

INCIDENCE OF ASTHMA IN TWELVE THOUSAND FINNISH ADULTS BORN IN 1966

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Abstract

Objectives: Asthma prevalence is increasing in many countries. Some recent articles, however, claim that this tendency is drawing to an end. Hence, the incidence of persistent asthma was drawn from a birth cohort study in Finland. **Materials and Methods:** A cohort of 6107 men and 5839 women was followed from 1981 to 2004. The participants were members of the Northern Finland Birth Cohort 1966 Study (NFBC-66). The single-year birth cohort was followed from the age of 15 to 38 years by means of a complete register held by the national Social Insurance Institute (SII) in Finland. Within the register data, an incident case of asthma was defined by the received right for reimbursement for asthma medication from the SII. **Results:** Over a 23-year follow-up period, persistent asthma occurred in 466 study participants of whom 54% were women. The incidence of persistent asthma increased from the rate of 10 cases per 10 000 person-years at the age of 15–20 years to 21 cases per 10 000 person-years at the age of 36–38 years. In females, a peak of incidence rate was found between the age of 31 and 35 years, up to 27 cases per 10 000 person-years. **Conclusions:** The follow-up of a population-based birth cohort among young working aged Finns shows the increasing incidence rate of persistent asthma. In recent years, however, a decline in new cases of asthma occurred in females aged between 36 and 38 years.

Key words:

Asthma, NFBC-66, Incidence, Prospective study, Prevalence

INTRODUCTION

The rising worldwide trend of asthma remains a major medical concern. Studies carried out in the same population and with the same instruments have corroborated this increment in Finland [1,2] and in many other regions of the world [3–6]. However, recent studies [7–11] have suggested that asthma morbidity rates continue to plateau or decrease. It has been reported that in adulthood, asthma is more prevalent among women than among men [9,12,13]. Most of the studies deal with the prevalence rather than the incidence rate of asthma. When interest lies in studying the etiology of asthma, the incidence rate is a reliable measure of occurrence. However, only few data on the inci-

dence of asthma based on prospective longitudinal studies are available. In Finland, a recent study reveals that self-reported incidence rate of asthma in young adults (aged 23–32 years) is 26 new cases per 10 000 person-years [13]. In order to assess trends of asthma in Finland, we investigated the incidence rate of persistent asthma prospectively from the age of 15 to 38 years. We also estimated the prevalence of persistent asthma at the age of 15, 20, 25, 30, 35, and 38 years.

MATERIALS AND METHODS

Study population

A cohort of 6107 men and 5839 women was followed from 1981 to 2004. Subjects were members of a population-

The study was supported by The Finnish Work Environment Fund.

Received: August 18, 2005. Accepted: August 29, 2005.

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based cohort, the Northern Finland Birth Cohort 1966 (NFBC-66) [14]. Briefly, the participants were determined by the calculated term: the series comprised all the mothers in the two northernmost provinces of Finland, Oulu and Lapland, with the calculated term falling between January 1 – December 31, 1966. The data on the place of residence in 1997 are shown in Table 1. The procedure used in this study complied with the Declaration of Helsinki and was approved by the University of Oulu.

Case ascertainment

The follow-up was done through a national register, the Medication Reimbursement Register of the Social Insurance Institute (SII). In Finland, the medication for asthma can be reimbursed at a higher than ordinary level. However, all the patients have to provide a medical certificate written by a specialist in pulmonary medicine and the criteria of persistent asthma must be fulfilled. A typical history, clinical features, and course of asthma must be documented in the medical certificate and the following physiological criteria are applied (at least one of the criteria 1 to 3): 1) a variation of $\geq 20\%$ in diurnal PEF recording (reference to maximal value); 2) an increase in $\geq 15\%$ in PEF or FEV₁ with β_2 -agonist; 3) a decrease in $\geq 15\%$ in PEF of FEV₁ in exercise testing; and 4) a continuing regu-

lar use of asthma medication that has lasted for 6 months at the time of the decision.

The national health insurance system and registration cover the entire population. Participants were defined as an incident case of asthma when they received the right for reimbursement for asthma medication from SII.

Statistical analysis

The statistical classification of municipalities presented by Statistics Finland divides municipalities into three categories according to the proportion of people living in urban settlements. In urban-type municipalities at least 90% of the population lives in urban settlements and the population of the largest urban settlement is at least 15 000. Densely populated municipalities are municipalities in which at least 60%, but less than 90% of the population lives in urban settlements and in which the population of the largest urban settlement is at least 4000 but less than 15 000. Rural-type municipalities includes those in which less than 60% of the population lives in urban settlements and in which the population of the largest urban settlement is less than 15 000; and those municipalities in which at least 60%, but less than 90% of the population lives in urban settlements and in which the population of the largest settlement is less than 4000.

The prevalence of persistent asthma was calculated by dividing the number of cases by the size of the total study population at the given age. The incidence rate of persistent asthma was calculated in five-year periods according to the date of the onset of reimbursement medication for asthma: 1981 through 1985; 1986 through 1990; 1991 through 1995, 1996 through 2000, and 2001 through 2004. The incidence rate was calculated by dividing the number of new asthma cases by the amount of person-time free of disease experienced by the cohort, which produced the new cases. Concerning time spent in cohort, the individual person-time was eliminated after death over the ongoing follow-up period. The national population register held by statistics of Finland elicited data on the occurrence of death. The exact 95% confidence intervals (95% CI), based on binomial distribution, were calculated. We used the normal approximation in our calculation.

Table 1. Characteristics of Northern Finland Birth Cohort 1966 (NFBC-66) study participants

	Males	Females	Total
NFBC-66, number of participants	6 265	5 964	12 231
Place of residence in 1997	n (%)	n (%)	n (%)
Urban-type municipalities	3 038 (56)	3 117 (60)	6 155 (58)
Densely populated municipalities	980 (18)	867 (17)	1 847 (17)
Rural-type municipalities	1 389 (26)	1 241 (24)	2 630 (25)
Prevalence of persistent asthma			
Age (years)			
15	33 (0.5)	19 (0.3)	52 (0.4)
20	50 (0.8)	49 (0.8)	99 (0.8)
25	87 (1.4)	101 (1.7)	188 (1.6)
30	129 (2.1)	142 (2.4)	271 (2.3)
35	175 (2.9)	214 (3.7)	389 (3.3)
38	206 (3.5)	245 (4.2)	451 (3.9)

Table 2. The incidence of asthma in the Northern Finland Birth Cohort 1966 by gender, 1981–2004

Age range	Males				Females			
	New cases	Person-years at risk	IR*	95% CI	New cases	Person-years at risk	IR*	95% CI
15–20	31	36 183	8.6	5.6–11.6	40	34 806	11.5	7.9–15.1
21–25	44	29 788	14.8	10.4–19.1	58	28 728	20.2	15.0–25.4
26–30	49	29 334	16.7	12.0–21.4	44	28 385	15.5	10.9–20.1
31–35	53	28 903	18.3	13.4–23.3	77	28 000	27.5	21.4–33.6
36–38	36	17 071	21.1	14.2–28.0	34	16 585	20.5	13.6–27.4
15–38	213	141 279	15.1	13.1–17.1	253	136 504	18.5	16.3–20.8

* Number of new cases per 10 000 person-years

RESULTS

Persistent asthma occurred in 466 study participants, including 54% of women between 1981 and 2004. During the 1990s, the occurrence of persistent asthma among study subjects increased from 21 to 32 new cases per year. The prevalence of persistent asthma from the age of 15 to 38 years changed from 0.4% to 3.9% (males from 0.5% to 3.5%; females from 0.3% to 4.2%). There was a tendency in early adolescence that asthma was more prevalent among boys than among girls, whereas in adulthood, asthma was more frequent among females (Table 1). In 1997, when subjects were in their early thirties, overall 75% of the study population dwelled in urban-type or densely populated municipalities. Table 2 shows the age-specific incidence rates by gender, for specialist-diagnosed persistent asthma. In the overall follow-up period of 23-years, there was a tendency among females to show a higher incidence rate for asthma, 18.5 new cases per 10 000 person-years (95% CI: 16.3–20.8), slightly higher than in males 15.1 (95% CI: 13.1–17.1). However, the gender difference was reversed at the age of 26–30 years. In females, a significant peak of incidence rate was found between 31 and 35 years of age, up to 27.5 per 10 000 person-years (95% CI: 21.4–33.6). In males, the peak of asthma incidence rate was found at the age of 36–38 years, resulting in the diminished gender difference.

DISCUSSION

The results of this study make a contribution to the literature of the asthma epidemic, and our analyses show that

the increasing incidence of persistent asthma has stabilized over the recent years in Finland. In our cohort, the incidence of specialist-diagnosed persistent asthma steadily increased from 1981 to 2000 among young men and women. Our incidence rates of asthma among adults aged between 26 and 30 years was lower than previously reported in Finland, 26 per 10 000 person-years [13], and elsewhere [15,16]. In the present study, however, only cases with specialist-diagnosed persistent asthma were counted in the follow-up. In a previous analysis of an Italian study on asthma in young adults, the asthma-like symptom prevalence tended to decrease in subjects aged 35 years and more [9]. According to the age-dependent result, the analyses performed over the recent years show that asthma incidence tends to decrease in subjects aged over 35 years and more. Previous reports on the asthma prevalence and incidence show conflicting data drawn from a wide range of age, ethnic, and racial backgrounds. Due to differences in case definitions, survey techniques, periods of study, and population characteristics, the results are not easily comparable.

A large sample size, covering over 20% of the population born in 1966 in Finland, and the asthma diagnoses made by chest specialists are the specific strength of this study. The definition of asthma (i.e. clinical assessment) used in the present study is the standard applied in validating other measurements of asthma in epidemiological studies [17]. The definition of asthma by SII remained stable for the whole follow-up period. In a birth cohort follow-up, the temporal trend that we found in the analysis of five periods of time, may reflect the age-dependent changes

in the occurrence of asthma. There is no method to specify the influence of time period and aging. Furthermore, a limitation was the lack of data on the aged population. We followed young adults born in 1966, and no data were available to analyze the incidence of asthma among age groups over 40 years. With increasing age, however, asthma may be over-diagnosed because patients with chronic obstructive pulmonary disease (COPD) misclassify themselves as asthmatics.

Persistent asthma entails direct medical expenditures like medications, services provided by physicians, and hospital care. Furthermore, aggravation of asthma symptoms at work is common among adult employees afflicted with asthma [18]. Indirect costs like loss of work and mortality are also important [19]. Further research on the generalisability of these findings is needed to examine whether the incidence of asthma is changing in older age groups. Similarly, the causal relation between exposure to airborne dusts, gases or fumes, abnormal temperatures, or poor indoor air quality and asthma occurrence needs further research.

REFERENCES

1. Haahtela T, Lindholm H, Bjorksten F, Koskenvuo K, Laitinen LA. *Prevalence of asthma in Finnish young men*. *BMJ* 1990;301(6746):266–8.
2. Huovinen E, Kaprio J, Laitinen LA, Koskenvuo M. *Incidence and prevalence of asthma among adult Finnish men and women of the Finnish Twin Cohort from 1975 to 1990, and their relation to hay fever and chronic bronchitis*. *Chest* 1999;115(4):928–36.
3. Hansen EF, Rappeport Y, Vestbo J, Lange P. *Increase in prevalence and severity of asthma in young adults in Copenhagen*. *Thorax* 2000;55(10):833–6.
4. ECRHS. *Variations in the prevalence of respiratory symptoms, self-reported asthma attacks, and use of asthma medication in the European Community Respiratory Health Survey (ECRHS)*. *Eur Respir J* 1996;9(4):687–95.
5. Ciprandi G, Vizzaccaro A, Cirillo I, Crimi P, Canonica GW. *Increase of asthma and allergic rhinitis prevalence in young Italian men*. *Int Arch Allergy Immunol* 1996;111(3):278–83.
6. Vollmer WM, Osborne ML, Buist AS. *20-year trends in the prevalence of asthma and chronic airflow obstruction in an HMO*. *Am J Respir Crit Care Med* 1998;157(4 Pt 1):1079–84.
7. Fleming DM, Sunderland R, Cross KW, Ross AM. *Declining incidence of episodes of asthma: a study of trends in new episodes presenting to general practitioners in the period 1989–1998*. *Thorax* 2000;55(8):657–61.
8. Senthilselvan A, Lawson J, Rennie DC, Dosman JA. *Stabilization of an increasing trend in physician-diagnosed asthma prevalence in Saskatchewan, 1991 to 1998*. *Chest* 2003;124(2):438–48.
9. Verlatto G, Corsico A, Villani S, Cerveri I, Migliore E, Accordini S, et al. *Is the prevalence of adult asthma and allergic rhinitis still increasing? Results of an Italian study*. *J Allergy Clin Immunol* 2003;111(6):1232–8.
10. Vargas MH, Diaz-Mejia GS, Furuya ME, Salas J, Lugo A. *Trends of asthma in Mexico: an 11-year analysis in a nationwide institution*. *Chest* 2004;125(6):1993–7.
11. Latvala J, von Hertzen L, Lindholm H, Haahtela T. *Trends in prevalence of asthma and allergy in Finnish young men: nationwide study, 1966–2003*. *BMJ* 2005;330(7501):1186–7.
12. Anderson HR, Pottier AC, Strachan DP. *Asthma from birth to age 23: incidence and relation to prior and concurrent atopic disease*. *Thorax* 1992;47(7):537–42.
13. Huurre TM, Aro HM, Jaakkola JJ. *Incidence and prevalence of asthma and allergic rhinitis: a cohort study of Finnish adolescents*. *J Asthma* 2004;41(3):311–7.
14. Rantakallio P. *The longitudinal study of the northern Finland birth cohort of 1966*. *Paediatr Perinat Epidemiol* 1988;2(1):59–88.
15. Basagana X, Sunyer J, Zock JP, Kogevinas M, Urrutia I, Maldonado JA, et al. *Incidence of asthma and its determinants among adults in Spain*. *Am J Respir Crit Care Med* 2001;164(7):1133–7.
16. Ownby DR, Johnson CC, Peterson EL. *Incidence and prevalence of physician-diagnosed asthma in a suburban population of young adults*. *Ann Allergy Asthma Immunol* 1996;77(4):304–8.
17. Pekkanen J, Pearce N. *Defining asthma in epidemiological studies*. *Eur Respir J* 1999;14(4):951–7.
18. Saarinen K, Karjalainen A, Martikainen R, Uitti J, Tammilehto L, Klaukka T, et al. *Prevalence of work-aggravated symptoms in clinically established asthma*. *Eur Respir J* 2003;22(2):305–9.
19. Weiss KB, Gergen PJ, Hodgson TA. *An economic evaluation of asthma in the United States*. *N Engl J Med* 1992;326(13):862–6.