

The descriptive epidemiology of house dust mite-specific and total immunoglobulin E in England using a nationally representative sample

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Summary

Background Previous studies have shown that IgE levels vary according to factors such as age, gender and smoking but most studies have been small and none have been based on a nationally representative sample.

Objectives To investigate the influence of epidemiological factors on serum total IgE and house dust mite-specific IgE levels.

Methods An interviewer-led questionnaire was carried out and blood samples taken from 24 952 people aged 11 and over as part of the 1995 and 1996 Health Surveys for England. Serum total IgE and house dust mite-specific IgE were measured.

Results Both total and house dust mite-specific IgE were more frequently raised in men and in younger age groups. After adjusting for age and sex, raised total IgE was more common in current smokers and non-white ethnic groups and was not related to social class. The higher levels in non-white ethnic groups was not explained by smoking, urban living or being born outside the UK. Whilst total IgE levels declined in older age groups in non-smokers, among smokers they increased across successive age groups from 50 years onwards. In contrast, following adjustment for age and sex, raised house dust mite IgE was more common in non-manual workers and in some non-white ethnic groups but was not related to smoking.

Conclusions This large nationwide study provides further confirmation of differing epidemiological patterns for total serum IgE and allergen-specific sensitization. Indicative ranges for 'usual' values for a wide range of ages among men and women in England are given.

Keywords atopy, ethnicity, house dust mite, smoking, social class, specific IgE, total IgE

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Introduction

Previous studies have presented descriptive data on the distribution of total and specific IgE. A number of studies have shown that factors such as age, gender, smoking and social class affect levels of total IgE and house dust mite-specific IgE, but the overall pattern of explanatory variables remains unclear.

Some studies have found that total IgE levels are higher in men than women and this observation persists after adjustment for smoking [1, 2]. They have also been shown to be higher in younger adult age groups [3], although some studies have shown no relationship with age after adjustment for smoking [1] or after adjustment for smoking and specific IgE [2]. Total IgE levels are higher in smokers [4, 5], although some studies have found little effect of smoking after the effects of age and gender have been removed [1, 3].

The prevalence of raised house dust mite (HDM) IgE is higher in younger age groups [4] and in men [2]. The relationship

with smoking is unclear. Some studies show a positive association with smoking [5], whilst another study showed allergen-specific IgEs to be lower in current and former smokers than in those who had never smoked [4].

Both total IgE and HDM IgE levels vary considerably between countries [3] but it is not clear what factors are responsible for this variation. Socioeconomic status, ethnicity, lifestyle factors and climate may be important.

In this study we explore the descriptive epidemiology of total and mite-specific IgE using data from the Health Surveys for England 1995 and 1996. This provides a large, nationally representative sample in which both IgE levels and a wide range of sociodemographic variables have been measured.

Methods

Data source

The study used data from the Health Survey for England for 2 years, 1995 and 1996 [6, 7]. The Health Survey for England is an annual survey of people living in households in England and is commissioned by the Department of Health. The surveys were conducted in two stages, with an initial administered questionnaire followed by a nurse visit for physical

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measurements and to obtain a blood sample. The questionnaire included recording of age and gender and questions on smoking, ethnic origin, place of birth and occupation of the head of the household from which social class was derived. The NHS region and whether the household was in an urban or rural area was also recorded.

Analysis of total and HDM IgE was carried out on serum specimens using the Pharmacia Autocap analyser (Pharmacia Diagnostics AB, Uppsala, Sweden), using the Pharmacia CAP system immunoassay method [7].

Subjects

A sample of private households in England was selected using a multistage stratified probability sampling design [6]. Although the study population for the Health Survey for England covers the age range of 2 and over, blood samples were obtained only from people aged 11 and over. This report analyses data on only those people providing a usable blood sample and the age range is therefore 11 and over.

Analysis

Raised total IgE was defined as greater than 100 kU/L and raised house dust mite IgE as above 0.3 kU/L. Odds ratios were calculated for raised total IgE and for raised house dust mite IgE with adjustment for a range of variables using logistic regression. Odds ratios were calculated for the whole population and then for people who had never smoked in order to eliminate any effect of smoking. The geometric mean of total IgE and the percentage of raised total IgE and HDM IgE were calculated by gender, smoking status and age band for subjects of white ethnic origin only. This was because earlier analyses showed that people from other ethnic groups have quite different distributions of total and HDM IgE to white people. All analyses were carried out using SPSS 10.0 for Windows (SPSS Inc., Chicago, IL, USA).

Results

A total of 18 434 households co-operated with the survey (78% of eligible households). There is no information on the characteristics of households who did not co-operate except that they were more frequently located in urban areas, in the North-west and Thames regions. Within co-operating households 32 498 adults (93%) and 2504 children aged 11–15 (98%) were interviewed. Amongst the people who were not interviewed, there was a higher proportion of males and younger age groups. Among the 35 002 interviewed people, 24 952 (71%) provided blood samples sufficient for assays of both total IgE and DHM IgE. The characteristics of those giving a blood sample were broadly similar to the overall sample group except in respect of age and ethnicity. Only 56% (2385/4246) of the 11–19 age group and 59% (1337/2251) of people from ethnic minorities had a usable blood sample.

The distribution of serum total IgE and house dust mite IgE

Serum total IgE ranged from less than 1 kU/L to over 2000 kU/L. Serum HDM IgE ranged from less than 0.1 to 123.5 kU/L. The distributions of both total IgE and HDM IgE were highly positively skewed. The distribution of total IgE was approximately normal on the log scale (Fig. 1). Overall, 28.0% (6985/

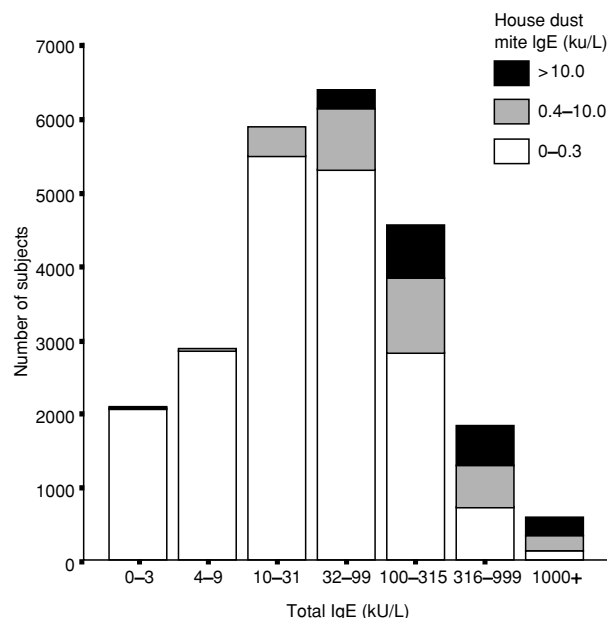


Fig. 1. The relationship between total IgE and house dust mite IgE.

24 952) of the population who gave blood samples had total IgE greater than 100 kU/L, and 19.8% (4946/24 952) had HDM IgE greater than 0.3 kU/L. The geometric mean of total IgE for the population was 37.7 kU/L.

The relationship between total IgE and house dust mite IgE

Figure 1 shows the relationship between total IgE and HDM IgE. The percentage of subjects with raised HDM IgE increased as total IgE increased. Only 9% (1563/15 733) of subjects with a total IgE below 100 had raised HDM IgE, whereas 47% (3280/6944) of subjects with a total IgE of 100 or above had raised HDM IgE. Although there was a strong correlation between total IgE and HDM IgE, in subjects with a total IgE above 1000 nearly a quarter (131/559) had normal HDM IgE levels.

The descriptive epidemiology of total and house dust mite-specific IgE

Table 1 shows the odds ratios for the main risk factors for raised total IgE (> 100 kU/L). The effect of adjustment for other factors is small for most variables. For two variables, place of birth and urban/rural location, the odds ratios change from being significant to non-significant following adjustment. This is probably due to confounding by ethnicity as people from ethnic minorities are more likely to be born outside the UK and to live in urban areas.

It can be seen that men, younger age groups and current smokers all have significantly higher total IgE levels. The adjusted odds ratio is greater than one for all ethnic minority groups compared to people classifying themselves as white. Being an ex-smoker has a small but significant effect. After adjustment for other factors, social class, place of birth (inside versus outside the UK) and NHS region are not significantly related to high total IgE.

Table 2 shows the odds ratios for the risk factors for raised HDM IgE. Adjustment generally has only a small effect on associations. After adjustment, raised HDM IgE is significantly

Table 1. Unadjusted and adjusted odds ratios for raised total IgE (i.e. IgE > 100 kU/L)

		<i>n</i>	% with total IgE > 100 kU/L	Unadjusted odds ratio	Adjusted* odds ratio	95% CI	<i>P</i> -value [†]
Sex	Female	13 021	24.0	1	1	(reference)	< 0.001
	Male	11 931	32.3	1.51	1.48	1.39–1.57	
Age	11–19	2385	39.1	1	1	(reference)	< 0.001
	20–29	3371	31.9	0.73	0.64	0.57–0.73	
	30–39	4726	28.8	0.63	0.59	0.53–0.66	
	40–49	4400	25.4	0.53	0.49	0.44–0.55	
	50–59	3529	24.4	0.50	0.48	0.43–0.55	
	60–69	3210	24.9	0.52	0.51	0.45–0.58	
	70–79	2366	26.2	0.55	0.56	0.49–0.64	
	80–89	885	21.8	0.43	0.46	0.38–0.55	
	90+	80	30.0	0.67	0.86	0.52–1.41	
Social class	I	1647	27.9	1	1	(reference)	0.835
	II	7302	27.2	0.96	0.97	0.85–1.10	
	III nm	3246	27.5	0.98	1.98	0.85–1.13	
	III m	7095	28.3	1.02	0.95	0.84–1.08	
	IV	3300	28.4	1.02	0.94	0.82–1.08	
	V	1204	27.4	0.98	0.94	0.79–1.13	
Urban/rural	Rural	5916	25.9	1	1	(reference)	0.396
	Urban	19 006	28.6	1.15	1.03	0.96–1.11	
Place of birth	Within UK	22 914	27.3	1	1	(reference)	0.489
	Outside UK	1112	35.0	1.43	1.06	0.90–1.24	
Smoking	Never	12 092	26.6	1	1	(reference)	< 0.001
	Ex	6368	26.7	1.01	1.16	1.07–1.25	
	Current	6448	31.9	1.29	1.43	1.33–1.54	
Ethnicity	White	23 605	26.7	1	1	(reference)	< 0.001
	Black Caribbean	191	48.7	2.60	2.63	1.82–3.80	
	Black African	110	40.9	1.90	2.17	1.14–4.11	
	Black other	44	63.6	4.79	3.68	1.73–7.82	
	Indian	414	49.5	2.69	2.77	2.10–3.66	
	Pakistani	233	51.1	2.86	2.58	1.76–3.80	
	Bangladeshi	61	65.6	5.21	4.51	1.99–10.23	
	Chinese	49	42.9	2.05	1.92	0.71–5.17	
	Other	235	49.4	2.67	2.38	1.66–3.41	
NHS region	Northern and Yorkshire	3362	26.4	1	1	(reference)	0.090
	North-west	3188	28.5	1.12	1.08	0.97–1.21	
	Trent	2532	27.0	1.03	0.96	0.84–1.08	
	West Midlands	2661	28.9	1.14	1.06	0.94–1.20	
	Anglia and Oxford	2899	26.4	1.00	0.96	0.85–1.08	
	North Thames	3239	31.2	1.27	1.14	1.01–1.28	
	South Thames	3393	28.6	1.12	1.04	0.93–1.17	
	South and West	3678	26.9	1.03	1.01	0.90–1.13	

*Adjustment is for all variables listed. [†]Significance tests for the adjusted odds ratios are based on a test for heterogeneity except for age and social class which are based on tests for trend using ordered categories.

more common in men compared to women, in the higher social classes and in some ethnic minority groups. HDM IgE levels are lower in older age groups but, unlike total IgE, they appear to peak in the 20–29 age group. There is no significant independent effect of urban versus rural location, birth in or outside the UK, NHS region or of current or ex-smoking.

Comparing the risk factors for total IgE with those for HDM IgE, both types of IgE are raised in men and some ethnic minorities. Current smoking has an effect on total IgE but not HDM IgE. HDM IgE shows a social class gradient (highest in social class I), whereas total IgE does not and the age gradient (highest in younger age groups) is stronger for HDM IgE than for total IgE.

In Tables 3 and 4, analysis has been restricted to those who classify themselves as never having smoked. This eliminates the confounding effect of smoking which may have been inadequately controlled for by using the three categories of smoking in Tables 1 and 2.

Table 3 shows the main risk factors for raised total IgE in people classified as never having smoked. The adjusted odds ratios are higher in men, younger age groups, the higher social classes and some ethnic minority groups. Social class does not have a significant effect. Comparing Tables 1 and 3 it can be seen that the adjusted odds ratios for people who have never smoked are similar to those of the total population. Importantly the effect of male sex and ethnic minority groups on total IgE

Table 2. Unadjusted and adjusted odds ratios for raised house dust mite (HDM) IgE (i.e. IgE > 0.3 kU/L)

		<i>n</i>	% with HDM IgE > 0.3 kU/L	Unadjusted odds ratio	Adjusted* odds ratio	95% CI	<i>P</i> -value [†]
Sex	Female	13 021	15.5	1	1	(reference)	< 0.001
	Male	11 931	24.5	1.77	1.80	1.68–1.93	
Age	11–19	2385	28.6	1	1	(reference)	< 0.001
	20–29	3371	32.4	1.19	1.21	1.07–1.38	
	30–39	4726	26.0	0.88	0.90	0.80–1.01	
	40–49	4400	18.6	0.57	0.57	0.50–0.65	
	50–59	3529	14.3	0.41	0.42	0.37–0.49	
	60–69	3210	11.4	0.32	0.34	0.29–0.39	
	70–79	2366	8.6	0.23	0.25	0.21–0.30	
	80–89	885	5.0	0.13	0.14	0.10–0.19	
	90+	80	7.5	0.20	0.26	0.11–0.60	
Social class	I	1647	23.1	1	1	(reference)	< 0.001
	II	7302	20.2	0.84	0.87	0.76–1.00	
	III nm	3246	18.4	0.75	0.82	0.70–0.95	
	III m	7095	19.5	0.81	0.80	0.70–0.92	
	IV	3300	18.4	0.75	0.78	0.67–0.91	
	V	1204	16.5	0.66	0.74	0.60–0.91	
Urban/rural	Rural	5916	18.3	1	1	(reference)	0.441
	Urban	19 006	20.3	1.14	1.03	0.95–1.12	
Place of birth	Within UK	22 914	19.7	1	1	(reference)	0.227
	Outside UK	1112	20.4	1.04	0.89	0.73–1.08	
Smoking	Never	12 092	20.7	1	1	(reference)	0.486 0.254
	Ex	6368	15.9	0.61	0.97	0.88–1.06	
	Current	6448	22.1	1.08	1.05	0.97–1.14	
Ethnicity	White	23 605	19.2	1	1	(reference)	< 0.001
	Black Caribbean	191	29.3	1.75	1.63	1.10–2.43	
	Black African	110	22.7	1.24	0.88	0.40–1.96	
	Black other	44	45.5	3.51	2.54	1.21–5.31	
	Indian	414	34.3	2.20	2.12	1.58–2.84	
	Pakistani	233	29.6	1.77	1.40	0.92–2.12	
	Bangladeshi	61	37.7	2.55	2.40	1.09–5.24	
	Chinese	49	30.6	1.86	1.98	0.71–5.55	
	Other	235	26.8	1.54	0.90	0.58–1.39	
NHS region	Northern and Yorkshire	3362	19.6	1	1	(reference)	0.647
	North-west	3188	20.4	1.05	1.02	0.90–1.16	
	Trent	2532	18.7	0.94	0.88	0.76–1.02	
	West Midlands	2661	20.0	1.02	0.97	0.84–1.11	
	Anglia and Oxford	2899	19.5	0.99	0.94	0.82–1.08	
	North Thames	3239	20.7	1.07	0.98	0.86–1.12	
	South Thames	3393	20.2	1.04	0.97	0.85–1.11	
	South and West	3678	19.4	0.99	0.98	0.86–1.11	

*Adjustment is for all variables listed. [†]Significance tests for the adjusted odds ratios are based on a test for heterogeneity except for age and social class which are based on tests for trend using ordered categories.

can not therefore be explained by insufficient adjustment for smoking.

Table 4 shows the main risk factors for raised HDM IgE in people classified as never having smoked. The prevalences are higher in men, younger age groups, the higher social classes and some ethnic minority groups. The pattern of risk factors for raised HDM IgE in this table is similar to that for the total population in Table 2.

In Table 5, values for raised total and HDM IgE and geometric mean total IgE are shown for combinations of gender, smoking status and age band for people classifying themselves as white. A typical coefficient of variation for total IgE within the categories shown in Table 5 is 162%. Approximate

percentiles or 'normal ranges' can be derived for groups of known age, sex and smoking habit, assuming a normal distribution for log IgE, with mean = log_eGM and SD = 1.62.

The percentage of subjects with raised HDM IgE is consistently higher in men and the younger age groups, with a peak in the 20–29 age group. Total IgE (both geometric mean and percentage raised) is consistently higher in men. However, the tendency for total IgE to be lower in older age groups is not seen amongst current smokers in whom it increases across successive age groups from about age 50 (Figs 2 and 3). Conversely, higher levels of IgE in current smokers compared to ex-smokers and those who have never smoked are apparent only in the older age groups.

Table 3. Odds ratios for total IgE in people who have never smoked

Variable*		<i>n</i>	% with total IgE > 100 kU/L	Unadjusted odds ratio	Adjusted odds ratio	95% CI	<i>P</i> -value [†]
Sex	Female	7010	22.8	1	1	(reference)	< 0.001
	Male	5082	31.9	1.59	1.49	1.36–1.63	
Age	11–19	1838	40.8	1	1	(reference)	< 0.001
	20–29	1703	32.4	0.70	0.67	0.58–0.78	
	30–39	2451	27.2	0.54	0.53	0.46–0.61	
	40–49	1931	23.1	0.44	0.43	0.37–0.50	
	50–59	1432	18.8	0.34	0.36	0.30–0.43	
	60–69	1356	19.5	0.35	0.39	0.33–0.47	
	70–79	904	19.8	0.36	0.42	0.35–0.52	
	80–89	430	18.6	0.33	0.38	0.29–0.51	
	90 +	47	25.5	0.50	0.77	0.39–1.53	
Social class	I	1031	27.2	1	1	(reference)	0.638
	II	3900	26.2	0.95	1.02	0.86–1.20	
	III nm	1632	25.4	0.91	0.98	0.81–1.19	
	III m	3054	27.0	0.99	0.99	0.84–1.18	
	IV	1382	26.0	0.95	0.91	0.75–1.11	
	V	489	23.5	0.82	0.87	0.66–1.14	
Ethnicity	White	11118	24.7	1	1	(reference)	< 0.001
	Non-white	827	49.1	2.94	2.48	2.00–3.07	

*Place of birth, urban/rural location and NHS region were included as variables in the model. They did not show significant effects and have been omitted from the table. [†]Significance tests for the adjusted odds ratios are based on a test for heterogeneity except for age and social class which are based on tests for trend using ordered categories.

Table 4. Odds ratios for raised house dust mite (HDM) IgE in people who have never smoked

Variable*		<i>n</i>	% with HDM IgE > 0.3 kU/L	Unadjusted odds ratio	Adjusted odds ratio	95% CI	<i>P</i> -value [†]
Sex	Female	7010	15.8	1	1	(reference)	< 0.001
	Male	5082	27.5	2.03	1.82	1.66–2.01	
Age	11–19	1838	29.1	1	1	(reference)	< 0.001
	20–29	1703	32.1	1.15	1.21	1.04–1.41	
	30–39	2451	25.5	0.83	0.87	0.75–1.00	
	40–49	1931	19.7	0.60	0.62	0.52–0.73	
	50–59	1432	13.9	0.39	0.42	0.35–0.51	
	60–69	1356	10.1	0.27	0.31	0.25–0.39	
	70–79	904	6.5	0.17	0.20	0.15–0.27	
	80–89	430	5.8	0.15	0.19	0.12–0.29	
	90 +	47	2.1	0.05	0.08	0.01–0.60	
Social class	I	1031	24.3	1	1	(reference)	0.002
	II	3900	21.1	0.83	0.87	0.73–1.03	
	III nm	1632	18.4	0.70	0.79	0.64–0.97	
	III m	3054	20.8	0.81	0.81	0.68–0.97	
	IV	1382	18.6	0.71	0.75	0.61–0.93	
	V	489	16.2	0.60	0.72	0.53–0.97	
Ethnicity	White	11118	19.9	1	1	(reference)	< 0.001
	Non-white	827	30.5	1.76	1.63	1.29–2.05	

*Place of birth, urban/rural location and NHS region were included as variables in the model. They did not show significant effects and have been omitted from the table. [†]Significance tests for the adjusted odds ratios are based on a test for heterogeneity except for age and social class which are based on tests for trend using ordered categories.

Discussion

This study demonstrated that both total and HDM IgE were more frequently raised in men and younger age groups. Raised total IgE was more common in current smokers and non-white

ethnic groups, whereas raised HDM IgE was more common in non-manual workers and some non-white ethnic groups. Total IgE levels declined across age groups in non-smokers but in smokers increased across successive age groups from 50 years onwards.

Table 5. Geometric mean serum total IgE and percentage raised total and house dust mite (HDM) IgE by gender, smoking status and 10-year age band for people of white ethnic origin

	Smoking status	Age	<i>n</i>	Geometric mean total IgE	Total IgE > 100 (%)	HDM IgE > 0.3 (%)
Males	Never smoked	11–19	836	63.7	42.3	33.9
		20–29	716	43.4	33.2	35.6
		30–39	1013	36.6	26.9	30.7
		40–49	748	38.9	25.9	26.6
		50–59	538	33.5	21.4	17.5
		60–69	446	36.5	27.8	15.0
		70–79	263	30.2	22.4	9.1
		80–89	95	29.1	20.0	14.7
		90 +	8	34.6	37.5	0.0
		Total	4663	40.8	29.6	26.7
	Ex-smoker	11–19	62	80.8	43.5	33.9
		20–29	151	54.4	40.4	44.4
		30–39	357	42.6	30.3	31.7
		40–49	624	40.2	28.7	22.4
		50–59	677	40.9	28.1	15.7
		60–69	732	37.7	27.5	14.6
		70–79	661	41.6	30.1	11.2
		80–89	218	42.0	27.1	6.0
		90 +	16	56.1	31.3	25.0
		Total	3498	41.5	29.4	18.4
	Current smoker	11–19	179	48.9	34.6	35.2
		20–29	603	48.7	33.8	35.8
		30–39	731	48.6	32.4	29.4
		40–49	633	49.4	30.6	20.2
		50–59	415	57.1	38.8	20.2
		60–69	303	64.9	37.0	18.5
		70–79	165	74.9	46.1	17.6
		80–89	44	38.6	34.1	2.3
		90 +	0	–	–	–
		Total	3073	52.4	34.5	25.8
Females	Never smoked	11–19	769	51.5	36.4	22.1
		20–29	799	29.2	25.9	27.4
		30–39	1187	27.4	22.9	20.2
		40–49	1010	23.0	17.7	14.2
		50–59	825	22.7	15.4	10.9
		60–69	867	20.0	13.6	7.3
		70–79	628	23.7	18.2	5.1
		80–89	331	21.2	17.8	2.7
		90 +	39	27.9	23.1	2.6
		Total	6455	26.4	21.1	15.0
	Ex-smoker	11–19	83	44.8	34.9	21.7
		20–29	182	36.5	29.7	32.4
		30–39	400	37.2	28.3	22.0
		40–49	527	26.2	18.2	10.8
		50–59	450	24.9	16.4	8.9
		60–69	468	29.4	21.8	5.8
		70–79	455	25.8	21.8	6.4
		80–89	156	28.0	21.2	2.6
		90 +	14	51.4	42.9	7.1
		Total	2735	29.1	22.2	11.8
	Current smoker	11–19	167	34.7	26.9	20.4
		20–29	641	37.5	25.3	26.7
		30–39	676	35.5	26.5	22.0
		40–49	608	35.0	26.6	14.6
		50–59	511	39.0	27.6	12.9
		60–69	326	44.3	32.2	10.4
		70–79	172	46.2	35.5	5.2
		80–89	37	27.4	16.2	2.7
		90 +	3	79.0	33.3	0.0
		Total	3141	37.6	27.4	17.6

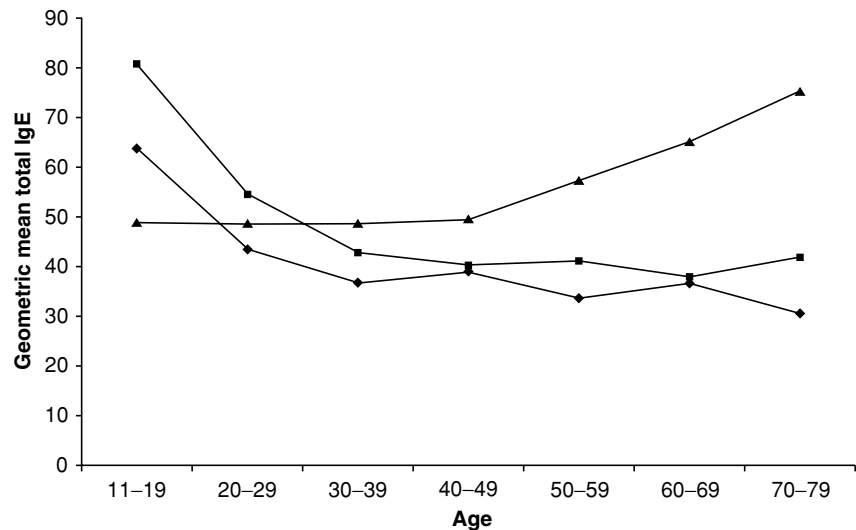


Fig. 2. Geometric mean total IgE for white men by age and smoking status. ◆: never smoked, ■: ex-smoker, ▲: current smoker.

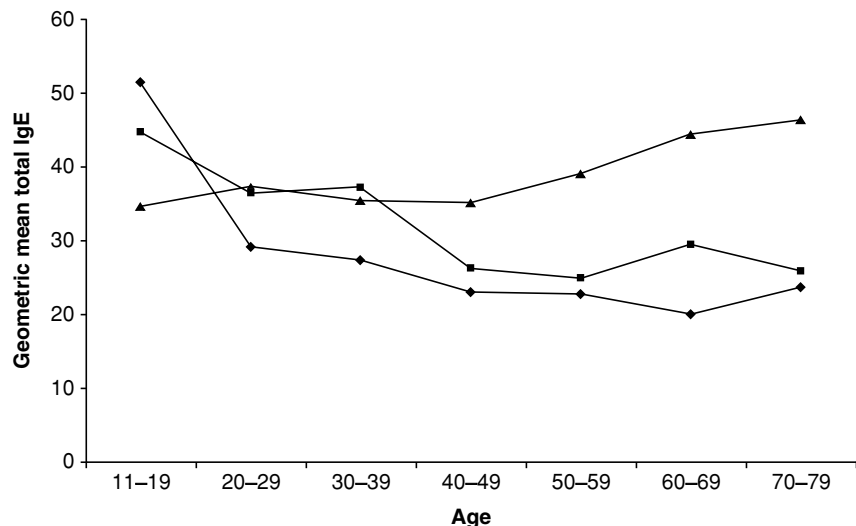


Fig. 3. Geometric mean total IgE for white women by age and smoking status. ◆: never smoked, ■: ex-smoker, ▲: current smoker.

Study population

This study uses the largest published data set of serum IgE measurements. The sample is representative of the population of England living in private households and covers a wide age range (11 and over). Most previous studies have used only adults and have an upper age limit, and many have used selected subjects such as occupational groups or blood donors [8].

Response rate

There was an overall under-representation of younger age groups and ethnic minorities which is likely to have caused an under-estimation of total and HDM IgE for the population. However, it seems implausible that the association between total and HDM IgE and other factors will have been biased.

The overall geometric mean total IgE for the population of 37.7 kU/L is comparable with the median value for all centres in the European Community Respiratory Health Survey

(ECRHS) of 35.9 kU/L [3]. Previous studies have also found similar proportions of the population with raised total IgE [4] and raised HDM IgE [9] to this study.

Gender

This study shows that men have significantly higher levels of total IgE and HDM IgE than women. This difference persists after adjustment for age and smoking and is also present in people who have never smoked. A number of other large studies have observed similar sex differences [2, 5]. However, one study observed no sex difference in total IgE levels in the 18–54 age group [10] and a previous study of English adults showed no relationship between HDM IgE and sex after adjustment for age and town of residence [1].

Age

We found both total IgE and HDM IgE to be more frequently raised in younger age groups, with peak HDM IgE in the 20–29

age. These relationships were also seen in those who had never smoked.

The European Community Respiratory Health Survey also found higher total and HDM-specific IgE levels in younger age groups amongst never smokers [5], although this was not found in an analysis of English centres participating in ECRHS [1]. The observed relationship between age and IgE may be due to an age-related decline or a cohort effect. A longitudinal study from Tucson, Arizona observed an age-related decline in total IgE which was greatest in the under 35s and in atopic subjects [11]. A study in Japan showed that raised HDM IgE became more prevalent amongst 13–14-year-old girls over a 10-year period, suggesting that successive cohorts may be at increasing risk of allergic sensitization in childhood [12].

Geographic factors

It has been suggested that variations in IgE levels and atopy between populations are due to differences in climate or levels of urbanization [13]. Increasing urbanization has also been postulated as a cause of rising IgE levels over time [12]. Our study does not support these hypotheses as neither geographical region nor urban versus rural location had a significant independent relationship with either total or HDM-specific IgE levels. The ECRHS showed substantial variation in both total and specific IgE among participating countries. It is possible that within England there is not sufficient diversity of the relevant environmental, social or lifestyle factors to significantly affect IgE levels.

Ethnicity

We found that half (49.9%) of people from non-white ethnic groups had raised total IgE compared to 26.7% of white people. All non-white ethnic groups showed higher total IgE levels than white people and this persisted after adjustment, demonstrating that the differences were not explained by factors such as smoking, urban location or social class. Being born outside the UK was not an independent risk factor for raised total IgE. HDM IgE had a similar but less marked variation among ethnic groups as total IgE.

Previous studies have found total IgE levels to be higher in black populations compared to white [14, 15]. The reasons for this were unclear but it has been suggested that higher levels of IgE in immigrants are due to exposure to helminthic parasites in the country of origin [16, 17]. This is not the explanation for our population as being born outside the UK was not a risk factor for raised IgE. There is little published information on specific IgE in different ethnic groups.

This is the first published study that is large enough to look at a number of different ethnic groups and to adjust for immigration and sociodemographic factors. The remaining differences after adjustment suggest genuine genetic variation among ethnic groups. It is difficult to assess whether this variation corresponds to prevalence of allergic disease as most studies on allergic disease in racial groups have been confined to children and the overall picture is unclear. Some studies have shown black children to have a higher prevalence of asthma [18] and eczema [19] after adjustment for sociodemographic factors whilst others have not [20, 21]. The relationship between IgE and ethnicity needs to be further explored.

Social class

Published information on the relationship between IgE and social class is limited. Whereas atopy is generally more prevalent in higher socioeconomic groups [22, 23], some studies have shown both total and specific IgE to be higher in people of lower socioeconomic status [24]. This study demonstrates a significant association between higher social class and raised HDM IgE but no relationship between socioeconomic status and total IgE, independent of the effects of cigarette smoking.

Smoking

Our study clearly shows that there is no relationship between smoking and HDM IgE, whereas total IgE levels are higher in smokers than non-smokers except in the 11–19 age group. This observation in the youngest age group might represent a healthy smoker bias, i.e. younger people with allergic disease not starting to smoke. However, these young smokers do not have lower HDM IgE levels than non-smokers. The effect of smoking on total IgE appears greater in men than women. This may be due to heavier smoking in men which was observed in this survey. The relationship between smoking and IgE has been examined in a number of studies and most have found total IgE to be higher in smokers than non-smokers [4, 10, 25], but problems arise in comparing results because of different ways of dealing with confounding factors such as age and gender [1].

Our study demonstrates that for ex-smokers and never smokers, total IgE is lower in older age groups but amongst current smokers the levels are higher in the 50 and over age groups. In a cross-sectional study, Burrows et al. observed that although IgE was lower in older age groups in smokers, the difference was not as great as for non-smokers [26] and, in a longitudinal study, Sherrill et al. showed that amongst non-atopic smokers IgE did not decline with age [27]. A number of mechanisms have been proposed for smokers in older age groups having higher IgE levels than non-smokers of the same age. Smoking or infections in smokers may interfere with some IgE regulator mechanism causing a general rise in IgE levels [26]. Alternatively, specific IgE may be produced in response to tobacco smoke or micro-organisms such as pneumococcus infecting the airways of smokers [28]. Another possible explanation is that bronchi irritated by smoking may be more permeable to aeroallergens [26]. Our study shows that HDM-specific IgE levels in smokers are lower in older age groups and therefore do not support the last of these mechanisms.

Conclusions

This study provides values for the prevalence of raised total and HDM IgE using the largest published data set of serum IgE measurements and with adjustment for a wide range of sociodemographic variables. The results confirm previous reports that raised HDM IgE and total IgE are more common in men and younger age groups. Whilst total IgE levels were lower in older non-smokers, they tended to be higher in older smokers. The study demonstrates that social class affects HDM IgE but not total IgE levels, whereas ethnicity has a more marked effect on total IgE than HDM IgE. These contrasts in descriptive epidemiology strongly suggest differences in the determinants of total serum IgE and allergen-specific sensitization.

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