

Sibship size and self-reported inhalant allergy among adult women

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Summary

Background An association of allergic sensitization with small families and low birth order has been described and attributed to a protective effect of early infection. The influence of like-sex and unlike-sex siblings has not been investigated, although the severity of viral infections may be greater if acquired from unlike-sex siblings.

Objective To investigate the association of self-reported inhalant allergy with family composition.

Methods Reports of allergy to grass, dust or cats by 11042 pregnant women recruited to a longitudinal study of pregnancy and childhood in Avon, UK, were analysed in relation to respondent's age, maternal age and sibship composition (older and younger brothers and sisters) by multiple logistic regression.

Results The prevalence of self-reported inhalant allergy decreased with increasing numbers of brothers (test for trend: $P < 0.0001$), but was unrelated to the number of sisters. The unadjusted prevalences for subjects with none, one, two and three or more brothers were 26%, 23%, 20% and 17%, respectively. The corresponding prevalences for numbers of sisters were 23%, 24%, 22% and 23%. After adjustment for total sibship size, offspring of older mothers were more likely to report allergy (test for trend: $P < 0.001$), but there was no association with position in the sibship.

Conclusion Although it is not possible to determine whether brothers specifically, or unlike-sex siblings in general, are inversely associated with inhalant allergy, these findings are consistent with the hypothesis that patterns of sibling interaction within young families influence the risk of future aeroallergen sensitization.

Keywords: atopy, allergic diseases, sibships

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Introduction

The prevalence of hayfever [1–4], eczema [1,2] and sensitization to common aeroallergens [4–6] is inversely related to sibship size. Position in the sibship may also be of importance, with firstborn children being at highest risk for any given family size [1–5]. One explanation for these associations is that there is reduced opportunity for cross-infection in smaller families and early infection may protect against allergic sensitization [2,3], plausibly through its

effect on the cytokine environment of developing allergen-specific T-helper lymphocytes [7,8].

Transmission or severity of infections such as measles in early childhood is greater when siblings are of unlike sex [9,10], but it is not known whether the effect of sibship size on allergic disease differs according to the sex of the siblings. We investigated whether the prevalence of self-reported inhalant allergy among a large sample of pregnant women was influenced to a greater extent by the number of brothers or the number of sisters.

Methods

The Avon Longitudinal Study of Pregnancy and Childhood

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(ALSPAC) aimed to recruit all pregnant women expected to deliver during the period 1 April 1991 to 31 December 1992 [11]. Women were asked the following questions about a history of allergy:

Would you say you were allergic to anything?

If yes, is it to:

- (i) cat; (ii) pollen; (iii) dust; (iv) insect bites or stings;
- (v) something else?

We defined inhalant allergy as a positive response to the first question and to one or more of questions (i), (ii) or (iii). The number of positive responses to questions i–iii was defined as the number of inhalant allergies. Non-inhalant allergy was defined as a positive response to the first question and to question (iv) or (v). In a separate questionnaire, respondents were asked about the number of brothers and sisters, and the ages of their parents.

Data were analysed by cross-tabulations using the statistical analysis system (SAS) [12] and multiple logistic regression using generalised linear interactive modelling (GLIM) software [13]. The outcome variables in logistic regression models were, in turn, the prevalence of any inhalant allergy and the prevalence of three inhalant allergies. The age of the respondent and her mother were included in all models. Additional explanatory variables considered were the total number of siblings, total brothers, total sisters, older siblings, younger siblings, older brothers, younger brothers, older sisters and younger sisters.

Results

Information during pregnancy was contributed by 12471 women, of whom 11042 (89%) had complete data for self-reported allergy and sibship composition. Their ages ranged from 14 to 45 yr, with 9463 (86%) being aged 20–34 yr.

Table 1 shows the relationship of self-reported allergy to sibship composition. The prevalence of inhalant, but not of non-inhalant allergies, declined with increasing sibship size. This reflected a marked influence of the number of brothers, but little effect of number of sisters. The strength of the associations with numbers of older and of younger siblings were similar. The graded association with number of siblings, and specifically with number of brothers, became increasingly marked as the number of self-reported inhalant allergies increased.

Table 2 shows the effect of number of brothers on the prevalence of inhalant allergy, controlling for the number of sisters, and vice versa. This confirms the dominant effect of number of brothers. Table 3 presents the data for older and younger siblings in a similar manner, showing that each made an independent contribution to the prevalence of inhalant allergy.

The results of multiple logistic regression analyses are shown in Table 4. After adjustment for respondent's age (not shown: no significant trend), maternal age and number of sisters, the independent effect of brothers on prevalence of any inhalant allergy was strong and highly significant (χ^2 for trend = 69.7, d.f. = 1, $P < 0.0001$), whereas there was no independent trend by numbers of sisters ($\chi^2 = 2.26$, d.f. = 1, $P > 0.1$). The effect of number of brothers was significantly greater than the effect of number of sisters ($\chi^2 = 21.0$, d.f. = 1, $P < 0.0001$).

The effect of brothers on the prevalence of three inhalant allergies was of similar magnitude, although somewhat less statistically significant due to the smaller number of cases ($\chi^2 = 24.4$, d.f. = 1, $P < 0.0001$). There was no corresponding trend by numbers of sisters ($\chi^2 = 0.00$, $P = 0.99$), and the effect of brothers was again significantly greater than the effect of sisters ($\chi^2 = 15.4$, d.f. = 1, $P < 0.0001$). The number of older brothers and of younger brothers had effects of similar magnitude which did not differ significantly from each other ($\chi^2 = 0.82$, d.f. = 1, $P > 0.1$).

After adjustment for respondent's age and numbers of brothers and sisters, there was a statistically significant trend of higher prevalence of inhalant allergy among respondents whose mothers were older at the time they were born. The corresponding trend statistics were $\chi^2 = 16.44$, d.f. = 1, $P < 0.001$, for any inhalant allergy and $\chi^2 = 9.24$, d.f. = 1, $P < 0.01$ for three inhalant allergies.

Discussion

In this large, representative sample of pregnant women, self-reported inhalant allergies were inversely related to the number of siblings. This confirms earlier reports based on recall of hay fever or eczema [1–4] and objective tests of aeroallergen sensitization [4–6] among children [1,2,6], adolescents [4] and young adults [3,5] in Britain [1–5] and Germany [6]. We did not confirm a stronger effect from older siblings, which has been observed in three other cohorts [1–5]. However, the effect of number of siblings was almost entirely due to an inverse association with the number of brothers, rather than the number of sisters. Because the sample were all female, it is not possible to determine whether this reflects an influence of brothers specifically, or of unlike sex siblings more generally. Two other studies have shown an increasing prevalence of allergic symptoms among the offspring of older mothers, after adjustment for family size and birth order [3,4].

Our findings are based on reported allergy, but it is unlikely that awareness and reporting of symptoms would be influenced by sibship size and maternal age which were ascertained in a separate questionnaire. It is almost inconceivable that the association with brothers, but not with

Table 1. Prevalence (%) of allergy by sibship composition

		No. of subjects	Type of allergy reported				No. of inhalant allergies		
			No allergy	Inhalant only	Non-inhalant only	Both types	1	2	3
Total number of siblings	0	556	49.5	15.3	20.9	14.4	15.1	9.4	5.2
	1	3734	56.2	14.9	18.7	10.2	12.0	7.7	5.4
	2	3302	57.1	14.0	20.0	8.9	10.9	7.5	4.5
	3+	3450	61.5	12.1	18.8	7.7	10.3	5.9	1.7
Number of older siblings	0	3413	55.4	14.4	19.7	10.4	11.9	7.9	5.1
	1	4497	58.0	14.1	18.6	9.3	11.2	7.3	4.9
	2	2056	59.3	13.1	19.5	8.1	11.1	6.3	3.8
	3+	1076	61.2	11.6	19.8	7.4	10.2	5.7	3.2
Number of younger siblings	0	3848	55.7	14.3	19.6	10.5	12.2	7.7	4.8
	1	4307	57.1	14.7	19.3	9.0	11.4	7.3	4.9
	2	1906	60.8	11.7	19.1	8.4	10.2	6.0	3.9
	3+	981	63.0	12.0	17.7	7.3	9.3	6.5	3.5
Number of brothers	0	4152	54.9	15.2	19.0	10.8	12.4	8.5	5.2
	1	3725	57.7	14.0	19.1	9.1	10.9	7.0	5.2
	2	1778	59.9	12.8	19.7	7.7	10.5	6.5	3.5
	3+	1387	63.6	10.2	19.3	6.9	10.2	4.5	2.4
Number of sisters	0	4197	58.2	13.3	19.1	9.4	11.7	6.8	4.3
	1	3902	56.6	14.3	19.4	9.7	11.5	7.5	5.1
	2	1928	58.1	13.9	19.9	8.1	10.5	7.3	4.3
	3+	1015	59.9	13.9	17.4	8.8	10.7	7.4	4.6

Figures shown are percentages of the number of subjects shown in the lefthand column.

Table 2. Prevalence (%) of inhalant allergy by numbers of brothers and sisters

		Number of sisters			
		0	1	2	3+
Number of brothers	0	29.7 (165/556)	26.7 (513/1910)	22.9 (254/1108)	25.8 (149/578)
	1	23.2 (424/1824)	23.9 (281/1178)	22.6 (110/487)	19.5 (46/236)
	2	21.9 (222/1016)	18.3 (87/477)	18.8 (35/186)	19.2 (19/99)
	3+	17.7 (142/801)	16.3 (55/337)	17.0 (25/147)	15.7 (16/102)

Table 3. Prevalence (%) of inhalant allergy by numbers of older and younger siblings

		Number of younger siblings			
		0	1	2	3+
Number of older siblings	0	29.7 (165/556)	25.5 (438/1720)	21.1 (172/814)	22.6 (73/323)
	1	24.8 (499/2014)	23.8 (374/1575)	20.9 (130/622)	17.5 (50/286)
	2	23.1 (210/913)	21.0 (142/675)	18.0 (52/289)	17.9 (32/179)
	3+	21.1 (77/365)	19.3 (65/337)	16.0 (29/181)	17.6 (34/193)

Table 4. Mutually adjusted* odds ratios for any inhalant allergy, and three or more inhalant allergies, by mother's age and number of brothers and sisters

Risk factor		Any inhalant allergy Odds ratio (95%CI)	3 inhalant allergies Odds ratio (95%CI)
Number of brothers	0	1.00 (reference)	1.00 (reference)
	1	0.80 (0.72–0.90)	0.98 (0.79–1.22)
	2	0.66 (0.57–0.76)	0.62 (0.45–0.84)
	3+	0.51 (0.47–0.56)	0.40 (0.27–0.60)
Number of sisters	0	1.00 (reference)	1.00 (reference)
	1	0.98 (0.88–1.10)	1.11 (0.89–1.40)
	2	0.88 (0.76–1.01)	0.94 (0.70–1.26)
	3+	0.93 (0.78–1.11)	1.08 (0.76–1.54)
Maternal age at birth of subject	< 20	1.00 (reference)	1.00 (reference)
	20–	1.17 (0.99–1.37)	1.21 (0.88–1.67)
	25–	1.22 (1.03–1.44)	1.34 (0.95–1.89)
	30–	1.33 (1.09–1.62)	1.44 (0.97–2.15)
	35+	1.54 (1.23–1.94)	1.60 (1.00–2.55)

*Adjusted for respondent's age in addition to other factors shown in the table

sisters, could have arisen as a result of reporting bias. Any misclassification of the reported allergies which was independent of sibship size would tend to dilute the associations observed.

These results add to the accumulating evidence that aeroallergen sensitization and symptomatic allergy in European countries is strongly influenced by family composition in childhood. Further detailed studies of the patterns of social interaction and infectious illness in relation to sibling gender, birth order, birth spacing and maternal age are required in order to elucidate the underlying mechanisms.

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