

Prevalence of bronchial asthma in schoolchildren in Oslo, Norway

Comparison of data obtained in 1993 and 1981

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In 1993, 4521 schoolchildren in Oslo, Norway, participated in a European study on air pollution and respiratory health. Incorporated in the primary questionnaire were five questions taken from a study performed 12 years earlier on 1772 schoolchildren in the same city. The response rate was 85% in 1993 vs 95% in 1981. The current and cumulative prevalences of doctor-diagnosed asthma in 1993 were 4.2% and 8.0%, respectively, compared to 2.2% ($P < 0.01$) and 3.4% ($P < 0.01$) in 1981. Attacks of breathlessness during the last 3 years were experienced by 7.1% in 1993 and 3.3% in 1981 ($P < 0.05$). Wheezing or breathlessness on exposure to pollen in 1993 and 1981 was reported by 6.1% and 3.7% ($P < 0.01$), respectively; to animals by 4.0% and 2.8% ($P < 0.05$); and to exercise by 10.2% and 4.8% ($P < 0.01$). The prevalence of occasional wheezing and the cumulative prevalence of doctor-diagnosed eczema, urticaria, and hay fever were not significantly altered. To summarize, a higher prevalence of both doctor-diagnosed asthma and symptoms of obstructive airways disease was reported by children attending primary school in Oslo in 1993 than 12 years earlier. No increase was observed in the prevalence of other atopic diseases.

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Serial studies from different parts of the world have reported an increased prevalence of symptoms of bronchial asthma among children (1–8). This trend has been accompanied by an increase in both doctor-diagnosed asthma (1–8) and hospital admissions due to asthma attacks (9–11). It has been suggested that the higher number of asthmatic children reflects an increase in the prevalence of atopy as a whole (7, 12); in fact, the prevalence of both hay fever and eczema has been reported to have increased (4, 7). Both environmental (8, 13) and dietary (14) factors and genetic influence (15) have been adduced to explain the observed increase in the prevalence of asthma and atopy. Therefore, it might be of interest to collect data from different countries where these factors may vary.

In 1981, Skarpaas & Gulsvik conducted a study among schoolchildren in Oslo, Norway, to determine the prevalence of respiratory symptoms, doctor-diagnosed bronchial asthma, and other atopic diseases (16). By including questions from this investigation 12 years later, we wanted to determine whether there had been an increase in the prevalence

of asthma, and, if so, whether an accompanying increase in the prevalence of hay fever, urticaria, and eczema could be observed.

Material and methods

In 1993, a questionnaire employed in the European collaboration study, "Effects of short-term changes in urban air pollution on the respiratory health of children with chronic respiratory symptoms" (PEACE), was distributed by the teachers to all parents of children attending the first six grades in 17 primary schools in Oslo; i.e., 4521 children. The 17 schools were chosen because of their location, half of the schools being in areas exposed to traffic pollution and half in areas considered relatively unexposed, according to the protocol in the European collaboration study. The questionnaire consisted of 31 questions, including five questions taken from an asthma prevalence study among schoolchildren in Oslo performed in 1981 by Skarpaas & Gulsvik (16). These five questions were preceded in the questionnaire by 15 questions also related to respiratory

symptoms and general health. The questionnaires were collected by the teachers after one reminder.

The questionnaire in the 1981 survey was distributed by health nurses and teachers to 1772 children attending 81 school classes at 60 schools, randomly selected from the 1797 first to ninth grade classes in Oslo (16). Sixteen of these schools included only seventh to ninth grade pupils. Of the remaining 44 schools, 22 were considered to be exposed to traffic pollution, and the remaining schools were considered to be relatively unexposed. The questionnaire consisted of 21 questions, of which only five were identical to those asked in 1993. These five questions were numbered 10, 14, 15, 16, and 17 in the questionnaire, and were preceded by questions related to colds and respiratory symptoms. The questionnaires were collected by the health nurses and the teachers after several reminders.

In comparing the prevalence data from 1993 and 1981, all children below the age of 7 and above the age of 12 years were excluded from both studies: i.e., 64 and 621 children, respectively. The number of children excluded from the 1981 study was considerably higher, since the original survey included the seventh to ninth grades, as well as the first six. In 1981, subjects were classified by age and sex. This information was therefore used also in the 1993 survey. Other results from the latest survey concerning confounding factors will be used in separate analyses not including the 1981 data and will be the subject of a later paper. Only answers to the five identical questions in the 1993 and 1981 studies were evaluated. Differences between prevalences and confidence intervals were calculated by a minicomputer program (Confidence Interval Analysis (CIA): M. J. Gardner, S. B. Gardner, P. D. Winter, BMJ, Tavistock Square, London).

The five questions stated in both the 1993 and 1981 surveys were as follows:

- 1) Does the pupil's chest ever sound wheezy?
- 2) In the last 3 years, has the pupil had an attack of breathlessness without having a cold?
- 3) Do any of the following cause wheezing or attacks of breathlessness?
 - a) newly cut grass, flowers, or trees?
 - b) animals?
 - c) running or playing games?
- 4) Has the pupil been treated by a doctor or admitted to hospital because of asthma? If so, does the pupil still have asthma? Does the pupil currently take medicine for asthma?
- 5) Has the pupil been treated by a doctor or admitted to hospital because of
 - a) eczema?
 - b) urticaria?
 - c) hay fever?

Table 1. Number of children receiving questionnaires and response rate at each grade (first to sixth) in 1993 and 1981

Grade	1993		1981	
	No. in sample	Response rate (%)	No. in sample	Response rate (%)
1	804	84	164	94
2	753	89	210	97
3	710	90	195	94
4	716	81	207	96
5	778	85	194	95
6	760	82	174	96
Total sample	4521	85	1144	95

Results

The overall response rate in 1993 and 1981 was 85% and 95% (first to sixth grade), respectively (Table 1). The age distribution and the number of boys and girls answering the questionnaires are given in Table 2. Thirty-three children in the 1993 study had not reported their sex and/or age and were therefore not included in the table.

The current and cumulative prevalence of doctor-diagnosed asthma in schoolchildren in Oslo more than doubled from 1981 to 1993, as did the current use of asthma medication (Table 3).

The number of participants giving positive answers when asked about attacks of breathlessness during the last 3 years was also markedly increased, as was the prevalence of respiratory symptoms caused by allergens and exercise (Table 4). The increase in occasional wheezing, however, was not significant (Table 4).

No change in the prevalence of doctor-diagnosed eczema, urticaria, or hay fever was observed between the two studies (Table 5).

The prevalence of current and cumulative doctor-diagnosed asthma was higher in boys than in girls in

Table 2. Age distribution and number of boys and girls attending survey in 1993 and 1981. The group "others" consisted of children aged 5 ($n=5$), 6 ($n=19$), 13 ($n=41$), 14 ($n=1$), 15 ($n=1$), and 16 years ($n=1$) in 1993 survey, and children aged 6 ($n=1$), 13 ($n=198$), 14 ($n=184$), 15 ($n=161$), and 16 ($n=15$) years and group of children whose age was unknown ($n=62$) in 1981 survey

Age (years)	1993			1981		
	Boys	Girls	Total	Boys	Girls	Total
7	317	338	655	76	80	156
8	332	313	645	113	81	194
9	311	312	623	94	85	179
10	290	288	578	89	102	191
11	316	325	641	84	88	172
12	313	294	607	69	92	161
Others	36	32	68	316	305	621
Total	1915	1902	3817	841	833	1674

Table 3. Prevalence (%) of cumulative and current doctor-diagnosed asthma, and regular use of asthma drugs in 1993 and 1981 (** $P < 0.01$)

Age (years)		7	8	9	10	11	12	Total	Difference (95% CI)
Diagnosed asthma	1993	7.9	10.2	6.6	8.8	6.7	7.4	8.0	4.5 (3.1–5.9)**
	1981	4.5	2.1	5.0	4.2	4.1	0.6	3.4	
Current asthma	1993	3.7	5.3	4.2	5.5	3.0	3.6	4.2	2.2 (1.1–3.3)**
	1981	2.6	2.1	3.4	2.1	1.2	0.6	2.0	
Regular use of asthma drugs	1993	2.0	2.6	3.7	3.1	2.0	2.8	2.7	1.4 (0.5–2.2)**
	1981	1.3	1.6	1.7	1.6	1.7	0	1.3	

Table 4. Prevalence (%) of occasional wheezing and breathlessness at rest, and similar symptoms on exposure to grass/trees, animals, and during running and playing (* $P < 0.05$; ** $P < 0.01$)

Age (years)		7	8	9	10	11	12	Total	Difference (95% CI)
Wheezing	1993	11.8	11.5	10.3	12.6	8.4	10.0	10.7	1.5 (–0.5–3.5)
	1981	8.3	9.3	11.7	10.0	8.1	7.5	9.2	
Attacks of breathlessness	1993	6.4	8.2	7.9	8.5	5.6	6.3	7.1	3.8 (2.4–5.2)**
	1981	3.9	3.6	3.4	4.7	2.9	1.2	3.3	
Wheezing/breathlessness:	1993	4.4	5.3	7.2	6.4	6.2	7.3	6.1	2.4 (1.0–3.8)*
	1981	3.9	2.1	2.8	6.3	5.2	1.9	3.7	
a) Grass/trees	1993	3.2	3.1	4.7	4.3	3.4	5.3	4.0	1.2 (0.1–2.4)*
	1981	3.2	1.6	3.4	3.1	4.1	1.2	2.8	
b) Animals	1993	6.7	11.0	10.0	10.9	10.8	12.0	10.2	5.4 (3.8–7.0)**
	1981	1.9	6.7	2.8	7.3	5.2	4.4	4.8	
c) Running/playing	1993	6.7	11.0	10.0	10.9	10.8	12.0	10.2	5.4 (3.8–7.0)**
	1981	1.9	6.7	2.8	7.3	5.2	4.4	4.8	

Table 5. Prevalence (%) of doctor-diagnosed atopic diseases: eczema, hay fever, and urticaria

Age (years)		7	8	9	10	11	12	Total	Difference (95% CI)
Eczema	1993	10.4	8.8	9.6	9.2	9.4	10.4	9.6	1.0 (–0.9–3.0)
	1981	10.9	4.6	8.4	10.5	8.1	9.3	8.6	
Urticaria	1993	4.9	3.7	4.3	5.9	3.1	4.9	4.5	–0.5 (–2.1–0.9)
	1981	3.2	7.7	3.9	4.7	4.7	5.6	5.0	
Hay fever	1993	2.8	3.3	4.2	2.8	3.7	6.4	3.8	–0.2 (–1.5–1.2)
	1981	2.6	2.6	2.2	3.7	7.0	6.2	4.0	

both 1993 and 1981 (Fig. 1). Boys reported regular use of asthma drugs more often than girls in 1981, and a similar trend was observed in 1993, but this was not significant (Fig. 1). In 1993, the prevalence of occasional wheezing, attacks of breathlessness,

and respiratory symptoms on exposure to pollen and exercise was significantly higher among boys than girls (Fig. 2). In the 1981 survey, however, such a difference was observed only with regard to expo-

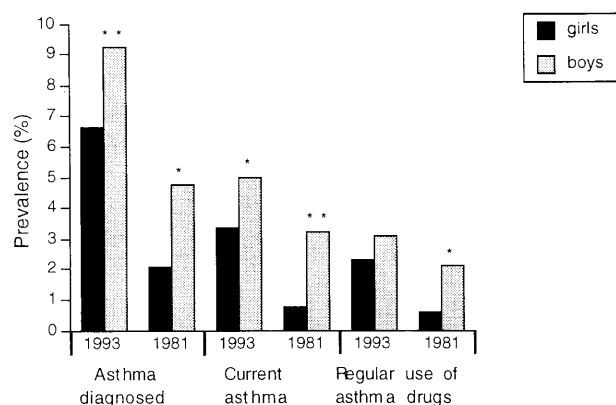


Fig. 1. Prevalence (%) of current and cumulative doctor-diagnosed asthma in boys and girls in 1993 and 1981 (difference between sexes within each survey: * $P < 0.05$; ** $P < 0.01$).

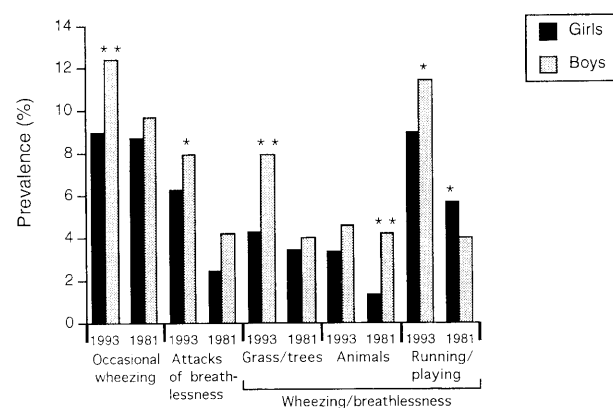


Fig. 2. Prevalence (%) of occasional wheezing and breathlessness at rest, and similar symptoms on exposure to grass and trees, animals, and during running and playing in boys and girls in 1993 and 1981 (difference between sexes within each survey: * $P < 0.05$; ** $P < 0.01$).

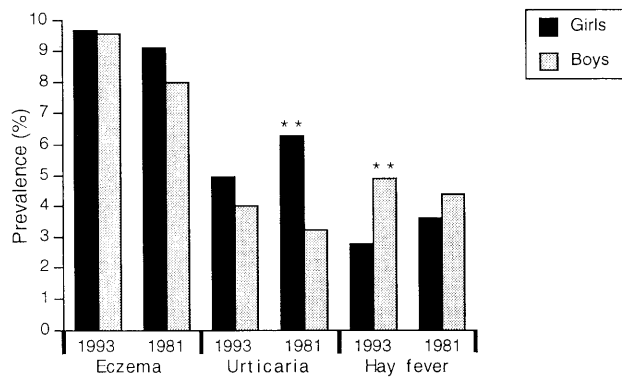


Fig. 3. Prevalence (%) of doctor-diagnosed atopic diseases in boys and girls in 1993 and 1981 (difference between sexes within each survey: * $P < 0.05$; ** $P < 0.01$).

sure to animals (Fig. 2). In addition, wheezing or breathlessness caused by exercise was reported by more girls than boys in 1981 (Fig. 2). Significant differences between the sexes were observed for urticaria in 1981, when twice as many girls gave a positive answer, and in 1993 when more boys than girls had been diagnosed as having hay fever (Fig. 3).

Discussion

The present study is based on comparison of answers obtained from five identical questions relating to bronchial asthma and atopic diseases in 1981 and 1993. The study population in both investigations included children attending primary schools in Oslo. We observed an increase in the prevalence of both doctor-diagnosed asthma and symptoms of obstructive airways disease. Occasional wheezing, however, had not increased significantly, an observation also reported by Burney et al., in spite of finding an increased prevalence of both persistent wheezing and doctor-diagnosed asthma (5). In accordance with previous studies, more boys than girls reported having respiratory symptoms and being diagnosed as asthmatic in the 1993 survey (1, 4, 5, 7). This trend was also observed in 1981, but seems to have been strengthened. In contrast to the other studies mentioned above (4, 7–9), the present investigation has revealed no increase in the prevalence of other atopic diseases.

From 1980 to 1986, an increased number of hospitalizations due to obstructive airways disease among children was reported in Oslo (10). This observation supports our impression that the increased asthma prevalence found in our questionnaire-based study actually reflects an increased asthma morbidity. An increased asthma prevalence among children has also been reported from New Zealand, Australia, the USA, and the UK (1–8). Thus, this tendency is observed under quite

different conditions of climate, allergen exposure, air pollution, and population structure. The cause of the suggested increase in asthma prevalence is unclear. In Oslo, the air pollution situation has improved during the last decade. The concentration of SO_2 has shown a clear decrease, whereas the concentration of suspended particles has shown a moderate, and NO_2 a possibly slight, decrease (17, 18). The prevalence of smoking among Norwegian women has remained unaltered. Since the number of male smokers has decreased, the number of smoking parents has actually decreased (19). Data on possible changes in indoor air during the last 12 years are not available, but it has been speculated that improved insulation of houses contributes to the development of an unfavorable indoor climate. Increased prevalence of atopy as a whole has also been suggested as an explanation for the increased prevalence of asthma (7, 12). Our data do not support this theory, since no increase in atopic diseases was observed. In spite of the stable percentage of atopic schoolchildren, however, a significant increase in asthma symptoms caused by allergen exposure has occurred from 1981 to 1993. Thus, more children suffering from other atopic diseases seem to have developed symptoms of bronchial hyperreactivity, as suggested by Peat et al. (8).

The stated questions in the two investigations were identical, but there were methodological differences. The selection of the participating schools was not identical. In 1993, all classes attending 17 nonrandomly selected primary schools were included, while, in the 1981 survey, randomly selected classes from all consenting primary schools in Oslo participated. The proportion of schools exposed to traffic pollution was, however, similar in the two surveys, and should therefore not influence the results. The difference in response rate might also be of importance. The lower response rate in the 1993 survey could have produced a higher asthma prevalence if parents of symptomatic children were more likely to respond. However, even if all nonresponders in the 1993 survey were classified as not having asthma or respiratory symptoms, there would still be a significant increase in current and cumulative doctor-diagnosed asthma, breathlessness, and respiratory symptoms caused by pollen and exercise.

What seems more important than these methodological differences is probably the increased awareness among both doctors and the general population regarding bronchial asthma and allergy. This may have contributed to the increased prevalence of doctor-diagnosed asthma (5, 8), and may also have influenced the participants' answers regarding wheezing and breathlessness. There was, however, no increase in the prevalence of doctor-diagnosed eczema, urticaria, and hay fever, as would be ex-

pected if the increased focus on asthma and allergy was the sole explanation of the increased asthma prevalence. It is also difficult to determine the influence of the change in population structure which has occurred in Oslo during the last decade, the number of immigrants having increased, since questions about the children's ethnic origin were not included in the questionnaire.

Within the limitations of a questionnaire-based study, the present survey has identified a markedly higher prevalence of doctor-diagnosed bronchial asthma and symptoms of obstructive airways disease among schoolchildren in Oslo in 1993 than 12 years earlier.

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References

- SMITH JM. The prevalence of asthma and wheezing in children. *Br J Dis Chest* 1976; 70: 73-7.
- MITCHELL EA. Increasing prevalence of asthma in children. *N Z Med J* 1983; 96: 463-4.
- GERGEN PJ, MULLALLY DI, EVANS R III. National survey of prevalence of asthma among children in the United States, 1976 to 1980. *Pediatrics* 1988; 81: 1-7.
- BURR ML, BUTLAND BK, KING S, VAUGHAN WILLIAMS E. Changes in asthma prevalence: two surveys fifteen years apart. *Arch Dis Child* 1989; 96: 1452-6.
- BURNEY PGJ, CHINN S, RONA RJ. Has the prevalence of asthma increased in children? Evidence from the national survey of health and growth 1973-86. *BMJ* 1990; 300: 1306-10.
- ROBERTSON CF, HEYCOCK E, BISHOP J, NOLAN T, OLINSKY A, PHELAN P. Prevalence of asthma in Melbourne schoolchildren: changes over 26 years. *BMJ* 1991; 302: 1116-18.
- NINAN TK, RUSSEL G. Respiratory symptoms and atopy in Aberdeen schoolchildren: evidence from two surveys 25 years apart. *BMJ* 1992; 304: 873-5.
- PEAT JK, VAN DEN BERG R, GREEN WF, MELLIS CM, LEEDER SR, WOOLCOOK AJ. Changing prevalence of asthma in Australian children. *BMJ* 1994; 308: 1591-6.
- ANDERSON HR. Increase in hospital admissions for childhood asthma: trends in referral, severity and readmission from 1970 to 1985 in a health region of the United Kingdom. *Thorax* 1989; 44: 614-19.
- CARLSEN KH, LØDRUP KC, CARLSON O, MOWINCKEL P. Morbidity and mortality from obstructive lung disease among Norwegian children. *Tidsskr Nor Laegeforen* 1990; 110: 2068-71.
- STRACHAN DP, ANDERSON HR. Trends in hospital admission rates for asthma in children. *BMJ* 1992; 304: 819-20.
- BURNEY P. Epidemiology of asthma. *Allergy* 1993; 48: 17-21.
- ROBERTSON CF, BISHOP J, SENNAUSER FH, MALLOL J. International comparison of asthma prevalence in children: Australia, Switzerland, Chile. *Pediatr Pulmonol* 1993; 16: 219-26.
- SEATON A, GODDEN DJ, BROWN K. Increase in asthma: a more toxic environment or a more susceptible population? *Thorax* 1994; 49: 171-4.
- NG TP, HUI KP, TAN WC. Prevalence of asthma and risk factors among Chinese, Malay, and Indian adults in Singapore. *Thorax* 1994; 49: 347-51.
- SKARPAAS IJK, GULSVIK A. Prevalence of bronchial asthma and respiratory symptoms in schoolchildren in Oslo. *Allergy* 1985; 40: 295-9.
- LARSSEN S, RØSTAD A. Monitoring of automotive pollutant concentration at fixed stations in Oslo for the period 1989-92 [in Norwegian]. Norwegian Institute for Air Research, 1993: OR 7/93.
- HAGEN LO. Routine surveillance of air pollution April 1992-March 1993 [in Norwegian]. Norwegian Institute for Air Research, 1993: OR 49/93.
- SANNER T. Tobacco and children [in Norwegian]. Norwegian Health Department, Oslo, OR 1992.