# School absence and treatment in school children with respiratory symptoms in the Netherlands: data from the Child Health Monitoring System

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**Abstract**

***Study objective*—To assess the prevalence of respiratory problems, and the relation of these problems with school attendance, medicine use, and medical treatment.**

***Design*—The Child Health Monitoring System.**

***Setting*—Nineteen public health services across the Netherlands.**

***Participants*—5186 school children aged 4–15 years, who were eligible for a routine health assessment in the 1991/1992 school year.**

***Main results*—Respiratory symptoms were present in 12% of the children. Recent symptoms suggestive of asthma (wheezing or episodes of shortness of breath with wheezing in the past 12 months, or chronic cough, or a combination of these) were reported for 8%. These symptoms were most frequent in the younger children, and in children at school in towns with less than 20 000 inhabitants. Of the children with recent symptoms suggestive of asthma, 37% reported school absence for at least one week during the past 12 months, compared with 16% in children without respiratory symptoms. School absence because of respiratory illness was reported for 22%, and medicine use for respiratory problems for 38% of the children with recent symptoms suggestive of asthma. Of these children, 21% were receiving medical treatment, compared with 15% of the asymptomatic children.**

***Conclusions*—Respiratory symptoms are a common health problem in children, and they are an important cause of school absence and medicine use. However, the percentage of children receiving medical treatment seemed quite low, indicating that proper diagnosis and treatment are probably still a problem.**

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Respiratory problems are an important cause of chronic ill health in children of school age.[1–5] The impact of respiratory problems on children themselves as well as on their families is considerable.[1 2 6 7] In the Netherlands, respiratory symptoms have been reported for 25–30% of the primary school children, and combinations of symptoms for 10–15%.[8 9] The prevalence of asthma in these children was estimated to be 5–6%.[8 9] An increase in asthma prevalence has been reported during the past decades in various countries.[10–14] From the Netherlands, there is no information about changing asthma prevalences in children. However, hospital admission rates for asthma as well as for other respiratory diseases appeared to have increased in the period from 1980 to 1987.[15]

Respiratory symptoms are an important reason for school absence,[6] and this may have a negative effect on school performance.[5 6] School absence can be used as an indicator of disability caused by the disease.[1] Despite a greater awareness of asthma symptoms, underdiagnosis, misclassification, and undertreatment of asthma are still common in children.[2 9 16]

The Dutch child health monitoring system (CHMS) is an ongoing cross sectional study among school children, in which 20 municipal or regional public health services across the Netherlands participate annually. The aim of the CHMS is to provide national data on the health status of children. Respiratory problems were assessed as part of the first CHMS study, which took place in the 1991/1992 school year. The questions to be answered are the following:

What are the prevalences of recent respiratory symptoms in school children, and is there an association with sociodemographic variables?

What is the relation between the respiratory symptoms and school attendance?

What are the proportions of children receiving medical treatment and using medicines for respiratory symptoms?

## Methods

### POPULATION

A sample of 22 of 63 regional or municipal public health services was drawn, with a stratification by region and degree of urbanisation. For this purpose, the Netherlands was divided into four regions: north east (provinces of Groningen, Friesland, Drenthe, and Overijssel), north west (province of Noord-Holland), central (provinces of Zuid-Holland, Utrecht, Flevoland, and Gelderland), and south (provinces of Zeeland, Noord-Brabant, and Limburg). Within these four regions, public health services were classified as "urban" if at least 25% of the municipalities in the catchment area had more than 25 000 inhabitants, while for "rural" public health services this percentage was less than 25%. The five largest cities, with approximately 200 000 inhabitants or more, were considered a separate region.

The sample consisted of children in the second, fourth, and seventh or eighth grade of primary school, and in the second grade of

secondary school, corresponding to the 4–6, 7–9, 10–12, and 13–15 year age groups respectively. A "rural" public health service had to select children from schools in a village with less than 20 000 inhabitants, and an "urban" public health service in a town with 20 000 inhabitants or more. A public health service in a large city had to select children form schools within the city. Each public health service was supposed to assess 75 children per grade, evenly distributed by sex. Therefore, the public health services were instructed to select two or three school classes per grade, and to invite all children in these classes to participate in the CHMS. In primary education, "urban" public health services as well as those in the large cities should select these classes from schools in districts from different socioeconomic background. In smaller villages, the socioeconomic classes are more or less evenly spread over primary schools, therefore "rural" public health services should select schools from different denominational background. In secondary education, the selected school classes should represent different levels of education.

### STUDY DESIGN

The data collection took place in the course of the 1991/1992 school year (from October until May), during the preventive health assessments by school doctors or nurses from 19 public health services. Respiratory symptoms were assessed by means of a questionnaire, which was compiled from the WHO questionnaire on respiratory symptoms and a validated Dutch questionnaire.[17] Questions were asked to the parents of the younger children and from age 12 onwards to the children themselves. Respiratory symptoms were assessed (and not diagnosed illness) to avoid recall bias or bias caused by differences in the criteria used to diagnose asthma.[18] A recent symptom was considered to be present only when a positive answer was given to both parts of a question (table 1). In a previous study, the reproducibility of most questions was found to be good (Cohen's $\kappa$ ranging from 0.60 to 0.75) when the questionnaire is completed at home by parents of school children aged 6–12 years. The reproducibility of the questions on "usually cough" and "more than 3 months cough" was less satisfactory ($\kappa$ value 0.27 and 0.50 respectively).[19] According to an international paediatric asthma consensus group,[20 21] we considered recent symptoms suggestive of asthma in children with recent wheeze or recent episodes of shortness of breath with wheeze or chronic cough, or a combination of these. These children were compared with children without any of the assessed past or recent respiratory symptoms.

*Table 1 Items in questionnaire on respiratory symptoms*

| | |
|---|---|
| 1 Shortness of breath | a ever<br>b in the past 12 months (= recent) |
| 2 Wheeze | a ever<br>b in the past 12 months (= recent) |
| 3 Episodes of shortness of breath with wheezing | a ever<br>b in the past 12 months (= recent) |
| 4 Cough | a 5 or more days a week (= usually)<br>b for at least 3 consecutive months (=chronic) |
| 5 Cough and phlegm | a in the past 12 months<br>b for at least 3 consecutive weeks |

School absence was recorded when the child had not attended school for at least one school week in the past 12 months, because of illness in general, and because of respiratory problems more specifically. These periods of school absence probably reflect the more severe episodes of (respiratory) illness. Medicine use during the past month was assessed by asking whether the child had used any prescribed medication, and medication for respiratory problems. The questions on school absence and medicine use were also derived from the validated Dutch questionnaire.[22] Medical treatment included present treatment by a physician as well as regular visits to a physician for a particular health problem, occurring at least once a year.

Recorded sociodemographic variables included age, sex, school type, ethnicity, parental educational level, region, and rural/urban areas. Ethnicity was defined by the nationality of the father, except for Surinamese and Antillean children. For these children, the father's country of birth was used, because many of them have the Dutch nationality but they are still a separate cultural group. Parental educational level was used as a measure of socioeconomic status, and was defined by the father's educational level. If the father's nationality or educational level were not known, or if there was no father living with the child at the time of the study, the data for the mother were used instead. Regions and rural/urban areas were distinguished as defined above.

Statistical analyses were carried out with the Statistical Package for Social Sciences (SPSS). $\chi^2$ Tests were used to determine the statistical significance of differences between distributions of categorical data. Because of the large number of variables in the CHMS and a sufficient sample size, p values less than 0.01 were considered statistically significant. Logistic regression analysis was applied to estimate the adjusted odds ratios and the 99% confidence intervals of the association between recent symptoms suggestive of asthma and the sociodemographic variables. Variables that were not significant in the stepwise analyses (p value of the likelihood ratio test larger than 0.01) were deleted by means of backward elimination.

## Results

### RESPONSE

Of the 5622 children invited for the CHMS, 5349 participated, and 5186 completed the questionnaire on respiratory symptoms (92%). Of the study group, 51% were boys and 49% girls; 28% were between 4 and 6 years old (mean age 5.7 years), 24% 7–9 years (mean age 8 years), 22% 10–12 years (mean age 11.7 years) and 27% 13–15 years (mean age 14.1 years). Nearly three quarters (73%) of the children attended primary school, 11% junior vocational training, 9% junior secondary school, and 7% senior secondary school or pre-university education. Of the study group, 89% were Dutch, 2% Surinamese/Antillean, 4% Turkish/Moroccan, and 4% were of "other" non-Dutch origin; in

*Table 2 Prevalence of respiratory symptoms in school children*

| *Age group (y)* | *Total population* 4–15 (n=5186) %* | *Boys* | | | | *Girls* | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | *4–6 (n=702) %* | *7–9 (n=630) %* | *10–12 (n=544) %* | *13–15 (n=753) %* | *4–6 (n=731) %* | *7–9 (n=614) %* | *10–12 (n=586) %* | *13–15 (n=626) %* |
| Recent shortness of breath | 6 | 7 | 7 | 8 | 7 | 5 | 4 | 4 | 10 |
| Recent wheeze | 7 | 11 | 9 | 6 | 6 | 9 | 6 | 4 | 6 |
| Recent shortness of breath with wheeze | 4 | 6 | 5 | 4 | 4 | 4 | 3 | 1 | 2 |
| Chronic cough | 2 | 3 | 1 | 1 | 2 | 4 | 2 | 1 | 2 |
| >3 Weeks cough with phlegm | 1 | 3 | 1 | 1 | 1 | 2 | 1 | 1 | 1 |
| Symptoms suggestive of asthma† | 8 | 12 | 10 | 7 | 8 | 12 | 6 | 5 | 7 |

*In each of the respiratory symptoms, the answer "unknown" was reported for 1% of the children. †Recent wheeze and/or recent episodes of shortness of breath with wheeze and/or chronic cough.

0.5% of the children the ethnicity was not known. In 12% of the children, the educational level of the parents was primary education only, or no formal education; in 42% it was junior vocational/general training; in 21% it was senior vocational/general training; in 18% it was vocational colleges of university education; and in 7% it was unknown. Of the children, 20% were from the region north east, 21% were from north west, 26% were from central, 16% were from south, and 17% were from one of the largest cities. Apart from the children at school in the largest cities (17%), 28% were at school in rural areas, and 55% in urban areas.

### RESPIRATORY SYMPTOMS

Recent respiratory symptoms were reported for 12% of the study group, 88% had no recent symptoms; in 75% none of the assessed past or recent symptoms were recorded. Table 2 shows the prevalences of the various symptoms. Of the five recent respiratory symptoms in the study, one symptom was present in 6% and two or more symptoms in 5%. Episodes of shortness of breath with wheeze mainly occurred in combination with other respiratory symptoms (in 93% of the cases). Boys more often experienced wheeze and episodes of shortness of breath with wheeze than girls. Children in the youngest age group (4–6 years) most frequently reported recent wheeze, chronic cough, and cough with phlegm. On the other hand, 13–15 year olds most frequently had shortness of breath, with girls in junior vocational training having the highest percentage with this symptom (15%). Children at school in rural areas most frequently reported wheeze. Differences in respiratory symptoms by ethnicity and by parental educational level were only found within some age groups. In the 4–6 year age group, the children whose parents had a low level of education more frequently reported chronic cough (9% compared with 2–4% in children with higher educated parents). In the 7–9 year age group, cough with phlegm was more common in Turkish/Moroccan (3%) and "other" non-Dutch children (5%) than in Dutch (0.5%) and Surinamese/Antillean children (0%); and in children whose parents had a low level of education (4%) compared with 0.4–0.7% in children with higher educated parents.

*Table 3 Odds ratios (99% confidence intervals (CI)) recent symptoms suggestive of asthma (n=441) compared with no past or recent symptoms (n=3905) by age group and urban/rural areas*

| | *Number* | *OR (99% CI)** |
|---|---|---|
| Age group (y) | | |
| 4–6† | 1172 | 1 |
| 7–9 | 1054 | 0.62 (0.44,0.88) |
| 10–12 | 982 | 0.45 (0.31,0.67) |
| 13–15 | 1138 | 0.59 (0.42,0.83) |
| Area | | |
| rural† | 2344 | 1 |
| urban | 1227 | 0.73 (0.54,1.00) |
| large city | 775 | 0.61 (0.42,0.91) |

*OR age group adjusted for area; OR area adjusted for age group. †Reference group.

Recent symptoms suggestive of asthma were more frequent in children aged 4–6 years, and in children in rural areas (table 3). The other sociodemographic variables—that is, sex, region, ethnicity, and parental educational level—were not significantly related to the occurrence of recent symptoms suggestive of asthma.

### SCHOOL ABSENCE, MEDICINE USE, AND MEDICAL TREATMENT

The differences in school absence and medicine use between the children with recent symptoms suggestive of asthma and the asymptomatic children (table 4) were mainly a consequence of the respiratory problems. Children with recent shortness of breath or cough with phlegm most frequently reported school absence or medicine use not for respiratory problems, but for school absence this difference was not statistically significant ($0.01<p<0.05$). Among the children with recent symptoms suggestive of asthma, there was no statistically significant difference in school absence because of respiratory symptoms

*Table 4 School absence, medicine use, and medical treatment by respiratory symptoms (n=5186)*

| | *Recent symptoms suggestive of asthma (n=441) %* | *Recent shortness of breath or cough with phlegm (n=151) %* | *Other respiratory symptoms* (n=689) %* | *No past/recent symptoms (n=3905) %* |
|---|---|---|---|---|
| School absence because of illness | 37 | 28 | 24 | 16 |
| School absence because of respiratory problems | 22 | 8 | 7 | 2 |
| Any medicine use | 48 | 32 | 23 | 12 |
| Medicine use for respiratory problems | 38 | 17 | 11 | 3 |
| Medical treatment at time of study | 21 | 21 | 15 | 15 |

*Symptoms not meeting the criteria for the presence of recent respiratory symptoms in this study (a positive response was given only to the first part of question(s), table 1).

between children who were receiving medical treatment (30%) and those who were not (20%); but in children who took medication for respiratory problems, school absence because of respiratory symptoms was higher (34%) than in children who did not take such medication (11%). Among the children with recent shortness of breath or cough with phlegm, school absence because of respiratory symptoms did not significantly differ between children who were receiving medical treatment (16%) and those who were not (6%), or between children who took medication (17%) and those who did not so (4%).

Respiratory symptoms were a cause of school absence in 22% of the children who reported absence because of illness in the past 12 months. Nearly half (42%) of the children who used any prescribed medication in the previous month, took medicines for respiratory problems.

## Discussion

Recent respiratory symptoms were reported for 12% of the school children aged 4 to 15 years. It is unlikely that we missed many children who were absent because of (respiratory) illness, because children who did not attend the health assessment received a repeated invitation. The percentage of children who attended after a repeated invitation, was 2% in children with and 3% in children without respiratory symptoms. We assume the CHMS study population to be representative of the groups of children in mainstream education eligible for a routine health assessment, although detailed information on the distributions of the background variables at national level is not available. Surinamese and Antillean children were underrepresented in the CHMS compared with the general population (2% versus 4%; Central Bureau of Statistics, personal communication), but this presumably has only a very limited effect on the prevalences observed.

The prevalences of wheezing, episodes of shortness of breath with wheezing, and cough with phlegm from our study were lower as those from other studies on respiratory symptoms in primary school children in the Netherlands. The prevalences of shortness of breath and cough were more or less the same.[22–25] The differences between the present study and the other Dutch studies can partly be because of the fact that in our study the questions were asked by a school doctor or nurse, while in the other studies the parents completed the questionnaire themselves. In addition, regional differences can play a part, because most of the other studies were performed in specific regions. Differences in age distribution between the various study populations are unlikely to account for the lower prevalences in our study.

Compared with other countries, the prevalence of recent wheezing in our study was low (7%), and comparable to that for Swiss school children.[26] Among children in Australia,[26 27] New Zealand,[12] England,[2 14] Scotland,[3] Turkey,[28] and Chile,[26] recent wheezing was present in 12% to 28%.

KEY POINTS

- The Child Health Monitoring System (CHMS): ongoing data collection on health of school children.
- The assessment of respiratory symptoms instead of (diagnosed) illness improves the comparability of studies on asthma.
- Respiratory symptoms are an important reason for school absence.
- Early recognition, referral, and treatment of children with respiratory symptoms may lower the impact of the illness on children's functioning.

Recent symptoms suggestive of asthma were more frequent among school children in rural areas compared with school children in the largest cities. No other regional differences were detected. Differences in respiratory symptoms between regions were reported in some studies in the Netherlands.[22 29] One study described higher prevalences in school children in the large cities, but these findings may be related to the considerable (and probably selective) non-response in the large cities.[25] A study in the province of Noord-Brabant reported lower frequencies of wheezing in rural areas,[24] which is in contrast with the findings from our study. The differences between countries and between regions are thought to be related to environmental differences, life style, and living conditions.[30] The CHMS study did not go into that, and as a consequence we have no information on for example parental smoking. Data on smoking in the Netherlands, however, do not indicate that smoking is less common in the large cities (Foundation for public health and smoking (Stivoro), personal communication). The prevalences from the CHMS study probably reflect a "national average", and can be used as a reference for further (regional) studies.

Wheezing and shortness of breath with wheezing were more common in boys than in girls. In other studies in the Netherlands, shortness of breath and chronic cough were more often reported by boys as well.[9 22 24 25] Studies among primary school children in Switzerland,[26] England,[31] and Australia,[26 32] also reported higher prevalences of respiratory problems in boys. Respiratory symptoms were more common in the younger children, which is in accordance with the results from other studies.[24 25 31] In contrast with a study in the city of Amsterdam, we did not find differences in respiratory symptoms between Dutch and Turkish children.[33]

Respiratory problems were an important reason for school absence and medicine use. This is in accordance with other studies in Dutch school children.[8 22 24] The percentage receiving medical treatment seemed quite low in children with recent symptoms suggestive of asthma. This also included treatment for other conditions, so the percentage receiving medical treatment for their respiratory illness might even be lower. Among the children with respiratory

symptoms, school absence was higher in the children who took medication in the previous month. This probably indicates children with more severe problems. From other studies we know that respiratory illness is often underdiagnosed and undertreated.[2 9 16] It may therefore be argued that if the untreated children would receive treatment, and if all treated children would receive the appropriate treatment, school absence in children with respiratory symptoms might diminish, and might even come close to school absence in children without respiratory symptoms. School health care might play an important part in the early recognition and referral of children with respiratory symptoms, and in the education and counselling of children, their parents, and their teachers to make the school environment more healthy, and to minimise the effects of respiratory illness on school absence and performance.[4 5 34 35]

Respiratory problems are common, especially among the younger school children. However, in comparison with other countries the prevalence of wheezing in our mainstream education population is low (7%). Respiratory problems are an important reason for school absence and medicine use. Diagnosis and treatment of children with respiratory illness may still be a problem, as the percentage of children receiving medical treatment is quite low. At the moment, there is no evidence of an increasing prevalence of wheezing. The ongoing Child Health Monitoring System offers the opportunity to assess trends in the prevalence of respiratory symptoms and medical treatment, by using the same method in future years.

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1 Anderson HR, Bailey PA, Cooper JS, *et al*. Morbidity and school absence caused by asthma and wheezing illness. *Arch Dis Child* 1983;**58**:777–84.
2 Powell CVE, Primhak RA. Asthma treatment, perceived respiratory disability, and morbidity. *Arch Dis Child* 1995;**72**:209–13.
3 Austin JB, Russell G, Adam MG, *et al*. Prevalence of asthma and wheeze in the Highlands of Scotland. *Arch Dis Child* 1994;**71**:211–16.
4 Bremberg SG, Kjellman N-I M. Children with asthma: how do they get along at school? *Acta Paediatr Scand* 1985;**74**:833–40.
5 Fowler MG, Davenport MG, Garg R. School functioning of US children with asthma. *Pediatrics* 1992;**90**:939–44.
6 Nocon A. Social and emotional impact of childhood asthma. *Arch Dis Child* 1991;**66**:458–60.
7 Lask B. Psychological treatments for childhood asthma. *Arch Dis Child* 1992;**67**:891.
8 Rijcken B, Verkerk PH. Schoolverzuim en CARA. *Tijdschr Jeugdgezondheidsz* 1988;**20**:28–9.
9 Cuijpers CEJ, Wesseling GJ, Swaen GMH, *et al*. Asthma-related symptoms and lung function in primary school children. *J Asthma* 1994;**3**;1301–12.
10 Bauman A. Has the prevalence of asthma symptoms increased in Australian children? *J Paediatr Child Health* 1993;**29**:424–8.
11 Britton J. Asthma's changing prevalence. *BMJ* 1992;**304**: 857–6.
12 Shaw RA, Crane J, O'Donnel TV. Prevalence of asthma in children. *BMJ* 1990;**300**:1652–3.
13 Burney PGJ, Chinn S, Rona RJ. Has the prevalence of asthma increased in children? Evidence from the national study of health and growth 1973–86. *BMJ* 1990;**300**:1306–10.
14 Anderson HR, Butland BK, Strachan DP. Trends in prevalence and severity of childhood asthma. *BMJ* 1994;**308**: 1600–4.
15 Wever-Hess J, Wever AMJ, Yntema JL. Mortality an morbidity from respiratory diseases in childhood in the Netherlands, 1980–1987. *Eur Resp J* 1991;**4**:429–33.
16 Flach KC, Brunekreef B. Luchtwegsymptomen en longfunctie bij kinderen van 6 tot 12 jaar oud. *Tijdschr Soc Gezondheidsz* 1991;**69**:159–64.
17 Boer A de, Steenbekkers A, Brunekreef B, *et al*. Een vergelijking van twee vragenlijsten naar luchtwegsymptomen bij kinderen. II De samenhang tussen de vragen. *Tijdschr Soc Gezondheidsz* 1990;**68**:483–8.
18 Woolcock AJ. Epidemiologic methods for measuring prevalence of asthma. *Chest* 1967;91(suppl):89–92
19 Brunekreef B, Groot B, Rijcken B, *et al*. Reproducibility of childhood respiratory symptom questions. *Eur Resp J* 1992;**5**:930–5.
20 Warner JO, Gotz M, Landau LI, *et al*. Management of asthma: a consensus statement. *Arch Dis Child* 1989;**64**: 1065–79.
21 International Paediatric Asthma Consensus Group. Asthma: a follow up statement. *Arch Dis Child* 1992;**67**: 240–8.
22 Werkgroep CARA Bij Jeugdigen. *De Regio's studie, deel I en II*. Groningen: Rijksuniversiteit, 1988.
23 Steenbekkers A, Boer A de, Brunekreef B, *et al*. Een vergelijking van twee vragenlijsten naar luchtwegsymptomen bij kinderen. I Vergelijking van prevalenties. *Tijdschr Soc Gezondheidsz* 1990;**68**:478–82.
24 Groot BJA, Boer E de, Baecke JAH. Luchtwegklachten in Noordoost-Brabant. Een studie naar de prevalentie van CARA, medische consumptie en schoolverzuim bij kinderen. *Tijdschr Soc Gezondheidsz* 1992;**70**:368–73.
25 Janssen NAH, Zock J-P, Brunekreef B, *et al*. Prevalentie van luchtwegklachten bij basisschoolkinderen in Nederland. *Tijdschr Soc Gezondheidsz* 1994;**72**:3–8.
26 Robertson CF, Boshop J, Sennhauser FH, *et al*. International comparison of asthma prevalence in children: Australia, Switzerland, Chile. *Pediatr Pulmonol* 1993;**16**: 219–26.
27 Peat JK, Berg RH Van den, Green WF, *et al*. Changing prevalence of asthma in Australian children. *BMJ* 1994; **308**:1591–6.
28 Kalyoncu AF, Selcuk ZT, Karakoca Y, *et al*. Prevalence of childhood asthma and allergic diseases in Ankara, Turkey. *Allergy* 1994;**49**:485–8.
29 Kok ME de, Mertens PLJM, Cuijpers CEJ, *et al*. The rate of respiratory symptoms among primary school children in two Dutch regions. *Eur J Pediatr* 1996;**155**:506–11.
30 Mutius E von, Fritzsch C, Weiland SK, *et al*. Prevalence of asthma and allergic disorders among children in united Germany: a descriptive comparison. *BMJ* 1992;**305**:1395–9.
31 Singleton CD, Gatrell AC, Briggs J. Prevalence of asthma and related factors in primary school children in an industrial part of England. *J Epidemiol Community Health* 1995; **49**:326–7.
32 Peat JK, Woolcock AJ, Leeder SR, *et al*. Asthma and bronchitis in Sydney schoolchildren. *Am J Epidemiol* 1980; **111**:721–7.
33 Wal MF van der, Rijcken B. Astmatische klachten bij autochtone en allochtone kinderen van 2–11 jaar in Amsterdam. *Tijdschr Soc Gezondheidsz* 1995;**73**:42–50.
34 Lindgren S, Lokshin B, Stromquist A, *et al*. Does asthma or treatment with theophylline limit children's academic performance? *N Engl J Med* 1992;**327**:926–30.
35 Carruthers P, Ebbutt AF, Barnes G. Teachers' knowledge of asthma and asthma management in primary schools. *Health Education Journal* 1995;**54**:28–36.