Papers and Originals

Prevalence, Natural History, and Relationship of Wheezy Bronchitis and Asthma in Children. An Epidemiological Study

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Summary: Three randomly selected groups of 7-year-old schoolchildren in Melbourne with mild wheezy bronchitis, with moderate wheezy bronchitis, and with asthma were compared with a control group, and the patients followed up until 10 years of age. Comparison showed that if there was any significant difference between the study groups and the controls it was usually present in all these study groups. It was considered that children with wheezy bronchitis and asthma were from the same population with the same underlying basic disorder, and that there was a wide spectrum in various aspects of the natural history of the disorder.

About 11% of all children aged 10 years had had some asthmatic episodes. Seventy per cent. of these children ceased having asthma before 10 years of age, while about 30% (3·7% of the whole community) continued to have episodes. There was a highly significant correlation between early age of onset, the frequency of episodes in the first year of symptoms, and the persistence of asthmatic episodes up to 10 years of age.

Ten per cent. of all children with asthmatic episodes continued to have symptoms as severely at 10 years as at an earlier period. In this group the onset of symptoms was almost always before 3 years of age, there was a high frequency of episodes in the first year of symptoms, and boys and girls were affected in the ratio of 7 : 3.

Introduction

Studies of the prevalence and natural history of asthma in children show considerable differences. Estimates of prevalence range from less than 1% up to 12% : 0·8% in Copenhagen schoolchildren aged 7 to 14 years (Frandsen, 1958), 0·85% in a rural and urban community in West Finland (Peltonen *et al.*, 1955), 1·4% in Stockholm schoolchildren aged 7 to 14 years (Kraepelien, 1954), 1·8% in Birmingham schoolchildren aged 6 to 15 years (Morrison Smith, 1961), 2·3% in Isle of Wight children aged 9 to 11 years (Graham *et al.*, 1967), 4·9% in upper social class American children (Arbeiter, 1967), 4·8% in Aberdeen schoolchildren aged 10 to 15 years (Dawson *et al.*, 1969), 12·1% in American children aged 10 to 14 years (Broder *et al.*, 1962), and 7·9% in primary schoolchildren in Tasmania (Gibson, 1966). Reports on the natural history vary with regard to the course of the disorder and to the aetiological factors and their interrelationships (Rackemann and Edwards, 1952 ; Barr and Logan, 1964 ; Buffum and Settipane, 1966 ; Graham *et al.*, 1967 ; Johnstone, 1968). The relationship of asthma to wheezy bronchitis is not clear. A child having episodic nasal discharge, wheezing, and cough will be diagnosed as infective wheezy bronchitis by one physician and as asthma by another.

While these reported differences could be due in part to variation of the prevalence and pattern of asthma in different communities, it is more likely that they are due to variations in the methods of study. There has been no uniformity in sample selection, definition of asthma, method of examination, and follow-up in the various studies, so that comparison is very difficult.

The aims of the present study were to determine the prevalence and natural history of children with asthma and wheezy bronchitis by random sampling of the whole community and by longitudinal study of the selected patients. The first part of the paper (Part A) deals with the relationship of asthma to wheezy bronchitis, the second (Part B) with the natural history and the prevalence of children with asthma and wheezy bronchitis.

Material and Methods

A broad definition of asthma and wheezy bronchitis was accepted—namely, "intermittent or episodic airways obstruction, characterized by breathlessness or noisy breathing of the wheezy type." The patients were obtained by random sampling of 7-year-old primary schoolchildren in Melbourne, a city of 2¼ million population situated in South-east Australia, latitude 37°.

The selection of children was based on the parents' answers to questions relating to a history of asthma, wheezing episodes, and bronchitis, which were specially included in the questionary used by the school medical service in the routine examination of all children in second grade, and on subsequent interview of the parents and examination of the children. A medical officer and two medical social workers from the hospital team worked in conjunction with two medical officers from the School Medical Service, which is responsible for the medical examination of about 85% of primary schoolchildren.

The children were allotted to one of four groups, defined as follows: (1) control group—children who had never wheezed ; (2) "mild wheezy bronchitis" group—children who had wheezed less than five times, the wheezing always being associated with bronchitis, or apparent respiratory infection ; (3) "wheezy bronchitis" group—children who had wheezed five times or more, the wheezing always being associated with bronchitis or apparent respiratory infection ; and (4) "asthma" group—children who had wheezed, the wheezing being unassociated with symptoms of apparent respiratory infection on at least one occasion.

About 30,000 children in grade 2 were available for sampling. The system of sampling was arranged to obtain (1)

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estimates of the community prevalence of each type of wheezing child, and (2) four groups of about 100 children, each representing one of the above categories, for more detailed longitudinal study.

Initially it was planned that all the second-grade children in one-quarter of all the schools served by the school medical service in Melbourne would be examined. All children with "asthma" and with "wheezy bronchitis" and one in four of the children with "mild wheezy bronchitis" were selected for the special study groups. Every fortieth child of those who had never wheezed was included in a control population. After sampling 13 schools it was evident that the prevalence of children with asthma and wheezy bronchitis had been greatly underpredicted in the Melbourne community. To fulfil the second sampling aim of selecting four equal-sized groups for longitudinal study, the selection ratio was changed to include a higher proportion of control children and children with mild wheezy bronchitis in the remaining schools visited. While every child with asthma and wheezy bronchitis was selected as before, every twentieth control child and every second child with mild wheezy bronchitis was now included. This change in the relative selection ratios did not affect the estimation of the community prevalence of each type of wheezing child, which was estimated from the total sampling of each wheezing type. The final subset of the school population in second grade from which the study groups were sampled consisted of the children from 38 schools, being about one-tenth of the available population. This final subset used for the sampling conformed to an original requirement of being a representative subset of the school population with regard to the distribution of socioeconomic and geographic variables.

Four hundred and one selected children with their families were finally included in the longitudinal study. The number of subjects in each category and their mean age and height are shown in Table I.

TABLE I

	No. of Subjects	Mean Age (Years)	S.D. (Months)	Mean Height	S.D.
Control	106	7½	6·4	123 cm.	5·7 cm.
Mild wheezy bronchitis	75	7 5/12	5·8	123 cm.	5·2 cm.
Wheezy bronchitis	107	7 5/12	6·2	123 cm.	5·8 cm.
Asthma	113	7½	6·1	123 cm.	5·6 cm.

The 401 children, one or both parents, and the child's schoolteacher were interviewed and the child was examined clinically. The following special tests were also carried out on each child: vital capacity and forced expiratory volume half and one second; scratch tests for common pollens, dust, and food allergens; nasal and blood eosinophil counts; radiological examination of the chest; and histamine-binding capacity of the serum (Freeman, 1969). Clinical, social, economic, and behavioural data of the family were also recorded.[1] Some 350 characteristics of each child and his family were recorded in standard forms and all data transferred in the form of a digital code on to 80-column punch-cards. Socioeconomic and behavioural data will be published in a subsequent paper.

The children, and their parents, were seen again two and a half to three years after the first examination, at a mean age of 10 years 3 months, when similar clinical and laboratory data were obtained and recorded. Of the original 401 children, 371 attended; 94 of the control group, 75 of the mild wheezy bronchitis group, 100 of the wheezy bronchitis group, and 102 of the asthma group. A more limited questionary by post was obtained from the parents of a further eight children who had moved overseas or interstate. Twenty-two children (5·5%) were not seen—three refused to co-operate and the remainder either could not be traced or repeatedly failed to keep appointments.

[1] Protocols for these data are available on application to the authors.

Part A. Relationship of Asthma to Wheezy Bronchitis

Initially the data were analysed by comparison of the frequency of each clinical feature, and of the distribution of each measurement in the three wheezing groups with the control group. Tables II–X show the relative frequency of a number of these findings—an associated history of recurrent bronchitis, persistent or recurrent nasal discharge, hay-fever, familial history of allergic disorders, skin sensitivity—to one of six standard allergen extracts C.S.L.[2] (mixed grasses, mixed inhalants, and mixed foods, rye grass, house dust, egg albumen), nasal eosinophilia, and serum histamine-binding response.

The Tables are presented in the form of the percentage of children in each group having the particular characteristic; the probability values have been calculated on the actual numbers of children in each category.

TABLE II.—*Relative Incidence of an Associated History of Recurrent Bronchitis at 7 Years of Age*

Control group	38·1%	
Mild wheezy bronchitis	90·5%	P < 0·001
Wheezy bronchitis	97·2%	P < 0·001
Asthma	87·3%	P < 0·001

TABLE III.—*Relative Incidence of a History of Persistent or Recurrent Nasal Discharge up to 10 Years of Age*

Control group	21·3%	
Mild wheezy bronchitis	49·3%	P < 0·001
Wheezy bronchitis	66·0%	P < 0·001
Asthma	73·6%	P < 0·001

TABLE IV.—*Relative Incidence of a History of Hay-fever at 7 and 10 Years*

	At 7 Years	At 10 years	
Control group	1·0%	4·3%	
Mild wheezy bronchitis	12·0%	30·7%	P < 0·001
Wheezy bronchitis	19·8%	28·3%	P < 0·001
Asthma	45·5%	56·0%	P < 0·001

TABLE V.—*History of Wheezing in Siblings*

Control group	14·6%	
Mild wheezy bronchitis	28·7%	P < 0·001
Wheezy bronchitis	23·9%	P < 0·001
Asthma	29·1%	P < 0·001

TABLE VI.—*Nasal Eosinophilia. Comparison of Findings from a Smear of Nasal Mucus*

	Finding of 5% or More Eosinophils	
	At 7 Years	At 10 Years
Control group	8·3%	7·5%
Mild wheezy bronchitis	22·7% P < 0·01	15·5% P > 0·05
Wheezy bronchitis	28·3% P < 0·001	18·4% P < 0·05
Asthma	58·9% P < 0·001	34·0% P < 0·001

TABLE VII.—*Skin Sensitivity. Positive Reaction to Rye Grass Allergen, at Either 7 or 10 Years of Age*

Control group	6·4%	
Mild wheezy bronchitis	16·4%	P < 0·05
Wheezy bronchitis	22·7%	P < 0·01
Asthma	59·4%	P < 0·001

TABLE VIII.—*Skin Sensitivity. Positive Reaction to House Dust Allergen at Either 7 or 10 Years of Age*

Control group	3·2%	
Mild wheezy bronchitis	17·8%	P < 0·01
Wheezy bronchitis	20·6%	P < 0·01
Asthma	57·4%	P < 0·001

[2] C.S.L. Commonwealth Serum Laboratories. Standard allergen extracts for testing.

TABLE IX.—*Skin Sensitivity, Positive Reaction to at Least One of the Six Standard Allergen Extracts Used in the Study (Mixed Grasses, Mixed Inhalants, Mixed Foods, Rye Grass, House Dust, Egg Albumen) at 7 or 10 Years of Age*

Control group	7·5%	
Mild wheezy bronchitis	28·8%	P < 0·001
Wheezy bronchitis	39·6%	P < 0·001
Asthma	80·2%	P < 0·001

TABLE X.—*Serum Histamine-binding Response. Latex Precipitation Test*

	Negative Response at 10 Years of Age	
Control group	36·3%	
Mild wheezy bronchitis	60·0%	P < 0·001
Wheezy bronchitis	72·1%	P < 0·001
Asthma	80·5%	P < 0·001

While we have presented some of the more outstanding findings, it was also found that if any other feature or measurement in any of the three wheezing groups differed from that in the control group at a statistically significant level, then this significant difference from the control group was usually present in all three wheezing groups.

Almost all of the children in each of the three wheezing groups had respiratory catarrhal features such as bronchitis and nasal discharge associated with their earlier attacks of wheezing. With recurring attacks of wheezing these catarrhal symptoms occurred less frequently or not at all. For example 13 of the total 75 children with mild wheezy bronchitis continued to have wheezing attacks between 7 and 10 years of age, but 4 of the 13 children did not have catarrhal symptoms with any of these further wheezing episodes. Similarly 43 of the 107 children with wheezy bronchitis continued to have wheezing episodes between 7 and 10 years, but 7 of the 43 did not have catarrhal symptoms on any occasion of wheezing. Again 84 of the 113 patients with asthma continued with wheezing episodes between 7 and 10 years, yet by contrast 47 of these 84 children had catarrhal symptoms associated with some of their episodes during this period. It was not possible to define clinically a specific subgroup of wheezing children who constantly developed symptoms suggestive of respiratory infection preceding or initiating the wheezing episodes.

In all wheezing groups of patients it was evident that there often appeared to be one or several factors associated with the episodes at one period, but with repeated episodes these factors changed.

Discussion

It has been long known that children who develop wheezy bronchitis in the early years of life often lose these symptoms later in childhood. Some children, however, continue to have wheezing attacks and are eventually diagnosed as having asthma. Clinicians have been uncertain of the relationship of wheezy bronchitis to asthma, and such terms as "pseudo asthma" and "asthmatic bronchitis" have been used as a diagnosis for children who have episodes of nasal discharge, cough, and wheeze. Fry (1961) and Aas (1969) offer a theoretical explanation of the pathogenesis of asthma and pseudo-asthma but without supporting evidence. Boesen (1953), Buffum (1963), and Freeman and Todd (1962), however, pointed out that the child with repeated episodes of so-called wheezy bronchitis eventually becomes a "truly" asthmatic subject.

The explanation most commonly offered for repeated episodes of nasal discharge, fever, cough, and wheeze is recurrent respiratory infections, most probably of viral aetiology. The evidence submitted for this is that the attacks are most frequent during the age period when respiratory infections are most common. Furthermore, there is a very close clinical resemblance to a viral infection of the respiratory system, and throat and nose swabs fail to yield pathogenic bacteria on culture. Detailed viral studies on a series of these patients in an attempt to isolate a virus at the onset of each attack and follow-up antibody titre estimations have not been carried out. E. Brain and I. Gregg (personal communication, 1969) have shown that in 25% of children under the age of 11 years with recurrent attacks of lower respiratory tract inflammation with wheezing a virus was isolated during the acute stage of the disorder. The viruses most commonly isolated were the respiratory syncytial virus, one of the rhinovirus types, and *Mycoplasma pneumoniae*. Glass and Archer (1968), using Papanicolaou staining techniques on nasal secretions to detect ciliocytophoria effects indicative of virus infection, were unable to confirm evidence of viral infection. The possibility exists that the nasal discharge, fever, cough, and wheeze which are assumed to be almost invariably due to infection may also be the result of a hypersensitive inflammatory reaction due to a factor or factors other than infection. Further virus studies are necessary to clarify the role of virus infections.

A most important clinical finding was that in none of the three groups of wheezing children was there a constant association of symptoms suggestive of respiratory infection with each recurrent wheezing episode. Other precipitating causes for recurrent episodes of wheezing occurred from time to time in all three groups. Respiratory catarrhal symptoms were commonly associated with wheezing episodes in the earlier years of the symptoms, but with increasing age other factors, such as emotional disturbance, seasonal change, pollens, and grasses were important precipitating causes. On the data available it was not possible to define any subset of the patients as having a sole precipitating cause for recurrent episodes of wheezing.

The surprising and unexpected finding was that if a clinical feature or the distribution of a measurement in any of the three wheezing groups differed significantly from the control group then this significant difference usually occured in all of the three wheezing groups. This finding strongly supports the proposition that the patients from the three groups belong to a single population with a common defect, but with manifestations which vary widely in severity from mild infrequent attacks to continued frequent attacks.

Part B. Natural History and Prevalence of Asthma and Wheezing

Material and Methods

Data are presented in Part A showing that there were no significant qualitative differences in the three groups of wheezing children and that they were probably representative of a single population of children with the same basic disorder. It is proposed to deal with the data of the three wheezing groups as a single population. All the Tables presented are shown in the form of calculated estimates of the prevalence and distribution of various aspects of the natural history of "wheezing" in the whole population of wheezing children. Account has been taken of the different sampling ratios used in selecting each of the three originally defined wheezing groups, and corrections have been made for those children originally sampled but not seen in the follow-up examination at the age of 10 years (mean age 10·25 years).

Results

The age of onset, the frequency, the persistence of the wheezing attacks up to 10 years of age, and the relationships between these features are shown in the following series of tables.

Age of Onset of Wheezing.—Fig. 1 shows the age of onset of wheezing as a percentage distribution, in separate one-year periods of age, of all children who began wheezing before 7

years (mean age 7½ years). Over 50% of the children had their first wheezing attack before 3 years, 18% under 1 year of age, and 13·8% in the period 6 months to 1 year. After 4 years of age there was a substantial decrease in the proportion of children presenting with their initial wheezing attack.

Frequency of Wheezing Episodes.—Fig. 2 shows a group distribution of the number of wheezing episodes from the onset to the mean age of 10·25 years. It was not expected that the mothers would remember the precise numbers of episodes of wheezing in any period, but it was possible to rate the episodes as follows: a "few," 5 or fewer, between 5 and 10, between 11 and 20, between 21 and 50, and more than 50. The small group of 2·2% refers to those children who had periods of persistent and chronic wheezing often lasting days or weeks at a time. The two significant features in this distribution are the high proportion, 56%, of children who had no more than 10 episodes of wheezing, and the small proportion, 5·7%, who progressed to regular recurrence or chronic and persistent wheezing.

Persistence of Wheezing Attacks.—Fig. 3 illustrates the percentage of children who at 10 years of age had not had a wheezing episode (*a*) in the last two years, (*b*) those whose last attack was one to two years previously, and (*c*) those who were still wheezing in the year preceding the examination at the mean age of 10·25 years of age. The hatched section shows the proportion, 20·7%, who had wheezed in the last three months. The bimodal distribution demonstrates the substantial dichotomy of the wheezing population by 10 years of age into 62% who had not wheezed for more than two years and 32% who continued to have regular wheezing episodes.

Age of Onset of Wheezing and Total Frequency of Wheezing Episodes

Table XI shows the percentage distribution of episodes of wheezing in various frequency ranges in three different ages of onset: (*a*) before 2 years of age, (*b*) between 2 and 4 years, and (*c*) after 4 years. The mean age when the children were last examined was 10·25 years.

There is a significant correlation between early age of onset of wheezing and the higher frequency of attacks by 10 years ($P<0·001$). Two out of three of the children who had 50 or more episodes or had persistent wheezing started wheezing before 2 years of age. Less than one-tenth of them came from the children whose wheezing began after 4 years of age.

Of those children who began wheezing in the first year of life four out of five were still wheezing five years later, while of those who began in the 3–4 year period only two out of five were wheezing five years later. By contrast, of those who began in the 5–6 year period only one in five was wheezing two years later, and 69% did not have any further wheezing attacks between the ages of 7 and 10 years.

TABLE XI.—*Relationship Between Age of Onset and Total Frequency of Wheezing at 10 Years*

Onset Age	Total Frequency of Wheezing at 10 Years				
	1–5 Attacks	6–10 Attacks	11–20 Attacks	21–50 Attacks	50 Attacks or Persistent and Chronic Wheezing
0–2 years ..	19·2%	13·8%	22·3%	29·8%	14·9%
2–4 years ..	28·6%	14·3%	27·6%	24·8%	4·8%
After 4 years	50·7%	14·7%	17·3%	14·7%	2·7%

TABLE XII.—*Relationship Between Age of Onset of Wheezing and Persistence of Symptoms Over Several Years*

Onset Age	Wheezing Attacks Persisting		
	2 Years after Onset	3 Years After Onset	5 Years After Onset
0–1 years ..	90·9%	90·9%	78·2%
1–2 years ..	89·6%	85·4%	72·9%
2–3 years ..	96·6%	96·6%	49·2%
3–4 years ..	79·2%	79·2%	41·3%
4–5 years ..	82·4%	55·5%	
5–6 years ..	21·0%		
	P < 0·001	P < 0·001	P < 0·001

There was a significant relationship between the age of onset and the frequency (Table XI) and the persistence (Table XII) of wheezing over a number of years.

The relationship between the number of attacks of wheezing in the first year of symptoms and the persistence of symptoms up to 10 years of age is shown in Table XIII.

TABLE XIII.—*Relationship Between Frequency of Attacks in the First Year and Persistence of Wheezing up to 10 Years of Age*

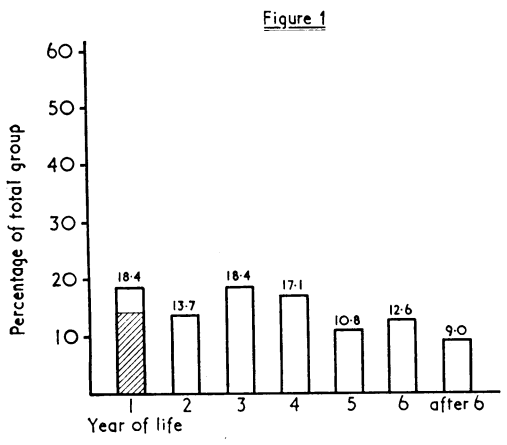
Frequency of Attacks in First Year of History	Period since Last Episode of Wheezing. Examination at 10 Years of Age		
	More than 2 Years Since Last Episode	1–2 Years Since Last Episode	Less than 1 Year Since the Last Episode
1–2 attacks ..	64·7%	13·2%	22·1%
3–5 attacks ..	28·6%	12·9%	58·6%
6–10 attacks ..	30·4%	17·4%	52·2%
10+ attacks ..	12·0%	4·0%	84·0%

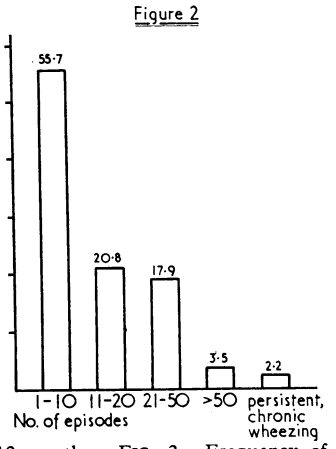
P < 0·001.

In the group who had only one or two attacks in the first year of wheezing 65% did not wheeze during the two years before examination at 10 years, whereas in the group who had more than 10 attacks in their first year 84% had attacks during the year preceding examination at 10 years.

Discussion

It was evident that there were two main trends in the natural history of the wheezing population when consideration was given to the age of onset, the number of episodes in the





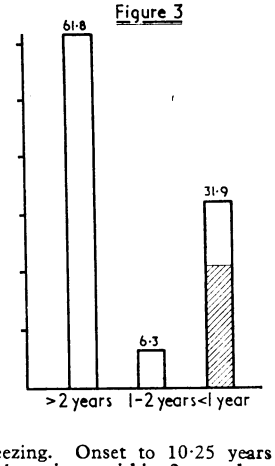


FIG. 1.—Age of onset of wheezing. Hatched section—6 to 12 months. FIG. 2.—Frequency of wheezing. Onset to 10·25 years mean age. FIG. 3.—Time lapse since last episode of wheezing (mean age 10·25 years). Hatched section—within 3 months.

first year, and the total number and persistence of episodes of wheezing up to 10 years of age. (1) The majority of children had a relatively short history of wheezing episodes at the rate of two or three per year over a period of two to five years. These attacks usually began between 2 and 4 years of age and commonly stopped or became less frequent after the age of 7 or 8 years. (2) The smaller group (about 20%) had fairly regular episodes of wheezing for more than five years and were still having regular episodes at 10 years of age. Almost all of this group of children developed wheezing before 3 years of age and more than half of them before 2 years.

What is the Prevalence of Asthma ?

Obviously this will depend on the criteria adopted for the diagnosis of asthma. Evidence was submitted in Part A that the three wheezing groups probably had the same basic disorder, and that the three groups were clinical variants of asthma. It would, however, be inappropriate to diagnose asthma at a clinical level in a patient who had had only a few episodes of mild wheezing. If the whole spectrum of the wheezy population is considered, then at one end was a group of children who had frequent regular episodes of asthma from early life up to 10 years of age, the time of the last examination. All of the children in this group had received treatment for asthma by their doctors and were unequivocally considered to have asthma. The prevalence in this group was 3·7%. At the other end of the spectrum was a group who had had not more than five episodes of wheezing, and had not had any episodes after 8 years of age. The symptoms of this group were mild and evanescent, and many of the patients had not consulted a doctor. Unless specific inquiry was made to seek them out they would not have been detected. The prevalence of this group was 7·7%.

In between the group of patients who at 10 years of age were continuing to have episodes of asthma and the group who had only a few mild episodes which had ceased before 8 years of age was a heterogeneous group who had had a variable number of episodes of asthma which had ceased by 10 years of age. Most of the children in this group had been diagnosed as having asthma or asthmatic bronchitis by their doctor. The prevalence of this group was 7·7%. If the prevalence rates for the children who had continuing asthma at 10 years of age, 3·7%, and the intermediate group of 7·7% who had been regarded as having episodes of asthma or wheezy bronchitis by their doctor are combined a surprisingly high figure of about 11% for children under 10 years is given. Strictly, the prevalence refers to children with onset of symptoms by 7½ years, as new children were not included up to 10 years of age. Much increase in prevalence, however, is unlikely after 7½ years owing to the rapid decline in onset after 6 years of age.

What are the reasons for the considerable differences in prevalence quoted in different centres, figures ranging from less than 1% to 14% ? Broder *et al.* (1962), in their survey of a total community—Tecumseh, Michigan—found that 4·7% of children between 6 and 8 years had asthma and 3·7% between 10 and 14 years. There was a group of patients in whom the diagnosis of asthma was less certain. The combined figures of the two groups gave prevalence rates of 14·4% in the 6–9 years of age group and 12·1% in the 10–14 year age group. A recent survey in Aberdeen by Dawson *et al.* (1969) gave a prevalence of 4·8% for schoolchildren aged 10–15. The authors stated that about 5·6% of the children in the sample studied had wheezed with what was called upper respiratory infection but had stopped wheezing before 10 years of age. It would seem probable that this 5·6% group of children, and the less certain asthmatic group in the study by Broder *et al.* (1962), would be similar to those in our group that ceased wheezing before 10 years of age.

Do the high figures in the various studies (Broder *et al.*, 1962 ; Gibson, 1966 ; Arbeiter, 1967 ; Derrick, 1967 ; Dawson *et al.*, 1969) and our own reflect a rising prevalence, or do the methods used in other studies fail to detect and record all patients with asthma ? It is not possible to answer this question on the available evidence, but it is more likely that the variations are due to different methods used in defining asthma, in sampling methods, and in examination techniques.

Examination of the relative prevalence of asthma in boys and girls shows an interesting differential ratio in the three groups of asthmatic children (Table XIV). In the mildest wheezing group there was a preponderance of girls, in the group with asthma which had apparently ceased at 10 years a considerable preponderance of boys, and in the group with continuing asthma at 10 years the ratio of boys to girls was 7:3. Up to 10 years of age boys and girls are equally likely to develop the mildest forms of asthma, but a much greater proportion of boys progress to a history of more persistent asthma.

TABLE XIV

	Boys	Girls
Total asthma population	60·0	40·0
Mild asthma	44·8	55·2
Asthma ceased by 10 years ..	63·2	36·8
Continuing asthma 10 years ..	69·9	30·1

$P < 0.01$.

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