

# Is initiation of smoking associated with the prodromal phase of schizophrenia?

Kaisa Riala, MD; Helinä Hakko, PhD; Matti Isohanni, MD, PhD; Anneli Pouta, MD, PhD; Pirkko Räsänen, MD, PhD

Riala, Hakko, Isohanni, Räsänen — Department of Psychiatry; Pouta — Department of Public Health Science and General Practice and Department of Obstetrics and Gynecology, University of Oulu, Finland.

**Objective:** Although the association between smoking and schizophrenia is well known, little attention has been paid to the time between initiation of smoking and onset of schizophrenia. Our goal was to study this putative temporal relation among patients with schizophrenia. **Methods:** We used data from the Northern Finland 1966 Birth Cohort ( $n = 11\ 017$ ) linked with the National Finnish Hospital Discharge Register to study age at initiation of smoking and age at onset of schizophrenia, and we examined associations between family and environmental factors and the retrospectively determined regular smoking among patients with schizophrenia. **Results:** Our main finding was that the initiation of regular smoking was closely related to the onset of schizophrenia. The mean difference in time between the initiation of regular smoking and the onset of schizophrenia among patients ( $n = 30$ ) was 2.3 (standard deviation [SD] 6.6) years, which was statistically significantly lower than that for subjects with other psychoses ( $n = 18$ ) (8.6 [SD 6.3] yr) ( $p < 0.001$ ). Among patients with schizophrenia, the increased likelihood of smoking was associated only with paternal smoking in the family environment, but not with any other background factors (odds ratio 3.5, 95% confidence interval 1.9–11.3). **Conclusion:** Smoking may be a sign of the prodromal phase of schizophrenia.

**Objectif :** Même si le lien entre le tabagisme et la schizophrénie est bien connu, on a accordé peu d'attention au temps écoulé entre le début du tabagisme et l'apparition de la schizophrénie. L'étude visait à analyser ce lien temporel hypothétique chez des patients atteints de schizophrénie. **Méthodes :** Nous avons utilisé des données tirées de la cohorte des naissances de 1966 du nord de la Finlande ( $n = 11\ 017$ ) reliées au registre national des congés d'hôpital de la Finlande pour étudier l'âge au début du tabagisme et l'âge à l'apparition de la schizophrénie. Nous avons étudié les liens entre les facteurs familiaux et environnementaux et la consommation régulière de produits du tabac, déterminée rétrospectivement, chez les patients atteints de schizophrénie. **Résultats :** Nous avons constaté principalement qu'il y avait un lien étroit entre le début de la consommation régulière de produits du tabac et l'apparition de la schizophrénie. La différence moyenne au niveau du temps écoulé entre le début de la consommation régulière de produits du tabac et l'apparition de la schizophrénie chez les patients ( $n = 30$ ) s'établissait à 2,3 (écart type [ET] 6,6) ans, ce qui était beaucoup plus bas sur le plan statistique que dans le cas des sujets atteints d'autres psychoses ( $n = 18$ ) (8,6 [ET 6,3] ans) ( $p < 0,001$ ). Chez les patients atteints de schizophrénie, on a établi un lien entre la probabilité accrue de tabagisme et seulement le tabagisme chez le père dans l'environnement familial, mais non avec aucun autre facteur lié aux antécédents (coefficient de probabilité 3,5, intervalle de confiance à 95 % 1,9–11,3). **Conclusion :** Le tabagisme peut être un signe de la phase prodromique de la schizophrénie.

## Introduction

The prevalence of cigarette smoking among individuals with schizophrenia has been found to be high in numerous

studies.<sup>1,2</sup> Smoking rates among patients with schizophrenia appear to be above 70% both for hospital inpatients<sup>3</sup> and for outpatients;<sup>4</sup> however, cultural and social factors also influence smoking behaviour among these patients. For example,

Correspondence to: Dr. Kaisa Riala, Department of Psychiatry, University of Oulu, Box 5000, FIN-90014 University of Oulu, Finland; fax 358 8 315 74 85; kaisa.riala@oulu.fi

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in a study by Srinivasan and Thara,<sup>5</sup> only 38% of Indian male patients with schizophrenia were found to be current smokers, and among women the smoking rate was even lower.

Male sex, young age, high neuroleptic dose, intramuscular administration of antipsychotic medication, the presence of polydipsia and shorter periods spent in hospital<sup>6-8</sup> have been found to be associated with smoking among patients with schizophrenia. In a study by Beratis et al,<sup>9</sup> the frequency of smoking increased with increasing positive symptoms and decreased with increasing negative symptoms. From a diagnostic point of view, the number of smokers was particularly high among male patients with paranoid, undifferentiated and residual schizophrenia.

The relation between smoking and age at onset of schizophrenia varies in different studies. Whereas Sandyk and Kay<sup>10</sup> and Goff et al<sup>4</sup> found that patients with schizophrenia who smoked had a significantly earlier age at onset of illness, more recent studies<sup>6,9</sup> have not found any statistically significant difference in age at onset of the disease between smokers and nonsmokers. In a pilot study of the chronological relation between smoking and schizophrenia, de Leon et al<sup>11</sup> found that 50% of patients had started daily smoking before the onset of the first schizophrenic psychosis. In addition, in 2 recent studies, initiation of smoking occurred before the onset of disease in 86%–90% of the patients.<sup>6,9</sup> According to Kelly and McCreadie,<sup>6</sup> the mean age at onset of smoking preceded the onset of schizophrenia by 11 years. Because the direction of causality seems to be from smoking initiation to onset of schizophrenia, it has been suggested that premorbid characteristics of neurodevelopmental schizophrenia could lead to smoking, or even that smoking could be an environmental risk factor for schizophrenia among vulnerable individuals.<sup>6</sup>

Patients with other psychiatric disorders, namely, alcoholism and major depression,<sup>12</sup> bipolar disorder<sup>13,14</sup> and anxiety disorders<sup>15</sup> smoke heavily. The prevalence of smoking in schizophrenia is reported to be higher than in mood disorders.<sup>16</sup> In a recent study by de Leon et al,<sup>7</sup> the initiation rate of daily smoking for individuals with schizophrenia was higher than in patients with mood disorders or controls after the age of 20 years, a difference that did not exist before that age. Among Indian patients, smoking started more often after the onset of illness in schizophrenia than in mood disorders.<sup>5</sup>

Thus far, smoking seems to be associated with schizophrenia, and the initiation of smoking precedes the onset of schizophrenia in most patients. Almost all previous findings are based on clinical patient samples that, however, are influenced by sampling biases, such as differences in referrals, admissions and duration of illness. To our knowledge, there are no reported studies so far in which the association between smoking initiation and onset of schizophrenia has been studied at an epidemiologic level in birth cohort settings. In addition, although the association between smoking and schizophrenia has been well documented in previous papers, none of these studies has focused especially on the temporal relation between initiation of smoking and onset of schizophrenia. We compared this putative temporal association among patients with schizophrenia with that of subjects with other

psychoses or nonpsychotic disorders by using a prospectively collected, general population, birth cohort database of 11 017 individuals from Northern Finland.

## Method

This study is part of the Northern Finland 1966 Birth Cohort (NFBC 1966) study. The study population comprised an unselected, general population-based, white birth cohort of 12 058 live births, which included 96% of all children born in Northern Finland in 1966.<sup>17,18</sup> Data for the cohort members' biologic, socioeconomic and health conditions, living habits and family characteristics were collected prospectively from maternal pregnancy up to the age of 31 years. Because some cohort members refused to allow the use of their data in the 31-year follow-up study, 10 934 (5589 men and 5345 women) subjects were finally included in the present study.

The National Finnish Hospital Discharge Register covers all mental and general hospitals in Finland. We identified all cohort members over the age of 16 years who appeared in the Finnish Hospital Discharge Register until the end of 1997 for any psychiatric disorder (DSM-III-R 290-316; mental retardation not included).<sup>19</sup> The validation of psychiatric diagnoses in this cohort has been previously described in detail.<sup>20,21</sup> For all individuals, the diagnoses were checked against hospital records by 2 senior researchers, who reached a consensus on a DSM-III-R diagnosis. Interrater reliability was ensured in several phases, with good kappa values from 0.6 to 0.9. The diagnostic categories are listed below. The numbers in parentheses describe the cases in each diagnostic subcategory.

1. DSM-III-R schizophrenia ( $n = 100$  [65 men]) included subcategories of disorganized (DSM-III-R code 295.1 [ $n = 13$ ]), catatonic (295.2 [ $n = 2$ ]), paranoid (295.3 [ $n = 27$ ]) and undifferentiated (295.9 [ $n = 58$ ]) schizophrenia.
2. Other psychoses ( $n = 55$  [26 men]) included subcategories of schizophreniform disorders (295.40 [ $n = 16$ ]), schizoaffective disorders (295.70 [ $n = 4$ ]), delusional disorders (297.10 [ $n = 10$ ]), psychotic depressions (296.24 [ $n = 5$ ] and 296.34 [ $n = 1$ ]), bipolar disorders (296.44 [ $n = 4$ ], 296.54 [ $n = 1$ ] and 296.64 [ $n = 1$ ]), brief psychotic reactions (298.8 [ $n = 1$ ]) and atypical psychoses (298.9 [ $n = 12$ ]).
3. Nonpsychotic disorders ( $n = 315$  [222 men]) included substance use disorders ( $n = 132$ ), personality disorders ( $n = 66$ ), nonpsychotic mood disorders ( $n = 57$ ), anxiety disorders ( $n = 51$ ), adjustment disorders ( $n = 61$ ) and other nonpsychotic disorders ( $n = 95$ ). Multiple diagnoses were possible in this category, and the number of diagnoses exceeds the number of cases.
4. Cohort members with no psychiatric hospital treatment before the age of 31 years were used as a comparison group ( $n = 10\,464$  [5276 men]).

The age at onset of disorder among patients with schizophrenia and cohort members with other psychoses was determined to be age of first psychotic symptoms as recorded in the case notes.<sup>22</sup> For cohort members without psychotic symptoms, the age of onset of nonpsychotic disorder was calculated as the age at first admission to a mental hospital.

The information about smoking habits was gathered from

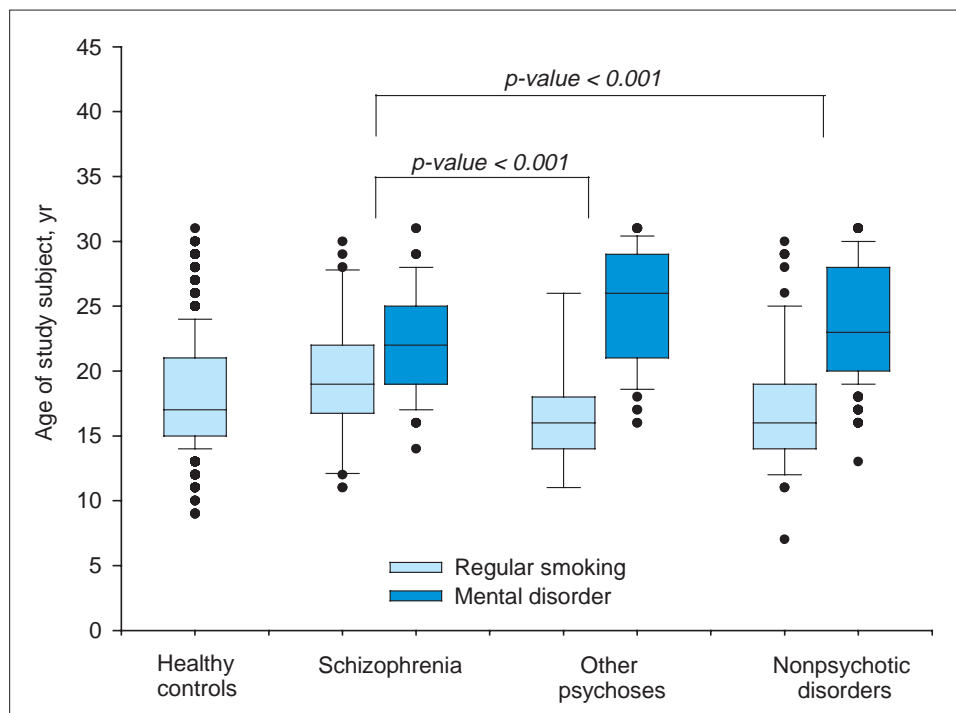
a questionnaire mailed to cohort members when they were aged 31 years. The response rate was 76.2% ( $n = 8332$ ). Later when cohort members were aged 33 years, a total of 50 new answers were obtained from an ongoing psychiatric follow-up study of the cohort (19 patients with schizophrenia, 11 cohort members with other psychosis, 2 with nonpsychotic disorders and 18 controls).

Smoking habits were assessed using the following questions: Have you ever smoked during your lifetime?, Do you smoke nowadays? and How many cigarettes do you smoke daily? If the answer to the first question was "yes" and if the cohort member reported current smoking weekly or more often, he or she was regarded as a current smoker ( $n = 2517$ ). If the answer to the first question was "yes" but if the cohort member reported no current smoking or smoking less often than once a week, he or she was regarded as a nonsmoker ( $n = 2772$ ), as were individuals who reported never having smoked during their lifetime ( $n = 3035$ ). The total number of patients with schizophrenia who had quit smoking was 10, and they were categorized as nonsmokers. The number of years of regular smoking was also asked for, and the age of onset of smoking was calculated based on that.

Only those subjects whose smoking data were available ( $n = 8324$ ; 3998 men, 76.1% of all cohort members) were included in this study. Information about smoking habits was finally obtained from 67% ( $n = 67$  [40 men]) of patients with

schizophrenia, 71% ( $n = 39$  [19 men]) of cohort members with other psychoses, 56% ( $n = 177$  [112 men]) of cohort members with nonpsychotic disorders and 77% ( $n = 8041$  [3827 men]) of healthy control subjects.

Factors such as male sex,<sup>23</sup> low socioeconomic status of the primary family,<sup>24</sup> single-parent family,<sup>25</sup> poor school performance,<sup>26</sup> alcohol use by an individual<sup>27,28</sup> and parental smoking in the home environment<sup>26</sup> are all known to increase the risk of smoking. Therefore, in this study we examined whether these factors explained the smoking among patients with schizophrenia. Information about these factors was gathered with a questionnaire mailed to the cohort members at the age of 14 years.<sup>26</sup> Alcohol use at the age of 14 was assessed by asking the following question: Do you drink alcohol? The possible answers were as follows: (1) never, (2) I have tried it once, (3) I have tried it twice or more often, (4) I drink alcohol at some time every month, and (5) I drink alcohol every week. The following categories were constructed from the 5 original responses: (1) never, (2) experimental use (original classes 2–3) and (3) regular pattern of alcohol use (original classes 4–5). The prevalence of smoking by women and girls in Finland in the 1980s was less than 20%.<sup>29</sup> However, for this cohort, information about maternal smoking was not available during that time. Thus, the father's smoking was used as a marker of smoking in the home environment and was assessed by asking the following question:



**Fig. 1:** Age of initiation of regular smoking and age of onset of mental disorder among healthy controls and subjects with schizophrenia, other psychoses or nonpsychotic disorders in the Northern Finland 1966 Birth Cohort. Medians are indicated by horizontal bars inside the boxes. Vertical lines indicate the range, and the horizontal bars at each end of the boxes represent the first (25%) and third (75%) quartiles. The  $p$  values indicate the statistical significance, when the mean difference between ages of regular smoking and mental disorder for patients with schizophrenia is compared with that for subjects with other psychoses or nonpsychotic disorders.

Does your father smoke? The possible answers were (1) never, (2) sometimes, but not nowadays, (3) current smoker, and (4) I do not know. The following categories were constructed from the 4 original responses: (1) no smoking in the home environment (original classes 1–2 and 4) and (2) smoking in the home environment (original class 3).

First, we assessed the proportion of regular smokers in each diagnostic category. The  $\chi^2$  test was used to evaluate the statistical significance of differences between the diagnostic groups and genders. Second, the mean age when subjects began regular smoking and the mean age of onset of mental disorder were calculated in each diagnostic category. The differences between these means were calculated by analysis of variance (ANOVA), and post hoc multiple comparisons were performed with Scheffé's procedure. The age of onset of mental disorder was evaluated separately among smokers and nonsmokers. A logistic regression analysis<sup>30</sup> was used to evaluate the association between family and environmental background factors and smoking among patients with schizophrenia. This provides a method for estimating the odds ratios for the smoking behaviour by each separate background factor. The logistic regression model is reported using odds ratios (OR) with 95% confidence intervals (95% CI).

## Results

At the age of 31 years, 48% (32/67) of patients with schizophrenia in our study were regular smokers and only 3 patients (10%) smoked fewer than 5 cigarettes daily. The corresponding percentage of light smokers among mentally healthy cohort members was much higher (16%). The corresponding smoking rates were 46% (18/39), 55% (98/177) and 29% (2369/8041) among cohort members with other psychosis, nonpsychotic disorders and controls without a history

of admission to a psychiatric hospital, respectively ( $\chi^2_3 = 69.7$ ,  $p < 0.001$  between groups). In general, smoking was more common among the men (37%) than among the women (24%) ( $\chi^2_1 = 161.5$ ,  $p < 0.001$ ). The corresponding percentages for men and women among patients with schizophrenia were 55% and 37% ( $\chi^2 = 2.1$ ,  $p = 0.15$ ), respectively, among subjects with other psychoses, 47% and 45% ( $\chi^2 = 0.02$ ,  $p = 0.88$ ), respectively, and among subjects with nonpsychotic disorders, 61% and 46% ( $\chi^2 = 3.5$ ,  $p = 0.06$ ), respectively.

The mean age of onset of schizophrenia among smokers and nonsmokers was 21.5 (standard deviation [SD] 3.5) years and 22.6 (SD 3.9) years, respectively. The corresponding mean age of onset of mental disorder for smokers and nonsmokers was 25.2 (SD 4.5) years and 25.1 (SD 4.7) years among subjects with other psychoses and 24.1 (SD 4.4) years and 23.7 (SD 4.1) years among subjects with nonpsychotic disorders. There was no statistically significant difference in the age of onset of mental disorder between smokers and nonsmokers in any diagnostic group.

The mean age at which cohort members started regular smoking and mean age of onset of mental disorders in various diagnostic categories are presented in Figure 1. The mean difference between the initiation of regular smoking and the onset of psychiatric disorder among patients with schizophrenia was 2.3 (SD 6.6) years, which was statistically significantly lower than that among subjects with other psychoses (8.6 [SD 6.3] yr) ( $p < 0.001$ ) or those with nonpsychotic disorders (6.6 [SD 5.5] yr) ( $p < 0.001$ ). The mean difference among patients with schizophrenia also remained lower when compared with specific diagnostic groups, namely, nonpsychotic mood disorders (3.8 [SD 5.7] yr) and substance use disorders (9.0 [SD 4.9] yr). Among patients with schizophrenia without hospital-treated comorbid substance use disorders (77%), the mean difference between age of onset of the disorder and age

**Table 1: Age of initiation of regular smoking and age of onset of psychiatric disorder among men and women according to diagnostic subgroup in the Northern Finland 1966 Birth Cohort**

Diagnostic group	Total (n = 10 934)		Subjects for whom data about smoking were available (n = 8324)					
	No.	Mean age of onset of disorder (and SD), yr	No.	No. of smokers†	Mean age of onset of disorder (and SD), yr	Mean age of initiation of regular smoking (and SD), yr	Mean difference between ages of onset (and SD), yr‡	p value§
<b>Men</b>								
Healthy control subjects*	5276	—	3827	1318	—	17.7 (4.0)	—	—
Schizophrenia	65	22.2 (3.9)	40	22	20.9 (3.4)	18.8 (4.5)	2.2 (6.5)	Ref
Other psychoses	26	24.1 (4.6)	19	9	24.7 (4.3)	16.0 (4.4)	8.7 (7.9)	0.015
Nonpsychotic disorders	222	23.3 (4.1)	112	63	23.7 (4.1)	15.9 (3.8)	7.8 (4.7)	< 0.001
<b>Women</b>								
Healthy control subjects*	5188	—	4214	925	—	18.5 (4.2)	—	—
Schizophrenia	35	22.1 (4.1)	27	8	23.9 (3.3)	21.2 (5.7)	2.6 (6.2)	Ref
Other psychoses	29	25.7 (4.3)	20	9	25.8 (4.8)	17.3 (4.4)	8.4 (4.7)	0.13
Nonpsychotic disorders	93	24.6 (4.6)	65	25	23.4 (5.1)	19.9 (5.7)	3.5 (5.9)	0.94

Note: SD = standard deviation.

\*These subjects had no psychiatric disorder.

†Not included in this column are smokers for whom the age of onset of smoking was missing, namely, 2 female subjects with schizophrenia, 5 men and 5 women with nonpsychotic disorders and 58 men and 68 women without psychiatric hospital treatment.

‡Mean difference (and SD) between age of onset of psychiatric disorder and age of onset of regular smoking.

§Analysis of variance with Scheffé's multiple comparison test: comparison of mean difference in ages of onset between subjects with schizophrenia (ref) and other diagnostic groups among smokers.

of initiation of smoking was even lower (0.9 [SD 5.8] yr) than that compared in the rest of the subjects.

The age of initiation of smoking and the age of onset of mental disorder and their difference by gender are presented in Table 1. The mean age of initiation of regular smoking among patients with schizophrenia did not differ statistically significantly from that of the control group. The time between the age of initiation of regular smoking and the age of onset of the disorder was statistically significantly shorter among male patients with schizophrenia compared with other diagnostic groups. A similar trend toward a temporal relation between smoking and schizophrenia was also seen among women.

The associations between family and environmental background factors and the likelihood of child's regular smoking later in life among patients with schizophrenia are presented in Table 2. Of all single family or environmental factors, only smoking in the home environment was statistically significantly associated with regular smoking of a cohort member with schizophrenia. This was also the only background factor that remained statistically significant when all variables were entered simultaneously into a multivariate logistic regression model (odds ratio 3.5 [95% CI 1.9–11.3])

## Discussion

The smoking rate among psychiatric patients was about 1.5 times higher than that among mentally healthy controls. In this birth cohort, the proportion of smokers was about 50% among subjects with schizophrenia. Our main finding was that the initiation of regular smoking was closely related to the onset of schizophrenia. The corresponding link was not found in any other diagnostic group. Of all the family background variables or individual features, only the father's

smoking in the home environment increased the risk of regular smoking in adulthood by cohort members with schizophrenia.

The elevated prevalence of regular smoking among psychiatric patients in this study is in line with findings from previous studies.<sup>31</sup> The smoking rate among patients with schizophrenia has been found to be higher than<sup>16</sup> or equal to<sup>14</sup> that in patients with mood disorders. In our study, the cohort members with nonpsychotic disorders were those whose smoking rate was highest compared with other diagnostic groups. There are some putative explanations for the different smoking rates between our study and earlier findings. First, we used a genetically homogeneous birth cohort of young adults who at the time of the 31-year study were not necessarily seeking any treatment for their psychiatric disorder in either inpatient or outpatient care. Second, in most earlier studies, the study populations have consisted of clinical samples of severely mentally ill patients.<sup>3,7</sup> Third, the nonpsychotic disorders in our study were probably very severe, because they had already led the cohort members to seek hospital treatment in young adulthood.

The initiation of smoking preceded the onset of schizophrenia by only 2.3 years in our study. Earlier studies have suggested that most patients with schizophrenia start regular smoking several years before the onset of the disorder.<sup>6,7</sup> In a study by Beratis et al,<sup>9</sup> in which the definition of the onset of schizophrenia was equivalent to ours, initiation of smoking preceded the onset of mental disorder by 5.0 years and by 4.6 years in male and female patients with schizophrenia, respectively. Thus, to our knowledge, this is the first study so far in which the temporal association between initiation of regular smoking and the onset age of schizophrenia has been shown so clearly.

It has been suggested that psychiatric medication, exposure

**Table 2: Univariate association of family and environmental background factors, measured at the age of 14 years, with likelihood of regular smoking in adulthood among subjects with schizophrenia from the Northern Finland 1966 Birth Cohort**

Family and environmental background factor	No. (and %) of smokers	No. (and %) of nonsmokers	OR (and 95% CI)	<i>p</i> value <sup>¶</sup>
Male	22 (69)	18 (51)	2.1 (0.8–5.6)	0.15
One-parent family*	10 (31)	7 (20)	1.8 (0.6–5.5)	0.29
Father's socioeconomic status lowest (III–IV) <sup>†</sup>	19 (59)	17 (49)	1.3 (0.5–3.9)	0.59
Father's socioeconomic status, farmer	3 (9)	6 (17)	0.6 (0.1–3.0)	0.54
School performance, not in age-appropriate class <sup>‡</sup>	7 (22)	4 (11)	2.2 (0.6–8.3)	0.26
Own alcohol use at experimental level <sup>§</sup>	16 (59)	20 (69)	0.7 (0.2–2.0)	0.45
Father smoking in home environment	14 (50)	6 (22)	3.5 (1.9–11.3)	0.035

Note: CI = confidence interval; OR = odds ratio.  
 \*One-parent families v. 2-parent families between 1966 and 1980.  
 †Socioeconomic status in 1980 (I–II [highest social standing/professional status] v. III–IV [skilled and unskilled workers, respectively] v. V = farmers).  
 ‡School performance at the age of 14 years categorized into 2 classes: not in age-appropriate class v. in age-appropriate class.  
 §Information based on a questionnaire mailed to cohort members at the age of 14 years.  
 ¶ $\chi^2$  test.

to psychiatric treatment settings or substance use may be associated with high smoking rates among subjects with schizophrenia. Atypical antipsychotic drugs<sup>6,32</sup> have been found to decrease daily cigarette use among patients with schizophrenia. However, there are studies confirming that medication, institutionalization or substance use<sup>3,8</sup> cannot account for the relation between schizophrenia and smoking. Our findings are in line with the findings of these earlier studies, because we found that the difference between the age of initiation of smoking and the age of onset of schizophrenia was even shorter among subjects without comorbid substance use disorders. In our study, neither adolescent alcohol use nor poor school performance were associated with smoking among patients with schizophrenia. However, we think that school performance may be a useful proxy measure of cognitive dysfunction among these patients. In this study, an increased likelihood of not being in an age-appropriate class, although statistically nonsignificant because of insufficient statistical power, was found among smoking patients with schizophrenia. Thus, assessment of cognitive dysfunction among nicotine-dependent individuals with schizophrenia needs to be studied further. The fact that in our study the father's smoking in the home environment increased the risk of smoking among subjects with schizophrenia may be a marker of the importance of family influences and the parent as role model for smoking behaviour among these patients. Our finding of the short time between initiation of smoking and onset of schizophrenia may be partly a product of the earlier age of onset of schizophrenia when compared with other diagnostic groups. However, this finding may also be associated with genetically mediated vulnerability to smoking among patients with schizophrenia and their relatives. It has been shown that nicotine transiently normalizes several sensory-processing deficits<sup>33,34</sup> as well as negative symptoms<sup>35</sup> of schizophrenia.

The strengths of this study are that it is based on a representative and unselected birth cohort, a genetically homogeneous population and valid national registers. The participation in the 14-year follow-up data collection was good (93.5%), and we were able to use prospectively collected information about the family and environmental background factors that are known to relate to the development of smoking.

This study has some limitations. No structured instruments or laboratory tests for nicotine dependence were available. In this study, the information about smoking habits was based on a self-report questionnaire in which the respondents may have tended to underestimate their smoking and may have failed to recall correctly the age at which they started smoking. However, there is recent evidence that self-reported smoking behaviour among patients with schizophrenia shows test-retest reliability and is interconnected with objective measures.<sup>36</sup> Even though the general response rate in the 31-year study was relatively high (76.2%), and we were able to trace some individuals later at the age of 33 years, there was missing information about the smoking habits of the hospital-treated psychiatric patients. This may lead us to underestimate the prevalence of smoking in the

different diagnostic groups. In addition, we were not able to draw any conclusions about the ages of smoking initiation in various schizophrenia subtypes because of the small number of cases. Finally, cohort members with a nonpsychotic disorder probably had a true onset of the disorder long before the first admission to hospital.<sup>37</sup> Thus, the interpretation of the results concerning the time between initiation of smoking and onset of disorder among cohort members with a nonpsychotic disorder compared with subjects with schizophrenia or with other psychoses should be undertaken cautiously.

In summary, in this study, based on birth cohort setting, the short time between initiation of smoking and the first admission to hospital because of schizophrenia was a novel finding that has not been reported previously. On the basis of this, we hypothesize that it is not only the genetic risk, or the developmental deviance associated with schizophrenia, but actually the first signs during the prodromal phase and ongoing abnormal psychophysiological processes that may make these patients prone to initiate smoking as a form of self-medication. Therefore, further genetic studies are needed, taking into consideration the shared vulnerability to schizophrenic disorders and smoking. Preventive efforts against smoking and other addictive behaviours should also be taken into consideration when planning programs targeting detection of and intervention in early schizophrenic psychosis.

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