biennially by the Adolescent Health and Lifestyle Surveys (Rimpelä and Rainio 2003, The Adolescent Health and Lifestyle Survey).

Two major stages of tobacco control policy to reduce tobacco consumption have been applied: the national Tobacco Control Act of 1976 (TCA), supplemented by a total ban on advertising in 1978, and the ETS amendment of the TCA in 1995 (TCAA).

#### *The Finnish Tobacco Control Act of 1976*

The first Tobacco Control Act (Act on Measures to Reduce Tobacco Smoking) was passed by the Parliament in 1976 and implemented in 1977. The 1976 TCA:

1. Prohibited smoking in public places (at schools and in most public indoor venues) and on public transport
2. Restricted tobacco advertising in 1977 and banned it from 1978
3. Obligated manufacturers to include health warnings on tobacco packaging
4. Set limit values for nicotine, carbon monoxide, and tar of cigarettes
5. Set a 16-year age limit for tobacco product purchasing
6. Allocated about 0.5% of tobacco tax revenue to tobacco control programs and other health promotion initiatives. (Finlex 2008.)

### *The Finnish Tobacco Control Act Amendment in 1995*

The 1976 TCA contained smoking restrictions in public buildings but not in workplaces. At the beginning of the 1990s, the Ministry of Social Affairs and Health started preparatory activities to amend the Tobacco Control Act to protect employees from ETS at the worksite. The TCAA was passed by the Parliament in 1994 and implemented in 1995. The 1995 TCAA:

1. Applied to all workplaces except restaurants and bars
2. Prohibited smoking at eligible workplaces (with the exception of separately ventilated smoking rooms or individual offices)
3. Prohibited smoking in the school playgrounds
4. Raised the age limit for buying tobacco products to 18 years
5. Banned also indirect tobacco advertising and sponsorship. (Finlex 2008.)

In 2000 the act was extended to cover restaurants and bars with at least 50% of the areas dedicated as smoke-free. Smoking was also banned at the service counters of bars and restaurants. At the same time and as the rationale for the extension, ETS was defined as a carcinogenic substance thus giving the employers an absolute responsibility to protect their employees from ETS. In 2003 the three-year transition period to implement the changes in restaurants and bars ended. In 2006 the second amendment of the TCA concerning smoking in restaurants was passed by the Finnish Parliament. According to the amendment, smoking is prohibited in all restaurants and inside restaurants it is allowed only in special isolated and ventilated booths. Due to the second amendment of the TCA, since 2007 nearly all restaurants, bars, pubs, and cafes became smoke-free in Finland, yet with an extension until June 2009 for a few restaurants having a smoking section with a separate ventilation system. (Finlex 2008.)

## **2.6 Tobacco control measures, smoking, and exposure to ETS**

The effectiveness of the tobacco control policies has been evaluated in Europe since the mid-1970s (Dalla-Vorgia, et al. 1990, Giskes, et al. 2007, Joossens and Raw 2006). At the beginning of the 1990s, trends in tobacco consumption and their association with the tobacco control measures from 1950 to 1985 were evaluated. The conclusion of the evaluation was that legislation would be effective by affecting the price levels and through other mechanisms including health education and a general smoke-free ethos. (Dalla-Vorgia, et al. 1990) The evidence suggests that the best results for the control of the tobacco epidemic are achieved when a comprehensive set of measures is implemented simultaneously (Jha and Chaloupka 1999, Jha, et al. 2006, Levy, et al. 2004a).

In a Finnish study (Rimpelä 1992) the implementation process of the 1976 TCA was reported critically. In this study the implementation was, likewise, found weaker than expected. This was also seen in the results which clearly lagged behind the ideal (Rimpelä 1992). In a recent study it was noted that the national tobacco legislation actions were associated with a weakly compatible change in smoking prevalence among women: from a linear rise to a maintained plateau (Heloma, et al. 2004).

The impact of the 1995 TCAA has also been assessed. In a follow-up of eight workplaces daily smoking and the number of smoked cigarettes per day among employees have been found to decrease after implementation of the new legislation in 1995 (Heloma and Jaakkola 2003). Especially employees with less education showed a proportionally larger decrease in smoking prevalence. Thus, the TCAA seemed to narrow the gap in smoking between the different education groups (Heloma, et al. 2001). The short-term effects of the 1995 TCAA were significant. A remarkable decrease in employee exposure to ETS in workplaces was perceived one year after the TCAA came into force (Heloma 2003). On the contrary, in 1999–2004 the exposure to ETS at work in restaurants decreased slowly. In restaurants serving food the exposure to ETS was lower than in nightclubs and pubs. Based on the results of nation-wide studies it could be suggested that the 1995 TCAA applied to restaurants in Finland was not effective enough to protect workers as well as customers in the restaurants from ETS before the amendment of TCA in 2006. (Johnsson, et al. 2003, Johnsson, et al. 2006) Rimpelä and Rainio (Rimpelä and Rainio 2004), in turn, found that the rising of the age for tobacco product purchasing changed tobacco sales practices and increased the use of social sources, rather than commercials, among the minors and might thus have contributed to the recent decrease in smoking.

The evidence suggests that increasing prices of the tobacco products, mainly determined by taxation, is the main factor in decreasing tobacco smoking (Hopkins, et al. 2001, Levy, et al. 2004a). Consequently, the price policy is an effective tobacco control measure, especially among young people and others on the low income level. In Finland since 1977 annual increases in the real prices of tobacco have been modest (Pekurinen 1992, Statistics Finland 2005a).

Smoke-free policies in workplaces have been an effective means of reducing exposure to ETS and its public health burden. Smoke-free worksite policy protects non-smokers, but also smokers, from the harmful effects of ETS. In addition, evidence exists that these policies have an effect on smoking habits and, also, that smoke-free policy in workplaces increases cessation and decreases consumption of cigarettes among smokers. (e.g. Bauer, et al. 2005, Borland, et al. 1990, Brigham, et al. 1994, Farkas, et al. 1999, Levy, et al. 2004b, Longo, et al. 2001, Wakefield, et al. 1992.)

An evaluation of the effects of a national-level comprehensive smoke-free law among adult smokers in Ireland before and after the implementation of the comprehensive smoke-free legislation in all workplaces including restaurants and pubs in 2004 revealed that the law led to a nearly total elimination of ETS pollution across a wide range of public venues including restaurants and bars. In addition, this was accompanied by increasing support among smokers for smoke-free legislation in public places. No parallel change was found in the United Kingdom where the smoke-free law was not in force in 2004. (Fong, et al. 2006)

### 3 AIMS OF THE STUDY

The general aim of the study was to evaluate the impact of the Finnish tobacco control measures of the last three decades on smoking and exposure to ETS. The numbers in brackets refer to the original articles (I–IV). The specific aims of the present study were:

1. To assess the trends and patterns of ever daily smoking among adult Finns and to evaluate the impact of the Tobacco Control Act in 1976 on them (I)
2. To find out how equally the 1976 Tobacco Control Act affected ever daily smoking in different socioeconomic groups (II)
3. To determine the impact of the Tobacco Control Act Amendment of 1995 on trends in the prevalence of daily smoking (III)
4. To assess the trends of exposure to ETS at work and home and the impact of the TCAA 1995 on them (IV).

The examination of the patterns of the ever daily smoking in the birth cohorts born in 1916–1980 (Substudy I) was applied as an indirect way to explore the risk of smoking initiation in each birth cohort. It can be assumed that the TCA would not have a visible impact on ever daily smoking in the cohorts born in 1955 or earlier, as people belonging to these birth cohorts had already passed their critical age range for smoking initiation at the time when the law came into force. The impact of the 1976 TCA should be visible in the birth cohorts which were at the smoking initiation age when the TCA was operational (birth cohorts born in 1961 or later). The impact of the TCA would manifest as a lower initiation rate in those birth cohorts than could otherwise be expected, according to a trend prediction based on the earlier cohorts.

In the Substudy II the associations between the socio-economic status and ever daily smoking in successive male and female birth cohorts born in 1926–1975 were examined in order to enhance the understanding of the development of smoking habits in the different socioeconomic groups in Finland. In particular, the aim was to find out whether the impact of the Finnish tobacco control policy has been similar on smoking initiation in the different socioeconomic groups in those birth cohorts which were at the smoking initiation age when the 1976 TCA was implemented.

In the Substudy III the changes of the prevalence of daily smoking in 1981–2005 in the population aged 25–64 years are presumed to reflect the variation in the cessation rate. The baseline hypothesis was that the impact of the 1995 TCAA should have increased smoking cessation among employees who were targeted by



the 1995 TCAA. The higher rate of cessation should appear as a lower rate of daily smoking among employees after 1995 than could otherwise be expected.

In the Substudy IV the trends of ETS at work and at home were described. In this substudy answers to the following questions were searched: 1) Were there differences between periods of exposure to environmental smoke at work and at home, and 2) Were there signs of effects of the 1995 TCAA in the trends of exposure to ETS especially at work?

## 4 MATERIALS AND METHODS

### 4.1 Data sources

Finland's National Public Health Institute (KTL) has been monitoring health behaviour among the adult population using independent, annual cross-sectional postal surveys from 1978 onwards. Each year a random sample (sample size about 5000 before 1984, since 1984 n=5000) of Finnish citizens aged 15–64 years has been drawn from the National Population Register. The questionnaire mailed from April to June, with one reminder in 1978–1985, two reminders in 1986–1997, and three reminders in 1998–2005, has been kept essentially unchanged over the years. The average, albeit gradually declining, response rate was 74%. The total data include responses from 50,524 men and 55,572 women (Table 1).

**Table 1.** *Numbers of respondents (n) and response rates (%) in the Health Behaviour among the Finnish Adult Population surveys, aged 15–64 years in 1978–2005 by study year and gender.*

<b>Year</b>	<b>Men</b>		<b>Women</b>		<b>Year</b>	<b>Men</b>		<b>Women</b>	
	<b>n</b>	<b>%</b>	<b>n</b>	<b>%</b>		<b>n</b>	<b>%</b>	<b>n</b>	<b>%</b>
<b>1978</b>	2493	83	2544	85	<b>1992</b>	1733	69	1981	80
<b>1979</b>	2548	81	2377	85	<b>1993</b>	1610	64	1863	75
<b>1980</b>	2431	77	2332	81	<b>1994</b>	1669	66	1831	75
<b>1981</b>	2097	79	2012	85	<b>1995</b>	1688	67	1956	79
<b>1982</b>	2102	77	1911	82	<b>1996</b>	1669	66	1928	78
<b>1983</b>	1964	74	2023	83	<b>1997</b>	1588	64	1928	76
<b>1984</b>	1749	73	2073	80	<b>1998</b>	1689	66	1816	75
<b>1985</b>	1637	65	1781	72	<b>1999</b>	1538	60	1833	75
<b>1986</b>	1902	78	2187	85	<b>2000</b>	1569	64	1899	75
<b>1987</b>	1873	76	2170	85	<b>2001</b>	1589	62	1880	77
<b>1988</b>	1884	74	2001	82	<b>2002</b>	1481	58	1778	72
<b>1989</b>	1853	73	2024	82	<b>2003</b>	1516	60	1819	73
<b>1990</b>	1811	73	2001	80	<b>2004</b>	1536	61	1833	74
<b>1991</b>	1783	72	2026	81	<b>2005</b>	1522	59	1765	73
<b>Total</b>						<b>50 524</b>	<b>69</b>	<b>55 572</b>	<b>79</b>

## 4.2 Subjects

For the analyses of the Substudy I altogether 13 five-year birth cohorts born between 1916 and 1980 were constructed using the survey data from 1978 to 2001. The number of subjects is given in the Appendix 1 by gender, birth cohort, and study period. Lexis diagram illustrating the structure of the data is given in the Appendix 4.

For the analyses of the Substudy II, ten five-year birth cohorts of 25–64-year-old persons born between 1926 and 1975 were constructed using the surveys from 1978 to 2002. The data in the year 1985 was not, however, available due to the missing personal identification codes. The birth cohorts were examined by socioeconomic status and this precluded the setting of the lower age limit to 25 years, since the socioeconomic status can be considered relatively stable since the age of 25 years. The number of subjects in the Substudy II is given in the Appendix 2 by gender, socioeconomic status, and study period.

In the Substudy III, 25–64-year-old respondents from 1981 to 2005 were included. The analysis was restricted to this age range, because the proportion of ever smokers was assumed to be relatively stable only after the age of 25, and therefore the variation of daily smoking can be considered to be mainly due to smoking cessation. The employment status was classified into two categories: 1. employed persons in sectors other than farming or forestry and 2. others (farmers, students, housewives, pensioners, and unemployed). The number of subjects in the Substudy III is described by gender, employment status, and study period in the Appendix 3.

The Substudy IV examining the exposure to ETS of 15–64-year-old men and women was restricted to persons from surveys 1985–2000, because the relevant questions were available only since 1985. The data on ETS included the respondents who worked outside home; occasional smokers were excluded from the analyses. In the data on ETS at home all respondents were included. The number of subjects in the Substudy IV is described by gender and study period in the Appendix 1.

The data of the surveys have been collected according to the good research practice applied in the National Public Health Institute (KTL). Individual respondents of the data sets cannot be identified. The data are kept safe in the KTL where only authorized persons have admission to it.

## 4.3 Study variables

### 4.3.1 Smoking and ETS exposure variables

#### *Studies I, II, and III: Ever daily smoking and daily smoking*

In the Substudies I and II the outcome variable was ever daily smoking. The smoking status of the respondents was obtained via a self-administered questionnaire, using two, and since 1996, three questions: “Have you ever smoked?” (every year), “Have you ever smoked regularly (i.e. almost every day for at least one year)” (pre-1996), and “Have you ever smoked daily for at least one year?” and “Have you ever smoked at least 100 times?” (post-1996). When the patterns of ever daily smoking were in focus, those who reported smoking regularly/daily for at least one year were regarded as ever daily smokers. In the Substudy III the analyses of daily smoking involved the respondents who had smoked regularly/daily for at least one year and who indicated having smoked during the day of filling the questionnaire or the day before it. The questions used in these substudies are presented in the Appendix 5.

#### *Study IV: Exposure to ETS*

In the Substudy IV the outcome variable was the exposure to environmental tobacco smoke. To assess exposure to ETS at work, the participants were asked how many hours during a workday they stayed in rooms where tobacco smoke was in the air. Exposure at home was assessed by asking whether anybody smoked at home. The questions used in this substudy appear in the Appendix 5.

### 4.3.2 Sociodemographic and other background variables

The most important survey-based independent variables applied in the analyses include age, gender, birth year, survey year, socioeconomic status, and employment status. In the Substudy II the survey data have been complemented by means of register-based information on the socioeconomic status. The personal identification code was used to link socioeconomic information at the individual level from the population registers to the survey data by Statistics Finland. The survey data of the year 1985 was excluded, because it could not be linked to the register data as personal identification codes were not available for this data set. Register-based occupational social classes were available from the 1970, 1975, 1980, 1985, 1990, 1995, and 2000 population census.

The classification of the socio-economic groups divides the population into groups according to their social and economic characteristics. The socio-economic status is formed of several different classification criteria. Such criteria include the person's stage in life (family member, student, economically active, pensioner, etc.), occupation, and status in employment (self-employed, employee, unpaid family worker) for economically active people. The complete classification is also supplemented by divisions according to the nature of occupation and work (employees and workers), industry, and the number of wage and salary earners. (Statistics Finland 1989) (Statistics Finland 2007) In the present study, the original classification was compressed into five categories: upper white-collar workers (upper-level employees), lower white-collar workers (lower-level employees), blue-collar workers (manual workers), farmers, and entrepreneurs (other self-employed persons than farmers). Non-working spouses were classified according to the occupation of the head of household. Students were classified according to their socioeconomic information in the next census. Pensioners and unemployed persons for whom information on current occupation was not available were classified on the basis of occupational information from the closest earlier census.

In the Substudy III the study population was divided by the employment status into two categories. The employment status of the respondents was derived from the report given by the respondents on their occupation status during the study year. Two pooled categories were created for the analyses: 1. the employed occupied in other branches than farming or forestry and 2. other population groups (farmers, students, housewives, pensioners, and unemployed). The questions used in the derivation of the employment status of the respondents are presented in the Appendix 5.

#### 4.3.3 Variables describing the impact of the tobacco law

In the first substudy the hypothesized effect of the TCA was included in the models on a sliding scale, because smoking initiation typically takes place within a range of teenage years, not just in one special year. No effect was assumed ( $TCA=0$ ) for the cohorts born in 1955 or earlier, as they had already passed the most critical age regarding smoking initiation; for those born in 1957 the TCA variable was assigned the value 0.2 and for the following year cohorts 0.4, 0.6, and 0.8, respectively. For the cohorts born in 1961 or later the effect of the TCA was assumed to be 100% ( $TCA=1$ ).

In the second substudy the term of the effect of the TCA has been added piecewise by dividing the years of birth into three periods. As in the earlier study, it was assumed that the TCA would not have any visible effect on ever daily smoking in the cohorts

born in 1955 or earlier. Among those born in 1956–62, a linear effect was added into the year of birth so that the effect was 0.125 in 1956 (aged 20 in 1976) and increased stepwise up to the above constant in 1963 (i.e. 25% of the constant in 1957, 50% of the constant in 1959 etc.). The gradual increase of the effect of the 1976 TCA in the model in the cohorts born in 1956–60 (Substudy I) and in 1956–1962 (Substudy II) allowed the variation in the year of smoking initiation.

In the Substudy III a dummy variable was included in the model in order to indicate the exposure to the 1995 TCAA. The value zero was assigned to this dummy variable for years prior to 1995 and one from 1995 onwards.

#### 4.3.4 Control variables

The secular cohort trends were included in the models to describe the general, long-term cohort trends. In previous studies it has already been shown that certain cohorts deviate from the secular cohort trends (Laaksonen, et al. 1999, Martelin 1984), i.e. those born in 1916–1925 (reached smoking initiation age during World War II), in 1931–35 (reached smoking initiation age in the post-war economic depression), and in 1946–50 (the ‘baby-boomer’ generation). For compensation confounding variables were included in the models in the first Substudy in order to take into account these three deviant birth cohorts.

The educational level which was included in the models in the third substudy is based on the reports given by the respondents concerning the number of years of schooling. The percentual change of the real price of tobacco (Statistics Finland 2005a) as well as that of the gross domestic product (GDP) (Statistics Finland 2005b) were included in the models of the third substudy to consider the effect of these changes, as they had an influence on the capacity of the smokers to spend money on tobacco.

## 4.4 Statistical methods

Logistic regression is applied as the principal statistical tool in the analyses concerning the effects of the Finnish tobacco control measures on the proportion of ever daily smokers and daily smokers. In the substudy examining the exposure to environmental tobacco smoke, trends in exposure were computed, and log-linear models were used to test the significance of the trends. All analyses were performed separately for men and women. The statistical analyses were carried out by means of the SAS program package (Statistical Analysis System, version 8.2) as explained below.

### 4.4.1 Study I

Birth cohort variations in ever daily smoking were first examined graphically; thereafter logistic models were used to test the impact of the TCA. The age profile (based on the age at survey) was used in the models for all birth cohorts and both genders, modelled by a continuous line which is ascending in the age range of 19–25 years, horizontal from 25 to 49 years, and descending thereafter. The slopes of the ascending and descending parts of the line were modelled by two special age variables.

The hypothesized effect of the TCA was included in the models. To illustrate the effect of the 1976 TCA on smoking initiation, the expected ever daily smoking prevalence was calculated by birth cohort in two different ways: (1) the fitted model including age profile, secular cohort trend, the three dummies for the deviant cohorts, and the hypothesized effect of the TCA, and (2) the prediction which used the model to describe the hypothetical situation where the effects of the three dummies and of the 1976 TCA were assumed to be zero. The expected prevalence of ever daily smoking based on the fitted model was thereafter compared to those expected on the basis of the prediction.

### 4.4.2 Study II

The variations in ever daily smoking by birth cohort, socioeconomic status, and study period were examined separately in the five socioeconomic groups using logistic regression models to assess the independent contributions of the cohort, the socioeconomic status, and the 1976 TCA. The continuous secular cohort trend was included. Also the hypothesized effect of the TCA was included in the models. The significance of the interactions between the socioeconomic position and the continuous secular cohort trend, and the TCA variable were tested.

In order to illustrate the effect of the 1976 TCA on smoking initiation in the different socioeconomic groups, the expected ever daily smoking prevalence by birth cohort was calculated separately for the three largest socioeconomic groups in two different ways: (1) using the fitted model including the secular cohort trend, and the hypothesized effect of the TCA, and (2) according to the prediction which used the model to describe the hypothetical situation where the effect of the 1976 TCA was assumed to be zero. The expected prevalence of ever daily smoking in the different socioeconomic groups based on the fitted model was compared to the prevalence expected on the basis of the prediction.

#### 4.4.3 Study III

The hypothesized effect of the TCAA was included in the models as were also the percentual changes of the real price of tobacco and the GDP compared to the previous year. The educational level was depicted by dividing each one-year birth cohort into tertiles according to years of formal schooling. In the model education was used as a continuous variable (values 0, 1, and 2 where 0 = the lowest tertile). The level of ever daily smoking in each one-year birth cohort was calculated for each education group separately. The levels of ever daily smoking, age at survey, and study year were included as continuous variables in the analyses. The impact of the 1995 TCAA on daily smoking among employees was assessed comparing the rates of daily smoking on the basis of the two models: (1) including all the variables in the model, and (2) similarly to the preceding model, but setting the value for the TCAA dummy to zero for the entire study period, i.e. removing the downward shift in the smoking rate in 1995.

#### 4.4.4 Study IV

Exposure to environmental tobacco smoke was studied separately for non-smokers and daily smokers. The exposure was first examined graphically by study year; thereafter log-linear models were used to test the significance of the changes in the trends.



## 5 RESULTS

### 5.1 Trends and patterns of ever daily smoking and the impact of the Tobacco Control Act of 1976 on them

Among both genders the probability of being an ever daily smoker increased with age up to 25 years, indicating a rather stable pattern of smoking initiation. Among men smoking initiation declined from earlier to later cohorts. The proportion of ever-regular smokers was as high as 70–80 per cent in the male cohort born in 1916–25, while among men born in 1956–60 or later it did not exceed 65 per cent. Among women smoking increased in the successive birth cohorts. The proportion of ever regular smokers was 15–30 per cent among women born in 1916–40 but reached about 50 per cent among those born in 1951–55. The gender gap in ever daily smoking which characterized earlier cohorts has nearly disappeared in recent cohorts. (Fig. 6.)

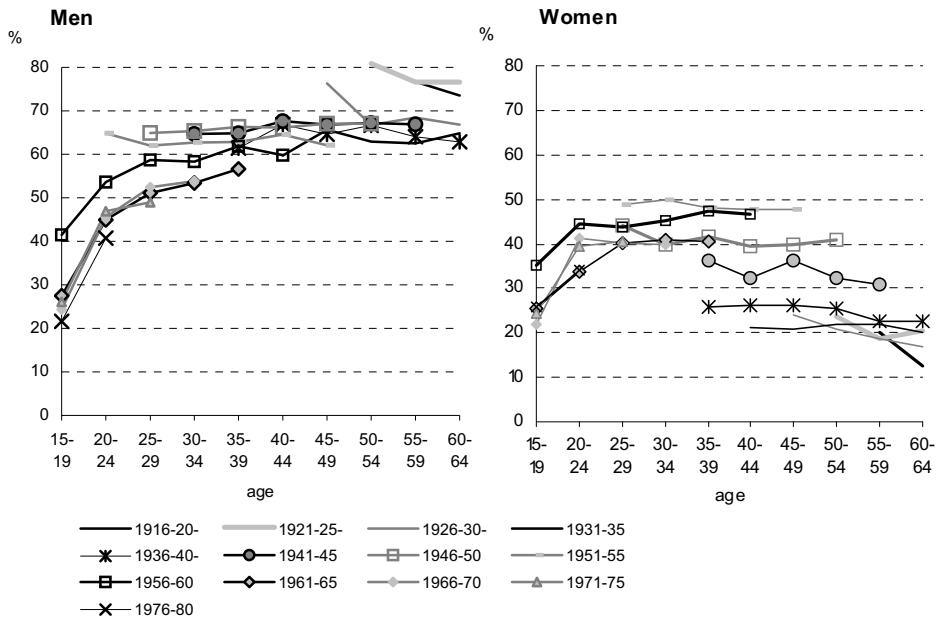
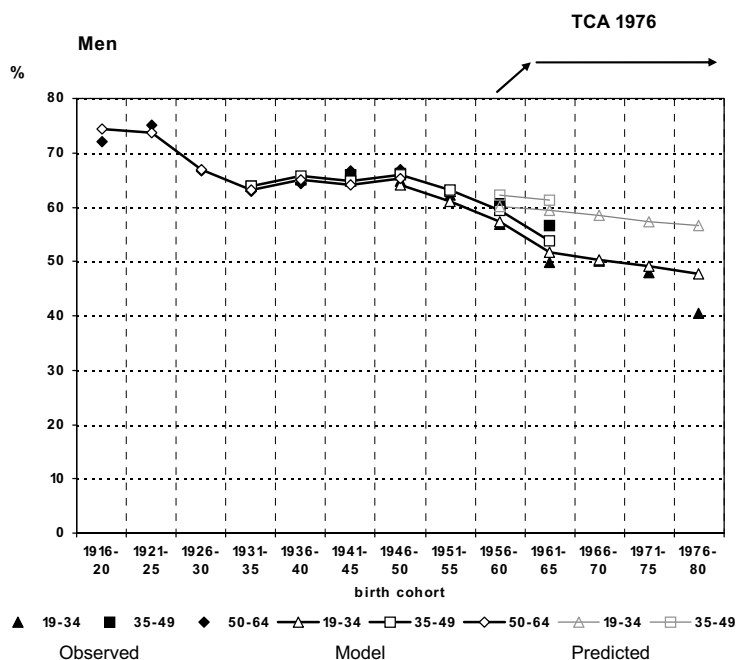
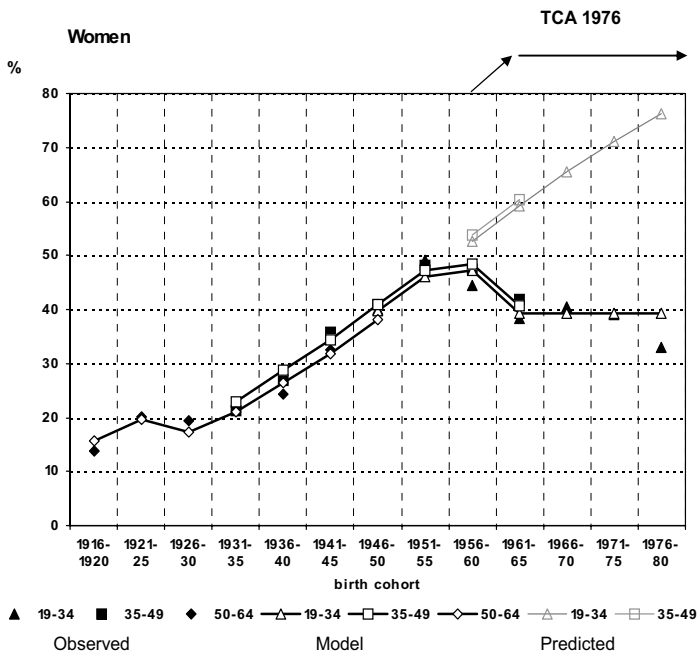


Figure 6. The proportion of ever daily smokers by 5-year birth cohort, age, and gender.

Smoking initiation among those who reached the age of initiation when the 1976 TCA was operational (born in 1961 or later) was less frequent than expected based on the prediction from trends in the birth cohorts born before 1955 or earlier. Among men the prevalence of ever daily smoking was estimated to be about seven percentage points lower than that expected on the basis of the prediction (Fig. 7). Among women, the corresponding difference was about 20 percentage points in the cohorts born in 1961–65: in the younger cohorts it proved to be even more (Fig. 8).



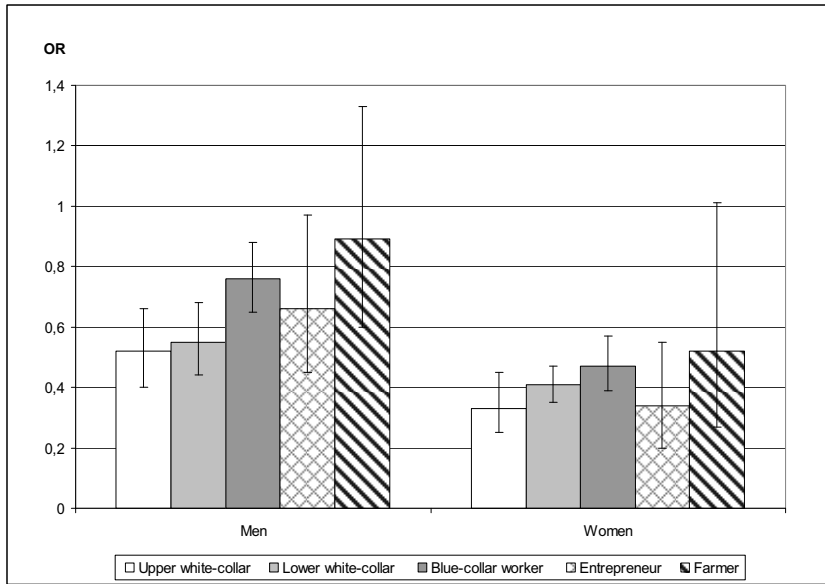
**Figure 7.** *Ever daily smoking among men by five-year birth cohort and 15-year age group according to observed prevalence, model estimated prevalence, and predicted prevalence without the impact of the 1976 Tobacco Control Act. Corrected for the bias due to declining response rate.*



**Figure 8.** *Ever-regular daily smoking among women by five-year birth cohort and 15-year age group according to observed prevalence, model estimated prevalence and model predicted prevalence without the impact of the 1976 Tobacco Control Act. Corrected for the bias due to declining response rate.*

## 5.2 Impact of the Tobacco Control Act of 1976 on ever daily smoking in different socioeconomic groups

The results showed that among men there was a widening gap in ever daily smokers between the socioeconomic groups by birth cohorts: in the birth cohorts born in 1926–1930, 75% of blue-collar workers but only 60% of upper white-collar workers had been daily smokers. In the cohort born in 1971–75 the corresponding prevalence was 62% among male blue-collar workers (manual workers) and 25% among upper white-collar workers (upper-level employees). Also, in almost every female birth cohort the proportion of ever daily smokers was higher among blue-collar workers than white-collar workers. Only in the earliest female birth cohorts (born 1930 or earlier) the difference in ever daily smoking prevalence was reversed.



**Figure 9.** *The effect of the 1976 Tobacco Control Act (TCA) on the prevalence of ever daily smoking by gender and socioeconomic status. Odds ratios (OR) and 95% confidence intervals from a logistic model on separate models for each SES group; reference category: before the TCA 1976 (OR=1) in each socioeconomic group. Model: men: Birth cohort + TCA 1976, women: Birth cohort + TCA 1976 + cohort trend after TCA 1976.*

A statistically significant decline in the proportion of ever daily smoking between the male and female birth cohorts was found in almost all socioeconomic groups conforming to the assumed effect of the 1976 TCA. Among men, smoking initiation in the cohorts reaching the age of initiation when the 1976 TCA was operational was less common than expected according to the trend in the earlier birth cohorts in each socioeconomic group with the exception of farmers. Among women the effect of the 1976 TCA was significant in all socioeconomic groups, except in farmers. (Fig. 9.)

In all socioeconomic groups a general declining cohort trend in ever daily smoking was observed among men. Contrary to men, among women the trend was increasing in the birth cohorts born before 1956 in all socioeconomic groups and declining after that. Table 2 presents the impact of the 1976 TCA as the difference between the prevalence of ever daily smoking expected on the basis of the model and that expected on the basis of prediction obtained by setting the effect of the TCA 1976 to zero in the susceptible cohorts born 1956 or later. The 1976 TCA appears to have had the strongest impact on male white-collar workers ( $p=0.007$  for the interaction between SES and the TCA). The decline in ever daily smoking compared to the trend estimate was about 15 percentage points among male upper and lower white-collar employees but only about six percentage points among male blue-collar workers. Among women the decline was either close 20 percentage points or more in all three socioeconomic groups. (Table 2.)

**Table 2.** *The estimated effect\* of the TCA 1976 as percentage points on the proportion of ever daily smokers by gender, socioeconomic groups, and five-year birth cohort.*

	<i>Socioeconomic Group</i>	<i>Birth cohort</i>			
		1956-60	1961-65	1966-70	1971-75
<b>Men</b>	<b>Upper white-collar worker</b>	-6.2	-15	-15	-15
	<b>Lower white-collar worker</b>	-5.5	-15	-15	-15
	<b>Blue-collar worker</b>	-2.2	-6.2	-6.2	-6.3
<b>Women</b>	<b>Upper white-collar worker</b>	-9.4	-24	-27	-29
	<b>Lower white-collar worker</b>	-8.5	-22	-28	-33
	<b>Blue-collar worker</b>	-6.7	-17	-27	-36

\*Calculated as the difference between the prevalence of ever daily smoking expected on the basis of the complete model<sup>1</sup> and that expected on the basis of prediction assuming no effect for the TCA 1976<sup>2</sup> in cohorts born after 1955

<sup>1</sup> Model applied in the first prediction: birth cohort + TCA 1976; for females the cohort trend after 1976 also included. <sup>2</sup> In this second prediction the effect of the TCA was assumed to be zero

### **5.3 Impact of the Tobacco Control Act Amendment in 1995 on daily smoking**

The proportion of daily smokers among employed men and women decreased after the 1995 TCAA. In the other population groups (those who were not directly affected by ETS legislation: farmers, students, housewives, pensioners or unemployed) the proportion of daily smoking was stable among men and increased among women.

Among both genders, the prevalence of daily smoking was reversely associated with age and education and positively related to the level of smoking in the birth cohort. The change in the real price of tobacco was not associated with the prevalence of smoking. A mild positive association was found with the change in the GDP per capita. After 1995 a statistically significant drop in daily smoking was seen among employed men but not among other men. Among employed women a corresponding impact of the 1995 TCAA was found. Contrary to employed women, among female farmers, students, housewives, pensioners, and unemployed women an increasing smoking trend after 1995 was observed.

Table 3 presents the observed prevalence of daily smoking and the prevalence predicted by the final logistic models among the employed as well as the prevalence expected on the basis of the secular trend only, i.e. omitting the effect of the 1995 TCAA dummy. During the period following the implementation of the 1995 TCAA, the proportion of daily smokers among the employed was lower than expected on the basis of the trend prediction where the impact of TCAA was zero among men and women. The observed decline in the proportion of daily smokers was approximately 3.8 percentage points among both men and women. (Table 3.)

**Table 3.** *Male and female daily smokers (%) by study year (three- or two-year pooled). Observed proportions of daily smokers and those predicted on the basis of the final model<sup>1</sup> and prediction<sup>2</sup> without the effect of the 1995 Tobacco Control Act (TCAA) among employed persons (occupied in sectors other than farming or forestry).*

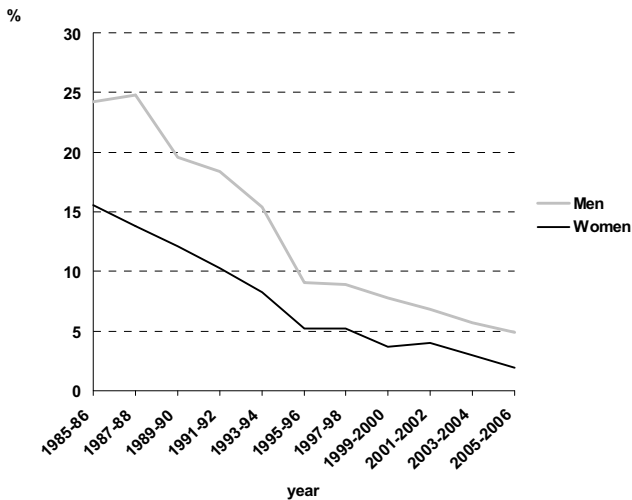
Men/ Year	Ob- served (%)	Model (%)	Pre- diction (%)	Model– Prediction	Wom- en			
					Ob- served (%)	Model (%)	Pre- diction (%)	Model– Prediction
1981-83	34.6	34.9			19.9	17.8		
1984-86	34.6	34.4			18.6	18.3		
1987-89	35.4	34.0			21.8	19.8		
1990-92	34.6	32.4			21.9	20.2		
1993-94	28.3	30.1			19.1	19.4		
1995-96	28.5	27.6	31.5	-3.9	17.6	17.7	21.5	-3.8
1997-99	29.1	27.2	31.1	-3.9	20.3	18.1	22.0	-3.9
2000-02	26.2	25.9	29.7	-3.8	18.7	17.5	21.3	-3.8
2003-05	25.5	25.4	29.1	-3.7	18.2	17.4	21.2	-3.8

<sup>1</sup> The model: employment status + ever-smoking + age + education + study year + change in tobacco price + change in GDP + TCAA

<sup>2</sup> In the prediction the effect of the TCAA in the model was assumed to be zero

## 5.4 Impact of the Tobacco Control Act Amendment in 1995 on exposure to ETS

During the 15-year period of the study exposure to ETS decreased markedly in Finland. Among non-smokers the exposure at work decreased to onethird between 1985 and 2000. In the mid-80s about 25% of male non-smokers were exposed daily to tobacco smoke at least one hour at work and the corresponding proportion of female non-smokers was 15%. A marked drop was seen in 1995 when the TCAA came into force, and a decreasing trend continued thereafter. Since 1995, about seven per cent of male non-smokers have been exposed to tobacco smoke at work and among women the corresponding prevalence has been four per cent. Since 2000, the declining trend has continued and in the mid-2000s about five per cent of non-smoking men and two per cent of non-smoking women were daily exposed to tobacco smoke at least one hour at work. (Fig. 10)



**Figure 10.** *Exposure to environmental tobacco smoke for at least one hour daily at work among non-smokers who worked outside home by gender in 1985–2006.*



Although the legislation did not concern private homes, smoking at homes declined. However, exposure at home decreased only slightly. In 2000, about 14 per cent of non-smoking men and 13 per cent of non-smoking women were still exposed to environmental tobacco smoke either at work or at home, or at both places. In 2006 the corresponding proportions were 10 and 11 per cent.

## 6 DISCUSSION

### 6.1 Main findings

The main findings to the specific aims of the study were the following:

1. Among the Finnish population born in 1916–1980 ever daily smoking among men decreased from older cohorts to younger ones. Smoking prevalence started with high figures of 70–80% ever smokers in the earlier birth cohorts. The biggest decrease in male ever daily smoking prevalence was in the birth cohorts born in 1961 or later. Among women ever daily smoking increased in successive birth cohorts born before 1956 and decreased after that.
2. Widening socioeconomic differences in ever daily smoking prevalence were visible between successive birth cohorts born in 1926–1975 indicating that members of lower socioeconomic groups were increasingly more apt to initiate smoking. In all socioeconomic groups a general declining cohort trend in ever daily smoking was observed among men. The largest drop in male ever daily smoking was in the birth cohorts born in 1961 or later, and the drop was seen in all socioeconomic groups, except farmers. The decline was most pronounced among white-collar male employees. Contrary to men, among women the trend was increasing in the birth cohorts born before 1956 in all socioeconomic groups and declining after that. Among women the decline was quite similar in each socioeconomic group.
3. Daily smoking decreased among employees after 1995. No parallel change in daily smoking was found among farmers, students, housewives, pensioners or unemployed.
4. In 1985–2006 exposure to tobacco smoke at work decreased significantly in Finland. However, exposure to tobacco smoke at home decreased only slightly.

## 6.2 Discussion of the findings

### *Smoking and gender*

The trends in smoking prevalence in the birth cohorts were quite similar to those in other cohort studies performed in Western industrialised countries (e.g. Birkett 1997, Brenner 1993, Kemm 2001). According to the Substudy I, however, there were lasting differences between the birth cohorts of men and women regarding ever daily smoking which were compatible with the assumed impact of the 1976 TCA in Finland. Among both genders, smoking initiation in the birth cohorts born in 1961 or later was less common than was expected on the basis of trends among the earlier birth cohorts. Members of the birth cohorts born in 1961 or later were exposed to direct campaigns and reached the age of smoking initiation when or after the 1976 TCA came into force. The proportion of ever daily smoking among men born in 1961 or later did not exceed 55 per cent and among women the corresponding proportion was approximately 40 per cent. For example in Germany, where no corresponding tobacco law was enforced, ever-smoking prevalence among men varied from 60 per cent to 70 per cent between the birth cohorts born in 1926–1930 and 1966–1970, and among women ever-smoking increased from 20 per cent born in 1926–1930 to about 50 per cent in those born in 1966–1970 (Schulze and Mons 2005). In Germany the initiation of female smoking continued to increase up to the birth cohort born in 1961–65 (proportion of ever smokers 59 per cent), but a minor decline was found in the following five-year birth cohort, though the smoking history in the earlier birth cohorts (born in 1926–1960) had been quite similar to the Finnish female smoking history in the corresponding birth cohorts.

It has been argued that there are differences between the genders in their response to the tobacco control policy (Dedobbeleer, et al. 2004, Townsend, et al. 1994). However, the trends in ever daily smoking of the birth cohorts observed in the Substudy I were compatible with the assumed impact of the Finnish tobacco control policy among both men and women. The price of tobacco rose in 1975–1976 and it possibly had an additional impact, especially among women who, according to previous research, are more responsive to price (Townsend, et al. 1994).

### *Smoking and socioeconomic status*

The Finnish results of smoking histories in the birth cohorts were consistent with those of previous studies which have shown that in most developed countries gender differences in smoking have diminished (Birkett 1997, Kemm 2001), whereas differences in smoking in the different educational groups have widened (Giskes, et al. 2005). Compatible with earlier Finnish findings (Laaksonen, et al. 1999, Martelin

1984), smoking was more prevalent in the lower socioeconomic groups compared to the higher ones in all birth cohorts, except in the female birth cohorts born 1930 or earlier. The decline in smoking has been least marked in the lowest socioeconomic groups. Consequently, the differences between the socioeconomic groups were larger in the later birth cohorts than in the earlier ones.

The widening of the inequalities between the social classes in smoking prevalence suggests that members of the lower socioeconomic groups are increasingly more likely to be smokers. The Finnish TCA of 1976 reduced smoking initiation in all socioeconomic groups in the birth cohorts which reached the age of smoking initiation when the TCA came into force or after, except among farmers. The decrease was less pronounced among male blue-collar workers. The proportion of ever-smoking among women dropped in all socioeconomic groups. In spite of the relatively even impact of the TCA on female smoking in all socioeconomic groups, female smoking prevalence continues to show wide socioeconomic disparities. Therefore, large socioeconomic disparities remain in smoking among both men and women. The results clearly demonstrated the development of smoking in the different socioeconomic groups. In Finland the diffusion processes of smoking have been similar to those observed in other Western industrialized countries (e.g. Pampel 2003).

The risk of smoking initiation is affected by environmental factors such as legislation and health education, socioeconomic background, and individual factors such as self-esteem and school performance (e.g. Backinger, et al. 2003, Koivusilta 2000). Environmental measures attempting to prevent smoking initiation influence first those eligible to adopt the advanced health claims, but they are less effective among adolescents of the lower socioeconomic groups (Backinger, et al. 2003, Whitehead and Dahlgren 1991). This is compatible with the finding of a slightly stronger effect of the 1976 TCA among men who had ended up white-collars. Although the respondents have obviously reached their socioeconomic status after having passed the most vulnerable age considering the risk of smoking initiation, different socioeconomic groups are likely to have differed from each other already at adolescence with regard to the distribution of educational paths and the socioeconomic status of parental home (Koivusilta 2000, Paavola, et al. 2004).

#### *Smoking and worksite smoking control*

The 1995 TCAA, focusing on prohibiting smoking at workplaces, appears to have reduced daily smoking among employed men and women. During the period following the implementation of the 1995 TCAA, the proportion of daily smokers among the employed was lower than expected on the basis of the trend prediction where the effect of the TCAA was zero among men and women. No parallel change in daily smoking was found among the population not directly affected by the 1995

TCAA: farmers, students, housewives, pensioners or unemployed persons. Early studies have suggested that the 1995 TCAA reduced daily smoking and tobacco consumption among employees in selected workplaces in the Helsinki metropolitan area (Heloma 2003). The Substudy III provides additional evidence that workplace smoking bans can lead to reductions in daily smoking prevalence at the level of the whole population.

Based on the previous studies (Bauer, et al. 2005, Brigham, et al. 1994, Farkas, et al. 1999, Heloma 2003, Levy, et al. 2004b, Longo, et al. 2001, Wakefield, et al. 1992), it can be argued that smoke-free worksite policy protects non-smokers from the harmful effects of environmental tobacco smoke and, in addition, supports smokers to quit smoking. The results of the Substudy III support the earlier findings. The impact of the restrictive workplace smoking policy measures was quite similar among both genders of Finnish employees. However, it has been argued in some studies that restrictive smoking policies in the workplace may have a greater impact on men than on women (e.g. Levy and Friend 2003).

#### *Exposure to environmental tobacco smoke*

The exposure to ETS at workplaces decreased during the study period of 1985–2006, and a marked drop was found since 1995 when the TCAA came into force. The decreasing trend continued thereafter. A properly enforced comprehensive ban of smoking in indoor public or working places is an important tool of the effective tobacco control policy. Additionally, in Finland the public places and vehicles meant for the general public have been smoke-free already for two decades prior to the ETS legislation on the worksite, which embedded the cultural acceptance of the ETS legislation. The social climate in Finland favoured smoke-free environments, and worksites were just one step further. The impact has been stronger in the countries where the ETS legislation has been implemented at same time to many environments and where a weaker legislation has existed previously (e.g. Fong, et al. 2006). However, a recent Finnish study showed that the hospitality industry workers were exposed to ETS still after the TCAA was extended to cover restaurants and bars in 2000 (Johnsson, et al. 2006). In consequence of these results, the TCA amendment of 2006 prohibited smoking in all restaurants, and smoking is allowed only in separate smoking booths.

### **6.3 Methodological considerations**

Many factors speak for the high reliability and validity of the present results. A large number of subjects representing well the total population have been contacted each year at the same time period, and the questions have been kept much the same – with a slight exception of measuring either regular or daily smoking. It is a known fact that self-reports may underestimate smoking prevalence (Patrick, et al. 1994). In studies comparing the self-reported smoking status to biochemical markers it has been generally found that self-reported data are reliable for population-based studies (Patrick, et al. 1994, Rebagliato 2002). A Finnish population-based study, serum cotinine validation of self-reported smoking, measured exactly in the similar way as was done in the present study, showed a very high level of agreement between the two measurements. The validity of self-reported smoking was also the same among people from different areas as well as from different age and socioeconomic groups. (Vartiainen, et al. 2002.)

In the Health Behaviour among the Finnish Adult Population -surveys in the past 25 years the response rate has been continuously declining, more rapidly among men than among women (Helakorpi, et al. 2005). Disparities in the smoking histories between the respondents and non-respondents may also lead to distortions in observed smoking prevalence. To ascertain this possible bias, in the Substudy I prevalence of ever daily smokers was corrected on the basis of information of the smoking habits of non-respondents, received from the CATI (= computer aided telephone interview) study. However, the influence of the correction on the results was very mild.

The response rate has declined more rapidly among those with low education compared to those with higher education (Tolonen, et al. 2006). As a consequence there is a risk of overestimating the decline in overall smoking prevalence, as smoking is more common among those with a low level of education or, more generally, representing the lower socioeconomic status. However, this problem is not likely to be very serious when examining differences between the socioeconomic groups instead of trends in the entire population. Moreover, if the smoking decreases were overestimated in the lower socioeconomic groups, the difference between the groups in the TCA impact would in reality be even larger than what was found in the Substudy II.

Preparatory activities for the 1995 TCAA were started in the early 1990s. They aroused public attention and probably contributed to the earlier declines in smoking. In fact, the daily smoking rates started to decline among employees already in 1993. Technically, it is impossible to estimate the ‘pure’ effect of the discussion of the

upcoming TCAA in 1993 and 1994 on daily smoking in the Substudy III, as social changes occur slowly and, more importantly, the law had its direct impact on workforce only after 1995. Secondly, also other phenomena such as the deep economic depression in Finland in 1991–1994 may have influenced the decline in smoking. The unemployment rate rose to 17% in 1994, and the gross domestic product (GDP) declined by around 15% over the period of 1990–93 (Statistics Finland 2005b). After the year 1995 a rising economic trend followed. In the Substudy III the change in the GDP was included in the model to account for this change, as it influenced the capacity of the smokers to spend money on tobacco.

The nature of the national policy impact assessment precludes the use of experiments, thus making the study causally challenging. The two laws, the TCA of 1976 and the TCAA in 1995, are broad in coverage, and therefore it is hard to find interventions directed to the lowering of smoking which could not be taken “under the legal umbrella”. A rather complicated statistical analysis scheme has been used, and factors not related to tobacco legislation have been controlled. Furthermore, the gradual change in the level of knowledge and in the smoking-related atmosphere as well as the increasing trend among women and the decreasing one among men have been controlled by including a secular cohort trend in the models.

## **6.4 Future prospects**

The present study showed that the examination of smoking behaviour by birth cohort is a useful tool when evaluating the impact of tobacco control policy and providing information for the future public health planning. However, more studies are needed in the future to assess the impact of different tobacco control policy measures on men and women in different socioeconomic groups. In addition, examining other outcome variables than the prevalence of ever daily smoking and daily smoking could provide a deeper insight into the effects of legislation, for example on quit attempts, number of cigarettes smoked per day, and occasional smoking. For successful measures of smoke-free policy among the whole population more studies are needed on the smoking initiation in different socioeconomic groups.

There are still challenges to address in the future. The findings of the present study confirm that there is a need for tobacco control policy measures specifically aimed at lower socioeconomic groups to achieve further reduction of smoking.

## **6.5 Conclusions**

In the Finnish tobacco control policy there are two major steps to harness tobacco consumption: the adoption of the national Tobacco Control Act of 1976 complemented with the total advertisement ban in 1978 and the environmental tobacco smoke amendment of the TCA in 1995 with the amendments in 2000 and 2006. The social climate in Finland towards smoking has continuously become less permissive for smokers. The change into a smoke-free society has occurred stepwise, first in public premises, then in workplaces and, finally, in restaurants and bars. There has been a wide acceptance of smoking restrictions among both smokers and non-smokers. The present study shows that national tobacco control policy can reduce health risks arising from tobacco use. The results on the changes of ever daily smoking in the successive birth cohorts, changes in daily smoking among employees, and changes in exposure to environmental tobacco smoke among non-smokers indicate a desired impact of the Tobacco Control Act of 1976 and its amendment in 1995.





## ACKNOWLEDGEMENTS

This thesis was carried out in the Unit of Health Promotion of the Department of Health Promotion and Chronic Disease Prevention in the National Public Health Institute (KTL). I would like to thank Professor Pekka Puska, M.D., Ph.D., M.Pol.Sc., Director General of the Institute, Professor Erkki Vartiainen, M.D., Ph.D., Director of the Department, and Adjunct professor Antti Uutela, Ph.D., Head of the Unit, for providing me the opportunity to work and make this thesis in KTL.

I am also grateful for the financial support of the study given by the Doctoral Programs in Public Health (DPPH) and for the collaboration with the Department of Public Health at the University of Helsinki.

My deepest gratitude goes to my supervisor, Adjunct professor Antti Uutela, for his support and stimulating and skilful guidance. Especially I want to thank him for his interest and encouragement throughout this work. I owe a large debt of gratitude to my other supervisor, Tuija Martelin, Ph.D., for her support and constructive comments to my questions throughout the years of this study. My thanks also go to my third supervisor, Adjunct professor Ossi Rahkonen, Ph.D. I am grateful to him for his excellent guidance and support.

I would like to express my sincere thanks to the co-authors of the original articles: Jorma Torppa, M.Sc, Adjunct professor Kristiina Patja, M.D, Ph.D, Urpo Kiiskinen, Ph.D, Professor Pekka Jousilahti, M.D., Ph.D., and Professor Erkki Vartiainen, M.D., Ph.D., for their collaboration and valuable contribution to this study. My special thanks go to Jorma Torppa for his help with the statistical issues throughout this work.

I want to express my gratitude to the official reviewers of this dissertation, Adjunct professor Leena Koivusilta, Ph.D. and Professor Kari Reijula, M.D., Ph.D., for their interest and their valuable comments on my work.

I wish to extend my sincere thanks to all my colleagues at our department for their help and support during these years. Special thanks to go Pilvikki Abzets, Ph.D., Piia Jallinoja, Ph.D., Heikki Heinonen, Ph.D., Meri Paavola, Ph.D., Hanna Tolonen, Ph.D., and Elina Laitalainen, M.Sc, for many fruitful conversations. I would thank also Ulla Broms, Ph.D. and Adjunct professor Sirpa Sarlio-Lähteenkorva, Ph.D., for their encouragement and support during these years. I also express my sincere thanks to Ms. Maija Ruth, for her help with technical issues regarding the pictures.

Furthermore, I would like to thank the staff of the Library and Information Service Unit, especially Mr. Jukka Lindeman, our information specialist, for excellent library services.

I would also like to thank Richard Burton, B.Sc. for doing such careful work in revising the language of the original articles. Furthermore, I would like to thank Ilona Pihlman, L.F.Ph., for revising the language of this thesis.

My family, relatives, and friends are thanked for encouragement and affection and all the good things in life. I wish to express my special thanks to my daughter, Jenni.

Helsinki, May 2008

*Satu Helakorpi*

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# APPENDICES

## Appendix 1

*Number of 15–64-year-old male and female subjects in the Substudies I and IV.*

<i>Men Year/ Birth cohort</i>	<i>78-80</i>	<i>81-84</i>	<i>85-89</i>	<i>90-94</i>	<i>95-99</i>	<i>2000</i>	<i>2001</i>	<i>Total</i>
1914-15 *	94							<b>94</b>
1916-20	472	262						<b>734</b>
1921-30	1305	1323	1060	427				<b>4115</b>
1931-40	1431	1450	1574	1414	1161	115	99	<b>7244</b>
1941-50	1943	2039	2074	1948	1871	364	387	<b>10626</b>
1951-60	1719	1744	2068	1853	1771	389	337	<b>9881</b>
1961-70	455	1013	1943	1783	1564	320	325	<b>7403</b>
1971-80			365	1103	1462	238	264	<b>3432</b>
1981-90*					272	129	165	<b>566</b>
missing*	53	81	65	78	71	14	12	<b>374</b>
<b>Total</b>	<b>7472</b>	<b>7912</b>	<b>9149</b>	<b>8606</b>	<b>8172</b>	<b>1569</b>	<b>1589</b>	<b>44469</b>
<b>Women</b>								
1914-15 *	125							<b>125</b>
1916-20	671	442						<b>1113</b>
1921-30	1288	1441	1392	461				<b>4582</b>
1931-40	1252	1287	1684	1609	1147	145	138	<b>7262</b>
1941-50	1651	1749	2244	2133	2111	435	374	<b>10697</b>
1951-60	1626	1705	2251	2197	2109	418	450	<b>10756</b>
1961-70	500	1082	2102	1924	1903	383	361	<b>8255</b>
1971-80			344	1263	1698	348	316	<b>3969</b>
1981-90*					356	151	212	<b>719</b>
missing*	140	313	146	115	137	19	29	<b>899</b>
<b>Total</b>	<b>7253</b>	<b>8019</b>	<b>10163</b>	<b>9702</b>	<b>9461</b>	<b>1899</b>	<b>1880</b>	<b>48377</b>

\* The subjects were excluded in the Substudy I. In the Substudy IV years from 1985 to 2000

## Appendix 2.

*Number of 25–64-year-old male and female subjects by socioeconomic status and study period in the Substudy II.*

<i>Men Year/ SES</i>	<i>78-80</i>	<i>81-84</i>	<i>86-89</i>	<i>90-94</i>	<i>95-99</i>	<i>2000</i>	<i>2001</i>	<i>2002</i>	<i>Total</i>
Entrepreneur	241	296	389	606	613	104	112	107	<b>2468</b>
Farmer	468	472	494	510	384	74	68	76	<b>2546</b>
Upper white-collar	704	846	890	1248	1161	237	242	237	<b>5565</b>
Lower white-collar	892	977	1934	1344	1385	277	305	259	<b>6473</b>
Blue-collar worker	2443	2949	2817	3141	3037	602	541	498	<b>16028</b>
SES/smoking missing*	103	99	70	70	117	16	18	15	<b>508</b>
<b>Total</b>	<b>4851</b>	<b>5639</b>	<b>5694</b>	<b>6919</b>	<b>6697</b>	<b>1310</b>	<b>1286</b>	<b>1192</b>	<b>33588</b>
<i>Women</i>									
Entrepreneur	172	151	286	380	480	83	76	87	<b>1715</b>
Farmer	366	348	405	498	333	66	49	50	<b>2115</b>
Upper white-collar	453	625	791	1166	1223	271	240	235	<b>5004</b>
Lower white-collar	1765	2196	2835	3637	3412	690	692	617	<b>15845</b>
Blue-collar worker	1411	1620	1932	2087	2086	411	404	361	<b>10312</b>
SES/smoking missing*	131	215	132	122	171	32	31	24	<b>858</b>
<b>Total</b>	<b>4298</b>	<b>5155</b>	<b>6381</b>	<b>7890</b>	<b>7706</b>	<b>1553</b>	<b>1492</b>	<b>1374</b>	<b>35849</b>

\* *The subjects were excluded. Study year 1985 excluded*

### Appendix 3.

*Number of 25–64-year-old male and female subjects by employment status and study period in the Substudy III.*

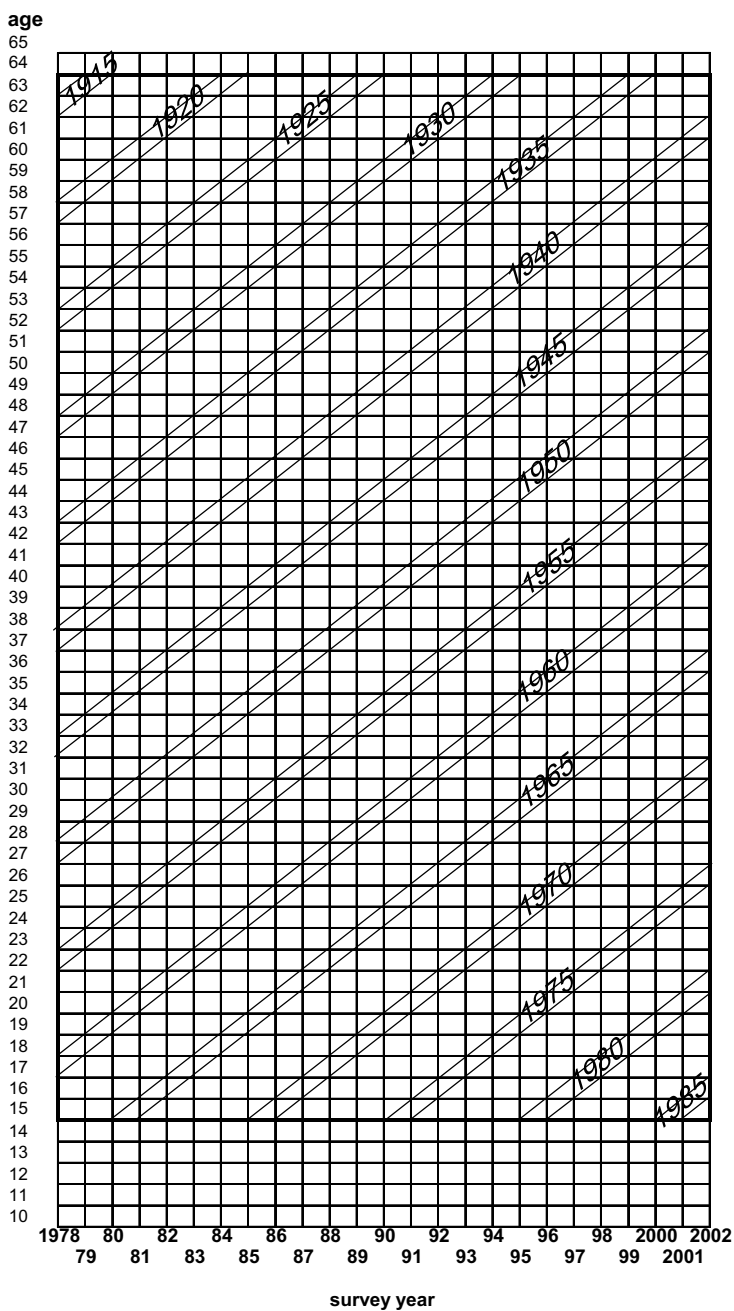
<i>Year/ Employment status</i>	<i>81-84</i>	<i>86-89</i>	<i>90-94</i>	<i>95-99</i>	<i>2000</i>	<i>01</i>	<i>02</i>	<i>03-05</i>	<i>Total</i>
<b>Men Employed*</b>									
Age≥25 years	4678	5185	4834	4353	853	920	828	2666	<b>24317</b>
<b>Men Others**</b>									
Age≥25 years	1852	2035	2085	2344	457	366	364	822	<b>10325</b>
<b>Women Employed</b>									
Age≥25 years	4010	5413	5256	4945	1038	1024	947	2890	<b>25523</b>
<b>Women Others</b>									
Age≥25 years	2522	2737	2634	2761	515	468	427	1242	<b>13306</b>
<b>Total</b>									<b>73471</b>

\* *employed persons in sectors other than farming or forestry*

\*\* *farmers, students, housewives, pensioners, and unemployed*

*Birth cohorts born in 1976-1990 were excluded*

**Appendix 4. Description of the age-period-cohort structure of the data in Lexis diagram.**





## Appendix 5. Questions used in this study

### BACKGROUND

#### Gender

- 1 man
- 2 woman

#### Year of birth 19

#### How many years have you attended school or studied full-time? Elementary school is included.

years

#### What kind of work do you do most of the year? (in survey years 1978–2002)

- 1 farming, cattle minding, forestry, farmer's wife
- 2 industrial work, mining, construction or other similar type of work
- 3 office work, services
- 4 studying
- 5 homemaker
- 6 pensioned
- 7 unemployed

#### Are you at the moment mainly (since 2003)

- 1 at work
- 2 partly at work, partly retired
- 3 laid off
- 4 unemployed
- 5 student
- 6 homemaker (also maternity leave, nursing leave)
- 7 on sick leave (>6 kk)
- 8 pensioned
- 9 not at work for any other reason

#### What is or was your status in the work community when being last employed outside your home? (since 2003)

- 1 employer, entrepreneur
- 2 farmer, farmer's wife
- 3 upper white-collar worker
- 4 lower white-collar worker
- 5 professionally trained worker
- 6 worker without professional training
- 7 I have not worked outside home

### SMOKING

#### Have you ever smoked?

- 1 no
- 2 yes

#### During your lifetime, have you smoked a total of at least 100 times (cigarettes, cigars or pipes)? (since 1996)

- 1 no
- 2 yes

#### Have you ever smoked regularly (i.e. almost every day for at least one year)? For how many years in all? (in survey years 1978–1995)

- 1 I have never smoked regularly
- 2 I have smoked regularly for a total of

years

#### Have you ever smoked daily for at least one year? For how many years in all? (since 1996)

- 1 I have never smoked daily
- 2 I have smoked daily for a total of

years

**When did you smoke last? If you smoke continuously, mark alternative 1.**

- 1 yesterday or today
- 2 2 days – 1 month ago
- 3 1 month – six months ago
- 4 six months ago – one year ago
- 5 1 year – 5 years ago
- 6 5 – 10 years ago
- 7 over 10 years ago

**EXPOSURE TO ENVIRONMENTAL TOBACCO SMOKE**

**Do you smoke or does any of your family members smoke at your home? (in survey years 1985–1998)**

- 1 nobody smokes
- 2 yes, somebody smokes

**Do you smoke or does any of your family members smoke at your home? (in 1999)**

	yes	no
myself	1	2
my spouse	1	2
somebody else	1	2

**Do you smoke or does any of your family members smoke at your home? (since 2000)**

	yes	no
myself	1	2
my spouse	1	2
another adult	1	2
another person (under 18 years of age)	1	2

**How many hours do you spend daily at your work place in rooms or other premises where there is smoke in the air? (since 1985)**

- 1 more than 5 hours
- 2 1–5 hour(s)
- 3 less than one hour
- 4 hardly ever
- 5 I do not work outside my home

**How is smoking arranged in your workplace? (since 1995)**

- 1 no one smokes
- 2 allowed only in a separate smoking room
- 3 allowed in the smoking room and individual offices
- 4 allowed also elsewhere indoors