Development of smoking by birth cohort in the adult population in eastern Finland 1972–97

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Abstract

***Objective*—To analyse the dynamics of smoking prevalence, initiation, and cessation in relation to sex, age, birth cohort, study year, and educational level.**

***Design*—Six independent cross-sectional population surveys repeated every five years between 1972 and 1997.**

***Setting*—The provinces of North Karelia and Kuopio in eastern Finland.**

***Subjects*—Independent random samples of 18 088 men and 19 200 women aged 25–64 years. Those comprising the oldest birth cohort were born in 1913–17 and those in the youngest were born in 1968–72.**

***Results*—Among men the prevalence of smoking decreased over time, but the cohort effect observed in smoking initiation was obscured by the changes in smoking cessation. Differences between the educational categories were small. Among women the prevalence of smoking increased during the study period. This was mainly caused by the less highly educated, in whom smoking initiation clearly increased in successive birth cohorts, but a more moderate cohort effect was also present among the more highly educated women.**

***Conclusions*—In men decreased initiation and increased cessation contributed to the downward trend in smoking prevalence, whereas among women, changes in smoking were mostly caused by augmented initiation in successive birth cohorts. During the study period educational inequalities in smoking widened, as the less highly educated came increasingly to form the smoking population.**

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Keywords: smoking prevalence; smoking initiation; smoking cessation; Finland

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Introduction

The health hazards of smoking have been well established. Smoking is one of the most important risk factors for cardiovascular disease (CVD) and also increases the risk for dozens of other diseases.[1 2] During the early 1970s eastern Finland was reported to have the highest mortality from CVD in the world. High levels of the main CVD risk factors, smoking among them, have been reported to be contributing factors to this.[3]

Thirty years ago half the men in eastern Finland smoked, in contrast to women, among whom only one in 10 smoked. Since then the prevalence of smoking has decreased notably among men but among women it has almost doubled. Among men the decrease has been similar in all age groups, whereas among women the increase has been greatest in the youngest age group.[4]

One of the most important determinants of smoking behaviour is educational level. In eastern Finland less highly educated men have been more likely to smoke than the more highly educated, and male smoking has decreased comparably across all educational categories. Among women the more highly educated used to smoke more than the less highly educated until the 1970s, after which the less highly educated have been smoking more.[5]

Birth cohort analysis may be used to gain further information on the development of smoking in the population. The aim of the present study is to examine the dynamics of smoking in eastern Finland in relation to birth cohort, calendar year, and age during the period 1972–97. We used all three variables in our analyses but did not try to quantify their separate effects, because of their interaction. As the changes in smoking prevalence result either from initiation in successive birth cohorts or from changes in cessation within the birth cohorts, we analysed these components separately. The analyses were done separately for men and women, and performed in two educational categories.

Methods

The data were derived from six cross-sectional risk factor surveys conducted in eastern Finland since 1972. Independent population samples were studied every five years in the provinces of North Karelia and Kuopio. In 1972 and 1977 random samples of 6.6% of the population born between 1913 and 1947 were drawn in both provinces. In 1977 an additional sample of 6.6% of those born between 1948 and 1952 was taken randomly in North Karelia only. For the subsequent surveys (1982, 1987, 1992, and 1997) the sampling method was modified to comply with the protocol of the World Health Organisation MONICA project (*moni*toring trends and determinants in *ca*rdiovascular disease).[6] The sample was stratified according to sex and 10-year age group so that at least 250 people were included in each subgroup in both provinces. Because in the earliest surveys the population aged 25–64 years was equally distributed to each 10-year age group, the results remained comparable.

Our analyses included 25–64 year olds, except in 1972 when 60–64 year olds were not studied. In 1977 the age group 25–29 years old consisted of North Karelians only. The number of respondents in the six surveys was 37 288, and the response rates varied between 75% and 92%.

As the overall development of smoking in the two provinces has been basically similar, despite the somewhat steeper decrease in male smoking in North Karelia during the first surveys,[4] the data from the two areas were combined for our analyses. Twelve synthetic five-year birth cohorts were constructed; those included in the oldest birth cohort were born in 1913–17 and those in the youngest cohort were born in 1968–72. The number of respondents decreased progressively from the earliest to later surveys. The smallest cell defined by birth cohort, age, study year, and sex included 135 respondents.

Respondents' smoking status was assessed with standardised questions in a self administered questionnaire. Those who had smoked regularly for at least one year and continued to do so during the previous month were regarded as current smokers. Smoking initiation was defined on the basis of ever having smoked regularly; those who declared they had smoked for at least one year at some point during their lifetime were considered as smoking initiators. Quitters were those who had smoked regularly but stopped at least one month before the study.

The analyses were performed in two educational categories. Among the indicators of socioeconomic status, educational level is the one showing the strongest and most consistent associations with CVD risk factors.[7 8] Here, educational level was measured by the total number of school years. As the average length of education in Finland has increased remarkably during the recent decades, the respondents were divided into two educational categories on the basis of their position below or above the median length of education in their own birth cohort.

The results are presented in the tables, stratified by sex and educational level, using five-year birth cohorts, five-year study periods and five-year age groups as classifying variables. Birth cohorts appear in rows and study years in columns, and trends at each age level can be traced by reading diagonally down and to the right. Even if the results do not allow complete separation of age, period, and birth cohort from each other, simultaneous use of the three variables can produce tentative evidence about their relative contribution to the development of smoking.

Logistic regression analysis was used to test the statistical significance between the explanatory factors and the smoking variables. The order of the modelling follows the order in the text. The models birth cohort, age group, and study year were treated as continuous variables. First-level interactions between the main effects were also tested. Odds ratios with significance levels for five-year increase in age, five-year period, five-year difference in birth cohort, and change from lower to higher educational level are shown in the table

Table 1 Current smoking by birth cohort, age (in diagonals), study year, and educational level in men

	Current smokers by year (%)						
Birth cohort	*1972*	*1977*	*1982*	*1987*	*1992*	*1997*	*Age (years)*
Less highly educated men							
1913–1917	52	39					
1918–1922	57	42	38				
1923–1927	55	48	36	31			
1928–1932	54	48	34	34	23		
1933–1937	53	44	43	35	34	24	
1938–1942	54	44	35	40	33	29	60–64
1943–1947	53	53	46	40	43	31	55–59
1948–1952		52	49	49	32	42	50–54
1953–1957			53	50	42	37	45–49
1958–1962				48	43	39	40–44
1963–1967					42	42	35–39
1968–1972						48	30–34
							25–29
Total	54	46	42	40	36	35	
More highly educated men							
1913–1917	48	28					
1918–1922	49	45	37				
1923–1927	53	38	30	26			
1928–1932	46	40	38	34	23		
1933–1937	37	38	42	26	24	23	
1938–1942	45	41	34	31	28	19	60–64
1943–1947	55	42	33	32	33	29	55–59
1948–1952		46	40	41	35	32	50–54
1953–1957			39	33	37	34	45–49
1958–1962				27	31	29	40–44
1963–1967					29	13	35–39
1968–1972						37	30–34
							25–29
Total	48	40	37	32	31	27	

Odds ratios and significance levels from logistic regression analyses: one-factor models: study year 0.85 ($p<0.001$); age group 0.93 ($p<0.001$); birth cohort 0.99 ($p = 0.15$); education 0.78 ($p<0.001$). Multivariate model: study year 0.91 ($p<0.001$); age group 0.98 ($p = 0.10$); education 0.78 ($p<0.001$); interaction between study year and age group 0.99 ($p = 0.002$). Multivariate model: study year 0.89 ($p<0.001$); age group 0.94 ($p<0.001$); education 0.84 ($p = 0.003$); interaction between study year and education 0.97 ($p = 0.15$).
For an explanation of educational level, see text.

Table 2 Current smoking by birth cohort, age (in diagonals), study year, and educational level in women

	Current smokers by year (%)						
Birth cohort	*1972*	*1977*	*1982*	*1987*	*1992*	*1997*	*Age (years)*
Less highly educated women							
1913–1917	5	2					
1918–1922	4	5	4				
1923–1927	7	7	10	5			
1928–1932	10	10	7	4	3		
1933–1937	11	11	14	14	8	7	
1938–1942	14	12	14	13	13	13	60–64
1943–1947	24	22	19	20	18	14	55–59
1948–1952		26	34	25	24	10	50–54
1953–1957			39	31	35	24	45–49
1958–1962				37	37	29	40–44
1963–1967					37	24	35–39
1968–1972						35	30–34
							25–29
Total		11	17	18	20	19	
More highly educated women							
1913–1917	10	6					
1918–1922	13	6	4				
1923–1927	16	11	13	10			
1928–1932	11	7	10	5	6		
1933–1937	12	10	11	10	10	17	
1938–1942	15	15	11	13	12	8	60–64
1943–1947	20	17	12	14	10	11	55–59
1948–1952		27	24	19	21	18	50–54
1953–1957			19	17	19	19	45–49
1958–1962				17	14	8	40–44
1963–1967					20	18	35–39
1968–1972						21	30–34
							25–29
Total		11	13	13	14	15	

Odds ratios and significance levels from logistic regression analyses: multivariate model: study year 1.39 ($p<0.001$); education 1.42 ($p<0.001$); interaction between study year and education 0.86 ($p<0.001$). Less highly educated: one-factor models: study year 1.20 ($p<0.001$); age group 0.73 ($p<0.001$); birth cohort 1.34 ($p<0.001$). Multivariate model: study year 1.23 ($p<0.001$); age group 0.71 ($p<0.001$); interaction between study year and age group 1.00 ($p = 0.68$). More highly educated: one-factor models: study year 1.03 ($p = 0.13$); age group 0.85 ($p<0.001$); birth cohort 1.12 ($p<0.001$). Multivariate model: study year 1.01 ($p = 0.76$); age group 0.84 ($p<0.001$); interaction study year and age group 1.01 ($p = 0.51$).
For an explanation of educational level, see text.

footnotes. The non-linear development of smoking cessation by study year and age was corrected by adding study year 1972 and age group 60–64 to the models as dummy variables. For the same reason, birth cohort was fitted in two parts into the model of women's smoking initiation. The statistical software package SAS was used for all the analyses.[9]

Results

CURRENT SMOKING

In men the prevalence of smoking decreased markedly between 1972 and 1997 (table 1). The decrease was observed in all age groups, but was slightly greater in the older groups. With the exception of the 1972 survey, younger subjects had a higher smoking prevalence than older subjects in cross-sectional analyses. Prevalence declined with advancing age within each birth cohort. In both educational groups the development of smoking was virtually equal, but less highly educated men had consistently higher smoking prevalence than the more highly educated men.

In contrast to men, the development of smoking prevalence over time differed between the educational categories in women (table 2). Among less highly educated women the prevalence of smoking doubled during the study period, whereas among the more highly educated it remained unchanged. As a result, smoking prevalence among less highly educated women has exceeded that of the more highly educated since the 1980s. Among less highly educated women the prevalence of smoking increased over time in every age group. In cross-sectional analyses smoking decreased markedly with age, as it did within birth cohorts, although more moderately; thus an increase in smoking prevalence in successive birth cohorts was clear. Among more highly educated women, periodical changes were small in every age group. The differences between age groups were parallel, but smaller in magnitude, to those in the lower educational category. The increase in smoking prevalence was clear from one birth cohort to the next, which was similar to the situation in the lower educational category.

SMOKING INITIATION

In men smoking initiation diminished quite steadily over time since the second survey in 1977 (table 3). The decreasing trend applied to all age groups. In cross-sectional analyses the proportion of smoking initiators increased when moving from the youngest to the oldest age groups. In contrast, no increase was noted as age advanced within the birth cohorts. In the oldest birth cohorts smoking initiation was more common than in the youngest cohorts. Birth cohort appeared to be an important factor contributing to decreasing initiation rate; the decrease occurred in both educational categories, but the more highly educated showed consistently lower initiation rates than the less highly educated.

In women smoking initiation increased over time in both educational categories, but

Table 3 Smoking initiation by birth cohort, age (in diagonals), study year, and educational level in men

	Smoking initiation by year (%)						
Birth cohort	*1972*	*1977*	*1982*	*1987*	*1992*	*1997*	*Age (years)*
Less highly educated men							
1913–1917	79	76					
1918–1922	81	83	85				
1923–1927	80	80	74	72			
1928–1932	71	75	66	66	68		
1933–1937	67	67	66	67	61	64	
1938–1942	67	69	60	63	67	62	60–64
1943–1947	64	70	72	67	69	63	55–59
1948–1952		66	68	72	61	72	50–54
1953–1957			70	65	53	62	45–49
1958–1962				59	69	49	40–44
1963–1967					55	56	35–39
1968–1972						61	30–34
							25–29
Total	72	73	69	67	64	62	
More highly educated men							
1913–1917	78	73					
1918–1922	79	84	77				
1923–1927	71	74	72	69			
1928–1932	67	66	78	61	61		
1933–1937	56	66	70	56	53	58	
1938–1942	62	65	59	62	69	63	60–64
1943–1947	66	62	58	63	59	59	55–59
1948–1952		67	57	62	60	65	50–54
1953–1957			59	54	51	62	45–49
1958–1962				40	47	48	40–44
1963–1967					37	36	35–39
1968–1972						46	30–34
							25–29
Total	68	69	64	58	55	56	

Odds ratios and significance levels from logistic regression analyses: one-factor models: study year 0.88 (p<0.001); age group 1.11 (p<0.001); birth cohort 0.88 (p<0.001); education 0.77 (p<0.001). Multivariate model: study year 1.00 (p = 0.97); birth cohort 0.89 (p<0.001); education 0.84 (p = 0.008); interaction between study year and education 0.98 (0.31).
For an explanation of educational level, see text.

the increase was greater at the lower educational level (table 4). In cross-sectional analyses the initiation rate of younger women was clearly higher than that of older women, whereas the change with age within the cohorts was minimal. Together, these two observations indicate a clear birth cohort effect.

Table 4 Smoking initiation by birth cohort, age (in diagonals), study year, and educational level in women

	Smoking initiation by year (%)						
Birth cohort	*1972*	*1977*	*1982*	*1987*	*1992*	*1997*	*Age (years)*
Less highly educated women							
1913–1917	6	3					
1918–1922	5	6	5				
1923–1927	9	10	11	9			
1928–1932	12	11	10	7	8		
1933–1937	15	14	19	18	17	11	
1938–1942	17	19	24	23	19	19	60–64
1943–1947	29	31	27	29	26	30	55–59
1948–1952		35	44	43	39	25	50–54
1953–1957			61	58	56	46	45–49
1958–1962				55	54	47	40–44
1963–1967					54	42	35–39
1968–1972						55	30–34
							25–29
Total	13	15	24	29	32	34	
More highly educated women							
1913–1917	11	10					
1918–1922	16	12	9				
1923–1927	19	16	16	18			
1928–1932	14	13	17	9	11		
1933–1937	14	17	19	15	16	32	
1938–1942	19	20	23	24	21	20	60–64
1943–1947	28	28	26	26	21	27	55–59
1948–1952		42	37	36	35	35	50–54
1953–1957			38	38	45	41	45–49
1958–1962				27	32	27	40–44
1963–1967					29	31	35–39
1968–1972						36	30–34
							25–29
Total	17	18	23	25	27	31	

Odds ratios and significance levels from logistic regression analyses: multivariate model: study year 1.43 (p<0.001); education 1.38 (p<0.001); interaction between study year and education 0.90 (p<0.001). Less highly educated: one-factor models: study year 1.28 (p<0.001); age group 0.72 (p<0.001); birth cohorts 1913–17 to 1953–57 1.45 (p<0.001) and birth cohorts 1958–62 to 1968–72 1.05 (p = 0.39). More highly educated: one-factor models: study year 1.16 (p<0.001); age group 0.86 (p<0.001); birth cohorts 1913–17 to 1953–57 1.20 (p<0.001) and birth cohorts 1958–62 to 1968–72 0.90 (p = 0.06).
For an explanation of educational level, see text.

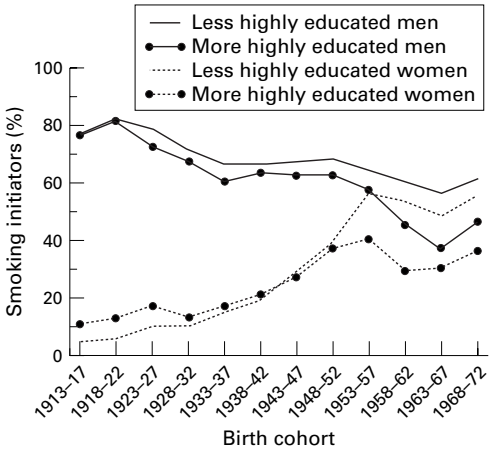

Figure 1 Smoking initiators by birth cohort, gender, and educational level.

Figure 1 shows the development of smoking initiation by birth cohort age groups combined. Among men smoking initiation declined steadily from one birth cohort to the next. The development was parallel in both educational categories until the cohorts born during the 1950s, after which the more highly educated experienced a marked decrease. Among women smoking initiation increased in both educational categories. In those cohorts born during the 1950s the increase levelled off, such that initiation among the less highly educated settled at a considerably higher level than the more highly educated. When moving from the oldest to the youngest birth cohorts, the difference between men and women became a difference between educational categories.

SMOKING CESSATION

In men smoking cessation increased notably from 1972 to 1977, after which the increase became more moderate (table 5). The increase took place throughout the age groups. The proportion of quitters increased with advancing age in cross-sectional analyses and within the birth cohorts. The development followed a similar pattern in both educational groups, even though the general level of quitting was higher among the more highly educated.

In women smoking cessation developed similarly to men; between 1972 and 1977 it increased strikingly and then became a more moderate but constant increase (table 6). The pattern was similar in both educational categories, although the increase over time was even more marked among the more highly educated. In cross-sectional analyses the differences between age groups were small, but within cohorts an increasing rate of cessation was evident. Cessation increased across age groups, and the differences between successive birth cohorts were small and inconsistent.

Discussion

In men the prevalence of smoking decreased markedly during the study period, but consistent change between successive birth cohorts was not observed. Among women, in contrast, temporal increase in smoking prevalence arose indisputably from changes in successive birth cohorts. The increase was mainly caused by smoking in less highly educated women, but also among the more highly educated smoking was clearly augmented in successive birth

Table 5 Smoking cessation by birth cohort, age (in diagonals), study year, and educational level in men

	Smoking cessation by year (%)						
Birth cohort	*1972*	*1977*	*1982*	*1987*	*1992*	*1997*	*Age (years)*
Less highly educated men							
1913–1917	34	49					
1918–1922	29	49	56				
1923–1927	32	40	51	57			
1928–1932	24	37	48	49	65		
1933–1937	21	35	35	48	44	62	
1938–1942	20	37	42	37	51	54	60–64
1943–1947	17	25	36	40	37	50	55–59
1948–1952		21	28	31	47	42	50–54
1953–1957			25	23	20	40	45–49
1958–1962				18	37	21	40–44
1963–1967					24	26	35–39
1968–1972						21	30–34
							25–29
Total	25	37	40	39	43	43	
Less highly educated men							
1913–1917	38	62					
1918–1922	38	46	52				
1923–1927	26	48	58	63			
1928–1932	32	39	51	45	63		
1933–1937	34	43	40	53	55	59	
1938–1942	28	37	43	49	60	70	60–64
1943–1947	17	33	43	50	43	51	55–59
1948–1952		31	30	34	43	51	50–54
1953–1957			34	39	27	44	45–49
1958–1962				34	34	40	40–44
1963–1967					23	65	35–49
1968–1972						20	30–34
							25–29
Total	30	42	43	46	45	51	

Odds ratios and significance levels from logistic regression analyses: one-factor models: study year 1.08 (p<0.001); study year 1972 0.63 (p<0.001); age group 1.20 (p<0.001); birth cohort 0.93 (p<0.001); education 1.23 (p<0.001). Multivariate model: study year 1.24 (p<0.001); study year 1972 0.66 (p<0.001); birth cohort 0.84 (p<0.001); education 1.22 (p = 0.01); interaction between study year and education 1.01 (p = 0.65).
For an explanation of educational level, see text.

Table 6 Smoking cessation by birth cohort, age (in diagonals), study year, and educational level in women

Birth cohort	Smoking cessation by year (%)						Age (years)
	1972	1977	1982	1987	1992	1997	
Less highly educated women							
1913–1917	23	42					
1918–1922	25	18	22				
1923–1927	22	31	9	47			
1928–1932	18	15	25	45	70		
1933–1937	30	24	25	22	50	42	
1938–1942	20	36	42	43	29	31	60–64
1943–1947	19	29	30	30	31	52	55–59
1948–1952		27	24	42	38	59	50–54
1953–1957			35	46	39	49	45–49
1958–1962				33	32	37	40–44
1963–1967					33	43	35–39
1968–1972						37	30–34
							25–29
Total	22	28	29	38	37	44	
More highly educated women							
1913–1917	8	39					
1918–1922	22	50	61				
1923–1927	15	32	19	45			
1928–1932	20	43	39	50	46		
1933–1937	14	43	41	37	39	48	
1938–1942	18	26	52	46	43	62	60–64
1943–1947	29	40	52	44	52	61	55–59
1948–1952		37	36	48	40	50	50–54
1953–1957			49	56	58	53	45–49
1958–1962				35	58	65	40–44
1963–1967					32	42	35–39
1968–1972						40	30–34
							25–29
Total	20	38	44	46	48	52	

Odds ratios and significance levels from logistic regression analyses: one-factor models: study year 1.16 ($p<0.001$) and study year 1972 0.60 ($p<0.001$); age group 1.00 ($p = 0.85$) and age group 60–64 1.63 ($p = 0.007$); birth cohort 1.09 ($p<0.001$); education 1.36 ($p<0.001$). Multivariate model: study year 1.09 ($p = 0.23$); study year 1972 0.60 ($p<0.001$); education 1.22 ($p = 0.19$); interaction between study year and education 1.05 (0.26). Multivariate model: study year 1.09 ($p = 0.06$); study year 1972 0.60 ($p<0.001$); age group 0.92 ($p = 0.11$); age group 60–64 1.29 ($p = 0.16$); interaction between study year and age group 1.01 ($p = 0.12$).
For an explanation of educational level, see text.

cohorts. An especially large increase was observed between female cohorts born during the late 1930s and early 1950s.

In smoking initiation a birth cohort effect was evident in both sexes, inducing a decreasing trend in men and a more prominent increase in women. Smoking cessation, on the other hand, showed an increasing trend, but no cohort effect, in both sexes. Among men the development of smoking cessation appeared to obscure the cohort effect in current smokers. Among women smoking initiation and cessation were augmented, but a greater increase in initiation produced an increase in smoking prevalence.

Birth cohort, period, and age are linearly interrelated such that any one of the variables can be derived given the other two. Separating these variables has been a constant problem in birth cohort studies. Because smoking behaviour is dependent on age, separating birth cohort effects and periodical effects is particularly difficult. At a given point in time, people in birth cohorts are at different ages and at different phases of their smoking career, and therefore the effects can be seen more clearly in some birth cohorts than in others. A change in the pricing policy, for example, constitutes a typical periodic phenomenon, but its influence may be seen more clearly in some birth cohorts than in others; in other words, the change can not be detected independently from the age effect.

Various strategies have been developed to separate these three effects statistically, but thus far none has gained collective acceptance.[10 11] Our statistical results (see table footnotes) do not allow separation of these effects. We presented all three variables simultaneously in the tables but did not attempt to isolate and quantify their separate effects; logistic regression analysis was used only to test the significance of the explanatory variables.

In addition to the tables, the figure describes smoking initiation in successive birth cohorts. Smoking initiation was defined as ever smoking regularly during one's lifetime; date or age of initiation were not taken into account. In the figure the respondents were combined into cohorts, disregarding their ages at the time of the study. Of course, some people have not yet initiated their smoking but will do so later, and this possibility is greater in the youngest birth cohorts than in the oldest ones. However, as smoking initiation in adulthood is uncommon[12] and our subjects were 25–64 years of age, we assumed that the possible bias caused by age differences between the cohorts was small. Tables 3 and 4 support this assumption: within the birth cohorts smoking initiation was quite stable, and systematic increase with advancing age could not be observed in any of them.

Smoking as a topic introduces other possible sources of bias; higher mortality rates of current smokers compared with those of non-smokers and former smokers may distort the results. Some of the previous cohort studies on smoking have estimated the effect of selective mortality[13–15]; this effect remained minimal, especially in younger birth cohorts. A previous Finnish study also found the effect of selective mortality to be small.[16] In addition,

the effect of selective mortality in our study was reduced by the low overall mortality in the age groups examined.

Previous birth cohort studies on smoking have been predominantly retrospective,[13–23] one of them combining retrospective and prospective approaches,[24] whereas our data were derived from repeated cross-sectional surveys. In both study designs, possible problems caused by selective mortality are equal. In contrast, recall errors are much more likely in retrospective studies; differences in the ability to recall dates of smoking initiation and cessation between older and younger cohorts may confound inter-cohort comparisons.

In the assessment of smoking status we relied on self reporting, the validity of which has sometimes been questioned. The data from the 1992 survey were validated elsewhere (Vartiainen E, Seppälä T, Korhnonen HJ, *et al*, submitted).[25] Self reporting and biochemical markers have shown a high degree of correspondence; thus, misclassification of smoking status due to self reporting is not likely to be great.

As far as comparison is possible, the results of our study are consistent with those of a previous Finnish study[16] which located the peak in male smoking in those cohorts born in 1911–25, whereas the prevalence in female smoking was highest in the most recent cohorts (born during the 1960s). For the most part, the changes followed the variation in smoking initiation, but among men smoking cessation was also augmented.

Compared with Norway, another Nordic country, Finnish men experienced their peak smoking prevalence earlier than Norwegian men, whereas Norwegian women were ahead of their Finnish counterparts. After a period of decline in smoking prevalence in both sexes, Norwegian women experienced another peak around 1970, at which time about half of the women born in 1940–49 smoked. From 1970 to 1990 smoking declined again in all birth cohorts among men and women. The gender gap diminished until no difference between men and women was observed among those born after 1950.[24]

The previous Finnish study[16] also showed a change in smoking prevalence between the educational categories in women. Moreover, the change was dated to the same birth cohorts as in our study—to those born at the beginning of the 1940s. In our study the change was observed in smoking prevalence and in smoking initiation. As previously reported, smoking is today more common among the less highly educated in both sexes.[5 25] The educational discrepancy already begins to emerge at the upper stage comprehensive level (12-15 years).[26] In Finland, less highly educated women have smoked as much as more highly educated men since the late 1980s.[25] Our results indicate that in the youngest birth cohorts, smoking initiation among less highly educated women clearly exceeds that of more highly educated men and approaches that of less highly educated men. Smoking initiation is thus determined as much by educational level as by gender in the youngest birth cohorts. In addition, the sex difference also appeared to be diminishing with regard to smoking cessation: among women the age gradient steepened and began to resemble that observed in men.

Comparisons with German results provide an intriguing contrast. Brenner[13] examined the prevalence of smoking in successive birth cohorts at two educational levels. As in Finland, smoking prevalence was higher among less highly educated men than among the more highly educated. From birth cohort 1941–50 onwards the gap widened because of a decrease in smoking among the more highly educated. Interestingly, this seemed to be mainly due to increased cessation among the more highly educated. Among women, the prevalence increased in each successive birth cohort, but, in contrast to Finland, the development was comparable in both educational categories.

We observed a decreasing trend in smoking prevalence among men and an increasing trend among women. Previous birth cohort studies reporting similarly diverging trends have considered differing responses to anti-smoking campaigns (more or less broadly conceived) or tobacco advertising as reasons for the sex difference.[13 17 19 20 22] Our data originate from an area that has been a target for a major community-level risk factor intervention,[27] initially directed more towards men than women, that may have resulted in some of the difference between the sexes. The harmful effects of smoking came into public awareness after the late 1950s, but women have been found to be less responsive to tobacco related health publicity than men.[28] The influence of advertising, in contrast, is likely to be negligible because advertising directed explicitly towards women has been rare, and since the late 1970s direct advertising has been banned.[29]

Similarly, the influence of pricing policy presumably remains small. Pricing policy is known to have a strong influence on tobacco consumption[28 30] and lower socioeconomic groups have been found to be more responsive to price fluctuations than higher socioeconomic groups, but no such difference has been observed between genders.[28] Moreover, in Finland pricing policy has not been used to control tobacco consumption; the price of tobacco has paralleled the consumer price index.[29 31]

The outcome of this dissimilar development between men and women has been the convergence of smoking behaviour between the genders. We presume that the most likely explanation is the change in women's social position. Social norms restricting women's behaviour relaxed, and within that development female smoking became more widely accepted.[32 33] Urbanisation, accelerating especially since the 1960s, led to eroding of the norms of the agrarian society and gave rise to women's increasing participation in the labour force.[34] In addition, the influence of the family has diminished and youth culture has become increasingly important, factors that plausibly

have promoted the adoption of smoking among young women.

Explanations concerning advertising or the lack of health education have been criticised for failing to take into account the positive aspects of smoking[35]—although people are aware of the negative health effects, smoking's positive social and cultural connotations may be more important at the point when the smoking behaviour is adopted or abandoned. It appears that in the case of women these factors have been more influential and have truncated anti-smoking efforts.

Despite the reduced difference between the sexes, men still smoke more than women, and the trend in men has not been completely positive. The number of male smokers in the youngest age groups is still large, especially among the less highly educated, and in recent surveys the increasing trend in female smoking has levelled off. Our results indicate that smoking initiation had already begun to decrease in those born during the 1950s. Smoking prevalence in women will not yet decline, however, because people in the the oldest, lightly smoking cohorts are being replaced by those in the cohorts where smoking is heavier. Overall, the development of smoking has been similar throughout the Western countries,[36 37] and other birth cohort studies have found trends parallel to ours. Although few of these studies have reported the more recent decrease in smoking prevalence in women,[20 22] the decline of female smoking may be a more general, Western phenomenon as well.

1 Doll R, Peto R, Wheatley K, *et al.* Mortality in relation to smoking: 40 years' observation on male British doctors. *BMJ* 1994;**309**:901–11.
2 Peto R, Lopez AD, Boreham J, *et al. Mortality from smoking in developed countries 1950–2000.* Oxford: Oxford University Press, 1994.
3 Vartiainen E, Puska P, Jousilahti P, *et al.* Twenty-year trends in coronary risk factors in North Karelia and in other areas of Finland. *Int J Epidemiol* 1994;**23**:495–504.
4 Vartiainen E, Korhonen HJ, Koskela K, *et al.* Twenty-year smoking trends in a community-based cardiovascular diseases prevention program: results from the North Karelia Project. *Eur J Public Health* 1998;**8**:154–9.
5 Pekkanen J, Uutela A, Valkonen T, *et al.* Coronary risk factor levels: differences between educational groups in 1972–87 in eastern Finland. *J Epidemiol Commun Health* 1995;**49**:144–9.
6 WHO MONICA project principal investigators. World Health Organisation MONICA project (monitoring trends and determinants in cardiovascular disease): a major international collaboration. *J Clin Epidemiol* 1988; **41**:105–14.
7 Luoto R, Pekkanen J, Uutela A, *et al.* Cardiovascular risks and socioeconomic status: differences between men and women in Finland. *J Epidemiol Commun Health* 1994; **48**:348–54.
8 Winkleby MA, Jatulis DE, Frank E, *et al.* Socioeconomic status and health: how education, income, and occupation contribute to risk factors for cardiovascular disease. *Am J Public Health* 1992;**82**:816–20.
9 SAS Institute, Inc. *SAS/STAT users's guide,* v. 6, 4th ed. Cary, North Carolina, SAS Institute, 1990.
10 Holford TR. Understanding the effects of age, period and cohort on incidence and mortality rates. *Annu Rev Public Health* 1991;**12**:425–57.
11 Kupper LL, Janis JM, Karmous A, *et al.* Statistical age-period-cohort analysis: a review and critique. *J Chron Dis* 1985;**38**:811–30.
12 Paavola M, Vartiainen E, Puska P. Predicting adult smoking: the influence of smoking during adolescence and smoking among friends and family. *Health Educ Res* 1996;**11**:309–15.
13 Brenner H. A birth cohort analysis of the smoking epidemic in West Germany. *J Epidemiol Commun Health* 1993; **47**:54–8.
14 Harris JE. Cigarette smoking among successive birth cohorts of men and women in the United States during 1900–80. *J Natl Cancer Inst* 1983;**71**:473–9.
15 LaVecchia C, Decarli A, Pagano R. Prevalence of cigarette smoking among subsequent cohorts of Italian males and females. *Prev Med* 1986;**15**:606–13.
16 Martelin T. *Development of smoking habits in Finland. Series of original reports 1/1984.* Helsinki: National Board of Health, 1984. (In Finnish, English summary.)
17 Birkett NJ. Trends in smoking by birth cohort for births between 1940 and 1975: a reconstructed cohort analysis of the 1990 Ontario Health Survey. *Prev Med* 1997;**26**:534–41.
18 Christie D, Gordon I, Robinson K. Smoking in an industrial population. An analysis by birth cohort. *Med J Aust* 1986; **145**:11–4.
19 Escobedo LG, Peddicord JP. Smoking prevalence in US birth cohorts: the influence of gender and education. *Am J Public Health* 1996;**86**:231–6.
20 Escobedo LG, Remington PL. Birth cohort analysis of prevalence of cigarette smoking among Hispanics in the United States. *JAMA* 1989;**261**:66–9.
21 Ferrence RG. Sex differences in cigarette smoking in Canada, 1900–1978: a reconstructed cohort study. *Can J Public Health* 1988;**79**:160–5.
22 Pelletier F, Marcil-Gratton N, Légaré J. A cohort approach to tobacco use and mortality: the case of Quebec. *Prev Med* 1996;**25**:730–40.
23 Warner KE, Murt HA. Impact of the antismoking campaign on smoking prevalence: a cohort analysis. *J Public Health Policy* 1982;**3**:374–90.
24 Rønneberg A, Lund KE, Hafstad A. Lifetime smoking habits among Norwegian men and women born between 1980 and 1974. *Int J Epidemiol* 1994;**23**:267–76.
25 Rahkonen O, Berg M-A, Puska P. Relationship between educational status, gender and smoking in Finland, 1978–1992. *Health Prom Int* 1995;**10**:115–20.
26 Vartiainen E. Antecedents of smoking behavior in adolescence. Abstract presented at the 14th international symposium on health risk behavior in adolescence, Bielefeld, 26–27 September 1997. Weinheim: Juventa, 1999. (In German.)
27 Puska P, Tuomilehto J, Salonen J, *et al. Community control of cardiovascular disease: evaluation of a comprehensive community programme for control of cardiovascular diseases in North Karelia, Finland 1972–1977.* Copenhagen: World Health Organisation, Regional Office for Europe, 1981.
28 Townsend J, Roderick P, Cooper J. Cigarette smoking by socioeconomic group, sex, and age: effects of price, income, and health publicity. *BMJ* 1994;**309**:923–7.
29 Leppo K, Vertio H. Smoking control in Finland: a case study in policy formulation and implementation. *Health Prom* 1986;**1**:5–16.
30 Pekurinen M, Valtonen P. Price, policy and consumption of tobacco: the Finnish experience. *Soc Sci Med* 1987; **25**:875–81.
31 Statistics Finland. Tobacco statistics 1997. *Health 1998:1.* Helsinki: Statistics Finland, 1998.
32 Rahkonen O, Berg M-A, Puska P. The development of smoking in Finland from 1978 to 1990. *Br J Addict* 1992; **87**:103–10.
33 Waldron I. Patterns and causes of gender differences in smoking. *Soc Sci Med* 1991;**32**:989–1005.
34 Karisto A, Takala P, Haapoja I. Towards modern times: the change of living standard, lifestyle and social policy in Finland. Porvoo, Finland: WSOY, 1988. (In Finnish.)
35 Piispa M. Popular education, paternalism, protection. Public discourse on alcohol policy and tobacco policy in Finland. *Acta Universitansis Tamperensis 564.* Vammala, Finland: University of Tampere, 1997. (In Finnish, English summary.)
36 Lopez AD, Collishaw NE, Piha T. A descriptive model of the cigarette epidemic in developed countries. *Tobacco Control* 1994;**3**:242–7.
37 Piha T. Tobacco control activities of the World Health Organisation in Europe. In Richmond R, ed. *Interventions for smokers: an international perspective.* New York: Williams and Wilkins, 1994:323–47.