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Symptoms of Asthma: Comparison of a Parent-Completed Retrospective Questionnaire With a Prospective Daily Symptom Diary

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Summary. In a study of the effects of indoor air pollution on the respiratory health of children in Newcastle, Australia, parental reports of symptoms experienced by children over the previous 12 months were compared with a prospective record of symptoms of cough and wheeze. Parents of 390 children aged 8–11 years completed a questionnaire about child and family respiratory health, which was used to assign children to one of four symptom groups: Wheeze (two or more attacks of wheezing in the last 12 months), Chest-Colds (two or more chest-colds in the last 12 months without wheezing), Cough Alone (a dry cough at night, without a cold or chest infection, that lasted for more than 2 weeks), or Control (none). A balanced sample of children (n = 139) was invited to participate further by completing lung function tests, atopy testing, and keeping a daily diary of peak expiratory flow (PEF) and symptoms of cough and wheeze over a 7-week period. Valid data for the daily diary were provided by 66/85 (77.6%) of participants who commenced this stage (47.5% of the 139 invited to participate). The Wheeze group reported significantly more subsequent wheeze (median 16.8% of days) than the other three groups (median 0% of days). Parent reports of asthma-like symptoms over the previous 12 months were consistent with the subsequent experience of symptoms recorded in a daily diary. **Pediatr Pulmonol. 2003; 36:509–513.**

Key words: asthma; childhood; symptoms; questionnaire; diary.

INTRODUCTION

Questionnaires completed by parents are widely used in epidemiological research as a proxy measure of asthma among children. The International Study of Asthma and Allergies in Childhood (ISAAC), researching worldwide variations in the prevalence of asthma, is one example of this approach.[1] The value of such studies depends on how well the proxy measure reflects the true prevalence of asthma. Recall of symptoms is subject to forgetting (recall error) and bias. A number of studies validated parent-completed questionnaires on child respiratory symptoms against other measures, such as clinical evaluation by a pediatrician based on a history,[2] a history with physical examination,[3] and measures such as spirometry.[4] One potential problem with validating a parent report against the child's history is that the parent provides recalled information on both the questionnaire and in the clinical setting. Thus any recall problems are reflected in both sets of data.

While a number of studies validated symptoms against clinical measures, relatively few studies directly compared questionnaires to prospectively recorded symptom frequencies using a daily diary. Symptoms recorded prospectively in a daily diary are less likely to suffer from recall bias than retrospective symptoms recorded in a

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questionnaire.[5] Here we report on the relationship between retrospective respiratory symptoms as reported by parents in a self-administered questionnaire and subsequent symptoms of cough and wheeze recorded by children and/or parents in a daily diary.

MATERIALS AND METHODS

Study Population

Subjects were drawn from five primary schools in two industrial/residential suburbs of Newcastle in the lower Hunter region of New South Wales, Australia. In 1997, primary schoolchildren in years 3, 4, and 5 (aged 8–11 years) were given a consent form and questionnaire to take home for their parents to complete. A second mail-out of the questionnaire was made to nonresponders after 3 weeks. The questionnaire was used to assess symptoms retrospectively. On the basis of their parents' responses to the questionnaire, some children were selected to participate in a prospective study in which the occurrence of wheeze and/or cough was recorded daily.

Retrospective Symptoms

Children with recent, frequent respiratory symptoms and a control group of children were chosen on the basis of the 12-month retrospective questionnaire. The questionnaire was based on one used previously in the Hunter region,[6] and the questions regarding wheeze symptoms and dry cough (questions 1 and 3 below, respectively) were directly comparable to ISAAC written questionnaire items.[7] The chest-cold question was developed for this study. The questions used were as follows:

1. Has your child ever had wheezing or whistling in the chest at any time in the past?
2. How many attacks of wheezing has your child had in the last 12 months?
3. In the last 12 months, has your child had a dry cough at night apart from a cough with a cold or chest infection?
4. Has this cough lasted for more than 2 weeks?
5. Has your child ever had colds that go to the chest?
6. In the last 12 months, how many chest-colds did your child have?

The children were allocated to one of four survey-reported symptom groups as follows. The Wheeze group consisted of children reported as having two or more attacks of wheezing in the last 12 months, irrespective of other symptoms. Children in the Chest-Cold group were reported to have two or more chest-colds in the last 12 months, but did not have wheeze as previously defined. The Cough Alone group included those children reported to have had a dry cough at night (without a cold or chest infection) that lasted for more than 2 weeks. The Control group consisted of all children ineligible for any of the three symptom groups.

Subsequent Symptoms

A sampling ratio was applied to balance the numbers of children in each symptom group to participate in the prospective phase of the study. The children and their parents were shown how to complete their diaries and were followed up every 2 weeks, either by telephone or by personal visit to the home. Symptom severity was scored separately for cough and wheeze each morning and evening, using the following scoring system: 0, absent, none at all; 1, barely noticeable, hardly aware of any discomfort; 2, very mild discomfort; 3, mild discomfort; 4, moderate amount of discomfort; 5, a great deal of discomfort; and 6, most severe discomfort ever.

Statistical Analysis

Cases were excluded from the analysis if less than 70% of the 56 days of the diary were completed. The first week of each diary was also excluded from the analysis to remove any learning effect associated with filling in the diary.

The frequency of subsequent symptoms among each of the 12-month survey-reported symptom groups was calculated. The frequency of symptoms for each child was calculated as the number of mornings, or evenings, where the symptom scored more than zero expressed as a percentage of total number of days completed in the diary. Since frequency of cough and wheeze were not normally distributed, nonparametric statistics were used. The Kruskal-Wallis statistic was used to test for an overall difference between groups, and then pairwise comparisons were made using Mann-Whitney U-tests. All statistical analyses were performed using SAS version 6.1.

RESULTS

Study Population

Of the 569 questionnaires sent home with the children, 390 questionnaires were returned (68%). To obtain balanced group sizes, all of the Cough group and the Wheeze group were invited to participate in the next stage of the study, while the Chest-Cold group and the Control group were randomly sampled at a ratio of 1 in 2. Of the 139 children invited to participate in the second stage, 85 (61%) agreed to take part and completed tests for atopy and lung function. Consent rates were reasonably similar across the symptom groups: Controls, 65% (26/40); Wheeze, 63% (29/46); Cough, 57% (12/21); and Chest-Cold, 56% (18/32).

Valid diary data for 70% or more of the days were returned by 66 children, and these were included in the

present analyses. The diary completion rate varied across symptom groups, with 16/29 (55.2%) of the Wheeze group included in the analyses, compared with 16/18 (88.9%) of the Chest-Cold group, 9/12 (75%) of the Cough group, and 25/26 (96.2%) of the Control group. However, completers and noncompleters were not significantly different in terms of sex (chi-square = 1.09, df = 1, $P = 0.03$) or age ($t = -0.761$, df = 83, $P = 0.45$).

Subsequent Symptom Levels Across the Four Groups

Subsequent Experience of Wheeze

The Wheeze group experienced a significantly higher percentage of mornings with subsequent wheeze than the other three groups, i.e., Cough ($P < 0.019$), Chest-Cold ($P < 0.0007$), and Control ($P < 0.0001$) (Fig. 1). Among those children whose parents reported two or more episodes of wheeze in the last 12 months (the Wheeze group), subsequent wheeze was reported in a median of 16.8% of mornings compared with a median of 0% of mornings for the other three groups. The same pattern of findings was observed for percentage of evenings with wheeze (Fig. 1) (Wheeze median = 8.7; Cough median = 0, $P < 0.009$; Chest-Cold median = 0, $P < 0.0003$; Control median = 0, $P < 0.0001$). With a Bonferroni correction for three comparisons ($P < 0.017$), these findings remain significant, with the exception that the comparison between the Cough and Wheeze groups on subsequent morning wheeze was not significant.

Subsequent Experience of Cough

Although all four survey-reported symptom groups experienced subsequent cough (Fig. 1), the questionnaire tended to distinguish between those children experiencing a relatively high level of subsequent cough (Wheeze and Cough groups) and those who did not (Chest-Cold and Control groups). The Wheeze group experienced a significantly higher percentage of mornings with cough (median = 38) than the control group (median = 9.8, $P < 0.022$), as did the Cough group (median = 61.7, $P < 0.01$). The Cough group experienced a significantly higher percentage of mornings with cough than the Chest-Cold group (median = 23.6, $P < 0.039$). The Wheeze and Cough groups experienced a similar frequency of morning cough, as did the Control and Chest-Cold groups. The same pattern of findings was observed for percentage of evenings with cough (Fig. 1) (Control median = 7.8; Wheeze median = 38.5, $P < 0.011$; Cough median = 64.7, $P < 0.01$; Chest-Cold median = 23.5 (vs. cough), $P < 0.047$). With a Bonferroni correction for three comparisons ($P < 0.017$), the Cough and Chest-Cold groups did not differ statistically on prospective cough (morning or evening), and the experience of subsequent morning cough between the Wheeze and Control groups was also not significant.

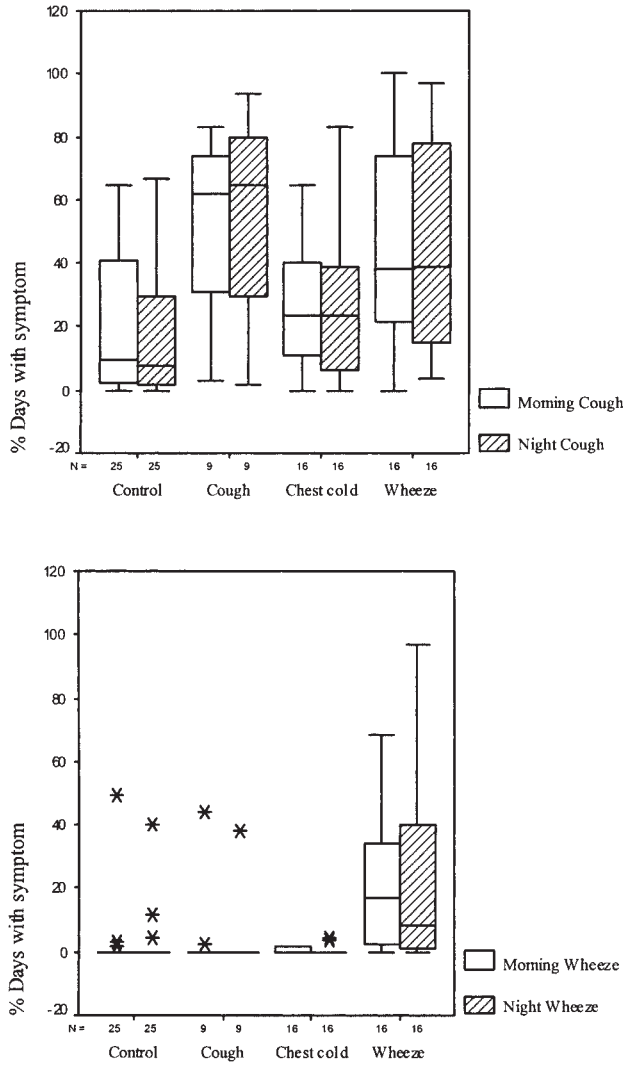

Fig. 1. Subsequent symptom frequency as recorded in daily diary by children allocated to one of four symptom groups as defined by a parent-completed retrospective questionnaire. *, outliers; whiskers, highest and lowest data excluding outliers.

DISCUSSION

This study demonstrated that a parent-completed questionnaire involving retrospective recall of respiratory symptoms was consistent with the subsequent experience of symptoms as recorded by children and parents in a daily diary. In particular, the questionnaire and criteria used to allocate children to the four symptom groups successfully distinguished between those children experiencing subsequent wheeze (Wheeze group) and those who did not (Control, Chest-Cold, and Cough groups).

These results are in accordance with a number of other studies that found children with survey-reported wheeze to have increased respiratory problems, such as more breathing problems;[8] lower forced expired volume in 1 sec (FEV_1); greater peak flow variability and increased severity (although not ''chronicity'') of respiratory symptoms;[9] more severe peak flow drops (but not greater frequency or duration of acute episodes of decreased peak flow);[10] increased chronic respiratory morbidity, including a higher percentage of symptomatic days and higher coefficient of variation of peak expiratory flow (PEF); and increased lower respiratory tract (LRT) episode severity (but not LRT episode rate).[11]

The role of cough as an indicator of asthma has been much debated.[11,12] While chronic cough is sometimes considered an underdiagnosed form of asthma,[12] other studies expressed concern about overdiagnosis of asthma based on chronic cough alone.[11] Differences between children with cough alone and those with wheeze (with or without cough) were noted.[9,11,12] Our study confirms that there is some overlap, or interrelationship, between the symptoms of wheeze and cough, as it showed that the Wheeze group also experienced a moderately high frequency of subsequent cough. However, the only good indicator of subsequent wheeze was parental report of wheeze in the past. That is, survey-reported chronic cough alone was not a good indicator of subsequent wheeze.

While the current study and those cited above demonstrated that children with survey-reported wheeze do experience different subsequent respiratory symptoms, at least two studies suggested that other markers may be more accurate. Toelle et al.[8] found that 28.9% of children reported to have had wheeze or exercise wheeze in the previous 12 months did not have bronchial hyperresponsiveness at baseline clinical testing. They concluded that using questionnaires alone to characterize children with asthma would be less accurate than including a bronchial histamine challenge. Further, Pattemore et al.[11] found that a recorded diagnosis of asthma, obtained by reviewing general practitioners' notes for each child, was a better marker of ongoing respiratory symptoms than survey-reported wheeze among children with cough or wheeze. However, implementation of either of these measures in large-scale, population-based epidemiological studies is logistically more difficult than applying questionnaire measures.

One of the limitations of the current study is the small sample size. However, this is more likely to be associated with a type II error (incorrectly concluding a lack of association). It is less likely that the positive associations observed are a result of the sample size. While the low participation rate is not atypical for respiratory diary studies,[13,14] the impact of this on the external validity of the study is difficult to determine. A further limitation of the study is that the time periods being compared do not overlap. It should also be noted that the validity of the daily diary is unknown, and thus the study addresses the consistency between two different types of symptom reporting by participants.

Another point to note is that the conclusions may have been affected by selection bias, as a lower percentage of children in the Wheeze group, and to a lesser extent in the Cough group, completed their diaries than children in the Control group. One possible explanation is that greater time and effort would be required of children experiencing symptoms to keep their diary. Consistent with this argument, there was a general tendency across symptom groups for the percentage of noncompleters to increase as the percentage of days with subsequent symptoms increased. Although the Cough group may have experienced a greater proportion of days with symptoms than the Wheeze group, the latter group could experience both wheeze and cough, effectively doubling the effort required to complete the diary. This type of selection bias may have led to the frequency of prospective symptoms in the Wheeze group being underestimated. If this were so, the conclusions of the study would be strengthened, since differences between symptom groups may actually be stronger than those reported here.

The results of this study demonstrate that retrospective questionnaire responses can reliably distinguish children with frequent wheeze and cough from controls and children with other respiratory symptoms. In particular, the absence of report of wheeze, even if cough is reported, is relatively specific. Subsequent wheeze was rare among the groups whose parents had not reported wheeze in the retrospective survey.

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REFERENCES

1. Anonymous. Worldwide variations in the prevalence of asthma symptoms: the International Study of Asthma and Allergies in Childhood. Eur Respir J 1998;12:315–335.
2. Ronmark E, Jonsson E, Platts-Mills T, Lundback B. Different pattern of risk factors for atopic and nonatopic asthma among children—report from the Obstructive Lung Disease in Northern Sweden Study. Allergy 1999;54:926–935.
3. Glasgow NJ, Ponsonby AL, Yates RE, McDonald T, Attewell R. Asthma screening as part of a routive school health assessment in the Australian Capital Territory. Med J Aust 2001;174:384–388.
4. Wolf RL, Berry CA, O'Connor T, Coover L. Validation of the brief pediatric asthma screen. Chest 1999;116 [Suppl]:224–228.
5. Stewart AW, Asher MI, Clayton TO, Crane J, D'Souza W, Ellwood PE, Ford RPK, Mitchell EA, Pattemore PK, Pearce N.

The effect of season-of-response to ISAAC questions about asthma, rhinitis and eczema in children. Int J Epidemiol 1997;26: 126–136.
6. Lewis PR, Hensley MJ, Wlodarczyk JH, Toneguzzi R, Wesley-Wise VJ, Dunn T, Calvert D. Outdoor air pollution and children's respiratory symptoms in the steel cities of New South Wales. Med J Aust 1998;169:459–463.
7. Gibson PG, Henry RL, Shah S, et al. Validation of the ISAAC video questionnaire (AVQ3.0) in adolescents from a mixed ethnic background. Clin Exp Allergy 2000;30:1181–1187.
8. Toelle BG, Peat JK, Salome CM, Mellis CM, Woolcock AJ. Toward a definition of asthma for epidemiology. Am Rev Respir Dis 1992;146:633–637.
9. Clough JB, Williams JD, Holgate ST. Effect of atopy on the natural history of symptoms, peak expiratory flow and bronchial responsiveness in 7- and 8-year old children with cough and wheeze: a 12 month longitudinal study. Am Rev Respir Dis 1991; 143:755–760.
10. Clough JB, Holgate ST. Episodes of respiratory morbidity in children with cough and wheeze. Am J Respir Crit Care Med 1994;150:48–53.
11. Pattemore PK, Lampe FC, Smith S, Clough JB, Holgate ST, Johnston SL. Asthma survey items as predictors of respiratory problems in children 2 years later: a longitudinal study. Eur Respir J 1999;14:650–658.
12. Timonen KI, Nielsen J, Schwartz J, Gotti A, Vondra V, Gratziou K, et al. Chronic respiratory symptoms, skin test results, and lung function as predictors of peak flow variability. Am J Respir Crit Care Med 1997;156:776–786.
13. Sharek PJ, Mayer ML, Loewy L, Robinson TN, Shames RS, Umetsu DT, Bergman DA. Agreement among measures of asthma status: a prospective study of low-income children with moderate to severe asthma. Pediatrics 2002;110:797–804.
14. Mitchell H, Senturia Y, Gergen P, et al. Design and methods of the National Cooperative Inner-City Asthma Study. Pediatr Pulmonol 1997;24:237–252.