

## *Aetiologic, Precipitating and Environmental Factors in Childhood Asthma*

WI ADERELE\*

### Summary

**Aderere WI. Aetiologic, Precipitating and Environmental Factors in Childhood Asthma.** *Nigerian Journal of Paediatrics*, 1982; 9: 26. A study of the aetiologic and precipitating factors in bronchial asthma in 380 children has revealed a positive family history in 37% of the cases, and allergy to various items (ascaris, *D. Pteronyssinus*, housedust and feathers, among others) in 60% of those tested. Exercise was a precipitating factor in 45%. Nocturnal attacks were prominent in 43% and increased frequency of attacks in the rainy season was a feature in 23%. Specific foods were identified as precipitating factors in only 4%, while the role of infection was difficult to evaluate. There was an association between the severity of asthma and the smoking habits of fathers and siblings. It is advocated that smoking should be strongly discouraged in the homes of children with asthma and efforts made to limit the exposure of these children to other identified precipitating and causal factors.

### Introduction

In addition to allergy, infection and emotion, other factors have been identified as causal and precipitating in childhood asthma. Early cow's milk feeds have been incriminated in the development of asthma,<sup>1 2</sup> while exercise is now a well-established precipitating factor.<sup>3 4</sup> Atmospheric and environmental factors such as dust, sulphur dioxide and tobacco smoke are also known to affect the course and severity of some respiratory diseases including, asthma.<sup>5 6</sup> Most of the studies on these and other aetiologic factors in childhood asthma have been carried out in other

parts of the world and there has been very little of such studies reported in African children. The present study seeks to determine some of the factors which might be of importance in the aetiology and precipitation of asthmatic attacks in the Nigerian child as well as to examine such environmental factors as may affect the course and severity of the illness. It is hoped that knowledge of these factors will contribute to better understanding of the condition and its rational management.

### Materials and Methods

The subjects were 380 consecutive cases of asthma diagnosed between 1976 and 1980, at the asthma clinic, department of paediatrics, University College Hospital (UCH), Ibadan. The criteria for diagnosis and the basis for the grading

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University College Hospital, Ibadan

Department of Paediatrics

\*Senior Lecturer

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of severity have been reported elsewhere.<sup>7</sup> In order to identify the aetiological and environmental factors, information was obtained by means of a questionnaire, from parents and guardians of the patients, and in some cases, from older patients themselves. Information obtained included any observed precipitating and associated factors such as the time of day and the season during which attacks were most frequent, items of food observed or suspected to be associated with attacks, family history of atopy, types of domestic animals and pets, sleeping conditions, cooking and smoking habits in the household as well as the general housing conditions. Skin sensitivity tests were performed on the subjects by the prick method, using the commercially prepared Bencard solutions. Statistical analysis was by the chi-squared tests.

### Results

#### *Age and sex distribution*

The cases were aged between 10 months and 13 years. There were 234 males and 146 females; a M/F ratio of 1.6:1.

#### *Severity of disease*

One hundred and eighty-six (49%) had mild disease, 87 (23%) moderate, and the remaining 107 (28%) had severe asthma.

#### *Familial factors*

One hundred and forty-one (37%) of the 380 cases had a positive family history of asthma (Table I). There were 39 (36%) of 107 severe cases, 33 (38%) of 87 moderate and 69 (37%) of 186 with mild disease. Seven mothers, six fathers and one sibling had a history of hay fever, while 6 siblings suffered from flexural eczema. It is worthy to note that 3 mothers suffered their first wheezy attack during pregnancies with the respective patients, while the mother of one moderate case, an established asthmatic herself, had her worst attacks during pregnancy with the patient.

#### *Precipitating and associated factors*

There was a positive history of precipitating and/or associated factors in 323 (85%) of the 380 cases. Exercise was the most frequent precipitating factor, being observed in 171 (45%) of the 380 cases (Table II). The usual story was that of a child who went out to play football or run around with his mates and returned home, wheezing. Other major precipitants included cold weather, air blown from a fan and cold water bath. Specific food precipitants occurred in 4% of the cases and included fish, groundnuts and corn. Among unusual precipitating factors was excessive straining during defaecation in 4 children whenever they were constipated. Non-causal factors associated with increased frequency of attacks included night time and the rainy season. Nocturnal attacks were more severe than daytime attacks in 163 (43%) cases while the attacks were more common and more severe during the rainy season in 87 (23%) others. There was also an increased frequency of attacks during the cold harmattan season in 32 (8%) of the cases.

#### *Early feeding practice*

Three hundred and sixty-nine (97%) of the 380 children were breast-fed from birth for varying periods. This prevalence compares with one of

TABLE I

*Positive Family History of Atopy in 141 Children with Asthma*

<i>Relation</i>	<i>Mild Cases</i>	<i>Moderate Cases</i>	<i>Severe Cases</i>	<i>All Cases</i>	<i>% of Total</i>
Sibling	39	20	17	76	54
Mother	15	11	9	35	25
Father	12	10	10	32	23
Grandparent	13	2	6	21	15
Cousin	5	5	2	12	9
Uncle	6	1	2	9	6
Aunt	4	1	1	6	4

TABLE II  
Precipitating and/or Associated Factors in Children with Bronchial Asthma

Factors	Mild Cases (187)	Moderate Cases (87)	Severe Cases (107)	All Cases (380)	% of Total
Exercise	81	48	42	171	45
Allergy					
Specific foods	5	4	6	15	4
Dust	4	2	4	10	2.6
Emotion/Excitement	4	1	5	10	2.6
Infection	1	2	1	4	1
Non-specific					
Night time	64	49	50	163	43
Rainy season	42	24	21	87	23
Cold weather	20	6	6	32	8
Fan	11	5	6	22	6
Cold water bath	11	4	5	20	5.3
Fever	10	6	2	18	4.7
Cold water drink	7	2	4	13	3.4
Dry weather	2	2	2	6	1.6

97% in 310 non-asthmatic children. Three hundred and nineteen (84%) of the 380 also had cow's milk supplement, in most cases, early in infancy, compared with a prevalence of 76% in 310 non-asthmatic children of similar background (unpublished data). The difference in the prevalence of early cow's milk feeds was significant ( $p < 0.025$ ).

#### Living and sleeping conditions

Many of the families, particularly those from the lower socio-economic sectors of the population, lived in buildings which were some distances away from motorable roads; consequently, children from these families were not often exposed to the dust generated by motor vehicles plying untarred roads. Analysis of the sleeping conditions revealed that 308 (81%) of the 380 children slept on mattresses which were placed on beds in 286

and on the floor in the remaining 22. Seventy-two (19%) children slept on mats on the floor. The mattresses were cotton wool in 123 (40%) of the 308, synthetic solid foam in 108 (35%), grass in 22 (7%), leaves in 2 and rags in another. In 52 (17%) others, the mattresses were interior sprung, and had nylon and other synthetic fibres inside them. One hundred and thirty-three of 380 cases did not use pillows regularly. One hundred and thirty-three (53%) of the remaining 247, used foam pillows and 104 (42%) used pillows filled with cotton wool. In 5 (2%) cases, the pillows contained feathers and in two (1%) others, grasses. In the remaining 3 cases, the pillows contained various items such as leaves and rags.

Bedroom floors were plastered with cement in 323 (85%) of the 380 cases; there were wooden tiles on the floor in 33, while in the remaining 24, the floors were neither plastered nor tiled. In 95 (25%) cases, the bedroom floor had rugs in addition to cement. Aeration of the bedroom was not aided by mechanical devices in 262 (69%) cases, while in 110 (29%) others, ceiling, table or standing fans were used, and in 8, including 4 who also had fans, the bedroom was air-conditioned. There was no correlation between severity of asthma and the living and sleeping conditions.

#### Domestic cooking and smoking habits

Inquiries into the smoking habits in the household revealed that in 99 (26%) of the 380 cases, some adult members of the household were regular cigarette smokers. These 99 consisted of 43 (23%) of 186 mild cases, 23 (26%) of 87 with moderate asthma and 33 (31%) of 107 who had severe asthma. Sixty-three (64%) of the 99 smokers were fathers or older siblings of the patients who came from all social classes, while the remaining 36 (36%) were co-tenants. No attempt was made to determine the number of cigarettes smoked daily. When the analysis was confined to those households where the fathers and older siblings, smoked, it was found that there was a relationship between severity of asthma in the

TABLE III  
Percentage of Positive Skin Reactions in Asthmatics and Controls

Antigen	ASTHMATICS		CONTROLS		X <sub>2</sub>	p
	No. Tested	% Positive	No. Tested	% Positive		
Ascaris	230	25	100	6	13.66	< 0.005
<i>D. Pteronyssinus</i>	250	21	100	12	3.99	< 0.05
Housedust	250	12	100	4	5.21	< 0.025
Feathers	250	12	100	0	13.13	< 0.005
Cat Fur	250	11	100	3	5.55	< 0.025
Meats	200	10	65	0	7.03	< 0.01
Grasses	250	10	100	2	6.42	< 0.025
Sheep wool	210	9	65	0	6.32	< 0.025
Fish	200	9	100	1	7.19	< 0.01
Cow Hair and Dander	126	8	65	0	5.44	< 0.025
Dog Hair	250	8	100	2	4.36	< 0.05
Mixed Yeast	200	6	100	0	6.25	< 0.025
Plantain pollen	240	6	100	0	6.08	< 0.025
Milk	250	6	100	0	6.27	< 0.025

Other antigens tested and compared include: Egg, Tree pollen, Cockroach, Moulds, Flowers and Shrubs, Cotton Flock, Fruits, Wheat grain, Cereals, Goat's hair, Human Hair, Horse hair ( $p > 0.05$ ).

children, and smoking by these relations; the fathers and sibs of a higher proportion of severe cases (25.2%) smoked, compared to moderate (18.4%) and mild cases (10.8%) ( $p < 0.01$ ). As far as could be ascertained, none of the asthmatic children smoked. Eighty (34%) of 234 children who were aged, 5 years and above and including most of those constantly exposed to cigarette smoke however, admitted that they usually coughed on passively inhaling cigarette smoke while 19 (8%) were not so affected and the remaining 135 (58%) did not know that the smoke affected them.

Cooking was regularly on kerosene stoves in 285 (75%) of the 380 households. In 30 (8%) other households, cooking was by firewood; by gas in 11 (3%) and in the remaining 54 cases, by a mixture of the above. Cooking took place in kit-

chens attached to the main house in 266 (70%); in kitchens outside the main house in 23 (6%); in open spaces outside the house in 30 (8%); in passage corridors within the house in 49 (13%) and on verandahs just outside the sleeping rooms in 12 (3%) others. Among those using wood, cooking was done in the open spaces outside the house, except in 3 (10%) of the 30 cases where it was done inside the house, along the passage corridor and in 10 (33%) others, in both inside and outside kitchens. There was no correlation between severity of asthma and the method of cooking ( $p > 0.5$ ). All the families using gas or electricity for cooking were from the upper socio-economic classes, while all those using firewood were from the lower socio-economic strata. Kerosene usage was however, evenly distributed among all social classes. Only 4 older children

identified firewood smoke as a precipitant of cough, and sometimes, breathlessness.

#### *Domestic animals*

Domestic animals were present in the homes of 152 (40%) families. There was no correlation between the presence of domestic animals and severity of asthma ( $p > 0.5$ ). Poultry, cats, goats and dogs were the commonest household animals to which the children were constantly exposed.

#### *Skin sensitivity tests*

Skin tests were carried out with at least, 8 antigens (and a total of 30 antigens) in each of 250 children. Negative reactions were obtained to all allergens tested in 40% of the cases. Analysis of the positive reactions showed that ascaris, *D. Pteronyssinus*, housedust and feathers were the commonest antigens (Table III). It is noteworthy that food items did not feature prominently among the positive skin reactions.

### Discussion

A number of the aetiological factors in bronchial asthma are unknown although its clinical manifestations are believed to be due to hyperresponsiveness of the airways to stimuli which would not evoke similar reactions in normal individuals. Allergy, heredity, infection, emotion and exercise were among causal and precipitating factors revealed by the present study as well as by others.<sup>2,8</sup> Early feeding with cow's milk, shown to be more prevalent among asthmatics than the controls in the present series has also been incriminated as a factor in the development of asthma.<sup>1,2</sup>

Although exercise was a prominent precipitant of asthmatic attacks in the present and other series,<sup>4</sup> it is recommended that asthmatic children should not be discouraged from physical games as long as these are within their limits of tolerance. Swimming for instance, does not provoke as much bronchospasm as does sustained running,<sup>4</sup> and is therefore a suitable form of exercise. Infection was not a major factor in the present series, presumably because most

informants who were illiterate or semi-literate, were ignorant of when attacks were precipitated by infection. It is possible that some of those attacks which were precipitated by fever, fell into this category. Similarly, the non-prominence of emotional factors as precipitants of attacks might have been due to the failure of parents to link the two.

A positive family history of atopy in the present series was in keeping with the findings by others.<sup>9</sup> Despite this widely acknowledged familial incidence, the mode of inheritance remains unknown. Apart from heredity, other factors which may be regarded as causal in the present series included items to which the children reacted on skin-testing. The most common of these were ascaris antigen, *D. Pteronyssinus* (housedust mite), housedust and feathers. The role of ascaris in the aetiology of asthma in childhood remains controversial and further studies are needed for its elucidation. *D. Pteronyssinus* has been identified in many parts of the world<sup>10,11</sup> as a causal agent in allergic asthma. It is evident however, that this mite is probably not the only allergen in the housedust, since not all children who reacted to housedust in the present series also reacted to *D. Pteronyssinus*. Other possible allergens in the housedust include products of the ubiquitous cockroach to which asthmatics are known to react.<sup>12</sup> Forty per cent of the families of asthmatic children in the present series had domestic animals and pets, consisting mostly of cats, goats, dogs and poultry. Since these animals do shed their hairs, furs or feathers which may then form part of the housedust, they could also act as allergens in the housedust in some cases, in addition to reactions caused by direct contact with the animals.

Cotton wool, feathers and grass used in pillows and mattresses in the present study are potential allergens. Similarly, dust which collects on fan blades could precipitate attacks when inhaled by patients when the fan is in action. This is in addition to the non-specific precipitating effect of the air blown by the fan. Advice on keeping fans free from dust, and against directing the fan fully

and unremittingly towards the faces of some asthmatics have led to an amelioration of their symptoms (personal observation). Apart from mattresses, their covers, window blinds and floor coverings (carpets and rugs), mats on which some patients sleep, may also harbour dust and the house-dust mite. The advice which may be offered to users of mats who are also sensitive to house-dust mite, would be to change such mats in favour of other beddings that can be more easily cleaned, or if that is not feasible because of the expenses involved, to change such mats fairly frequently and in the intervals, to shake and sun them regularly. The majority of patients who use mattresses should be advised to cover such mattresses with plastic materials to enable their regular cleaning, as advocated by Sarsfield *et al.*<sup>13</sup>

The effect of tobacco smoke on asthma in the present series appears to be significant. Thirty-four per cent of the older children admitted to coughing on inhaling tobacco smoke; the cough in turn, sometimes triggered attacks of breathlessness. Furthermore, the severity of asthma was directly related to the number of close relatives who smoked. Cigarette smoke is known to affect the respiratory tract by inducing mucus hypersecretion, increased incidence of respiration infection and airways obstruction.<sup>6</sup> These effects, although worse in active smokers are, unfortunately, not confined to them. Non-smokers chronically exposed to tobacco smoke have significantly reduced small airways function compared to non-smokers who are not so exposed.<sup>14</sup> Furthermore, Tager *et al.*<sup>15</sup> have shown that children living in households where parents smoked tobacco had lower mid-expiratory flow rates than those who lived in households where smoking

did not occur; the greater the exposure, the lower the pulmonary function score. From this evidence, tobacco smoking should be strongly discouraged in the homes of asthmatic children.

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