THE ASTHMATIC CHILD

BY

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Introduction.—In discussing the subject of allergy in pædiatrics Vaughan has written :—‘ The problem is much more vital to the pædiatrist than to men whose primary interest is disease among adults. The child is born with the allergic predisposition, and the sooner an actual sensitization is discovered the better it will be for the future health of that person.’

In dealing with allergy as a specialty it is remarkable how little attention the subject has received from most pædiatric physicians and how its manifestations are missed or ignored by the greater proportion of general practitioners. How rarely is the allergic basis of the recurrent bronchitis or pneumonia of some child realized since it does not conform in general with the text-book description of the adult type !

This astonishing fact cannot be better emphasized than by comparing the age to which the mother assigns the onset of allergic symptoms with the age at which the child first arrives at the special clinic. It is rare for a child to be referred before the fifth year. It may be argued that many cases are cured before this age and that only the more resistant ones are referred to hospital, but figures from our clinic compare very favourably with those in America and on the Continent (Table 1).

TABLE 1,

COMPARISON OF AGE OF ONSET OF SYMPTOMS AND AGE OF FIRST ATTENDANCE AT SPECIAL CLINIC.

Years of age at	London		Peshkin (New York)		Tuscherer (Berlin)	
	Onset	Clinic	Onset	Clinic	Onset	Clinic
0—1	22	—	10	—	26	7
1—2	18½	1½	21	—	17	13
2—3	14	6½	18	5	12	5
3—4	13	7½	18	9	9	6
4—5	12	9	9	16	10	12
5—6	8½	13½	9	16	16	36
6—7	5½	18	4	19	9	21
7—8	3	11	2	12		
8—9	1½	14	8	14		
9—10	1	9	1	9		

The figures in Table 1 represent percentages of the total series studied by the various observers, and give a comparison of the ages at which the majority commence to exhibit allergic symptoms and the age at which they first attend the clinics. On an average there is a lapse of a period of four years.

This lack of recognition is well exemplified by the following case-history :—

J. M., male, aged 4 years 10 months, had a bronchitic turn at 3 months of age. After vaccination at 4 months he suffered from infantile eczema and frequent urticaria, and during the next 2 months had two severe turns of ' pneumonia,' the quick recovery from which astonished both the mother and the doctor. For the past 4 years he has suffered from sudden severe attacks of ' bronchitis ' at 3-weekly intervals which appear to be getting more severe and frequent in spite of linctus and expectorants.

At hospital it was elicited that the paternal uncle had asthma, the grandfather eczema and the maternal great-aunt asthma. The attacks were more of a difficulty in breathing and always came on after the child went to bed. Skin tests revealed a definite feather sensitivity, and their exclusion has led to dramatic relief.

Had the possibility of asthma been entertained at the time of the pneumonic attacks in all probability the child could have been saved four years of illness. If the diagnosis is missed in such a typical case of the common form of infantile asthma, with what increased difficulty must the recognition of the less typical or more complicated cases be attended ?

In three out of every four cases of asthma in childhood relief can be assured. If the correct diagnosis is made, any endeavour to pacify the parents with the contention that the child will grow out of his asthma at the age of seven or at puberty is no consolation to the patient in later life, constantly incapacitated for work by chronic bronchitis, asthma, and permanent chest deformity. Not only are these cases handicapped physically but their education is seriously hampered. During childhood they have to stand back and watch their fellows at play, and they reach adult life with the additional discouragement that they are not as other men are.

It will be the author's endeavour to give a full and accurate description of the asthmatic child with the hope that it may facilitate the earlier diagnosis of the allergic state and lead to the easier eradication of the tendency in the more pliable years of life. The conclusions have been arrived at from the study of over 300 cases of asthma attending the Asthma Clinic at the Hospital for Sick Children, Great Ormond Street, under the auspices of the Asthma Research Council.

Historical.—Until the present century much discussion has raged on the frequency of asthma in infants and children, and numerous opinions have been entertained. These views may be summarized as follows :—

Hippocrates (460 B.C.) observed the effect of cold and moisture on the asthmatic and its autumnal seasonal incidence, and expressed the opinion that ' those who from asthma or cough have the spine incurvated before puberty generally die.' Aretæus (120 A.D.) recognized that children recover more readily than do adults, and gives a most vivid description of the attack. Cælius Aurelianus (5th century) stated that asthma was incident to some from the earliest infancy, that it occurred more frequently in old and young than in middle life, attacking patients after deep colds. Etmuller (1688) dealt with the cause and cure of asthma in children and recommended vomiting for relief. Floyer (1698) wrote ' I cannot remember the first occasion

of my asthma but have been told that it was a cold when I first went to school.' Harris (1727) regarded asthma as often fatal in children, probably confusing it with some other disease. Simpson (1761) described the symptoms, causes and cure of asthma in children. Whytt (1767) gave an excellent description of a case of asthma in a girl of 7 years. Millar (1769), probably the author of the first book on asthma in children, appears to have fallen into great confusion and described three or four different diseases as acute asthma of infants. This error led to abundant controversy, especially on the Continent, and so afforded a great stimulus to the differentiation of true asthma. Rush (1770) wrote a treatise on the spasmodic asthma of children. Sicard (1774) stated that children were often curable of this complaint. Infants unless they were cured became afflicted with a complicating suffocative catarrh. Cullen (1784) expressed the opinion that asthma seldom appeared very early in life, and hardly till the time of puberty or after it. Withers (1786) described 7 cases varying in age from 7 weeks to 3 years, stating, 'several cases of infants likewise have a place in this collection which may, perhaps, be objected to by some but, in my opinion without any just foundation as their lungs are very irritable and they are continually liable to this disease to a most alarming and dangerous height. Some, not accustomed to the diseases of children, may very easily mistake the asthma for another complaint as infants are unable to express their sufferings and parents often at a loss to give an account of them.' Bree (1807) confused the various causes of asthma and sided somewhat with Millar in his views regarding asthma in children. Bostock (1818), the 'pioneer' of hay-fever, assigned the cause of asthma to pulmonary trauma because 'a large proportion (as much as 80 per cent.) of cases of asthma in the young dates from one or other' of whooping cough, bronchitis or measles. Guersent (1821) discussed the absence of adequate pathological lesions in children dying from asthma. Forbes (1833) considered asthma rare in infancy and childhood but admitted the preponderance of the male sex. Ramadge (1835) was assured that 'every age is subject to the ingress of this disease; and it varies in its symptoms according to the time of life at which it appears,' being by no means of rare occurrence at an early period. He also disagreed with Millar's views. Copland (1858) did not consider asthma a disease of early life in its primary or idiopathic form as he had seldom or never seen it before the 23rd year of age. Salter (1860), analysing 47 cases of asthma, determined its onset in 9 cases during the first year and in 10 cases from 1-10 years. In his opinion the cases that come on in early life were usually due to the bronchial disorders of childhood acting on a constitution possessing a congenital proclivity to the disease. In one case distinct symptoms were recognized at 14 days, in another at 28 days, and in another at 3 months. Pridham (1860) described many cases of asthma commencing in infancy. One is of particular interest. An asthmatic clergyman's son was 'in infancy attacked with oppression and difficulty in breathing which was considered by his medical attendant as the forerunner of speedy dissolution. . . . The boy was sent to Eton (where he was quite free), having passed the usual diseases of infancy. . . . During his stay at Eton he was considered one of the most active boys out of 700; for he was one of the fastest runners, one of the best cricketers, and pulled the best oar in the whole school, proving that infantile diseases had produced no organic changes in the respiratory system.' Yeo (1881) stated that asthmatic children do well at Mont Dore. Berkart (1889) stated emphatically that 'with the greatest frequency asthma develops itself in childhood' and cited numerous cases.

Allergy.—It is usual to regard asthma as an allergic reaction resulting from a hyper-sensitiveness to some allergen or exciting factor. Briefly, in the human subject, allergy is a state of exaggerated susceptibility to various foreign substances or physical agents which are harmless to the great majority of ordinary individuals. The reaction is of similar type in the same individual for each substance, generally appearing in response to minute quantities and differing from any toxic action the allergen may have in large doses. The manifestation evidenced appears to depend both in site and intensity on three factors—(a) individual susceptibility, (b) specific cellular sensitivity, and (c) the rate and manner of absorption of allergen. The allergen is merely the

exciting factor, the trigger to the gun. Individual susceptibility is a factor predetermined by heredity, but is occasionally acquired by repeated traumata. Specific cellular sensitivity is the result of constant association with the particular allergen. The site of the reaction is in the specific tissue cells, and the pathological process is one of oedema, smooth muscle spasm, local eosinophilia, and secretory changes. In short, susceptibility is the result of hereditary predisposition, selectivity the result, of environment.

Sensitivity.—Many observers have reported instances of idiosyncrasy to various foods in infancy. Both experimental and clinical evidence have shown many of the ways in which this sensitivity may arise:

- (a) In many cases it is a recognized familial peculiarity.
- (b) In other cases infants may become actively sensitized in utero through the mother's over-indulgence in certain protein foods during the ante-partum period, and after birth, when the child first experiences this food, some form of allergic phenomenon is manifested.
- (c) Whilst being breast-fed an infant may exhibit some manifestation of hyper-sensitiveness which may disappear on removing some protein from the mother's dietary.

Abundant proof has been furnished that, in many infants, foreign proteins are able, from birth, to pass unchanged into the circulation through the normal alimentary mucous membrane. In other children, pathological conditions of the mucosa of the stomach and bowels are capable of impairing the protective power of these parts in such a way as to allow foreign proteins to pass unchanged into the blood.

With regard to animal epithelium and pollen such a sensitivity must be acquired after birth. As with foods and the alimentary mucous membrane, so inhalants may pass in small quantities through the nasal and bronchial mucous membrane into the circulation either through the normal membrane or after its protective power has been impaired through disease.

Sometimes the illness is so striking and characteristic as to afford abundant proof of hyper-sensitiveness; in other cases the symptoms are vague and indefinite, and there is no apparent relationship between the illness and protein sensitivity.

Protein skin reactions.—In children these reactions afford a rapid and valuable index of special sensitivity. Detweiler has shown that four-fifths of cases beginning in infancy are sensitive, two-thirds in childhood, one-half in young adult life, and when asthma begins after 45 years of age practically none are sensitive. To obtain the best results, obviously it is advisable to test these reactions at the earliest possible age.

It is interesting to note the natural loss of sensitivity to food proteins during childhood. In infancy the majority of patients give positive reactions to foods and few to inhalants. After the tenth year it is rare to find positive food reactions, practically all reactions being to inhalants. The common articles giving reactions are—

- (a) foods : fish, meat, milk, egg, wheat, oat, potato ;
- (b) inhalants : feathers, horse-hair, cat-hair, rabbit-hair, dog-hair,

Occasionally we find positive reactions, yet no improvement is noted in the frequency of the attacks on their withdrawal. It is in this type that the asthma has followed extensive pulmonary traumata, the attacks being associated with additional respiratory infections and invariably worse during the winter months or confined wholly to these times. On occasions these cases improve with vaccines from sputum, tonsils or post-nasal space, whether positive skin reactions are given to the individual organisms or not.

Allergic symptoms in childhood.—In children the protean symptoms of allergy may be arranged in six groups according to the system exhibiting them.

1. **SKIN.**—Itching is a troublesome symptom in all dermatological manifestations as eczema, urticaria, flexural pruritus, angio-neurotic oedema. In the majority of the cases the skin is of the xerodermic type, and congenital ichthyosis occasionally occurs.

2. **UPPER RESPIRATORY PASSAGES.**—Rubbing of the nose is often an early indication, and snuffing a frequent symptom. This stuffiness in the head occurs apart from adenoid vegetations. Frequent rhinitis and sneezing, especially if in rapid succession, are often indicative of the allergic diathesis.

3. **LOWER RESPIRATORY TRACT.**—Rapid breathing, wheeziness or cough are frequent symptoms in allergies. Unfortunately colds, sneezing fits and coughs, however frequent or protracted, are generally regarded as still within the limits of health, and are seldom suspected as precursors of more serious mischief. In addition, parents often state that their children only have asthmatic attacks when they catch cold. These so-called colds almost invariably represent an upper respiratory passage manifestation of hypersensitiveness, just as asthma is an analogous symptom in the lower respiratory tract.

4. **ALIMENTARY CANAL.**—Food idiosyncrasies, either immediate or remote, are frequently one of the earliest manifestations or indications. How often does the mother state that her asthmatic child ‘never could touch eggs or fish’ without grave upset! There may be immediate abdominal pain, and vomiting and diarrhoea may ensue. Possibly many children that are ‘difficult to feed’ are allergic individuals in whom the difficulty is of a protective nature. In many cases constipation has been noted from the earliest months of life, and this may be interspaced with bouts of mucous diarrhoea. These children have irregular appetites and their digestions are easily upset. Train or omnibus sickness is a frequent complaint.

5. **NERVOUS SYSTEM.**—Irritability, restlessness, fretfulness, and insomnia are of frequent occurrence. Sick headaches complicate a lot of cases, especially in girls nearing puberty.

Invariably will the mother state that the patient is a ‘frightfully nervy’ child. In my opinion the nerves are another manifestation of the allergic diathesis and not a cause. Pridham (1860) wrote, ‘So long as asthma is ranked amongst diseases that are peculiarly nervous, so long can we never hope to come to any correct conclusion; the idea being so vague and the laws which govern the nervous system for the most part so incomprehensible.’ As one

tends to improve the allergic state by counteracting sensitivity, in the great majority of cases the nervous manifestations begin to disappear. One of the most persistent of these is enuresis for no ascertainable cause. In a few cases of enuresis unattended by any urinary pathology or other allergic symptoms, by skin reactions I have found a definite sensitivity, the exclusion of which has led to dramatic relief of the habit. Shannon has written on the close association of the neuropathic and exudative diatheses, and attributes both to an anaphylactic cause. Vaughan recounts the case of a child in whom chronic food allergy quite changes the personality of the individual at times. The child was of an unusually nice disposition; if he eats one of the foods to which he is sensitive over a number of days he becomes an irritable, whiny, bad-tempered lad.

6. URINARY TRACT.—Straining and frequency are often noticed, and enuresis has been discussed in the previous section.

Age-incidence of asthma.—Amongst 4,317 cases of asthma where the age-incidence has been noted by decades (Rackemann, 1,074; Coke, 1,000; Balyeat, 638; Bullen, 500; Walker, 400; Menagh, 300; Salter, 225; Berkart, 180) the percentage incidence of the combined findings results as follows:—

Years	Per cent.
0—10	33·7
10—20	14·1
20—30	17·5
30—40	16·3
40—50	10·5
50—60	5·7
Over 60 years	2·2

Obviously, therefore, one-third of all cases of asthma have their onset during the first decade. During this decade the recorded ages of onset are shown in Table 2.

TABLE 2.
SHOWING AGE-INCIDENCE IN 1390 CASES OF ASTHMA ARISING DURING FIRST DECADE.

Author	No. of cases	Age in years at onset									
		0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10
Peshkin	273	75	53	36	25	22	17	14	12	14	5
Author	200	44	37	28	26	24	17	11	6	4	3
Bullen	197	27	20	35	26	19	22	11	19	12	6
Rackemann & Colmes	172	50	23	13	13	12	10	18	11	12	10
Tuscherer	148	39	25	17	14	15	24	5	4	3	2
Coke	139	39	19	10	13	23	12	11	5	2	5
Chobot	97	14	19	14	12	8	7	5	11	4	3
Thomson	95	12	17	17	14	11	6	9	2	5	2
Still	69	9	21	17	6	6	0	3	4	2	1
Totals	1,390	309	234	187	149	140	115	87	74	58	37
Percentages		22½	17	13½	10½	10½	8½	6¼	5½	4¼	1½

In one out of every four cases of asthma in children the onset can be dated to the first year, and in every twelve cases of asthma at all ages four have had their onset during the first decade. In two of the author's cases the mother was emphatic in her assertion that the baby had wheezed since birth, and La Fetra has described three similar cases.

Such figures must emphasize the importance of the early diagnosis of asthma in children. If we know the type of child in which it is liable to occur, as well as the early suspicious symptoms indicative of the tendency, we should be able to anticipate it.

Sex-incidence of asthma.—In 200 consecutive cases the sex-incidence was : males 151, females 49. This 3 : 1 preponderance of males is a very striking feature in children, both of this form of allergy and of infantile eczema. From the statistics of numerous observers who have noted the sex-incidence of asthma during the first decade Table 3 is drawn up :—

TABLE 3.
SEX-INCIDENCE IN 1346 CASES OF ASTHMA IN CHILDREN 1—10 YEARS OF AGE :
FROM VARIOUS AUTHORS.

Author	Males	Females	Total
Author	151	49	200
Tuscherer	93	59	152
Still	93	47	140
Coke	81	54	135
Thomson	60	40	100
Peshkin	68	32	100
Chobot	60	40	100
Rackemann	66	24	90
Goodhart & Still	57	28	85
Comby	43	32	75
Berkart	39	24	63
Cautley	46	17	63
La Fetra	27	16	43
Totals	884	462	1,346

In over 1,000 cases of asthma occurring during the first decade the sex-incidence has been approximately 2 : 1 in favour of the males. Some of the older observers have placed the proportion a great deal higher than this. Frank (1823) stated that in his own practice the proportion of males to females was 6 : 1, and Withers (1786) in describing seven cases in children cites six males.

Hereditary predisposition.—The author, in a previous publication, has gone fully into the consideration of the influence of heredity in allergy, and the main points that were established may be summarized as follows :—

1. A positive family history of allergy (asthma, hay-fever, eczema, nettle-rash, migraine) is present in about 70 per cent. of cases of asthma in children,—in 50 per cent. unilateral, in 20 per cent. bilateral.

2. Transmission appears to be twice as frequent through the female as through the male, the diathesis being transmitted as a Mendelian dominant.

3. The greater the heredity, the greater will be the tendency to multiple sensitization and the earlier in life will the symptoms be manifested, with the exception that, during the first decade, the age at onset of symptoms bears but little relationship to the character of the inheritance.

The predisposition to manifest sensitivity is an hereditary taint, the selectivity of sensitivity a factor of environment. But it is not in all asthmatic children that a definite heredity can be determined. Those cases in which it is not evidenced frequently give the history of onset following severe infections or illnesses, and one is justified in concluding that the sensitivity has been acquired. Peshkin has aptly remarked :—

There can be no question regarding the existence of a certain group of children in whom the tendency to develop asthma is inherited. There also occurs another group of children in whom the allergic disease is acquired and in which the lack of evidence pointing to the influence of heredity is striking.

Types of asthma.

1. **Acute bronchitic type of infancy.**—The earlier manifestations of asthma in infants are often obscure because they are associated with so much catarrh. The clinical picture is that of a bronchitis of the smaller tubes, coming on with great suddenness. Dyspnoea is frequently the primary symptom, even preceding the physical signs in the lungs ; and paroxysmal sneezing frequently ushers in the onset of the catarrh. There is a rise of temperature of 2 degrees or more, and the breathing becomes accelerated from 40 to 100 respirations a minute. Cough develops later and becomes persistent ; and this with cyanosis and prostration make the infant an alarming sight, resembling a case of severe pneumonia.

On auscultation expiration is prolonged, and accompanied by sibilant and sonorous râles, and as the condition progresses the catarrh completely overshadows any element of spasm. The râles may assume a subcrepitant type, resembling a commencing pneumonic process, especially in the axillæ. The symptoms may be brief in duration ; or a typical bronchitic course may be pursued and hardly be completed before the next bout is imminent.

2. **Asthmatic bronchitis** (Bronchitis with superadded spasm, common to 'toddler' and kindergarten child).—A respiratory infection or exanthem is usually the starting point of this type of asthma, and each subsequent attack or series of attacks is ushered in by a cold in the head or bronchitis. It is this type that is most persistently seasonal, occurring in winter when naso-bronchial affections are most prevalent ; that familial transmission is difficult to determine ; and that skin sensitivity is rarely elicited. The 'recurrent bronchitis' of young children with low fever and sibilant râles is probably a milder form of this type of asthma.

The characteristic symptoms of the fully developed state are preceded for twenty-four hours or more by a cold, inflamed throat, or rhinitis. In the earlier stages the onset of the asthma takes the form of frequent coughing spells of varying duration and frequency, and it is this cough which becomes the persistent and disturbing feature. Fever is present, generally slight, occasionally high. The dyspnoea usually appears from 24 to 48 hours after the cough, and is not so purely expiratory as in the adult type, inspiratory

difficulty occurring as well. There is evidence of abundant secretion, but it is rare for young children to expectorate it. The condition tends to pass more and more in to chronic bronchitis with more or less constant wheezing, and any sputum is of a mucopurulent nature. Frequently marked distress is experienced, with cyanosis, restlessness and orthopnoea.

Percussion shows an exaggerated resonance, and the pulmonary distension is demonstrated by an extension of the tympanitic note downward beyond the normal limits of the bases. On auscultation, the expiration is prolonged and accompanied by sibilant and whistling râles in all portions of the chest, to which moist sounds are added.

The duration is often transient, the attack terminating by relief in vomiting a large amount of mucus; or the attack may last for weeks, the râles tending to remain constant. Relapses are frequent.

3. Bronchial asthma.—The true adult type of spasmodic asthma is frequently seen after the age of five years. It is intimately related to eczema commencing in the early months of life; shows a strong tendency to hereditary transmission; and here positive skin tests are easy to elicit and of extreme practical importance.

The attack begins suddenly at night, the victim awaking with a stuffy suffocative feeling. He sits up, braces his shoulders, and clings to the back of the bed for support in his respiratory efforts. The pulse is rapid, the respiratory rate increased, and the temperature normal or slightly raised. Dyspnoea is intense, with little or no cough. The chief trouble is expiratory, the chest being in the position of full inspiration, the expiratory muscles making strenuous efforts to empty the air from it. There is no period of rest between the prolonged expiratory phase and the beginning of inspiration. The wheeze is quite audible from afar.

On inspection, the *alæ nasi* are expanded, the face pale or dusky with an extremely anxious look. Marked retraction of the soft parts, the supraclavicular spaces and the epigastrium are noted. The very slight expansile movement of the chest and its over-distension are striking features. This 'emphysema' is rarely accompanied by any bronchitic element. On auscultation practically no inspiratory sounds are heard, but wheezing, whistling, expiratory râles are found everywhere. As the attack subsides there appear râles which are both inspiratory and expiratory. Sputum is rare, but if obtained is clear and viscid.

Periodicity is the characteristic of these attacks, with complete or nearly complete cessation of any symptoms between the attacks. In some cases, following a sudden paroxysm of dyspnoea of varying intensity, two to three weeks of bronchitis supervenes.

4. Coryzal asthma (Hay-asthma).—Scheppegegrell states that 5 per cent. of hay-fever cases commence before the age of five and are not recognized, being simply called 'colds.'

True hay-asthma is of seasonal occurrence during the summer and autumn; is due to pollens, odours, or emanations; and is uncommon before four years of age. A severe form of coryzal asthma frequently occurs in children without

marked seasonal variation;—conjunctivitis, itching of the nose and eyes, profuse watery nasal discharge, frequent violent sneezing, lachrymation and photophobia preceding a definite wheeziness.

5. Eczema-asthma-prurigo syndrome.—This type usually begins in earliest childhood with intense recurrent nocturnal itching. The primary early papular and vesicular lesions become secondarily eczematized and lichenified from scratching. Jacquet has said that it is not the eruption which is itchy, but the itchiness which is eruptive. The lesions occur chiefly on the face (cheeks, forehead, and round mouth), the neck, and the flexures of the arms and legs. Occasionally the site of predilection is the outer side of the limbs, especially the arms. It is often complicated by a dry ichthyotic skin except in fat and flabby children when it takes on a more acute and weeping character. It shows remarkable intermissions and recurrences especially of a seasonal nature. It remains for about two years, the face clearing to a great extent.

About 25 per cent. of these cases develop marked asthma about their fourth year. In these cases can be noticed a climatic factor of great importance, such as proximity to sea, cold winds, and strong light.

The asthmatic appearance.—When the asthmatic state has been well established, the appearance of the child is somewhat characteristic even in the free interval. The face is troubled; there is a cyanotic tinge, particularly of the lips; frequently a dilatation of the small venules of the cheeks and conjunctivæ; and a widening of the *alæ nasi* on inspiration. There is frequently a paranasal depression, quite apart from any adenoids. The muscles of the neck are somewhat drawn, producing an apparent depression above the sternum. The chest is deformed, being increased in its antero-posterior diameter, and occasionally presenting a marked dorsal kyphosis as well as the pigeon deformity and local recessions. These deformities are further accentuated by the shrugged shoulders.

The stature of the asthmatic child is of extreme interest. In Table 4 200 consecutive cases the height, weight, and chest measurements have been averaged for each year; for comparison the average 'normal' figures given by Holt are included:—

TABLE 4.
HEIGHT, WEIGHT AND CHEST MEASUREMENTS IN 200 ASTHMATIC CHILDREN.

Age in years	No. of cases	Av. weight (lb.)		Av. height (in.)		Av. chest (in.)	
		Asthmatic	Normal	Asthmatic	Normal	Asthmatic	Normal
1—2	3	24½	23	31	31	19	19
2—3	13	30	29	37	34	20	19½
3—4	15	32	33	37½	36½	20¼	20½
4—5	18	36½	38	41½	40	21½	21
5—6	27	39	43	43	42¾	21¾	22¼
6—7	36	43¾	47	46	45	22¼	23½
7—8	22	48½	52	48	47	23	24
8—9	28	51	57¼	49	49	23¼	24¾
9—10	18	53	63¼	51¼	51	23¾	25½
10—11	13	58	69	53¼	53	24½	26
11—12	7	66½	76½	56	55	25	26¾

From the third year onwards the asthmatic child, although of correct height, is underweight for his age, the decrease in weight reaching a maximum of about 11 pounds at 11 years. The chest measurements are slightly under average due, in all probability, to the lack of flesh coverings and not to any diminution in diameter. The child in consequence appears of the tall thin type, although in a few cases stunting occurs as well.

COLOURINGS.—The eye and hair colourings of 200 consecutive asthmatic children have been noted. No statistics have been found as to the relative incidence of blonde and brunette children in the normal population, nor have the exact colourings of both parents in each case been determined.

With regard to the children, the results may be tabulated thus :—

Eyes	Hair	No.	Total
Blue	Fair	54	107
	Brown	43	
	Sandy-auburn	10	
Grey	Brown	19	21
	Sandy-auburn	2	
Brown	Fair	3	72
	Brown	66	
	Sandy-auburn	3	

The general impression obtained from the study of these cases is as follows :

- (a) It is the fair-haired, blue-eyed child that is most commonly afflicted with asthma of the bronchial type, preceded by an infantile eczema, and a strong hereditary predisposition, and giving positive skin reaction to various proteins.
- (b) It is the brunette that generally manifests either (i) asthmatic bronchitis following severe illnesses especially affecting the respiratory tract, in which an hereditary history is not obvious, and skin reactions difficult to elicit, or (ii) eczema-asthma-prurigo complex, with which several relatives may be affected.

Of course, there is no hard and fast rule, but the majority of cases fall into these categories, and one can frequently predict the history that will be given from the first appearance of the child.

Feeding.—In 85 per cent. of the cases the children, as babies, had been breast-fed for an average duration of 8 months. The cases breast-fed for a shorter period than this were generally the infantile eczema cases which were frequently taken off the breast on the first appearance of the eczema.

Month of birth and onset.—More children with asthma were born during the months of June, July, and August than during any other quarter. The next in frequency were October, November, and December. The most common months to which the onset of asthmatic symptoms were ascribed were March, August, and November.

Capriciousness.—The capriciousness of asthma is one of the most fascinating, even if at the same time disturbing, factors in the study of the subject.

This irregularity seems to depend both upon the presence of the specific sensitizing agent as well as upon the general state of bodily health of the patient. Some of the main variations noticed are :—

1. Time of onset. Asthma certainly shows a definite predilection for the early hours of the morning, but in many cases the onset is during the day; some cases are both diurnal and nocturnal. Once a definite hour is established it tends to remain constant.

2. Effect of locality. Some cases are free of symptoms by the sea, others inland; some are well in large smoky cities, others require the pure country air for relief. Some require pine woods, others the open spaces; some hilly country, some flat. Most observers are agreed that asthmatic symptoms do not occur above an altitude of 4,000 feet. With regard to convalescent homes, cases appear to do better at seaside resorts from Lancing westwards than in an easterly direction along the South Coast of England.

3. Influence of season. This is a very prominent feature in the history of most asthmatic children. Most consider winter the worst season. Some are entirely free during the summer, whilst others appear worst during the spring and warmer months. Many find no relief the whole year round.

4. Intervals between attacks. In some cases the interval between attacks may vary from a few months to a year or two, but the great tendency is for these intervals to become steadily diminished. In other cases the attack leaves behind a bronchitis that does not clear before the next attack arrives. Others have a constant wheeze.

In children, week-end periodicity is marked in over a third of the cases. All manner of theories have been advanced as to the cause—increased diet, increased or decreased activity, outings, different environment, difference in daily regularity, washing of hair—but as yet I have not been able to ascribe any cause common to all cases.

5. Tendency for alternation of allergic manifestations. One notes the frequent association of skin conditions, sick headaches, enuresis, and other complaints with asthma. In some cases the conditions co-exist, in others alternate; and in others no definite relationship can be deduced. In general one may state that eczema appears earlier than asthma, urticaria is co-existent with asthma either during or before the attacks, enuresis is worse during the attacks, and sick headaches tend to usher in the attacks especially in girls nearing puberty.

6. Schoolwork. During their well periods asthmatic children are studious, hardworking and precise, and frequently at the top of the form. Unfortunately during attacks they miss a lot of schooling. Before the attacks they pass into a state of indolence and fatigue, either not understanding or quickly forgetting their lessons. Any sudden reprimand or scolding and the attack is at hand, necessitating a week or two's absence or more.

At play the asthmatic child cannot run about like other children but stands rather timidly in his corner looking on and seeking companionship with younger and smaller children, a state encouraged by the parents who forbid the child to 'tear about' as they dread the consequences.

Assigned cause of onset of asthma.—In my series of cases the parents have assigned the onset of allergic symptoms to the following causes :—

Cause	Per cent.	Cause	Per cent.
Pertussis....	10	Pneumonia	7½
Measles	4½	Mumps	1
Acute bronchitis	1½	Scarlet fever, chickenpox, diphtheria,	
		laryngismus	each ½

In three cases the symptoms were assigned to a previous operation (tonsillectomy 2, circumcision 1).

In 10½ per cent. of the cases the asthma had been thought to be 'bronchitis' from infancy, the diagnosis of asthma only taking place since attending the hospital. Other common causes according to the parents are—physical exertion, variations in weather, winds, bathing. As previously stated week-end periodicity is marked.

Peshkin has furnished a comparable series of figures—pertussis 15 per cent., acute pneumonia 14 per cent., measles 4 per cent., tonsillectomy 3 per cent., scarlet fever 2 per cent., chronic unresolved pneumonia 2 per cent. Tuscherer gives the following figures from the study of 152 children—pertussis 22, measles 11, pneumonia 22, influenza 2, pleurisy 2. 73 gave a history of very frequent colds, 27 of indefinite fever, and 31 had a cold just before an attack. Berkart, in 180 cases, attributed the onset of the attacks to the following—sneezing fits, colds, hay-fever 59, whooping cough and measles 40, diphtheria, croup, tonsillitis 14, scarlatina 4, bronchitis, congestion of lungs, pneumonia 38, eczema and skin diseases 7. La Fetra, in 43 cases in infants and children, assigned the onset in 27 cases to some pre-existing respiratory inflammation. Adam states that nearly 10 per cent. of children ascribe the onset of asthma to pertussis and 8 per cent. to pneumonia. Percepid, in 45 cases, stated the onset occurred 15 times after simple bronchitis, 4 times after broncho-pneumonia, 2 after pneumonia, 14 after whooping cough, 8 after measles, 1 after diphtheria. Harkavy has shown both clinically and radiographically that unresolved pneumonia is often an important aetiological factor, especially the influenzal broncho-pneumonia of 1918-1920.

It will be seen that measles is half as common again as whooping cough in these asthmatic children, yet from the statistics of all observers the onset of asthmatic symptoms is twice as frequently ascribed to whooping cough as to measles.

Previous illnesses.—Many views are held as to the relative frequency of the infective diseases of childhood in asthmatics and in normal children. There appear to be three means by which the relationship between infection and allergy may be evidenced. First, an acute infection often ushers in the sensitive period in an allergic child, the dormant allergic state becoming active during the period of lowered resistance. Secondly, in many cases it appears that, in the absence of any hereditary taint, a definite sensitivity develops to some allergen during the damaged state of the mucous membrane. Thirdly, by reason of his allergy, an allergic may be more susceptible to the inroads of infection, invading micro-organisms thriving in the lowered resistance of a mucous membrane constantly irritated by specific protein.

In this series of cases, and a similar series of cases studied by Peshkin in New York, the findings are practically identical, with the exception of the previous history of recurrent bronchitis. It is difficult to determine where bronchitis ends and asthma commences in these cases. My findings are given in Table 5 and the results compared with the series reported by Peshkin.

TABLE 5.

PREVIOUS ILLNESSES IN AUTHOR'S CASES COMPARED WITH SERIES REPORTED BY PESHKIN.

Previous illness	Author	Peshkin
Recurrent bronchitis	77%	33%
Measles	70%	77%
Pertussis	49%	51%
Chickenpox	41%	—
Pneumonia	25%	—
Mumps	20%	—
Scarlet fever	8%	8%
Diphtheria	5½%	5%

Associated conditions.—The association of many skin and other conditions with asthma has been recognized for many years. Not only do these associations occur in the patient but they are extremely frequent in other members of the family. I have shown in a previous paper that of 4,152 relatives of 200 asthmatic children, there were 438 cases of asthma, 37 of hay-fever, 145 of eczema, 74 of urticaria, and 48 of migraine in a total of 597 affected persons.

When we come to consider the individual patients, the following percentages have been observed :—

1. Eczema—36 per cent. affected. This association is the commonest observed. Figures given by other observers are: Herman 40 per cent., Goodhart and Still 40 per cent., Comby 37 per cent., Still 35 per cent., Dowling 30 per cent., Thomson 26 per cent., Peshkin 22 per cent., Coke 18 per cent., Oriel 16 per cent., Bullen 10 per cent., Lyon 9 per cent.
2. Urticaria—37 per cent. affected. Baagoe 32 per cent., Herman 28 per cent., Oriel 16 per cent., Peshkin 9 per cent., Thomson 8 per cent., Lyon 4 per cent.
3. Prurigo—8½ per cent. affected. Baagoe noted itchiness in 40 per cent. of cases.
4. Ichthyosis—3 per cent. affected. Lyon 2 per cent., Thomson 2 per cent., Ichthyosis complicated 2 of the 4 cases quoted by Stanley (1903).
5. Migraine—7 per cent. affected. Oriel 15 per cent.
6. Hay-fever—4½ per cent. affected. Thomson 2 per cent., Oriel 6 per cent. in older people.
7. Enuresis—4½ per cent. affected. Thomson 5 per cent.

In 345 cases of allergic dermatitis Piness and Miller have shown the association with asthma and hay-fever in 281 or 81 per cent. of cases.

Eczema is usually thought to be due to food sensitization whilst asthma frequently follows sensitization to inhalants. The significance of this fact has been discussed with the remarks on skin sensitivity, but I would like to emphasize the fact here that many eczemas are very sensitive to epidermals as well as foods.

The nose and throat in asthmatic children.

1. Tonsils and adenoids.—These had been removed from 71 per cent. of 200 cases of asthma before attending the clinic. Of the remainder 19 per cent. were large and septic, whilst in only 10 per cent. were they small and not associated with any enlargement of the cervical lymph nodes. In Peshkin's series 72 per cent. had had their tonsils removed.

Still (1912) was the first to point out the fallaciousness of regarding enlarged tonsils and adenoids as the cause of asthma. Since then the matter has been well discussed by Walker, Lintz, Kahn, Rowe, Taylor and Balyeat. In Still's experience in only 1 out of 13 cases had the operation been of any value and then only temporarily. Myers has stated that in children, apart from the necessity of removing tonsils and adenoids, nasal surgery is almost always unnecessary. Intranasal conditions seldom call for surgery.

In my experience the operation, if properly performed, has been liable to decrease the frequency of the attacks for a few weeks or months, but has had little permanent benefit in the absence of other measures. Some children assign the onset of their asthma to the operation. On the other hand, in the presence of enlarged tonsils and especially of large adenoidal masses, (either mechanically blocking the airway, or septic and causing a persistent nasal

discharge), it is useless to endeavour to cure any case of asthma in a child, irrespective of the type. Coke has steadily advocated this view.

2. Sinus disease.—Many reports show sinus involvement in these asthmatic children, but such has not been my experience. The operation of tonsillectomy or adenoidectomy may in many instances allow the sinuses to drain, and there is good reason for viewing the nasal pathology in a great number of these cases as the result of allergy and not as the cause. Rackemann and Tobey found that in only 5 per cent. of cases did any operative procedure produce permanent relief of asthma. On investigating 2 cases of sinus involvement, the contents were found to be sterile and contain large numbers of broken down eosinophil corpuscles such as have also been found in polypi in these cases.

Hark, in 394 autopsies in non-asthmatic children in which the accessory nasal sinuses were opened, found evidence of disease in 62 cases. In asthmatic children Bullen found evidence of sinus disease in 13 out of 235 cases. Lierle reports 20 cases all of which showed sinus involvement. Chobot in 100 cases found sinus involvement in 41 per cent.

Tuberculosis and asthma.

Parents often ask whether their asthmatic children are liable to develop consumption. In my experience in children very few develop any evidence of the disease, and if so it is generally of a non-active or very slowly progressive fibrotic type. Tuberculous patients may present asthmatic symptoms. Expiratory dyspnoea may be associated with enlarged tracheo-bronchial glands, and has been reported many times since Variot and Bruder's original observations in 1904. Schick in 1910 presented 36 cases of asthma caused by these enlarged glands.

Possibly the infectious diseases of childhood often prepare the soil for the reception of the ubiquitous tubercle bacillus as well as for the onset of asthma. Landouzy (1912) was the first to suggest that asthma may be an anaphylactic reaction to the tubercle bacillus, but Dluski found only 1 case of tuberculosis and asthma in 2,450 sanatorium cases, but other observers have noted a higher percentage. Giffin noted 3 cases of asthma in 82 cases of tuberculosis. Reynier (1902) viewed the essential asthma of infancy as presenting a certain amount of immunity to tuberculosis. This accounts for the view that in the event of an asthmatic becoming tuberculous, the tuberculosis develops independently of the asthma, and Hoffmann (1902) held that when the two diseases do exist in the same individual, each gives up a part of its characteristics.

Tuberculin reactions.—The Mantoux intradermal reaction was carried out on 200 cases of asthma using 1/10 c.cm. of 1/1000 tuberculin and the reaction was repeated in a month with 1/100 if negative. By this means it was found that 35 per cent. gave positive reactions. D'Arcy Hart, using the same technique at the same hospital and the Royal Northern Hospital tested the reactions of 369 children from 3–10 years all of whom were clinically non-tuberculous, and found positive reactions in 28 per cent. From the consideration of such figures it is obvious that tuberculosis cannot play any definite role in the ætiology of asthma.

Reisman and Mason tested 158 consecutive cases of asthma in children from 8 months to 14 years by the intradermal reaction, and found 38.6 per cent. positive. Recent figures from America put the positive incidence for 'normals' at about 30 per cent. Rongel in 101 cases found 50 gave a positive von Pirquet reaction. Baagoe (1928) tested the reactions of 83 asthmatic children aged from 2 to 15 years. His results are given in Table 6. Under 2 years of age Marfan found the tuberculin reaction negative in 3 out of every 4 asthmatic children. Lavergne, in 28 cases under 15 months of age, did not find a single positive reaction. Lapage considered most asthma tuberculous.

TABLE 6

VON PIRQUET REACTIONS IN 83 ASTHMATIC CHILDREN (BAAGOE).

Age in years	Children with asthma			Children with no active tuberculosis (Monrad)
	Negative	Positive	% Positive	
1—5	13	2	13%	6%
5—10	29	11	28%	20%
10—15	13	10	36%	44%

Positive reactions simply indicate the existence of a tuberculous focus, and do not at all signify the spread of tuberculous disease. In most cases it only reveals the presence of small fibro-calcareous foci so frequent in children. Asthma appears in children independent of any tuberculous taint. This fact is again emphasized by the X-ray findings.

X-ray findings.—The main findings in 300 consecutive cases were:—

	Percentage
1. Nil	39.0
2. Peribronchial fibrosis	16.3
3. Excessive hilum shadows	14.6
4. Chronic bronchitis	10.0
5. Basal fibrosis	7.6
6. Bronchiectasis	3.6
7. Enlarged mediastinal shadows	2.6
8. Calcified glands	2.6
9. Cardiac enlargement	1.3
10. Dilated bronchioles	1.3
11. Unresolved pneumonia	0.6
12. Thickened interlobar pleura	0.6

Lapage, from the study of 75 children gives the following—Bronchial glands 31, mediastinal glands 6, fibrosis 18, adhesions 5, chronic bronchitis 11. From these figures he concludes that most asthma is tuberculous, but some degree of glandular enlargement is common in the X-rays of the chests of children, especially following infections and exanthemata.

Herman, in 27 cases found 6 normal, 3 tuberculous tracheal and peribronchial glands. The remainder showed chronic fibrous bronchitis with diffuse peribronchial thickening and congestion, and very frequently a hilum fibrosis of varying extent. Emphysematous changes were found in a considerable number.

Manges and Hawley describe the chest changes in 157 adult cases of asthma as follows—

	Percentage
1. General peribronchial thickening	27
2. Chronic lower lobe infection	23
3. Tuberculosis	18
4. No changes	16
5. Thickened root structures	12
6. Enlarged heart	3
7. Emphysema	1

In children, the skiagram most commonly (39 per cent.) shews no gross abnormality, or changes that would be inconsistent with a normal state of health. As regards prognosis, peribronchial thickening and enlarged root shadows (30 per cent.) have but little residual effect. It is with the chronic bronchitis, basal fibrosis and bronchiectasis cases (20 per cent.) that the prognosis must be more guarded, and these are the cases that do well at the seaside for a time.

Pathology.

As it is extremely rare for death to take place during an asthmatic spasm, the determination of the pathology is correspondingly difficult. Two cases of deaths in children during spasms have appeared in the literature, and the findings are summarized :—

(Heizer, 1911). Child, aged 2; family history negative, eczema since 4th month; first attack of dyspnoea at 9 months, death followed attack. Necropsy :—lungs distended; heart enlarged and right ventricle thickened; trachea and bronchi contained purulent secretion; all lymph glands of body greatly enlarged. Microscopic—alveoli varied in size, some walls thin, some ruptured; some bronchi dilated and occluded by masses of mucus containing leucocytes and epithelial cells; walls of large bronchi thickened by infiltrating cells and distended capillaries; bronchial mucous glands markedly enlarged and ducts filled with mucus.

(Huber & Koessler, 1922). Female, aged 15 months; negative family history; facial eczema from 3-8 months, at 1 year dyspnoea and cyanosis with pharyngitis and bilateral otitis media, marked urticaria appeared after eating farina; skin tests positive to wheat and lactalbumin. Child died in 3rd attack of asthma. Post-mortem :—complete occlusion of majority of middle-sized and smaller bronchi by mucus, two distinct stages of absorption atelectasis, extreme eosinophilia in bronchial wall, mucus content of bronchial lumen, mucous glands, spleen, lymphoid tissues and blood vessels, cell inclusions in thymus, hypertrophy of entire lymphoid apparatus, narrowing of aortic arch, enlargement of thymus.

The latter observers have shown that in asthmatics the thickness of the bronchial and broncheolar walls is definitely increased in all layers. In addition there is hyperæmia and cellular infiltration of the wall and increased activity of the glands. The changes are not present to the same degree in all parts of the lungs.

Many of the older observers were at a loss to explain the pathology of asthma cases in children dying in an attack as they were unable to detect any lesions attributable to uncomplicated asthma (Willis, Millar, Guersent). The lungs may show in old cases thickening of the bronchial mucous membrane, thickening of the muscular coat of the bronchi, and emphysema in the atria and terminal alveoli.

Blood groupings.—In 50 cases the blood groupings of the patient and the mother have been determined and the findings have been quite normal.

Group of child	1	2	2	3	4	4
„ „ mother	3	2	4	3	2	4
Number	2	18	5	3	7	15

In 46 per cent. of cases the child belonged to Group 2, in 44 per cent. to Group 4.

Blood counts.—Typical blood pictures of asthmatic children during the free interval show an eosinophilia, in 100 cases the average being 7·5 per cent., and the maximum 23 per cent. Wile, working in Holt's clinic found an average eosinophilia of 10·7 per cent., and counts as high as 26 per cent.

Typical counts are shown (a) in a child of 2, (b) in a child of 10.

Red blood corpuscles	5,392,000 per c.mm.	5,040,000 per c.mm.
White corpuscles	18,500 „	12,000 „
Hæmoglobin	98%	100%
Colour index	·9	1
Polymorphonuclears	32%	54%
Lymphocytes	45%	34%
Large mononuclears	1%	5%
Eosinophils	22%	7%

Diphtheria, scarlet fever, measles, and smallpox prophylaxis.—One is often consulted by parents as to the advisability of allowing their children to be submitted to any of these prophylactic measures. In many cases the onset of infantile eczema has been assigned to vaccination, and many startling accidents and even deaths have occurred on the injection of minute quantities of various sera in allergic individuals. It is always advisable to try skin reactions with great dilutions, or to give small desensitizing doses of the serum.

Prognosis.

Many children, especially boys, tend to recover before puberty. Age is an important factor, and the earlier the diagnosis the better the prognosis. The prognosis is greatly lowered by any complicating infection, especially of the lower lobes of the lungs as shown by X-ray. Peri-bronchial thickening and enlarged root shadows have little effect on the prognosis. All varieties of malformed chests in children have a strong tendency to improve as the child gains strength and the body grows and develops, provided their original causes have ceased to act.

Diagnosis.

During the attack the following are the most important points that will assist in the diagnosis of asthma—(a) time of onset: generally the early hours of the morning; (b) posture: the forward lean with the bracing of the shoulders; (c) inspection: cyanotic tinge, distended veins of neck and face, distended chest; (d) percussion: hyper-resonance of chest; (e) auscultation: prolonged difficult expiration, wheezing, sonorous and sibilant rhonchi, later secretory changes.

As most cases are seen during a free interval there are many points of the utmost importance of assisting in arriving at a diagnosis :—

1. **Family history.**—Special inquiries should be made for the presence of allergic manifestations in other members of the family or immediate relatives as asthma, hay-fever, eczema, urticaria, angio-neurotic œdema, migraine or food idiosyncrasies.

2. **Previous history.**—Any knowledge of eczema or prurigo in infancy, food idiosyncrasies, recurrent attacks of nettlerash, ‘ bronchitis ’ or ‘ pneumonia,’ and the relationship of the onset of symptoms of infectious diseases is of prime importance.

3. **Associated conditions.**—Prurigo, food upsets, sick headaches, sneezing attacks, stuffiness in the head, hard dry unproductive cough and ‘ wet ’ noses frequently associate themselves with the asthmatic state.

4. **Differential blood count.**—The eosinophilia is the most pronounced and characteristic change, but otherwise the normality of the count is of great assistance.

5. **Expectoration.**—Sputum is rarely obtained in children either during the first part of the attack or in the free interval, so Curschmann’s spirals, Charcot-Leyden crystals, and eosinophil corpuscles are seldom seen.

6. **Hypochlorhydria.**—Three out of every 4 cases of asthma in children show a hypochlorhydria on fractional gastric analysis, those with the more normal curves being generally of the excessive lung damage type. This is of extreme importance as regards prognosis, for the primary type respond rapidly to acid therapy, whilst this type show but little improvement. The analyses of 200 cases as well as the results of acid therapy will form the subject matter of a succeeding paper.

Prophylaxis.

1. Intermarriage between allergics should be discouraged.

2. Children of allergic parents should be watched from birth. Bronchitic attacks in eczema or prurigo children should be regarded as potential asthma ; coughs should be quickly investigated as well as sneezing, wet noses, or coryza on the slightest provocation.

3. Furniture and bedding for these children should be of the simplest kind. As inhalant sensitization is acquired, kapok should substitute feathers or hair as bedding; furs and pets should be restricted.

4. At the onset of any symptoms that may be of an allergic nature, thorough examination and testing both of the skin reactions and gastric contents should be advised.

5. Septic foci as teeth, adenoids, and tonsils should be remedied, and early breathing exercises and proper convalescence arranged after the infective diseases of childhood.

In conclusion, I wish to convey my sincere thanks to the honorary physicians of the Hospital for Sick Children, Great Ormond Street for permission and assistance in investigating cases under their care ; and to the Asthma Research Council under whose grant these researches have been rendered possible.

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