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A M E R I C A N C O L L E G E O F



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Reliability of a Respiratory History Questionnaire and Effect of Mode of Administration on Classification of Asthma in Children*

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Because there is no consensus definition of asthma for epidemiology, we have examined the reliability of a questionnaire and the effect of its mode of administration on classification of asthma in children. A symptom history questionnaire was parent self-administered and then re-administered within three months by a nurse. The questions of diagnosed asthma, cumulative wheeze, and recent wheeze (wheeze in the previous 12 months) were more repeatable than questions of night cough, but 7 percent of children changed diagnosed asthma category, 13 percent changed cumulative wheeze category, and 9 percent

changed recent wheeze category at second questionnaire. Because the numbers who changed from symptom positive to negative roughly equalled the changes from negative to positive, prevalence estimates were not affected. Methods of measuring asthma with greater precision are urgently needed. Because of reporting bias, epidemiologic information collected by current questionnaires should be treated with some caution. (*Chest* 1992; 102:153-57)

BHR = bronchial hyperresponsiveness; CI = confidence interval

The problem of how to measure asthma in populations has yet to be solved. To date, measurement of the presence of asthma has primarily relied upon the use of questionnaires to collect information of respiratory symptoms or asthma diagnosed by a doctor, although many recent population studies have included a measure of bronchial responsiveness as an objective measure of airway abnormality.

Because of the subjective nature of asthma symptoms, questionnaire estimates may lack precision. There are no standard criteria for diagnosing asthma, which is often underrecognized in the community,¹ and therefore, questionnaire responses tend to reflect local diagnostic practices. Questions of wheeze history are subject to differences in interpretation of the term, and because a large percentage of children experience respiratory symptoms at some time during childhood,²⁻⁵ such questions cannot adequately discriminate between trivial symptoms and clinically important asthma. On the other hand, measures of bronchial responsiveness are objective but the presence of bronchial hyperresponsiveness (BHR) cannot be regarded as a "gold standard" for asthma because it does not discriminate absolutely between symptomatic and asymptomatic groups.²⁻⁴

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To determine the extent to which the mode of administration of a symptom questionnaire affects reporting of symptoms and the classification of children according to different asthma criteria, we conducted a study of a population sample of school children in which we measured respiratory symptom history using a previously tested parent self-administered questionnaire.² Within three months, an identical questionnaire was administered to parents by a nurse who explained the questions. Between the times of the two questionnaires being administered, bronchial responsiveness to histamine was measured. In this article, we report responses to the two questionnaires and their effect on different classifications of asthma in children.

METHODS

Population

In 1988, all children aged eight to ten years at seven primary schools in the Villawood area of Sydney were invited to participate in a study of asthma prevalence, and 440 children were enrolled.⁶ The data from 312 children whose parents gave informed consent to a home interview are reported here.

Respiratory Symptom History

At enrollment, a previously tested parent self-administered questionnaire² was used to measure information about respiratory symptoms which had occurred since birth. The questions were as follows: Has your child ever wheezed (a whistling noise that comes from the chest)? Has your child ever had attacks of wheezing during or after exercise? Has your child ever had a dry cough at night apart from a cough associated with a cold or a chest infection? Has your child ever been diagnosed as having asthma by a doctor or at a hospital? Following each question, if the answer was "yes," parents were asked, "How long since the last wheeze/night cough/asthma

attack occurred?"

In the three months following collection of the self-administered questionnaire, an identical questionnaire was administered at a home interview by a nurse who explained the questions to parents. In the majority of cases, the same parent answered both questionnaires. The nurse was not aware of the purpose of readministering the second questionnaire and did not have access to the initial questionnaire or other baseline data.

Bronchial Responsiveness

Children had their bronchial responsiveness measured at their school in the period between questionnaires. Lung function was measured using a Vitalograph dry spirometer, with the subject standing. Forced expiratory maneuvers were repeated until two measures of FEV₁, reproducible to within 100 ml, were obtained after which FEV₁ was recorded a second time following inhalation of saline solution.

Each child had bronchial responsiveness to histamine measured on three consecutive days using the rapid method.⁷ Children who had taken a beta sympathomimetic aerosol within 6 h or theophylline compounds within 12 h were asked to withhold further medication and to return at least 4 h later for testing. The challenge was carried out with doubling doses of histamine from 0.03 to 7.8 μmol and was stopped if the FEV₁ fell by 20 percent or more or when the highest dose had been administered. Salbutamol aerosol was administered to aid recovery when necessary.

Dose response curves for each child were obtained by plotting the percentage of change in FEV₁ from the postsaline solution value against the logarithm of the dose of histamine. From this curve, the dose of histamine that caused a 20 percent fall in FEV₁ (PD₂₀ FEV₁) was estimated by interpolation. Children with a fall in FEV₁ of 20 percent or more on any of the three challenge days were classified as having BHR.

Definitions

Children who were reported to have had any of the three symptoms of wheeze, exercise wheeze, or night cough at any time were classified as having "any respiratory symptom." Children with both BHR and a positive response to the question of wheeze ever were classified as having "symptomatic BHR." Symptoms which had occurred in the 12 months prior to study were classified as recent symptoms. Children with a positive response to the question of asthma ever diagnosed by a doctor or at a hospital were classified as having diagnosed asthma.

Statistical Methods

Data were analyzed using the statistic computer package program SAS. Except where stated, the prevalence of symptoms reported

by questionnaire is the cumulative prevalence from birth to the enrollment time and is given with the 95 percent confidence interval (CI).

Because the prevalence of positive responses to different questions varied, the repeatability of the questions was assessed using the average correct classification rate⁸ in addition to the kappa statistic. The relation between respiratory symptoms and the presence or absence of BHR was assessed by measures of sensitivity (proportion of children with BHR who have a positive questionnaire response) and specificity (proportion of children with normal responsiveness who have a negative questionnaire response). Positive predictive value, that is proportion of symptom positive children who had BHR, was also calculated to determine the likelihood of children with symptoms having BHR.

RESULTS

A total of 312 children age 8 to 10 years had complete questionnaires administered by both parent and nurse. In this group with duplicate questionnaires, the prevalence of symptoms was similar to that of the total sample of 440 children (wheeze 26.9 vs 25.7 percent, exercise wheeze 11.2 vs 11.7 percent, night cough 32.7 vs 30.5 percent, respectively) indicating that no sampling bias occurred.

The prevalence of children with a positive response to questionnaire items at each administration is shown in Table 1. The prevalence of diagnosed asthma was the same from each questionnaire. Apart from the question of recent wheeze, prevalence rates of other symptoms were slightly, but not significantly, higher when the questionnaire was nurse-administered. The questions of diagnosed asthma, recent wheeze, and recent exercise wheeze all had a very high average correct classification rate, indicating a high degree of repeatability. Kappa statistic also showed the questions of diagnosed asthma and recent wheeze to have high repeatability with the remaining questions having only moderate repeatability.

Responses to each questionnaire are compared in Table 2. The number of children whose questionnaire response changed from symptom-negative to positive was balanced by a roughly equal number who changed from positive to negative. Changes in response were

Table 1—Prevalence, Average Correct Classification Rate (ACC) and Kappa Value of Cumulative and Recent Respiratory Symptoms*

	Parent Administered, %	Nurse Administered, %	ACC	Kappa
Cumulative symptoms				
Diagnosed asthma	19.6 (15.2, 24.0)	19.6 (15.2, 24.0)	0.96 (0.95, 0.98)	0.78 (0.69, 0.87)
Wheeze	26.9 (22.0, 31.8)	27.9 (22.9, 32.9)	0.93 (0.91, 0.95)	0.67 (0.58, 0.76)
Exercise wheeze	11.2 (7.7, 14.7)	13.8 (10.0, 17.6)	0.93 (0.91, 0.96)	0.44 (0.30, 0.59)
Night cough	32.7 (27.5, 37.9)	35.6 (30.3, 40.9)	0.86 (0.83, 0.90)	0.48 (0.38, 0.58)
Any respiratory symptom	42.3 (36.8, 47.8)	46.8 (41.3, 52.3)	0.86 (0.82, 0.89)	0.51 (0.41, 0.60)
Recent symptoms (in previous 12 months)				
Wheeze	17.3 (13.1, 21.5)	14.4 (10.5, 18.3)	0.95 (0.93, 0.97)	0.65 (0.54, 0.77)
Exercise wheeze	8.0 (5.0, 11.0)	12.5 (8.8, 16.2)	0.94 (0.92, 0.96)	0.41 (0.25, 0.57)
Night cough	26.6 (21.7, 31.5)	30.8 (25.7, 35.9)	0.86 (0.83, 0.89)	0.41 (0.30, 0.52)

*Given for 312 children for whom parent and nurse administered the questionnaire. Figures given with 95 percent confidence interval in brackets below.

Table 2—Percentage of 312 Children Whose Symptom Classification Changed When Questionnaire was Readministered

	Positive, to Negative, %	Negative, to Positive, %	Total Changes, %
Cumulative symptoms			
Diagnosed asthma	3.5	3.5	7.0
Wheeze	6.1	7.1	13.2
Exercise wheeze	4.8	7.4	12.2
Night cough	10.3	13.1	23.4
Any respiratory symptom	9.9	14.4	24.3
Recent symptoms (in previous 12 months)			
Wheeze	3.2	6.1	9.3
Exercise wheeze	7.7	3.2	10.9
Night cough	14.1	9.9	24.0

lowest for diagnosed asthma, where 3.5 percent of children who changed from positive to negative were exactly balanced by 3.5 percent who changed from negative to positive. Recent wheeze and exercise wheeze also had a low change rate. The questions of night cough had the highest change rate.

The change rate was related to the time since the symptoms had last occurred. Of the 41 children who changed cumulative wheeze category, only nine (22 percent) reported having recent wheeze. The percentage of children changing cumulative exercise wheeze and night cough response who had recent symptoms was higher. Of the 38 children who changed cumulative exercise wheeze category, 19 (50 percent) had recent exercise wheeze, and of the 73 children who changed cumulative night cough category, 38 (52 percent) had recent night cough reported.

The proportion of children classified by both cumulative wheeze and BHR responses is shown in Figure 1. From this figure, it appears that few children changed symptom category within BHR classification when the questionnaire was readministered, but 7.1 percent of children who changed from wheeze-negative to positive and was balanced by 6.1 percent who

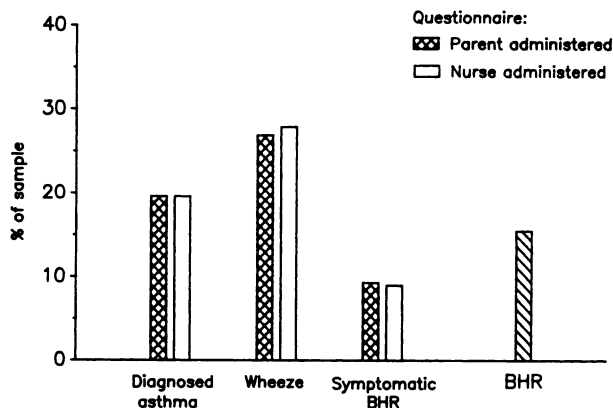


FIGURE 1. Prevalence of children classified by both cumulative wheeze, using a self parent-administered and a nurse-administered questionnaire, and by BHR status.

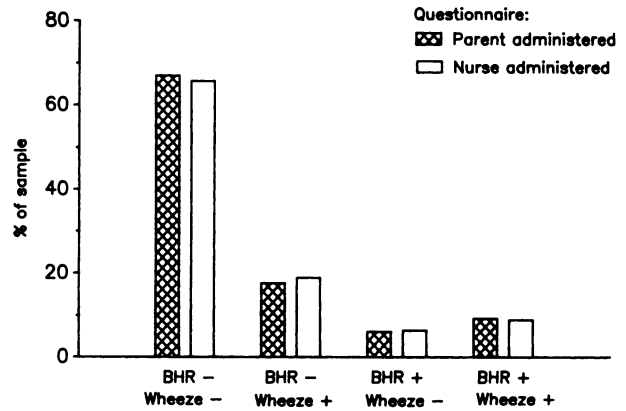


FIGURE 2. Prevalence of four criteria for defining 'asthma' when a self parent-administered and a nurse-administered questionnaire were used.

changed from wheeze-positive to negative (Table 2). The prevalence of diagnosed asthma, cumulative wheeze, and symptomatic BHR from each questionnaire, together with the proportion with BHR, is shown in Figure 2. There were no significant differences in the prevalence of any of the classifications after the questionnaire was readministered.

The issue of how well each symptom question related to BHR is shown in Table 3. The mode of administration of the questionnaire only slightly changed the specificity, sensitivity, and positive predictive value of BHR for any question. The questions of diagnosed asthma, recent wheeze, and exercise wheeze all had high specificity, indicating that a large proportion of children with BHR were positive to these questions. The exercise wheeze question had the highest positive predictive value for BHR. The composite category "any respiratory symptom" had low specificity and a low positive predictive value, but the highest sensitivity.

DISCUSSION

This study confirms that epidemiologic information of asthma which is derived by questionnaires should be interpreted with some caution. We examined the effect of two different modes of administration of a questionnaire specifically designed to collect population study data on the prevalence of asthma classified by different criteria. We found that the mode of administration of the questionnaire did not significantly affect the measured prevalence of any symptom or of symptomatic BHR because, for all questions, the number of children whose questionnaire response changed from negative to positive was roughly balanced by the number who changed from positive to negative. However, the relatively large number of children who changed category highlights the variable nature of questionnaire replies.

When the questionnaire was readministered, the nurse was unaware of the purpose of collecting a

Table 3—Specificity and Sensitivity of BHR

	Specificity		Sensitivity		Positive Predictive Value	
	Parent Administered	Nurse Administered	Parent Administered	Nurse Administered	Parent Administered	Nurse Administered
Cumulative symptoms						
Diagnosed asthma	0.85	0.85	0.44	0.46	0.35	0.36
Wheeze	0.79	0.78	0.60	0.58	0.35	0.32
Exercise wheeze	0.89	0.90	0.35	0.35	0.49	0.40
Night cough	0.70	0.67	0.46	0.48	0.22	0.21
Any respiratory symptom	0.63	0.58	0.73	0.71	0.27	0.24
Recent symptoms (in previous 12 months)						
Wheeze	0.88	0.90	0.44	0.40	0.39	0.42
Exercise wheeze	0.95	0.92	0.27	0.35	0.52	0.44
Night cough	0.77	0.72	0.46	0.48	0.22	0.24

second questionnaire and did not have immediate access to baseline data. Because we wanted to compare responses as they would occur, the nurse did not specifically administer the questionnaire to the same parent who responded the first time. However, in most cases, the same parent answered and the majority of questionnaires were completed by the mother. In the 10 percent of cases where a different parent replied, a differential awareness of symptoms may have contributed to some changes of response.

It is recognized that information on symptoms in children is essentially subjective, in that parents are either aware of the symptoms or are not, and that responses can also be influenced by a wide variety of cultural, sociologic, and psychologic factors.⁹ It is likely that some of the changes in symptom category were attributable to parental misunderstanding of questions of asthma symptoms in their child, especially since over 26 percent of families in this community used a language other than English at home. Most changes involved symptoms that occurred more than 12 months previously, so that parental recall appears to be important because recollection may be vague where symptoms are of a mild nature. Because the period between questionnaires was two to three months, the child's state of health may have changed, and parental concern may have altered accordingly. Also, the presence of the nurse may have influenced parents to consider the questions more carefully, or they may have obtained further information. Such problems are inherent in questionnaire replies. Inconsistent reporting of respiratory symptoms has been found in other studies of children¹⁰ and in adults self reporting their own respiratory illness.¹¹

We found that the questions of diagnosed asthma, recent wheeze, and recent exercise wheeze were the most repeatable with an average correct classification rate only marginally lower than that found at a previous validation when an identical questionnaire was parent self-administered at a one-month interval.² Questions

relating to symptoms that occurred more than 12 months previously did not improve reliability and are likely to only be accurate where the symptoms had a significant impact on the family. Because of this and because children with past symptoms only do not have different bronchial responsiveness than asymptomatic children,¹² questions of past symptoms are probably not useful for measuring asthma prevalence.

The questions of night cough were the least repeatable and had the lowest specificity and positive predictive value. The prevalence of this symptom may have been high because it is often associated with respiratory infections, even though the question was designed to eliminate this possibility with the inclusion of the phrase "in the absence of a cough or cold." In the clinic, night cough is regarded as a classic symptom of clinically important asthma, but physicians are able to question parents closely and elicit more specific information than questionnaires allow. Thus, the questions of night cough are probably not of value in measuring asthma prevalence in populations.

Although questions of respiratory symptoms do not absolutely distinguish BHR from normal responsiveness,¹³ we found that the questions of diagnosed asthma and recent wheeze had high specificity, indicating that many children with BHR had a positive response to these two questions and that the rate of false negatives was low. The positive predictive value of BHR was also high for the question of exercise wheeze but very low for night cough and "any respiratory symptom." It has been suggested that a composite symptom score is better than wheeze for measuring respiratory illness in adults because it incorporates more information.¹⁴ The composite category "any respiratory symptom" was not useful in this sample because it accounted for over 40 percent of children and had a lower specificity than any question by itself. The questions of diagnosed asthma, wheeze, and exercise wheeze appear to be preferable measures of asthma prevalence in regard to their repeatability and their association with BHR.

In the future, epidemiologic research should be able to contribute much information about risk factors for asthma, and by doing so, suggest interventions to potentially reduce prevalence. However, a consensus definition of clinically important asthma is essential before this can be achieved. Until objective measures of abnormal airway function that are both consistent with asthma and suitable for use in population studies are developed, questionnaires will continue to play an important part. To this end, it is clear that a standardized questionnaire to measure the prevalence of clinically important asthma with much greater precision is urgently required. Until then, information collected by questionnaire and in the absence of an objective measure will have a large margin of error associated with it.

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