

Biosocial factors in the epidemiology of childhood asthma in a British national sample

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SUMMARY The relation between biosocial factors and childhood asthma in a British national sample ($n = >14\ 000$) is examined. The presence of asthma was found to associate with sex of the child, parental age and occupation, housing type, and overcrowding as well as eczema and some infectious diseases. Discriminant analysis showed that it was possible to differentiate between asthmatics and non-asthmatics due mainly to allergy related factors.

Since community and public health organisations and governmental health funding agencies all allocate resources for particular health needs in relation to demands, information on the social aetiology of specific diseases assists the planners. The present study examines the extent and correlates of asthma in a prospective, longitudinal, national sample of individuals. Our data indicate that obstruction of bronchial air passages leads to breathing difficulties for approximately 3.5% of children between birth and 16 years of age in England, Scotland, and Wales.

The National Child Development Study (NCDS) began in 1958 with an investigation undertaken initially to explore prenatal and perinatal care in England, Scotland, and Wales. A national sample was drawn of over 14 000 children, including every infant born in Great Britain in the week 3-9 March 1958. Members of the original sample have been restudied periodically, together with those having the same birth dates who entered the country subsequently. These four restudies examined various aspects of the growth and development of 18 559 individuals and their families. Each survey included social information pertaining to every child and its family with data on parental occupation, education, marital status, age and birthplace of parents and of the child, parity, family size, housing tenure and type, birth order of the study child, number of schools attended by the study child, parental and subjects' smoking habits, languages spoken in the home, hospital and medical history, and a considerable body of health related matters, including a record of contagious and other diseases, hospital experiences, prescriptions, headache and migraine frequency, as

well as questions related specifically to asthma.

This report uses data collected when the children were in their seventh year to examine the relation between asthma and potentially relevant social, educational, and health related variables.

Methods

The health visitors asked mothers of children aged 7 years, "Has your child ever had attacks of asthma?" If the answer was 'yes' mothers were then asked about the frequency and severity of the attacks. The latter were categorised as mild, moderate, and severe.¹ The variables possibly relevant to the epidemiology of asthma in the first three NCDS restudies were selected for analysis. The computer files storing data collected in 1965 were analysed by SPSS Crosstabs programs to determine the relation of frequency of occurrence of asthma to many other variables. The program yielded information on χ^2 , percentages, and levels of significance. Other analyses involved the use of larger numbers of variables to search among the particular categories for the associations that contributed most significantly to asthma occurrence. Discriminant function analyses were also applied to study the difference between asthmatics and non-asthmatics in respect of a large number of variables appropriately weighted and examined simultaneously.

General findings

In 1964, 3.1% of the total cohort had been reported as suffering from (or having suffered from) asthma. Of the 430 cases, 25 had severe asthma, 368 had had

only one attack or had mild asthma, and for the 37 others the records showed only that the child had had or now had asthma,¹ with no additional information. Significantly more boys (3.8%) than girls (2.3%) reported having asthma,¹ although among the severe cases there is little divergence by sex.

Mothers with one or two children reported more asthma than did those with larger families,¹ and this is especially true of second children. There is significantly less asthma in families with four or more children. Seven year olds with fewer siblings are more likely to have asthma than are children born earlier in their mothers' reproductive careers.

Fathers' occupations were categorised as being either non-manual or manual using the categories for defining social class as established by the Registrar General. Corroborating other studies, there are more reports of young children with asthma in homes with non-manually employed fathers, and fewer where the fathers held manual jobs.

Many reports refer to climatic and other environmental effects on the prevalence of asthma. In the NCDS data, the Midlands and the North show less asthma than expected by chance, while Yorkshire and Scotland also show less than the overall average (figure: $\chi^2 = 29.62$, 10 df, $p < 0.001$). In London and the South, asthma incidence is higher than the overall average, and in Wales it is still higher. Demographically, there is a concentration of fathers in non-manual classes in the southern part of the country, so social rather than regional ecological factors alone could adequately explain the differences in different parts of the nation. Fathers with non-manual occupations are found in higher than expected frequencies where asthma frequencies are high: in London (38.6%), the East (36.1%), and the South (36.4%); and in lower than expected frequencies where reported asthma is low: in Scotland (24.2%), the North of England (25.0%), and in the Midlands (27.0%). The percentage of non-manual classes for the nation as a whole is 30.9%. More fathers with manual occupations are found in the regions where asthma occurrence is low: the North of England (72.0%), Scotland (72.9%), and the North Midlands (69.9%). There are also fewer than expected manually employed fathers in London and the Southeast (58.4%) and the South (60.6%). The percentage of manual workers for the nation as a whole is 66.2%. The difference in proportions of the social classes in the several regions is highly significant: $\chi^2 = 188.51$, 10 df, $p < 0.0001$.

Only 25 cases of severe asthma are reported in all the country, an overall occurrence of 0.2%. Severe asthma is most frequent in Scotland (0.4%) and is low in the North of England. Mild asthma, with



infrequent or single episodes, has a 2.5% occurrence everywhere in Great Britain but is most frequent in Wales (4.2%), while in Scotland (1.7%) and Yorkshire (1.4%) its occurrence is below the national average.

Supportive of the association between the distribution of asthma and the non-manual classes is the fact that a smaller percentage of those with asthma are reported living in rented or council houses (2.5%), while more are found in families buying or who own their homes (3.7%).

The association between asthma, the number of people with whom the asthmatic child shares a bedroom, as well as whether or not the child's bed is shared is significant. Fewer asthmatic children share beds than expected on the basis of the usual

hypotheses. Furthermore, when there is only one child in the bedroom a higher percentage than the national average report the presence of asthma, while in homes with two or more sharing the bedroom, that percentage of asthmatics is below the national average. These observations corroborate the finding that asthma is more prevalent in non-manual families, since such families tend to have larger homes and smaller families.

Crowding reflected in numbers of people per household and/or per room also show regional heterogeneity ($\chi^2 = 176.70$, 70 df, $p < 0.001$). London and the South (two of the regions with the highest asthma rates reported) are regions with the smallest number of people per household. These are also the regions where there are the most homes with the largest number of rooms, and where there are proportionally more non-manual workers.

Clearly, many social characteristics correlate with occupational position, and it is not one's parents' occupations per se that "determine" one's likelihood of having asthma but rather the lifestyle associated with a larger disposable income, a larger home, less crowding, a smaller family, etc.

BREAST FEEDING AND ASTHMA

There is a positive relation between children who, at birth, were breast fed for over one month and those reported as having had asthma by the age of 7 (table 1). Significantly fewer of those with asthma at 7 either were bottle fed or were breast fed for less than one month. In the late 1950s when less stress was laid on breast feeding than at present, those mothers who nursed their infants were more likely to come from non-manual than from manual classes. In fact, where the principal breadwinner was a manual worker, more than the expected number of mothers either bottle fed their infants or breast fed for less than one month (table 2). On the other hand, the distribution among non-manual workers' wives is exactly reversed, thus supporting those findings which indicate that class is associated with the occurrence of asthma. We also conclude that the breathing difficulties subsequently reported began later in life not in early infancy while the child was being bottle or breast-fed.

Table 1 *Breast feeding and asthma*

Breast feeding	Asthma		
	Yes	No	Total
No	109	4 450	4 559
Yes <1 month	99	3 476	3 575
Yes \geq 1 month	232	6 019	6 351
Total	440	13 945	14 385

$\chi^2 = 16.85$, $df = 2$, $p < 0.0002$

Table 2 *Breast feeding and social group*

Breast feeding	Social group			
	No male head	Non Manual	Manual	Total
No	154	1142	3246	4 542
Yes <1 month	106	1004	2472	3 582
Yes \geq 1 month	155	2291	3822	6 268
Total	415	4437	9540	14 392

$\chi^2 = 180.15$, $df = 4$, $p < 0.001$

ETHNICITY

At the time of the first follow-up an addition to the original cohort was made to include all children born during the "birthday week" who had subsequently entered Britain. This was done to account for the relatively large-scale immigration to Great Britain after the second world war from the Caribbean as well as from India, Pakistan, Cyprus, and elsewhere. Various questions were included in the first and subsequent studies to "tag" the new entries: parents' birthplace, languages spoken at home, year of entry to Britain, place of birth of the subject, ethnic identification of child by teachers and physicians, and, if a boy, whether he had been circumcised and at what age. By the late 1950s circumcision ceased to be an option under the National Health Service, thus it can be assumed that this question served only to identify Jews and Moslems, for both of whom circumcision is mandatory by religion, although a few outside these groups may be included where parents had personal reasons for wishing the operation to be performed.

When the cohort was first restudied in 1965, this question was asked about circumcision so we compared 1965 observations for asthma occurrence with the answer to this question posed in 1969, when the children were 11 years old. The association is significant (table 3). More of those reported as circumcised in 1969 had asthma at age 7, while fewer of the uncircumcised are so reported. Furthermore, fewer circumcised boys than expected are free from asthma. This is not to point to a direct causal relation between the biological phenomenon of asthma and the elective operation, but rather to suggest that other characteristics of these populations make them more prone to asthma than are members of other groups.

Table 3 *Circumcision and asthma*

Circumcised	Asthma		
	Yes	No	Total
Yes	38	653	691
No	104	5282	5486
Total	242	5935	6177

$\chi^2 = 5.17$, $df = 1$, $p < 0.025$

This relation has not yet been reported in other studies. It remains to be seen if, in later restudies, there are additional measures of a relation between ethnicity and asthma.

MATERNAL SMOKING AND ASTHMA

There is no meaningful divergence from national average occurrence of asthma when data are classified according to whether the mothers were heavy or light smokers or did not smoke at all during pregnancy. The expectation of a clear association between smoking and asthma occurrence is not therefore borne out, perhaps because the information on smoking refers only to the period before pregnancy and not subsequently.

ASTHMA AND ALLERGY-RELATED DISEASES

Symptoms other than asthma have been shown to be associated with a number of allergic reactions, and eczema, urticaria (hives), and hayfever are not limited to asthmatics although in the NCDS sample the asthmatics show a significantly high positive association with the occurrence of hayfever or sneezing (table 4) and eczema. More boys than girls suffer from hayfever ($\chi^2 = 9.94, 1 \text{ df}, p < 0.02$).

Table 4 *Asthma and hayfever*

Hayfever	Asthma		Total
	Yes	No	
Yes	160	633	793
No	282	13 395	13 677
Total	442	14 028	14 470

$\chi^2 = 824.46, \text{df} = 1, p < 0.001$

ASTHMA AND OTHER DISEASES

More asthmatics than expected are reported as having had whooping cough by the age of 7 (table 5). While few have severe asthma in this group, they were much more likely to have had whooping cough than were less seriously afflicted asthmatics. Except for whooping cough, the NCDS data show no significant associations between asthma and

Table 5 *Asthma and whooping cough*

Whooping cough	Asthma		Total
	Yes	No	
Yes	82	2 116	2 198
No	345	11 489	11 834
Total	427	13 605	14 032

$\chi^2 = 3.91, \text{df} = 1, p < 0.05$

infectious diseases. There is a positive association between the likelihood of having pneumonia and having asthma. The clear association between asthma and the early occurrence of pneumonia shows no significant sex difference among those who have had pneumonia.

Asthmatic children report frequent headaches, probably related to the strain associated with chronic respiratory difficulties.

USE OF HOSPITAL FACILITIES

Parents with asthmatic children seek hospital attention for their children in significantly higher frequencies than do parents of non-asthmatics, because they need either hospital care or tests. Besides treatment for breathing difficulties, asthmatics were admitted to hospital for tonsil operations in higher than expected frequencies.

DISCRIMINANT ANALYSIS

The results of these analyses clearly indicate that a large number of biosocial factors associate with the presence of asthma in 7 year old children. How different are asthmatics from the rest of the population? Is it possible to distinguish asthmatics from non-asthmatics on the basis of their association with these biosocial factors?

Discriminant analysis is used here to determine to what extent and how well asthmatics as a group differ from non-asthmatics. A stepwise discriminant analysis was carried out whereby the most powerful discriminating variable was entered first and then the second, etc. The results show a highly significant difference between the group characteristics of asthmatics and non-asthmatics (Wilks' Lambda = 0.90, $\chi^2 = 1009.6, \text{df}, p = 0.001$) based on the nine variables shown in table 6. Overall the analysis successfully classified 89.4% of the sample and correctly predicted 52.3% of those suffering from asthma.

It was clear from this analysis that the most powerful discriminating variables were allergy-related factors. These five variables were removed, and the analysis was repeated to determine what discriminatory power remained for the other variables, and there was still significant discrimination (Wilks' Lambda = 0.96, $\chi^2 = 39.2, 9 \text{ df}, p < 0.0001$). The percentage of grouped cases correctly classified dropped to an overall value of 55.4%, while 59.0% of asthmatics were correctly categorised.

It is clear that these variables provide considerable, albeit imperfect, group separation of asthmatics from others in the national sample. The presence/absence of hayfever and eczema and, to a lesser extent, pneumonia were major contributors to group

differentiation. Indeed, these three variables alone provided remarkable group separation for asthmatics and others.

Table 6 *Discriminant analysis for asthma*

	Wilks' Lambda	Standardised discriminant function	
Hayfever	0.925	+0.729	
Eczema after 1st year	0.911	+0.516	
Use of hospital facilities	0.905	+0.210	
Pneumonia	0.903	+0.146	
Sex	0.902	+0.114	
Breast fed	0.902	-0.059	
Housing type	0.902	+0.055	
Family moves since birth	0.902	-0.049	
Headaches	0.901	+0.048	
Group centroids	Asthmatics -1.82; Non-asthmatics +0.06		
<i>Predicted group membership</i>			
Classification	n	Asthmatics	Non-asthmatics
Asthmatics	428	224 (52.3%)	204 (47.7%)
Non-asthmatics	13 574	1278 (9.4%)	12 296 (90.6%)
	14 002	1502	12 500

Discussion

The findings reported here (table 7) show both similarities to and differences from published findings. Thus, Peckham and Butler¹ report that between birth and age 16 approximately 3.5% of children in England, Wales and Scotland suffer from obstruction of the bronchial air passages. Distribution by sex and social class also mirrors the findings of others: until the age of 12, more asthma is found among boys than girls, and the severity of attacks of childhood asthma tends to abate with time²⁻⁴ as more boys than girls "outgrow their attacks". By the late teens the ratio of boys to girls with asthma is about equal.^{3 5-7} The evidence also suggests that more asthmatic children, frequently second children, are found in small families where the principal breadwinner is a non-manual worker,^{5 8-10} while more severe asthma is found in social classes IV and V (manual workers) and in families with four or more children.

The regional variations noted here have not been stressed by others using the NCDS dataset since they grouped the data more inclusively, while we maintained the regional distinctions set up in the study itself.

Some of the variables examined here were not discussed by others, so that the associations between asthma and home ownership, crowding and regional distribution of the social classes, which are interrelated factors, do not appear elsewhere.

Table 7 *Significant associations with asthma*

	χ^2	df	p
Sex	27.36	1	<0.0001
Family size	16.25	9	<0.06
Age of mother	20.61	3	<0.0001
Age of father	16.08	3	<0.001
Social group by occupation	8.59	2	<0.025
Severity by region	66.0	30	<0.0002
Housing type (own, rent, etc)	15.09	4	<0.0045
Number sharing bedroom	20.77	4	<0.0001
Sharing bed	9.42	1	<0.002
Breast feeding	16.85	2	<0.0002
Breast feeding and social group	180.15	4	<0.001
Circumcision	5.17	1	<0.025
Smoking			Not significant
Hayfever	824.46	1	<0.001
Eczema in first year	536.78	1	<0.001
Eczema after first year	501.85	1	<0.001
Whooping cough	3.91	1	<0.05
Pneumonia	96.19	1	<0.001
Headaches	11.03	1	0.001
Major handicaps	10.51	1	0.001
Tonsils	4.61	1	0.05

Findings on other variables with significant positive association (breast feeding, whooping cough, pneumonia, and circumcision) are not dealt with elsewhere, although there is a large literature on the association between allergic skin reaction and the subsequent occurrence of asthma.^{2 6 11}

Finally, these data do not corroborate reports showing that smoking has a positive effect on the frequency of occurrence of asthma.²

References

- 1 Peckham C, Butler N. A national study of asthma in childhood. *J Epidemiol Comm Health* 1978; **38**: 79-85.
- 2 Fife D, Speizer F. In: Gershwin M Eric, ed, *Bronchial asthma: Principles of diagnosis and treatment*. New York: Grune and Stratton, 1981: 1-12.
- 3 Godfrey S. Childhood asthma. In: Gershwin M Eric, ed, *Bronchial Asthma: Principles of diagnosis and treatment*. New York: Brune and Stratton, 1981: 324-66.
- 4 Dawson B, Horobin G, Illsley R, Mitchell R. A survey of childhood asthma in Aberdeen. *Lancet* 1969; **1**: 827-30.
- 5 McNichol KN, Williams HE. Spectrum of asthma in children. I Clinical and physiological components. *Br Med J* 1973; **4**: 7-11.
- 6 Speizer F. Epidemiological aspects of asthma. *Triangle: Sandoz J Med Sci* 1978; **17**: 117-23.
- 7 Martin AJ, McLennan LA, Landau I, Phelan PD. The natural history of childhood asthma to adult life. *Br Med J* 1980; **4**: 7-11.
- 8 Gregg I. Management of asthma in general practice. *Br Med J* 1983; **287**: 57-8.
- 9 Mitchell RS, Dawson B. Educational and social characteristics of children with asthma. *Arch Dis Child* 1973; **48**: 467-71.
- 10 Graham PS, Rutter ML, Yule W, Pless JB. Childhood asthma: a psychological disorder. *Br J Prev Soc Med* 1967; **21**: 78-85.
- 11 Pepys J. Clinical aspects of Asthma. *Triangle: Sandoz J Med Sci* 1978; **17**: 125-30.