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ORIGINAL RESEARCH

Prevalence of respiratory symptoms, features of asthma, and characteristics associated with respiratory disease, in 6-11 year olds in Manchester

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Abstract

Aims: This paper describes the prevalence of respiratory symptoms, features of asthma, and characteristics associated with respiratory disease in 6-11 year old children in an historical cohort study.

Methods: The study included 5086 children, all born in the same maternity unit in the north west of England over a four-year period. The prevalence of respiratory symptoms, features of asthma, and characteristics associated with respiratory disease were determined by the use of parent-completed questionnaires. Skin prick tests were used to ascertain atopic status.

Results: The response was 47.5%. The prevalence of wheeze, asthma medication use and atopic sensitisation were 20.3%, 16.2% and 37.1% respectively. Wheeze and atopy were significantly more prevalent in boys (22.4% versus 17.9% and 43.0% versus 29.3%, respectively).

Conclusions: This study identified a high prevalence of respiratory disease in this population and provides a baseline for monitoring trends in respiratory disease in 6-11 year old children.

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The full version of this paper, with online Appendix A is available online at www.thepcrj.org

Introduction

Asthma is one of the most common childhood diseases in Britain[1] and its prevalence has increased considerably over recent decades[2-4] although recent evidence suggests that it has now stabilised.[5] However, interpretation of data in childhood asthma has been problematic because of disparities in the definitions used, differences between populations studied, and different study methodologies.

These problems have been partially overcome in recent years following the International Study of Asthma and Allergy in Childhood (ISAAC) study which used a uniform method for comparing prevalence of asthma and atopic disease within and between countries.[6] Nevertheless, identification of trends remains difficult when prevalence is being compared between different age groups and different populations.

The Manchester Community Asthma Study (MANCAS) investigated the prevalence of asthma and atopy in 6-11 year old children in a major city in the north, west of England as part of an investigation into the possible association between neonatal BCG vaccination and asthma/atopy. The results of that study have been reported elsewhere.[7] This paper uses data from the MANCAS study to describe the prevalence of respiratory symptoms, features of asthma, and characteristics

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Table 1. Characteristics of the study population.

	Non responders (n = 2672)	Responders (n = 2414)	p value (responders vs non responders	Skin prick tested (n = 949)	Not skin prick tested (n = 1465)	p value (tested vs not tested)
% Male (n)	50.7% (1356)	53.6% (1295)	0.04	56.9% (540)	51.5% (755)	0.006
Mean age in days (SD) at first mailing	2453 (383.5)	2488 (390.0)	0.001	2492 (388.4)	2485 (391.2)	0.7
% Wheeze (n)	–	–	–	24.2% (229)	17.9% (261)	<0.001

Table 2. Prevalence of respiratory symptoms, features of asthma, and characteristics associated with respiratory disease, with gender differences and associated odds ratios (OR) and 95% confidence intervals (CI).

Symptoms	Total % (n)	Boys % (n)	Girls† % (n)	OR [95% CI]	p for chi² test
Wheeze*	20.3 (490/2408)	22.4 (290/1292)	17.9 (200/1116)	1.33 [1.08-1.62]	0.01
Night cough*	33.5 (799/2387)	32.8 (421/1282)	34.2 (378/1105)	0.94 [0.79-1.12]	0.48
Features of asthma					
Asthma attack*	9.3 (220/2377)	10.2 (130/1274)	8.2 (90/1103)	1.28 [0.97-1.70]	0.09
Asthma medication	16.2 (388/2400)	17.5 (225/1288)	14.7 (163/2400)	1.23 [0.99-1.54]	0.06
Characteristics of respiratory disease					
Hayfever/eczema	38.8 (918/2369)	40.4 (512/1268)	36.9 (406/1101)	1.16 [0.98-1.37]	0.08
Family history asthma	59.6 (1415/2374)	59.8 (762/1275)	59.4 (653/1099)	1.02 [0.86-1.19]	0.86
1 or more smokers in household	46.3 (1052/2271)	45.2 (553/1223)	47.6 (499/1048)	0.91 [0.77-1.07]	0.25
>3 courses antibiotics*‡	10.9 (260/2387)	10.8 (138/1282)	11.0 (122/1105)	0.97 [0.75-1.26]	0.82

† Reference group; * in past 12 months; ‡ for chest, ear or throat problems

associated with respiratory disease in this population of children. The purpose of this paper is to contribute to the surveillance of respiratory disease prevalence and to facilitate comparisons with other children in similar age groups.

Method

The study population consisted of 5086 children, all born in the same maternity unit between 1st July 1993 and 31st March 1997. Parent-completed questionnaires were used to identify respiratory symptoms, features of asthma, and characteristics associated with respiratory disease. Questionnaires and study information leaflets were sent over a 21-month period (July 2002 to March 2004), and approximately 100 were posted on a phased weekly basis in chronological order with the oldest children in the study being selected first. The questionnaire (see Appendix A, available online at www.thepcrj.org), a modified version of the ISAAC core questionnaire for wheezing and asthma,[6] was based on that used in the Wythenshawe Community Asthma Project (WYCAP).[8] Reminders were sent to non-responders after four and eight weeks and at the end of the distribution period. The return of a completed questionnaire was considered as consent to participate in the study. Responders to the questionnaire were invited to participate in skin prick tests to identify atopic sensitisation.

Skin Testing

The study rationale and the skin prick test procedure were explained to parents and children and they were given an opportunity to ask questions. Parental signed consent and the child's verbal assent were then obtained prior to the skin prick test procedure. Children participating in the skin prick test phase of the study were tested for sensitisation to house dust mite, cat, dog, grass and *Alternaria* using Alk Abello antigen solutions. The skin prick test was carried out on the volar aspect of the child's forearm in a standardised manner.[9] Histamine was used as the positive control and a solution of saline as the negative control. Test results were read after 15 minutes and were calculated as the mean of the longest diameter and the diameter perpendicular to it. A reaction was considered positive if the mean wheal diameter was ≥ 3mm larger than the negative control.

Statistical methods

Analyses were performed using SPSS for Windows software.[10] Responses to the questionnaire were examined in univariate

Table 3. Frequency and features of wheeze with gender differences and associated odds ratios (OR) and 95% confidence intervals (CI).

Wheeze	Total % (n)	Boys % (n)	Girls† % (n)	OR [95% CI]	p for chi² test
No attacks of wheezing*†	11.9 (56/471)	11.2 (31/278)	13.0 (25/193)	0.84 [0.48-1.48]	0.56
1-3 attacks of wheezing*	55.2 (260/471)	55.0 (153/278)	55.4 (107/193)	0.98 [0.68-1.42]	0.93
4-12 attacks of wheezing*	24.8 (117/471)	24.8 (69/278)	24.9 (48/193)	0.99 [0.65-1.53]	0.99
>12 attacks wheezing*	8.1 (38/471)	9.0 (25/278)	6.7 (13/193)	1.37 [0.68-2.75]	0.38
Woken by wheeze*	47.8 (227/475)	46.2 (129/279)	50.0 (98/196)	0.86 [0.60-1.24]	0.42
Speech limiting wheeze*	20.6 (97/470)	22.8 (64/281)	17.5 (33/189)	1.39 [0.87-2.23]	0.16
Wheeze with exercise*	68.6 (325/474)	66.2 (188/284)	72.1 (137/190)	0.76 [0.51-1.13]	0.18

* in past 12 months; † Reference group

analyses to identify the prevalence of respiratory symptoms, features of asthma, and characteristics associated with respiratory disease. The severity of wheeze amongst those children reported to have wheezed in the past 12 months was also examined. Atopic sensitisation was investigated and the prevalence of sensitisation to each aeroallergen tested was identified. Prevalence was stratified by gender to identify important differences in risk and/or burden of disease. The statistical significance of differences in proportions was assessed using chi-squared tests and odds ratios with 95% confidence intervals. Differences in means were examined using t-tests, and logistic regression analyses were used to adjust for potential confounders of the associations between symptoms and disease characteristics.

South Manchester Local Research Ethics Committee approved the MANCAS study.

Results

The study population consisted of 5086 children (52.1% male). There were 2414 questionnaire responses (53.6% male), a response rate of 47.5%. The mean age was 7.3 years (range 6 to 11 years) and 46.3% of the children lived in a household with one or more smokers.

Amongst responders, 949 children (39.3%) had a skin prick test for atopic sensitisation performed.

Table 1 shows the known characteristics of the study population. The proportion of male responders was significantly higher than the proportion of male non-responders (53.6% versus 50.7%, p=0.04) and non-responders were younger than responders (mean age 2453 days versus 2488 days, p=0.001). Children who had a skin prick test were more likely to be male and to have wheezed in the past 12 months (p=0.006 and p<0.001 respectively).

Table 2 shows the prevalence of respiratory symptoms, features of asthma, and characteristics associated with respiratory disease. One-fifth (20.3%) of the study participants reported wheeze in the past 12 months and this prevalence was significantly higher in boys (odds ratio (OR) 1.33, 95% confidence interval (CI) 1.08-1.62). There were no other significant gender differences. The prevalence of night cough was high at 33.5%, and the most common associated characteristic was a family history of asthma reported by almost 60% of the responders. Over one-third of the children had a history of hay fever/eczema.

Children for whom wheezing in the past 12 months was reported were asked to respond to related questions on the nature and frequency of wheeze. The responses, stratified by gender, are shown in Table 3. Of the 490 children for whom wheezing was reported, 471 responded to a related question on the number of attacks of wheezing in the previous 12 months; 11.9% reported none, over half of the children (55.2%) had between one and three attacks of wheezing, almost a quarter (24.8%) had between four and 12 attacks, and 8.1% had suffered >12 attacks of wheezing in the past 12 months. One-fifth (20.6%) of the 470 respondents to question 4 had experienced wheeze severe enough to limit speech. Out of 475 respondents, almost half (47.8%) were woken by an attack of wheezing in the past 12 months. Wheeze was associated with exercise for over two-thirds (68.6%) of the 474 respondents to a question on exercise-related wheeze. There were no statistically significant gender differences in the frequency or characteristics of wheeze.

The association between respiratory symptoms/features of asthma and each characteristic associated with asthma, after adjustment for gender and for the other characteristics, is shown in Table 4. There was a statistically significant increase in risk of wheeze and night cough for children for whom any of the associated characteristics was reported. Having suffered an asthma attack in the past 12 months, or having used asthma medication was significantly associated with having had >3 courses of antibiotics for chest, ear or throat

Table 4. Adjusted odds ratios and 95% confidence intervals for respiratory symptoms, features of asthma and characteristics of respiratory disease among questionnaire responders (n = 2414).

	Characteristics associated with respiratory disease			
Symptom/feature of asthma	>3 courses antibiotics*‡	Hay fever or eczema	Family history of asthma	≥1 smoker in household
Wheeze	3.79 [2.80-5.13]	2.79 [2.22-3.50]	2.27 [1.76-2.93]	1.27 [1.01-1.59]
Night cough	3.70 [2.75-4.98]	2.20 [1.82-2.67]	1.81 [1.48-2.21]	1.45 [1.20-1.75]
Asthma attack	3.94 [2.75-5.64]	2.94 [2.13-4.07]	1.91 [1.33-2.73]	0.78 [0.57-1.07]
Asthma medication	3.22 [2.34-4.41]	3.15 [2.45-4.04]	2.20 [1.66-2.92]	0.97 [0.76-1.24]

*in past 12 months; ‡ for chest, ear or throat problems

Table 5. Atopic sensitisation with gender differences and associated odds ratios (OR) and 95% confidence intervals (CI).

	Total % (n)	Boys % (n)	Girls† % (n)	OR [95% CI]	p for chi² test
Atopic	37.1 (352/949)	43.0 (232/540)	29.3 (120/409)	1.81 [1.38-2.38]	<0.01
House dust mite	25.1 (238/949)	28.9 (156/540)	20.0 (82/409)	1.62 [1.19-2.20]	<0.01
Cat	12.1 (115/949)	13.7 (74/540)	10.0 (41/409)	1.43 [0.95-2.14]	0.09
Dog	7.9 (75/949)	9.6 (52/540)	5.6 (23/409)	1.79 [1.08-2.98]	0.02
Grass	20.4 (193/949)	25.4 (137/540)	13.7 (56/409)	2.15 [1.53-3.03]	<0.01
Alternaria	0.4 (4/948)	0.4 (2/539)	0.5 (2/409)	N/A	N/A

† Reference group; N/A Not applicable due to small numbers

Table 6. Prevalence of respiratory symptoms and features of asthma by atopic status with odds ratios (OR) and 95% confidence intervals (CI).

	% (n) with respiratory symptoms		Adjusted OR [95% CI]	p for chi² test
	Atopic	Non Atopic		
Wheeze in the past 12 months*	41.8 (147/352)	13.8 (82/595)	3.63 [2.54-5.17]	<0.001
Night cough in the past 12 months*	49.3 (171/347)	30.3 (179/590)	2.07 [1.51-2.83]	<0.001
Asthma attack in the past 12 months*	21.8 (75/344)	5.8 (34/588)	3.47 [2.15-5.58]	<0.001
Asthma medication*	35.8 (125/349)	10.8 (64/594)	3.54 [2.44-5.14]	<0.001

*adjusted for gender, household smoking, >3 courses antibiotics, history hay fever/eczema and family history of asthma

problems, with a history of hay fever or eczema and with a family history of asthma.

Table 5 shows the prevalence of atopic sensitisation. Over one third of the children tested were sensitised to at least one of the aeroallergens examined. Boys were significantly more likely to be sensitised than girls (OR 1.81, 95% CI 1.38-2.38), and allergy to house dust mite, dog and grass was significantly more common among boys whilst there were no statistically significant gender differences for cat allergy. Only four children were sensitised to *Alternaria*.

Symptoms and features of asthma were significantly more common among atopic children than non-atopic children (Table 6).

Discussion

This paper describes the prevalence of respiratory symptoms, features of asthma, and characteristics associated with respiratory disease, in 6-11 year olds in the north west of England. The questionnaire used contained the core ISAAC questions for respiratory symptoms in the previous 12 months[6] and was based on the WYCAP questionnaire. The WYCAP questionnaire has been validated for use in children aged between 5 and 15 years.[8] Skin prick tests were carried out to identify the prevalence of atopic sensitisation.

The 47.5% response rate was lower than had been anticipated at the outset of the study. The letter accompanying the questionnaire stated that the study was investigating

asthma and allergy in children and although it did state that responses from children who did *not* have asthma or allergies were also important, this emphasis may have influenced potential participants' perception of the study and its relevance to them. Evidence that parents of children with respiratory symptoms may have been more inclined to respond was suggested by the higher number of male responders compared to non-responders, given that the prevalence of respiratory symptoms is said to be higher in boys.[11]

The study team was unknown to the study population and this might have influenced inclination to participate, although a steady decline in response rates was also noted in WYCAP studies even though the questionnaires were accompanied by a letter from the recipient's GP practice.[12,13] Decreasing response rates were also reported in other community studies in the UK and worldwide[14-16] and so it may be that the low response rate in this study reflects current attitudes to research participation rather than sample bias.

A possible explanation for the finding that non-responders were likely to be younger than responders is that the questionnaires were sent out over a 21-month period with the oldest children receiving their questionnaire first; consequently, parents of older children will have received their questionnaire closer to the time that they were informed of the study. Males and children who (according to the MANCAS study definition) had asthma and/or wheezing were more likely to have participated in the skin prick test phase of the study. The higher participation rate in the skin prick test phase of males and children with respiratory symptoms might, again, reflect a greater tendency amongst parents of children with respiratory symptoms to participate in the study.

Thus, a limitation of this study may be the increased participation of children with respiratory and/or atopic symptoms leading to an overestimation of prevalence in this population. However, although this study reports a high prevalence of respiratory disease in children in Manchester, it is not dissimilar to prevalences detected in other studies in the UK. Studies in the north east of England reported a prevalence of 18.0% for wheeze in the past 12 months, 27.7% for night cough and 22.7% for asthma in 6-7 year olds[17] and respective prevalences of 19.9%, 20.4% and 22.3% for 13-14 year olds.[18] In a study of 10 year olds on the Isle of Wight, the 12-month prevalence of wheeze was 18.9%[19] and a study in the south of England also reported prevalence of 18.9% for wheeze in the past 12 months and 25.3% for night cough in 7-9 year olds.[20] The WYCAP study, carried out in one area of Manchester, included children up to the age of 15 years and, from a 2001 survey, reported a prevalence of 22% for wheeze in the previous 12 months, 25% for night cough and 19% for asthma.[12] Phase 3 of the ISAAC study reported a prevalence of 20.9% for wheeze in 6-7 year olds and 24.7% in 13-14 year olds in the UK.[21]

Although the age of children in this study ranged from 6 -11 years, age-specific prevalences were not calculated since 92% of the children were either seven or eight years old at the time of questionnaire response so stratification by age was inappropriate.

The higher prevalence of wheeze in boys noted in this study was in keeping with gender differences reported for children in similar age groups in other studies.[19,22,23] There were no statistically significant gender differences in the severity of wheeze, suggesting that although boys are more likely to wheeze than girls, amongst children who do experience wheeze severity is similar in both males and females.

Over 10% of the children had more than three courses of antibiotics in the preceding 12 months and the risk of wheeze, night cough, asthma attack and asthma medication was greatest for these children. This might reflect an increased risk of asthma in children who suffer repeated respiratory tract infections, an increased risk of respiratory infections in children with asthma, or alternatively might reflect inappropriate antibiotic prescribing for children presenting to general practitioners with asthma symptoms.[24,25]

Atopy and a family history of asthma are established risk factors for asthma,[26,27] supporting the increased risk identified for these factors in this study.

Almost half (46.3%) of the children lived in a household with smokers. Living with one or more smokers was associated with an increased risk of wheeze and night cough in this study. Previously reported associations between smoking and doctor-diagnosed asthma have been limited to certain subgroups. An Italian study only identified an increased risk of asthma for children if 40 or more cigarettes are smoked per day in the home and only in one of three surveys in the study.[28] Maternal but not paternal smoking was significantly associated with asthma in UK studies.[17,29] However, several studies identified significant associations between wheeze and exposure to cigarette smoke[17,18,20,22] and it may be that even if exposure to cigarette smoke does not directly cause asthma, it does increase expression of respiratory symptoms.

The prevalence of atopic sensitisation in this study was higher than that identified in another UK study where the prevalence amongst 10 year olds was 26.9%[30] but much lower than the 62.7% reported in a UK study of 7-14 year olds, all of whom had asthma.[31]

An advantage of the MANCAS study was its large population of children, all born in the same hospital but living in various areas of a large city with diverse socio-economic and social groups. Also, the children were all aged at least six years old at the time of their participation in the study; this increases the likelihood that symptoms were related to

asthma, since wheezing in children younger than five years old might indicate other wheezing illnesses.

This study identified a high prevalence of respiratory symptoms, and characteristics commonly associated with respiratory disease in children were observed. Similar high prevalences have been reported in other UK studies. Thus, it would appear that despite the low response rate, this study is comparable with other UK studies and can, in the current climate of declining response rates, provide a baseline for monitoring future trends in the prevalence of respiratory diseases in schoolchildren.

Conflict of interest declaration

Dr M Linehan received a British Thoracic Society/Schering-Plough Travel Fellowship bursary of £750 in 2003. Dr P Frank has no conflict of interest. Dr R Niven has no conflict of interest. Dr M Hazell received a British Thoracic Society/Schering-Plough Travel Fellowship bursary of £750 in 2002, a fee for speaking from Boehringer Ingelheim and honoraria for providing training in evidence based practice and research methods for Education for Health. J Morris has no conflict of interest. Dr H Francis received a travel grant from Novartis. Dr T Frank received fees from GSK, Boehringer Ingelheim, Schering Plough and AstraZeneca for speaking; funds for research from GSK, Boehringer Ingelheim, MSD and Schering Plough; funds for consultancy from GSK and Pharmacia and travel grants from GSK, Boehringer Ingelheim, AstraZeneca, Chiesi Pharmaceuticals and MSD.

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Appendix A. Questionnaire

To be completed by the Parent or Guardian – Please tick the appropriate box

What is your child's date of birth? ☐

Is your child FEMALE ☐ MALE ☐

1. Has your child had wheezing or whistling in the chest **in the last 12 months?** NO ☐ YES ☐
   IF 'NO' PLEASE GO TO QUESTION 7
2. How many attacks of wheezing has your child had **in the last 12 months?**
   None ☐ 1 to 3 ☐ 4 to 12 ☐ More than 12 ☐
3. **In the last 12 months**, how often, on average, has your child's sleep been disturbed due to wheezing?
   - Never woken with wheezing ☐
   - Less than one night per week ☐
   - One or two nights per week ☐
   - More than 2 nights per week ☐
4. **In the last 12 months**, has wheezing ever been severe enough to limit your child's speech to only one or two words at a time between breaths? NO ☐ YES ☐
5. Has your child been woken by an attack of wheezing in the last 12 months? NO ☐ YES ☐
6. In the last 12 months, has your child's chest sounded wheezy during or after exercise? NO ☐ YES ☐
7. In the last 12 months, has your child had a dry coughat night, apart from a cough associated with a cold or chest infection NO ☐ YES ☐
8. Has your child had more than 3 courses of antibiotics for respiratory infections (chest, ears or throat) **in the last 12 months?** NO ☐ YES ☐
9. Is your child currently taking any medicine for asthma? (including inhalers, aerosols or tablets) NO ☐ YES ☐
10. Has your child had an attack of asthma **in the last 12 months?** NO ☐ YES ☐
11. Has your child had hay fever or eczema NO ☐ YES ☐
12. Has anyone in your child's family (parents, grandparents, sisters or brothers had asthma? NO ☐ YES ☐
13. How many adults live in your house? ☐

    How many of these adults smoke? ☐

PLEASE TURN OVER

Appendix A. Questionnaire continued

14. How many children live in your house? ☐

    How many of these children are older than the child for whom you have answered this questionnaire? ☐

15. What is **your child's** ethnic group?
    Please tick as appropriate (listed in alphabetical order)

- Bangladeshi ☐
- Black-African ☐
- Black-Caribbean ☐
- Black-other ☐
  - Please describe ☐
- Chinese ☐
- Indian ☐
- Pakistani ☐
- White ☐
- Any other ethnic group ☐
  - Please describe ☐

In line with other Health Authorities in the UK, we are required to collect information on the ethnic origin of the children and families for whom we provide services. We collect this information to ensure that we are providing services fairly and equitably to all those who need them.

THANK YOU FOR YOUR HELP

PLEASE RETURN THIS FORM TO US IN THE REPLY-PAID ENVELOPE