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Investigation into the increase in hay fever and eczema at age 16 observed between the 1958 and 1970 British birth cohorts

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Abstract

Objective: To investigate whether changes in certain perinatal and social factors explain the increased prevalence of hay fever and eczema among British adolescents between 1974 and 1986.

Design: Two prospective birth cohort studies.

Setting: England, Wales, and Scotland.

Subjects: 11 195 children born 3-9 March 1958 and 9387 born 5-11 April 1970.

Main outcome measures: Parental reports of eczematous rashes and of hay fever or allergic rhinitis in the previous 12 months at age 16.

Results: The prevalence of the conditions over the 12 month period increased between 1974 and 1986 from 3.1% to 6.4% (prevalence ratio 2.04 (95% confidence interval 1.79 to 2.32)) for eczema and from 12.0% to 23.3% (prevalence ratio 1.93 (1.82 to 2.06)) for hay fever. Both conditions were more commonly reported among children of higher birth order and those who

were breast fed for longer than 1 month. Eczema was more commonly reported among girls and hay fever among boys. The prevalence of hay fever decreased sharply between social classes I and V, increased with maternal age up to the early 30s, and was lower in children whose mothers smoked during pregnancy. Neither condition varied significantly with birth weight. When adjusted for these factors, the relative odds of hay fever (1986 *v* 1974) increased from 2.23 (2.05 to 2.43) to 2.40 (2.19 to 2.63). Similarly, the relative odds of eczema rose from 2.02 (1.73 to 2.36) to 2.14 (1.81 to 2.52).

Conclusions: Taken together, changes between cohorts in sex, birth weight, birth order, maternal age, breast feeding, maternal smoking during pregnancy, and father's social class at birth did not seem to explain any of the observed rise in the prevalence of hay fever and eczema. However, correlates of these factors which have changed over time may still underlie recent increases in allergic disease.

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Introduction

The risk of developing eczema and hay fever in childhood is reported to be increasing in many countries, including Great Britain.¹ Evidence for such a change in Great Britain has come from studies of school-children,^{2,3} consultation rates in general practice,⁴ and follow up studies of the 1946, 1958, and 1970 birth cohorts.⁵

A recent comparison of the 1958 and 1970 cohorts at the age of 16 showed a near doubling in the reported period prevalence of both hay fever and eczema between 1974 and 1986.⁶ There were also increases between cohorts in the proportions of teenage mothers, bottle fed babies, firstborn children, mothers smoking in pregnancy, and low birthweight babies,⁶ all factors which have been implicated in the aetiology of allergic disease.⁷⁻¹³

We investigated these social and perinatal variables further in relation to hay fever and eczema and their possible role in the increasing prevalence of these diseases.

Subjects and methods

All children born in England, Wales, and Scotland over the 7 days from 3 to 9 March 1958 and from 5 to 11 April 1970 plus subsequent immigrants with the same dates of birth were followed up at various intervals in the national child development study (1958 cohort) and the British cohort study (1970 cohort). The British cohort study was formerly known as the British births survey at birth, the child health and education study at 5 and 10 years, and Youthscan at 16 years. Data on perinatal and social factors including father's social class,^{14,15} maternal smoking during pregnancy, birth weight, and maternal age and parity were collected by midwives at birth in both studies. Information on the duration of breast feeding was obtained from parental interviews at age 7 in the 1958 cohort and age 5 in the 1970 cohort.^{16,17}

Both cohorts were studied extensively at age 16, when interviews with parents contained a question relating to the general health of the child in the previous 12 months. The phrasing of this question in the two

studies was almost identical, being: "Has the study child [teenager in the 1970 cohort] suffered in the past 12 months from any of the following...?" which included hay fever or allergic rhinitis and eczematous rashes.

Logistic regression models containing a parameter to adjust for cohort were fitted by SAS¹⁸ to examine the association between hay fever, eczema, and potential risk factors. Whether changes in the distributions of these potential risk factors between cohorts could explain the observed doubling in the parental reporting of these diseases was investigated by looking at changes in the cohort parameter after the inclusion and exclusion of such factors from the logistic model.

When assessing response rates the population for each study was taken to be all children whose parents contributed information at birth minus stillbirths and early neonatal deaths (< 7 days) plus subsequent participating immigrants and late traces. Calculated in this way, response may be slightly underestimated as populations do not exclude later deaths and emigrations.

Results

Subjects

Information on the parental reporting of hay fever and eczema at 16 was available for 11 195 subjects (62%) from the 1958 cohort and 9387 subjects (54%) from the 1970 cohort. In both cohorts response rates were similar for subjects with and without a previous report of symptoms (table 1). However, for the 1970 cohort response rates were slightly lower for boys than for girls and for manual than for non-manual social classes. For the 1958 cohort they were slightly lower for social class I (table 1). Complete data on hay fever, eczema, sex, birth weight, parity, maternal age, duration of breast feeding, maternal smoking during pregnancy, and father's social class were available for 8460 children from the 1958 cohort and 7104 children from the 1970 cohort.

Prevalence data

The prevalence of hay fever over a 12 month period was 12.0% (1348/11195) in the 1958 cohort and 23.3% (2183/9387) in the 1970 cohort.⁶ The prevalence of eczema was 3.1% (350/11195) and 6.4% (599/9387) respectively.⁶ These estimates changed little when weighted for possible response bias due to sex and social class (weighted prevalence estimates: 12.2% and 23.3% for hay fever; 3.2% and 6.2% for eczema). Basic tabulations of unweighted prevalence by risk factors are presented for each cohort in table 2.

Risk factors for hay fever

After adjustment for cohort and other potential risk factors (table 3), the prevalence of hay fever over a 12 month period was higher for boys than girls (odds ratio 1.19 (95% confidence interval 1.09 to 1.29); $P < 0.001$) and lower for mothers who smoked during pregnancy (odds ratio 0.87 (0.79 to 0.95); $P < 0.01$). There were significant trends ($P < 0.001$) with decreasing birth order, increasing duration of breast feeding, increasing maternal age, and higher social class. The odds of hay fever were 40% lower for social class V compared with social class I, nearly three times higher for a firstborn child compared with a child born fifth or more in line, and 20% higher for breast fed babies (> 1 month dura-

Table 1 Response rates to general health question specifically mentioning hay fever and eczema at age 16 by sex, social class, and history of hay fever or eczema

	% (proportion) responding in 1974 (1958 cohort)	% (proportion) responding in 1986 (1970 cohort)
Sex		
Male	61 (5681/9263)	51 (4623/9032)
Female	64 (5514/8677)	57 (4761/8392)
Father's social class at birth^{14,15}		
I	58 (425/734)	54 (420/782)
II	63 (1311/2071)	57 (1025/1799)
IIINM	64 (1000/1553)	60 (1094/1809)
IIIM	63 (5084/8050)	54 (3840/7132)
IV	64 (1244/1932)	52 (1213/2314)
V	63 (984/1552)	50 (499/1008)
Hay fever by age 7 (1958 cohort) or age 5 (1970 cohort)*		
Yes	70 (561/801)	59 (323/549)
No	67 (9219/13 701)	60 (7196/11 972)
Eczema by age 7 (1958 cohort) or age 5 (1970 cohort)*		
Yes	66 (697/1052)	61 (938/1539)
No	67 (9083/13 457)	60 (6602/11 016)

*Response rates tend to be higher as they are based on children with a response at a previous follow up.

Table 2 Reported prevalences of eczema and hay fever over period of 12 months at age 16 and their association with potential risk factors

Potential risk factor	1974 (n=11 195)			1986 (n=9387)		
	% (No) of subjects	% (No) with hay fever	% (No) with eczema	% (No) of subjects	% (No) with hay fever	% (No) with eczema
Sex						
Female	49.3 (5514)	10.9 (602)	3.9 (213)	50.7 (4761)	21.9 (1045)	7.8 (373)
Male	50.7 (5681)	13.1 (746)	2.4 (137)	49.3 (4623)	24.6 (1138)	4.9 (226)
Birth weight (g)*						
< 2000	0.9 (95)	4.2 (4)	3.2 (3)	1.5 (128)	17.2 (22)	3.9 (5)
2001-2500	4.8 (494)	10.9 (54)	2.2 (11)	4.9 (422)	23.0 (97)	5.5 (23)
2501-3000	19.3 (1970)	12.4 (244)	3.0 (59)	19.1 (1654)	24.0 (397)	7.7 (127)
> 3000	74.9 (7654)	12.3 (938)	3.3 (250)	74.6 (6460)	23.3 (1504)	6.2 (400)
Birth order						
1	37.0 (3803)	15.4 (584)	3.7 (142)	38.8 (3361)	27.8 (933)	7.1 (239)
2	30.7 (3155)	12.6 (397)	3.1 (98)	33.5 (2899)	22.4 (648)	6.3 (182)
3	15.5 (1596)	9.6 (154)	2.9 (46)	15.4 (1334)	19.9 (266)	5.3 (71)
4	7.9 (815)	7.1 (58)	2.9 (24)	6.9 (598)	16.9 (101)	6.4 (38)
≥5	8.8 (900)	5.9 (53)	2.0 (18)	5.4 (471)	15.5 (73)	5.3 (25)
Maternal age (years)						
< 20	5.3 (564)	10.6 (60)	3.2 (18)	8.9 (768)	21.0 (161)	6.0 (46)
20-24	28.8 (3040)	11.2 (339)	3.7 (113)	36.4 (3140)	23.7 (745)	6.0 (189)
25-29	33.1 (3490)	13.3 (464)	2.9 (101)	31.7 (2737)	24.1 (659)	7.3 (199)
30-34	20.2 (2126)	12.4 (264)	3.1 (65)	14.9 (1286)	23.9 (307)	6.6 (85)
35-39	10.1 (1070)	12.1 (129)	2.5 (27)	6.2 (536)	20.3 (109)	5.4 (29)
≥40	2.4 (255)	8.2 (21)	2.7 (7)	1.9 (160)	21.9 (35)	3.8 (6)
Duration of breast feeding (months)						
None	31.2 (3045)	9.7 (295)	2.5 (77)	61.9 (4835)	22.1 (1068)	6.0 (288)
< 1 month	24.6 (2405)	11.5 (276)	3.0 (73)	16.6 (1293)	26.5 (343)	6.1 (79)
> 1 month†	44.2 (4315)	14.4 (620)	3.7 (158)	21.5 (1682)	26.0 (438)	7.3 (122)
Maternal smoking during pregnancy‡						
No	66.9 (6975)	13.2 (923)	3.2 (223)	57.9 (4997)	24.7 (1236)	6.9 (343)
Yes	33.1 (3454)	9.9 (341)	3.0 (105)	42.1 (3629)	21.4 (775)	5.8 (210)
Father's social class at birth^{14 15}						
I	4.2 (425)	18.8 (80)	3.8 (16)	5.2 (420)	29.8 (125)	8.1 (34)
II	13.0 (1311)	17.2 (226)	3.6 (47)	12.7 (1025)	25.0 (256)	6.7 (69)
IIINM	10.0 (1000)	17.2 (172)	3.1 (31)	13.5 (1094)	26.9 (294)	7.6 (83)
IIIM	50.6 (5084)	11.1 (563)	2.9 (149)	47.5 (3840)	23.0 (884)	6.0 (229)
IV	12.4 (1244)	7.6 (94)	2.9 (36)	15.0 (1213)	19.5 (237)	5.9 (71)
V	9.8 (984)	8.4 (83)	4.0 (39)	6.2 (499)	18.2 (91)	5.2 (26)

*Birth weight was measured in ounces in the 1958 cohort and converted to grams by multiplying by 28.35.

†≥1 month in 1970 cohort.

‡Maternal smoking after the fourth month of pregnancy.

tion) than for bottle fed babies. The association with maternal age seemed to reach a plateau by the early 30s, with the odds of hay fever about 60% higher for children born to mothers in their 30s and 40s than for those born to teenage mothers.

The associations with social class, birth order, and breast feeding differed between cohorts ($P < 0.001$, $P < 0.01$, $P < 0.05$ respectively in tests for a statistical interaction), with steeper trends being observed among children from the 1958 cohort. The association with smoking during pregnancy also differed significantly, with odds ratios of 0.77 and 0.93 for children born in 1958 and 1970 respectively.

Risk factors for eczema

The prevalence of eczema over a 12 month period was lower for boys than girls (odds ratio 0.6 (0.51 to 0.70); $P < 0.001$). Like hay fever, eczema was associated with decreasing birth order ($P < 0.05$) and increasing duration of breast feeding ($P < 0.05$), although the trend with birth order was not as steep or well defined. For eczema no significant differences in associations between cohorts were detected.

Investigating increase in prevalence

On the basis of the 15 564 children with complete information on potential risk factors, the prevalence odds ratios between cohorts (1986 *v* 1974) were 2.02 (1.73 to 2.36) for eczema and 2.23 (2.05 to 2.43) for hay fever. After adjustment for sex, birth weight, birth order, maternal age, duration of breast feeding, maternal smoking during pregnancy, and father's social class at birth the relative increase in the odds of eczema rose slightly, giving an adjusted odds ratio of 2.14 (1.81 to 2.52). The relative increase in the odds of hay fever also rose, giving an adjusted odds ratio of 2.40 (2.19 to 2.63). Thus changes over time in the distributions of the potential risk factors listed did not seem to explain any of the relative increase in the prevalence odds of eczema and hay fever between the 1958 and 1970 cohorts (table 4).

Discussion

Is atopy increasing?

This comparison of data from two national British cohorts shows about a twofold increase in the reported

Table 3 Adjusted odds ratios* (95% confidence intervals) for eczema and hay fever by potential risk factors in combined cohorts (n=15 564)

	Hay fever	Eczema
Birth weight (g)		
2001-2500	1.49 (0.90 to 2.46)	1.08 (0.43 to 2.70)
2501-3000	1.53 (0.96 to 2.45)	1.39 (0.60 to 3.22)
>3000	1.47 (0.93 to 2.34)	1.37 (0.60 to 3.13)
Test for trend	P >0.70	P >0.35
Birth order		
2	0.70 (0.63 to 0.77)	0.81 (0.68 to 0.98)
3	0.53 (0.46 to 0.61)	0.74 (0.57 to 0.95)
4	0.41 (0.33 to 0.50)	0.82 (0.59 to 1.14)
≥5	0.35 (0.27 to 0.44)	0.66 (0.45 to 0.98)
Test for trend	P <0.001	P <0.05
Maternal age (years)		
20-24	1.23 (1.01 to 1.49)	1.14 (0.81 to 1.60)
25-29	1.50 (1.23 to 1.83)	1.28 (0.90 to 1.82)
30-34	1.67 (1.35 to 2.08)	1.28 (0.87 to 1.89)
35-39	1.60 (1.24 to 2.07)	1.11 (0.70 to 1.76)
≥40	1.61 (1.10 to 2.35)	0.80 (0.37 to 1.72)
Test for trend	P <0.001	P >0.65
Duration of breast feeding		
<1 month	1.09 (0.97 to 1.22)	0.99 (0.80 to 1.23)
>1 month	1.20 (1.08 to 1.33)	1.25 (1.04 to 1.50)
Test for trend	P <0.001	P < 0.05
Maternal smoking during pregnancy		
Yes	0.87 (0.79 to 0.95)	0.94 (0.80 to 1.11)
Test for heterogeneity	P <0.01	P >0.45
Father's social class at birth^{14 15}		
II	0.84 (0.69 to 1.04)	0.90 (0.61 to 1.31)
IIINM	0.89 (0.73 to 1.10)	1.06 (0.72 to 1.55)
IIIM	0.72 (0.60 to 0.87)	0.90 (0.64 to 1.27)
IV	0.60 (0.48 to 0.75)	0.94 (0.64 to 1.40)
V	0.60 (0.47 to 0.77)	1.08 (0.70 to 1.68)
Test for trend	P <0.001	P >0.80

*Odds ratios are adjusted for cohort, sex, and all other factors in table and are calculated relative to baseline categories (birth weight ≤2000 g, birth order=1, maternal age < 20, duration of breast feeding=never, maternal smoking during pregnancy=no, father's social class at birth=I).

Table 4 Odds ratios (95% confidence intervals) for hay fever and eczema reported at age 16 in 1986 v 1974, both before and after adjustment for potential risk factors (n=15 564)

Adjustment*	Hay fever	Eczema
None	2.23 (2.05 to 2.43)	2.02 (1.73 to 2.36)
Sex	2.24 (2.06 to 2.44)	2.01 (1.73 to 2.35)
Birth weight	2.24 (2.06 to 2.44)	2.03 (1.74 to 2.37)
Birth order	2.18 (2.00 to 2.38)	2.00 (1.71 to 2.33)
Maternal age	2.24 (2.05 to 2.44)	2.01 (1.72 to 2.35)
Breast feeding	2.45 (2.24 to 2.68)	2.17 (1.85 to 2.56)
Maternal smoking in pregnancy	2.29 (2.10 to 2.49)	2.04 (1.75 to 2.39)
Father's social class at birth	2.20 (2.02 to 2.40)	2.01 (1.72 to 2.35)
Breast feeding + birth order	2.35 (2.15 to 2.58)	2.13 (1.81 to 2.51)
Breast feeding + birth order + father's social class	2.29 (2.09 to 2.51)	2.12 (1.80 to 2.50)
All the above	2.14 (1.95 to 2.35)	2.09 (1.76 to 2.48)

*By logistic regression.

12 month period prevalence of hay fever and eczema at the age of 16,⁶ and this increase is broadly consistent in magnitude with evidence from other British studies.²⁻⁴

These trends may be due in part to changes in the reporting and consulting behaviour of parents and in the labelling of disease by general practitioners.^{5 19 20} However, increases in the prevalence of skin prick positivity reported in west London between 1974 and 1988 and increases in the prevalence of IgE antibodies to specific allergens in Japanese schoolchildren between 1978 and 1991 point to increases in allergic

sensitisation, suggesting a more fundamental rise in the prevalence of atopy.^{19 21}

It is therefore important to try to identify factors which may have contributed to the increase, and several factors, including maternal age,⁸ breast or bottle feeding,¹² birth order,⁷⁻¹¹ birth weight,^{6 7} and maternal smoking¹³ have been implicated.

Perinatal and social factors

Evidence in support of a negative association between birth order and both hay fever and eczema has come from studies of skin prick tests,^{9 10} as well as other follow up studies of the 1958 and 1970 cohorts.^{7 11} This association might have arisen because a child with a larger number of siblings is at greater risk of infection, and early childhood infections might reduce the risk of atopic disease.¹¹

The finding of a positive rather than a negative association between breast feeding and atopic disease has also been reported in other follow up studies of the birth cohorts^{5 8} and is in line with results from other studies.^{9 22} The possibility that mothers with a history of atopic disease are more likely to breast feed goes against the interaction found in our current comparison. This interaction indicated a more pronounced association in the 1958 cohort than the 1970 cohort, whereas studies suggesting a beneficial effect of breast feeding among infants at high risk of allergy were not published until after 1958.⁸

Maternal smoking during pregnancy was negatively rather than positively associated with hay fever, which is in agreement with studies using skin prick testing in German and Norwegian schoolchildren^{10 23} but not with other studies.¹³ The results may simply reflect a tendency for mothers with a history of atopy to avoid smoking.^{8 23}

The relation between maternal age and hay fever was an increasing trend that seemed to plateau by the early 30s. This relation was in contrast to the negative association between maternal age and parental reported asthma or wheezy bronchitis, or both, at age 16 in our previous analysis of the combined birth cohorts,⁶ and it may be confounded, at least in part, by the number of younger siblings. In the 1958 cohort, however, self reported hay fever at the age of 23 was positively associated with maternal age after adjustment for certain factors, including the number of older and younger children in the household at age 11.⁸

The positive trend for hay fever prevalence with increasing social class has already been reported within the 1958 and 1970 cohorts.^{7 8 20} Eczema ascertained by school medical officers showed a similar association in the 1958 cohort.²⁰ This suggests a true association rather than reporting bias.^{8 20}

Explaining the increase in prevalence

Changes between cohorts in terms of birth order and social class, and in the case of eczema in sex and maternal age, were associated with slight increases in prevalence odds, the largest of which was for birth order, which seemed to explain 2.3% of the relative increase in the odds of reported eczema and 4.2% of the relative increase in the odds of reported hay fever (table 4). These changes were, however, more than outweighed by a reduction in the proportion of breast fed babies from 69% in 1958 to 38% in 1970 (table 2),

Key messages

- Between 1974 and 1986 there was an apparent doubling in the 12 month period prevalence of both hay fever and eczema among British 16 year olds
- The prevalence of hay fever increased significantly with higher social class and decreasing birth order, both trends being steeper for children born in 1958 than for those born in 1970
- Hay fever was less common if the mother smoked during pregnancy and more common with increasing maternal age up to the early 30s. The prevalences of hay fever and eczema were slightly higher among children breast fed for more than one month
- When taken together, differences in sex, birth weight, birth order, maternal age, breast feeding, maternal smoking during pregnancy, and father's social class at birth between children born in 1958 and those born in 1970 did not seem to explain any of the observed increases in prevalence of hay fever and eczema at age 16
- Factors related to father's social class at birth, birth order, maternal age, smoking during pregnancy, and breast feeding deserve further investigation as possible explanations of the increase in atopic disease in Britain and elsewhere

which, combined with a positive association between breast feeding and disease, seemed to explain a 21% decrease in the odds of reported hay fever and a 15% decrease in the odds of reported eczema (table 4). Taken together, changes in the distributions of sex, maternal age, breast feeding, maternal smoking during pregnancy, father's social class at birth, and birth order did not seem to explain any of the relative increase in the prevalence odds of hay fever and eczema between the 1958 and 1970 birth cohorts.

Other factors to change between cohorts included ambient concentrations of environmental pollutants. In recent years concern has focused on the possible relation between allergic disease and air pollution from both heavy industry and car exhausts.²⁴ Between 1960 and 1970 emissions of black smoke in the United Kingdom decreased but emissions of sulphur dioxide and oxides of nitrogen increased by about 7% and 24% respectively.²⁵ Air pollution at birth and its association with reports of allergic symptoms are currently being investigated in the 1958 cohort.

The distribution of social class differed little between the 1958 and 1970 cohorts (table 2). However, what is being measured by social class and other markers of social factors including maternal age, birth order, breast feeding, and maternal smoking during pregnancy may have changed over time, with differences between categories in terms of risk becoming less distinct. This idea is supported by the finding of significant interactions, which suggest steeper trends and larger associations in the 1958 cohort. Thus, factors that are related to social class, maternal age,

birth order, breast feeding, and maternal smoking and which have changed over time may still explain the apparent increase in atopic disease in Great Britain and elsewhere and deserve particular attention.

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Endpiece

Prudent at the end

Voltaire on his deathbed was advised to renounce the devil. He replied, "Now is not the time to make enemies."

From John G Murray, *A Gentleman Publisher's Commonplace Book* (1996)