

Worldwide variations in prevalence of symptoms of allergic rhinoconjunctivitis in children: the International Study of Asthma and Allergies in Childhood (ISAAC)

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Background: As part of the International Study of Asthma and Allergies in Childhood (ISAAC), prevalence surveys were conducted among representative samples of school children from locations in Europe, Asia, Africa, Australasia, North and South America.

Subjects: 257,800 children aged 6–7 years from 91 centres in 38 countries, and 463,801 children aged 13–14 years from 155 centres in 56 countries.

Methods: Written symptom questionnaires were translated from English into the local language for self-completion by the 13–14-year-olds and completion by the parents of the 6–7-year-olds. Rhinitis was described as a problem with sneezing, or a runny, or blocked nose when you (your child) DID NOT have a cold or the 'flu. Additional questions were asked about rhinitis associated with itchy-watery eyes, interference with activities and a history of hay fever ever.

Results: The prevalence of rhinitis with itchy-watery eyes ("rhinoconjunctivitis") in the past year varied across centres from 0.8% to 14.9% in the 6–7-year-olds and from 1.4% to 39.7% in the 13–14-year-olds. Within each age group, the global pattern was broadly consistent across each of the symptom categories. In centres of higher prevalence there was great variability in the proportion of rhinoconjunctivitis labelled as hay fever. The lowest prevalences of rhinoconjunctivitis were found in parts of eastern Europe, south and central Asia. High prevalences were reported from centres in several regions.

Conclusion: These results suggest substantial worldwide variations in the prevalence and labelling of symptoms of allergic rhinoconjunctivitis which require further study. These differences, if real, may offer important clues to environmental influences on allergy.

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Little is known about worldwide variations in the prevalence of allergic rhinitis. Estimates of the prevalence of hay fever in surveys from different countries vary between 0.5% and 28% for children and between 0.5% and 15% for adults (1). However, much of this variation could be due to differences in the age and other characteristics of the samples, and the case definition used in the various studies. A few studies have used a standardised case definition and demonstrated regional differences in the prevalence of hay fever among adults in Britain (2) and Australia (3). Urban-rural variations in adult hay fever have been found in Australia (3), USA (4) and Denmark (5), but not in Britain (2).

Less is known about geographical variations in the prevalence of allergic rhinitis in children. Comparative studies in former East and West Germany (6) and in Estonia, Poland and Sweden (7, 8) have shown substantial differences in the prevalence of allergic sensitization in northeast and northwest Europe. Symptoms of allergic rhinitis follow a similar pattern (9). These observations suggest that true international differences in the prevalence of atopic disorders may exist. These differences, when synthesized with other epidemiological features of allergic rhinitis (2), could provide important clues to the underlying causes of allergy (10).

This paper reports the first global comparison of the prevalence of non-infective rhinitis, rhinoconjunctivitis and diagnosed hay fever conducted using standardised methods among over half a million children participating in the International Study of Asthma and Allergies in Childhood (ISAAC) (11).

Methods

The methodology of ISAAC has been described in detail elsewhere (11). Collaborators were recruited through professional and academic networks and were asked to define local study centres, consisting of a city or defined geographical area. Centres were not in general chosen to be representative of the whole country, and the countries included were not a ran-

dom sample of the global population. Cluster samples of at least 1000 children (and generally 3000 children) within each centre were selected by randomly sampling schools within the study area. In some smaller centres all schools were included in the study. Within each school children were selected either by choosing grades, levels or years in which the majority of children were of the required age range (74% of schools), or by choosing children by exact age (26% of schools). All centres studied 13- and 14-year-olds and some centres additionally studied 6- and 7-year-olds.

Questionnaires were translated from English into the local language for self-completion by the 13-14-year-olds and for completion by the parent of the 6-7-year-olds. The translated questionnaires were then translated back into English to confirm that other languages used terms as equivalent as possible to the English version. Respondents were asked:

1. Have you (Has your child) ever had a problem with sneezing or a runny or blocked nose, when you (he or she) DID NOT have a cold or the 'flu?

If no to question 1, skip to question 6

2. In the past 12 months, have you (has your child) had a problem with sneezing or a runny or blocked nose, when you (he or she) DID NOT have a cold or the 'flu?

If no to question 2, skip to question 6

3. In the past 12 months, has this nose problem been accompanied by itchy-watery eyes?
4. In which of the past 12 months did this nose problem occur?
5. In the past 12 months, how much did this nose problem interfere with your (child's) daily activities? (Not at all, a little, a moderate amount, a lot).

All respondents asked:

6. Have you (Has your child) ever had hay fever?

Centres who submitted verified data to the ISAAC international data centre by the end of November 1997 and gave a detailed report on study design and methods have been included in this analy-

sis. Statistical analysis and mapping used SAS software (12). Symptom prevalences in each centre were calculated by dividing the number of positive responses to each question by the number of completed questionnaires. This paper will focus in particular on rhinitis with itchy eyes in the past year ("rhinoconjunctivitis"). This combination of symptoms was selected as those which best predict allergic rhinitis (13), both in adults (2,14) and children (15).

The prevalence of rhinoconjunctivitis was calculated as the number of children responding positively to both question 2 and question 3, divided by the total number of completed questionnaires. Percentiles of the distribution of prevalence of each symptom in each age group were calculated using the UNIVARIATE procedure and Spearman rank correlation coefficients derived using the CORR procedure in SAS. No tests of statistical significance are presented because the correlation coefficients are used as a descriptive summary rather than for analytical purposes. Responses to question 4 about the month of occurrence of rhinitis symptoms in the past year are difficult to interpret in a global context and have been found to be influenced by the month of data collection (16), so they are not analysed further here.

Results

Participating centres, response rates and sample size

The participating centres, response rates and sample sizes are listed in appendix table 1. The 13–14-year-old age group was studied in 155 centres from 56 countries in Europe, Asia, Africa, Australasia,

Table 2. Interrelation of symptom prevalences within and between age groups

	Rhinitis ever	Rhinitis in past year	Itchy eyes	Affecting activities	Hayfever ever
Rhinitis* ever	0.65	0.94	0.79	0.69	0.50
Rhinitis in the past year	0.97	0.68	0.86	0.77	0.59
with itchy-watery eyes	0.88	0.90	0.66	0.67	0.74
interfering with daily activities	0.68	0.77	0.66	0.75	0.60
Hay fever ever	0.55	0.61	0.61	0.62	0.70

Upper triangle shows rank correlations for different symptoms in 13–14-year-olds (155 centres).

Lower triangle shows rank correlations for different symptoms in 6–7-year-olds (91 centres).

Rank correlations on the diagonal are for the same symptom in the two age groups (90 centres).

* Rhinitis = "A problem with sneezing, or a runny or blocked nose when you (your child) did not have a cold or the 'flu'."

North and South America. The 6–7-year-old age group was studied in 91 centres from 38 countries, with all major regions represented except Africa. Both age groups were studied in 90 centres.

Response rates within participating schools were generally high, with 96% (149/155) centres achieving a response rate of 80% or higher in the 13–14-year-olds and 98% (89/91) of centres achieving a response from 70% or more parents for the 6–7-year age group. Centres with lower response rates are identified with an asterisk in appendix table 1.

Prevalence estimates were based on at least 1000 children in all centres included in this analysis. A total of 721,601 children were studied: 463,801 aged 13–14 years and 257,800 aged 6–7 years.

Distribution of prevalences

The prevalences of positive responses to each question in each centre are listed in appendix table 2. Table 1 summarises the worldwide range of prevalence figures, but these percentiles should not be interpreted as representative of the global prevalence, because the selection of ISAAC centres was determined by local enthusiasm and resources, rather than by systematic attempt to sample the global population.

There is substantial variation in the prevalence of positive responses to every question. Even if the more extreme values are excluded by comparing the 10th to the 90th percentile of the distribution, there is more than a threefold variation in the prevalence of symptoms of rhinitis in each age group, and a fourfold or greater variation in the prevalence of rhinoconjunctivitis. The variation in lifetime prevalence of hay fever was even greater: a sixfold difference between the 10th and 90th percentiles in the younger age-group and almost a ninefold variation in the older age-group.

Table 1. Range and percentiles of symptom prevalences (%) for each age group

6–7-year-olds (91 centres)	Percentiles						
	Min	10th	25th	50th	75th	90th	Max
Rhinitis* ever	2.0	10.5	15.0	20.5	28.6	34.0	64.8
Rhinitis in the past year	1.5	8.3	11.6	15.1	24.4	28.6	41.8
with itchy-watery eyes	0.8	2.8	3.8	5.9	9.4	11.2	14.9
interfering with daily activities	0.5	4.3	5.9	12.6	16.9	20.4	28.1
Hay fever ever	0.0	2.7	4.8	7.2	12.4	15.9	34.9
13–14-year-olds (155 centres)	Percentiles						
	Min	10th	25th	50th	75th	90th	Max
Rhinitis* ever	4.2	18.6	29.7	40.8	47.2	52.1	80.5
Rhinitis in the past year	3.2	13.3	21.2	30.3	37.4	41.5	66.6
with itchy-watery eyes	1.4	4.8	9.0	13.6	17.6	21.0	39.7
interfering with daily activities	2.2	8.5	11.6	19.0	26.4	30.9	57.4
Hay fever ever	0.0	4.0	7.3	16.4	27.0	35.9	54.4

* Rhinitis = "A problem with sneezing, or a runny or blocked nose when you (your child) did not have a cold or the 'flu'."

The wide range of prevalences persists when centres using a common language are considered. For instance, among 52 centres delivering the questionnaire in English, the prevalence of rhinoconjunctivitis among 6–7-year-olds varied from less than 3% in several Indian centres to 14% or more in Adelaide, Perth and Hamilton. There were similarly wide variations in the older age group: from less than 5% in several Indian centres to over 20% in Adelaide, Perth, Hamilton, Kottayam, Malta, Ibadan, Chicago and several UK centres. There were 21 Spanish-language centres, with prevalences of rhinoconjunctivitis among 6–7-year-olds ranging from less than 5% in Castellón, Pamplona and Valencia to over 10% in Rosario, Central Santiago and Costa Rica, and prevalences among 13–14-year-olds varying from 8% in Punta Arenas to over 20% in Buenos Aires, Rosario, Asunción and Cádiz. Among nine Portuguese-speaking centres, the prevalence in the younger age group ranged from 5% (Portimao) to 13% (Sao Paulo), and in the older age group from 6% in several centres in Portugal to 25% in Salvador.

Consistency between symptom prevalences within age groups

The rank correlations between centre prevalences for the different symptom questions are shown in Table 2. The upper triangle relates to the 13–14-year-olds and the lower triangle to the 6–7-year age group. Within each age group there is a moderately

close correlation between the prevalences of each symptom, including restriction of daily activities. The correlation across centres of the prevalence of each symptom and the reported prevalence of hay fever is generally weaker than the correlations between symptom prevalences. This reflects a high degree of variation between centres in the proportion of children with rhinoconjunctivitis who reported (or whose parents reported) a history of hay fever. Figs 1 and 2 show the relationship between these two variables within each age group. Despite the general correlation, some exceptions are apparent.

In the 6–7-year-olds, the highest prevalences of rhinoconjunctivitis were in Hong Kong (14%), Hamilton (14%), Perth (15%), Adelaide (15%) and Taipei (15%). These centres displayed a very wide range of prevalence figures for hayfever ever: 1%, 11%, 21%, 24% and 35%, respectively. Nine centres from South America and southeast Asia had a prevalence of hay fever substantially greater than the prevalence of rhinoconjunctivitis: Borivali (13% for hayfever, 3% for rhinoconjunctivitis), Kota Bharu (16% and 4%), Chiang Mai (18% and 5%), Montevideo (22% and 7%), Metro Manila (26% and 9%), Porto Alegre (26% and 11%), Bangkok (29% and 10%), Sao Paulo (29% and 13%), and Taipei (35% and 15%). Among the remaining centres, the lifetime prevalence of hayfever ranged from zero up to, but rarely exceeding, the prevalence of rhinoconjunctivitis in the past year.

Among the 13–14-year-olds, self-reported hay fe-

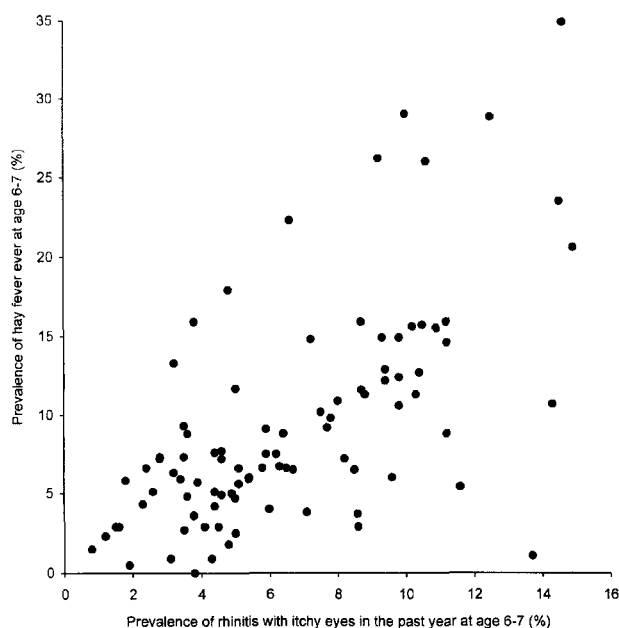


Fig. 1. Scatter plot comparing prevalence of hay fever and prevalence of rhinoconjunctivitis across ISAAC centres in 6–7-year-olds.

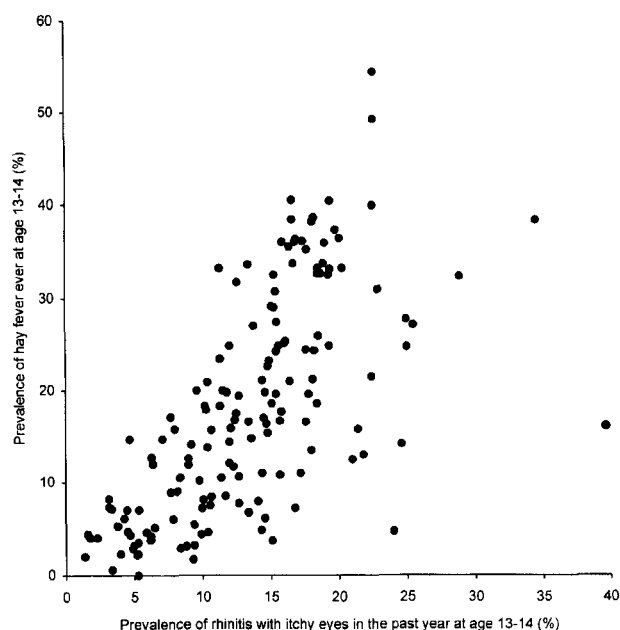


Fig. 2. Scatter plot comparing prevalence of hay fever and prevalence of rhinoconjunctivitis across ISAAC centres in 13–14-year-olds.

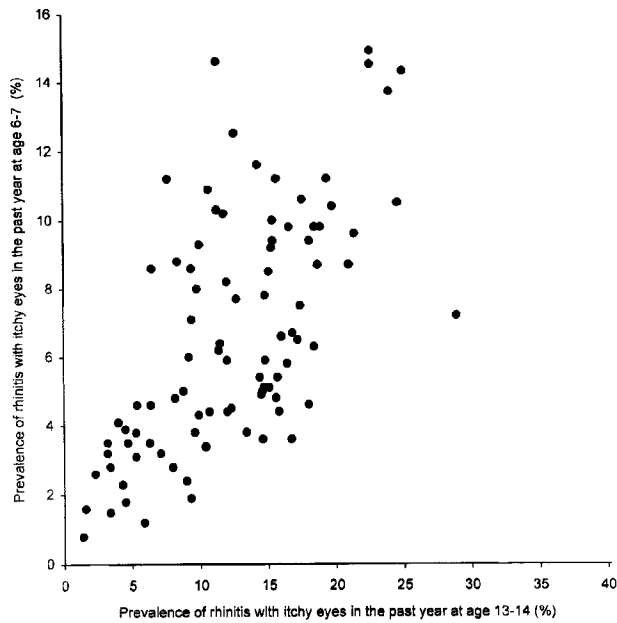


Fig. 3. Scatter plot comparing the prevalence of rhinoconjunctivitis in each age group across ISAAC centres.

ver prevalence was highest in two Australian centres (Adelaide, 54% and Perth, 49%), which also had high rates of rhinoconjunctivitis (23% in each centre). In contrast, the prevalence of rhinoconjunctivitis was similar (24%) in Hong Kong, where the lifetime prevalence of hayfever was less than 5%. Two centres had unusually high rates of rhinoconjunctivitis: Asunción (35%) and Ibadan (40%). Again, the relationship to hayfever was inconsistent, with a high prevalence in Asunción (38%) but a medium level in Ibadan (16%).

Comparison of symptom prevalences between age groups

The correlations shown in bold typeface on the diagonal of Table 2 compare the prevalence of the same symptom in the two age groups. Figs 3 and 4 illustrate these comparisons for rhinoconjunctivitis and for hay fever. Centres with a particularly high prevalence of rhinoconjunctivitis in both age groups were Adelaide (15% in 6–7-year-olds, 23% in 13–14-year-olds), Perth (15% and 23%), Hamilton (14% and 25%) and Hong Kong (14% and 24%). However, two notable outliers are apparent (Fig. 3): in Taipei the prevalence of rhinoconjunctivitis was higher at age 6–7 (15%) than at age 13–14 (11%), whereas in Malta, the prevalence in the younger children was average (7%) but in the older age group it was among the highest (29%).

As might be expected, the lifetime prevalence of hay fever was generally higher in the older age group than in the 6–7-year-olds (Fig. 4), although in

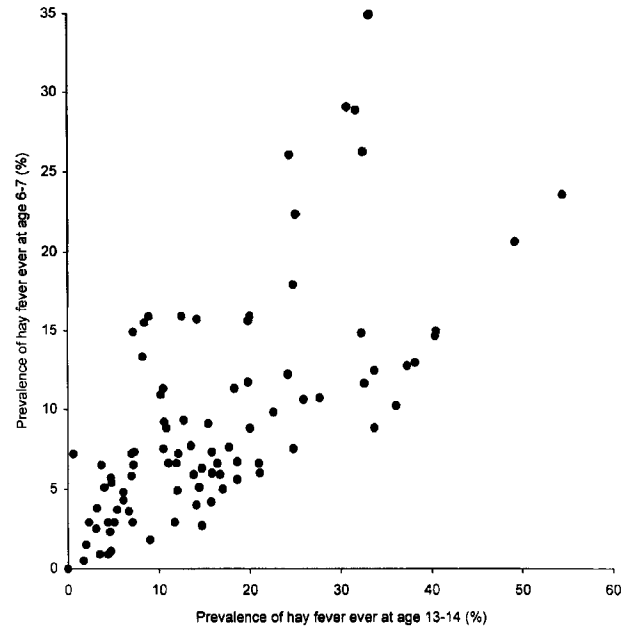


Fig. 4. Scatter plot comparing the lifetime prevalence of hay fever in each age group across ISAAC centres.

six centres from southeast Asia and South America the prevalences were similarly high in both age groups: Taipei (35% and 33%, respectively in 6–7-year-olds and 13–14-year-olds), Bangkok (29% and 31%), Metro Manila (26% and 33%), Sao Paulo (29% and 32%), Porto Alegre (26% and 24%) and Montevideo (22% and 25%). In other centres from these regions (Seoul, Provincial Korea, Buenos Aires and Rosario) the prevalence in the 6–7-year-olds was greater than that in the older age group.

Geographical variation in the prevalence of rhinoconjunctivitis

Figs 5 and 6 show the global distribution of rhinoconjunctivitis prevalence as maps. Among the centres with low prevalences of rhinoconjunctivitis in both age groups are several from eastern Europe, central and southern Asia. In the older age group there are also consistently low prevalences in China and Portugal. The distribution of high prevalences is less distinct and differs somewhat between the two age groups. Single centres with high prevalence figures for the 13–14-year-olds are found in countries as diverse as Argentina, Australia, Brazil, Canada, Finland, France, Hong Kong, India, Malta, Nigeria, Paraguay, Peru, Spain, the United Kingdom and United States (Fig. 6). In the 6–7-year-olds, there were high prevalences in countries on the Pacific rim (Australia, Hong Kong, New Zealand, South Korea, Taiwan, Thailand) and in South American centres (Argentina, Brazil, Chile, Costa Rica), with single centres of high prevalence in Canada, Portugal and Poland (Fig. 5).

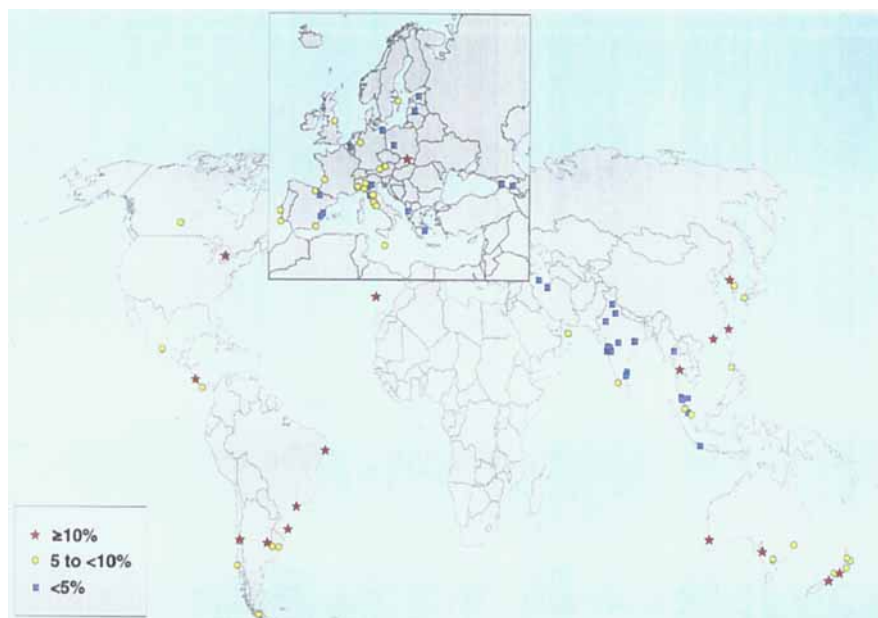


Fig. 5. Global map of the prevalence of rhinoconjunctivitis in 6–7-year-old children in ISAAC centres.

Discussion

This is the first study to compare the prevalence of rhinitis, conjunctivitis and hay fever among representative population samples from centres in all major regions of the world, using a common symptomatic case definition. Considerable variations are apparent, but before attributing these to real differences in the prevalence of allergic rhinitis, the possibility of spurious differences arising from bias or sampling variations needs to be considered.

The purpose of ISAAC is to describe variations in the prevalence of allergic disorders within and between populations. Questions which are of proven validity for discriminating the allergic individuals

within a population may nevertheless be of limited value for comparisons between populations. This is particularly the case where cultural and linguistic differences occur. The concept of non-infective rhinitis is a complex one, embracing three nasal symptoms (sneezing, running and/or blocking) and the absence of common upper respiratory infections. The addition of two ocular symptoms (itching and/or watering) further complicates the case definition, and there are ample opportunities for translation or interpretation of these questions to introduce spurious variation in symptom prevalence. Whereas the wide variations in reported symptom prevalence within groups of centres sharing a common lan-

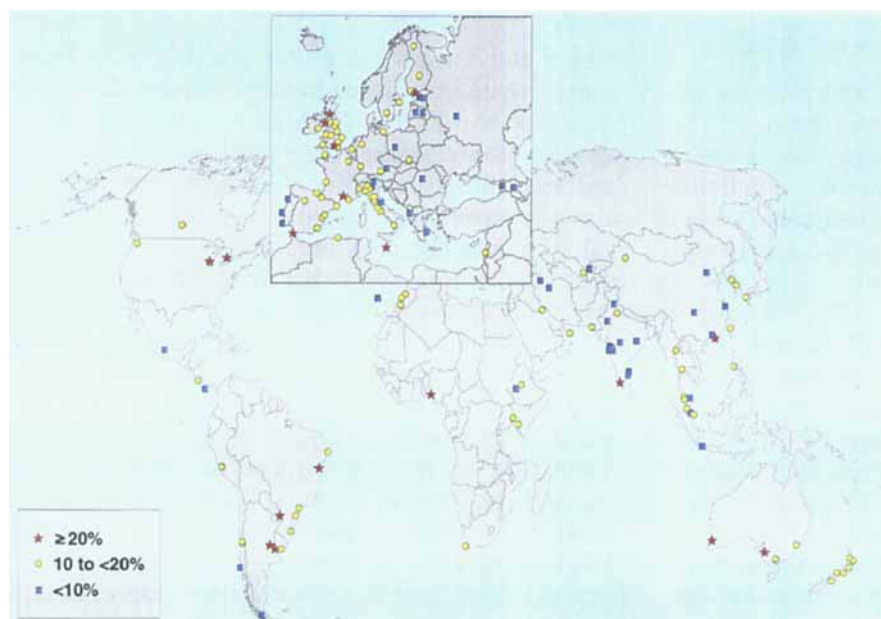


Fig. 6. Global map of the prevalence of rhinoconjunctivitis in 13–14-year-old children in ISAAC centres.

guage argue against a purely linguistic artifact, we acknowledge that dialect and familiarity with the written language may lead to spurious differences in responses even when language is held constant. Furthermore, cultural factors which are independent of language may influence awareness and reporting of nasal symptoms and related disease labels.

As might be expected, there is seasonal variation in reporting of symptoms of allergic rhinitis and conjunctivitis (16), even though the questions referred to symptoms during the past year. Although centres were asked to complete the surveys outside the local pollen season, some residual seasonal variation may persist and result in spurious differences between centres. The choice of rhinitis with itchy eyes as the variable to be analysed in detail was justified because this symptom combination most closely relates to objective indicators of allergic sensitisation in European populations (13–15). However, some children with perennial allergic rhinitis may have nasal blockage without conjunctival symptoms and would be included in the prevalence of "rhinitis in the past year", but not in "rhinoconjunctivitis". Conversely, it is possible that other conditions contributing to conjunctival irritation may lead to lack of specificity in our case definition.

For these reasons, the international variations in prevalence of symptoms of non-infective rhinoconjunctivitis must be considered indicative rather than definitive evidence of true differences in the prevalence of allergic rhinitis and need to be confirmed by surveys of objective measures of allergic sensitization, as proposed for phase II of ISAAC (11). Nevertheless, it is reassuring that the variation in symptom prevalence observed in the Baltic centres corresponds closely to the geographical pattern of skin prick test positivity in previous surveys of children of a different age group in the same centres (7, 8).

Artifacts due to translation are unlikely to be the explanation for variations within countries, although cultural differences may exist within some countries in the attitudes to nasal symptoms and the use of specific labels such as hay fever. Some variation may be expected due to random sampling error, but the 95% confidence interval for a prevalence of 13.6% (the median for rhinoconjunctivitis in the older age group) is $\pm 2.1\%$ with a sample size of 1000, and $\pm 1.2\%$ with a sample size of 3000. Even if an allowance is made for possible design effects related to the cluster sampling, much of the variation within and between countries cannot be attributed to sampling errors.

The relationship between hay fever prevalence and the prevalence of related symptoms varied substantially between countries. This probably reflects variation in the use of this particular diagnostic label and the attribution of symptoms of allergic rhinitis

to a specific aeroallergen. Thus, although a diagnosis of hay fever is highly predictive of skin test positivity within a population, it appears of limited value for comparisons between populations.

The prevalence of self-reported "nasal allergies including hay fever" was studied in a multi-centre survey of young adults (the European Community Respiratory Health Survey) (17). There is limited scope for comparison with our findings among children, as few centres participated in both studies. Nevertheless, a consistent observation in both adolescents and young adults is the high prevalence of self-reported hay fever in New Zealand and the United Kingdom.

The ranking of centres by prevalence of rhinoconjunctivitis sometimes differed substantially in the two age groups. This could reflect differing interpretation of the questionnaire or variation in perception of symptoms by children and their parents, or there could be global variation in the age of onset of allergic rhinitis. A third possibility is that there is a cohort or generation effect influencing the prevalence of allergy and this has progressed to a greater extent in some centres, such as those in rapidly industrialising countries of South America and the Pacific rim.

There is general concern that the prevalence of allergic disorders is increasing worldwide (18), and suggestive evidence from at least one centre (19) that this may be due to a cohort effect. The global overview provided by ISAAC questionnaire data extends to areas of the world not previously studied and offers a substantial set of baseline prevalence figures against which future trends may be assessed, as proposed in phase III of ISAAC (11). Meanwhile, it is important to validate the questionnaire data as a measure of disease prevalence in centres with diverse culture, language and systems of medical care, and to explore the potential of these geographical variations for testing aetiological hypotheses (2).

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Appendix 1. ISAAC centres, collaborators, languages used, response rates and sample sizes

Country	Centre	Collaborators	Languages used in questionnaires	6-7-year-olds				13-14-year-olds			
				Response rates (%)		Achieved sample		Response rates (%)		Achieved sample	
				schools	children	schools	children	schools	children	schools	children
Albania	Tiranë	A Priftanji	Albanian	100	90	30	2981	100	97	33	2957
Algeria	Algiers	A Bezzaoucha	Arabic				0	100	98	14	1173
Argentina	Buenos Aires	N Salmun	Spanish	97	90	76	3005	98	88	44	2996
	Rosario	N Salmun	Spanish	98	89	61	3007	100	91	33	3008
Australia	Adelaide	D Kennedy	English	95	90	41	3063	94	95	15	3030
	Melbourne	C Robertson	English	92	90	84	2840	93	97	25	2759
	Perth	L Landau	English	97	74	34	2192	90	93	9	3650
	Sydney	J Peat, A Bauman	English	93	82	42	2804	85	90	22	2839
Austria	Salzburg	J Riedler	German	100	88	37	3658	76	85	22	3371
	Urfahr-Umgebung	G Haidinger	German	100	95	31	2129	100	93	13	1515
Belgium	Antwerp	P Vermeire	Dutch	96	86	136	6533	90	97	27	1515
Brazil	Curitiba	NA Rosário	Portuguese				0	100	94	32	3004
	Porto Alegre	R Stein	Portuguese	100	92	62	2846	100	97	38	3195
	Recife	PG Bezerra	Portuguese	100	100	30	1410	100	98	30	3086
	Salvador	LS Souza	Portuguese				0	95	93	54	3162
	Sao Paulo	D Solé	Portuguese	66 *	72	27	3005	70	94	28	3007
Canada	Hamilton	M Sears	English	94	73	113	3337	82	67 *	84	3051
	Saskatoon	B Taylor	English	100	91	81	2418	100	71 *	81	1901
Chile	Central Santiago	I Sanchez	Spanish	100	99	35	1458	100	100	43	2944
	Punta Arenas	L Amarales	Spanish	100	87	24	3060	100	93	32	3482
	South Santiago	E Correz	Spanish	100	74	33	3182	100	100	33	3051
	Valdivia	M Calvo-Gil	Spanish	100	88	75	3138	100	82	73	3231
China	Beijing	Y Chen	Chinese				0	79	99	11	4167
	Chongqing	K-H Chen	Chinese				0	100	99	10	4296
	Guangzhou	N-S Zhong	Chinese				0	100	100	10	3855
	Shanghai	M Bao-Shan	Chinese				0	100	98	10	3483
	Wulumuqi	M-L Xiao	Chinese				0	100	98	15	3207
Costa Rica	Nationwide	ME Soto-Quiros	Spanish	100	84	56	2942	100	91	24	3200
Estonia	Narva	M-A Riikjärv	Russian				#	100	86	14	1424
	Tallinn	M-A Riikjärv	Estonian	100	89	78	3070	100	85	35	3560
Ethiopia	Addis Ababa	K Melaku	Amharic				0	100	99	28	2951
	Jima	B Seyoum	Amharic				0	100	99	10	3027
Finland	Helsinki	M Kajosaari	Finnish				0	100	95	17	2855
	Kuopio county	J Pakkanen	Finnish				0	100	97	16	2878
	Lapland area	L Soinenen	Finnish				0	100	97	20	3077
	Turku & Pori county	TA Koivikko	Finnish				0	100	97	13	3085
France	Marseille	D Charpin	French				0	100	83	12	3494
	Montpellier	P Godard	French				0	72	93	135	3384
	Pessac	A Fayard	French				0	95	74 *	21	3302
	Strasbourg	E Quoix	French	100	80	55	3202	93	80	25	5403
	West Marne	I Amesi	French				0	100	86	16	2961

Appendix 1 (continued)

Country	Centre	Collaborators	Languages used in questionnaires	6-7-year-olds				13-14-year-olds			
				Response rates (%)		Achieved sample		Response rates (%)		Achieved sample	
				schools	children	schools	children	schools	children	schools	children
Georgia (Republic)	Kutaisi	N Khetsuriani	Georgian	100	94	18	3356	100	90	23	3297
	Tbilisi	A Gamkrelidze	Georgian	100	90	35	3414	100	91	30	3449
Germany	Greifswald	A Kramer	German	100	86	48	2863	100	88	49	3169
	Münster	U Keil	German	100	81	55	3739	100	94	35	4003
Greece	Athens	C Gratiou	Greek	100	85	72	1654	100	87	36	2561
Hong Kong	Hong Kong	C Lai, YL Lau	Chinese	52 *	97	17	3618	81	97	13	4666
India	Akola	R Maheshwari	English	100	83	13	2030	100	87	15	2138
	Bombay (16)	MK Joshi	English	100	90	12	3967	100	91	12	4225
	Bombay (17)	UA Pai	English	100	95	7	1148	100	88	7	2226
	Bombay (18)	K Raghavan	English	100	96	10	3568	100	99	10	3178
	Borivali	VA Khataev	English	100	99	10	1672	100	100	10	3678
	Chandigarh	L Kumar	English	100	94	31	2891	100	97	31	3139
	Jodhpur	KC Jain	English	100	76	12	1104	100	85	12	1094
	Kottayam	TU Sukumaran	Malayalam, English	100	78	35	2155	100	91	35	2047
	Madras (2)	S Rajasee	Tamil, English	100	89	11	1466	100	89	12	1903
	Madras (3)	N Somu	English	100	95	16	2491	100	96	9	3086
	New Delhi	GR Sethi	English	100	99	15	2938	100	100	11	3026
	Neyveli	G Jayaraj	English	100	100	19	1498	100	100	19	3281
	Orissa	PK Kar	English	100	95	19	1520	100	100	16	1248
	Pune	NM Hanumante	English	100	100	18	3248	100	100	11	2702
Indonesia	Bandung	B Kamien	Indonesian	100	93	44	1390	100	96	10	2249
Iran	Rasht	M-R Masjedi	Persian	100	99	48	3013	100	99	14	3182
	Tehran	M-R Masjedi	Persian	97	83	35	2456	100	87	17	2691
Irish Republic	Nationwide	L Clancy	English				0	100	92	30	3147
Italy	Ascoli Piceno	S Bonini	Italian				#	100	99	18	1130
	Cosenza	E Bondi	Italian				0	72	89	13	1068
	Cremona	F Rusconi	Italian	100	100	23	1392	100	99	24	1201
	Emilia-Romagna	M Biocca	Italian	99	98	74	4472	100	98	55	3951
	Empoli	L Chetoni	Italian	100	91	22	1434	100	98	12	1046
	Firenze	E Chellini	Italian	100	96	15	1138	100	97	11	1171
	Frosinone	R Ronchetti	Italian				0	100	98	8	1147
	Milano	L Bisanti	Italian	100	96	30	3616	100	97	35	3373
	Roma	F Forastiere	Italian	90	95	46	4027	87	94	41	3323
	Siena	E Renzoni	Italian				0	100	97	19	1181
	Torino	G Ciccone	Italian	100	97	14	1429	100	97	14	1242
	Trento	S Pirfer	Italian				0	100	94	87	4426
	Verona	A Boner	Italian	91	94	80	2076	84	98	42	2208
	Viterbo	G Corbo	Italian	30 *	98	13	1231				#
Japan	Fukuoka	S Nishima	Japanese	100	91	36	2900	93	94	14	2831
Kenya	Eldoret	FO Esamai	English				0	100	100	58	3024
	Nairobi	JA Odhiambo	English				0	100	99	15	3243

Appendix 1 (continued)

Country	Centre	Collaborators	Languages used in questionnaires	6-7-year-olds				13-14-year-olds			
				Response rates (%)		Achieved sample		Response rates (%)		Achieved sample	
				schools	children	schools	children	schools	children	schools	children
Korea (South)	Provincial Korea	S-I Lee	Korean	100	90	24	5527	100	98	24	6990
Kuwait	Seoul	S-I Lee	Korean	100	98	10	2582	91	96	10	2993
	Kuwait	JA Al-Momen	Arabic				#	100	70*	30	1056
Latvia	Riga	M Leja	Latvian, Russian	94	93	51	3003	100	95	32	3004
	Rural Latvia	M Leja	Latvian, Russian				0	93	92	82	3145
Lebanon	Beirut	FM Ramadan	Arabic				0	100	100	32	2993
Malaysia	Alor Setar	KH Teh	Malay	100	85	38	2978	100	91	16	3298
	Ipoh	WY Lim	Malay	100	96	16	2506	100	97	9	3313
	Klang Valley	J de Bruyne	Malay	100	75	28	3109	100	92	18	6079
	Kota Bharu	BS Ouh	Malay, Chinese	100	96	33	3819	100	96	13	3113
Malta	Muar	KW Chum	Malay, Chinese	100	93	84	2873	100	91	13	2833
	Malta	S Montefort	English, Maltese	100	79	24	3493	96	89	23	4184
Mexico	Cuernavaca	I Romieu	Spanish	100	94	72	3097	100	92	72	3102
Morocco	Casablanca	Z Bouayad	Moroccan Arabic				0	100	98	12	3183
	Marrakech	Z Bouayad	Moroccan Arabic				0	100	90	14	2900
New Zealand	Rabat	A Bennis	Arabic, French				0	100	95	13	3276
	Auckland	MI Asher	English	96	90	47	3526	81	95	13	3206
	Bay of Plenty	C Moyes	English	100	87	45	2681	100	89	12	2813
	Christchurch	P Pattemore	English	98	91	62	3318	93	96	14	3191
	Hawke's Bay	D Barry	English	96	78	72	3338	73	80	36	3550
	Nelson	R Mackay	English	100	98	58	1868	100	92	21	1839
Nigeria	Wellington	J Crane	English	99	92	83	3838	96	89	23	4424
	Ibadan	BO Onadeko	English				0	100	76*	15	3057
Oman (Sultanate)	Al-Khod	BMS Al Riyami	Arabic	100	99	118	3891	100	94	102	3174
Pakistan	Karachi	ZA Bhutta	English, Urdu				0	72	100	13	1829
Panama	David/Panamá	G Cukier	Spanish	90	98	45	3043	95	96	54	2885
Paraguay	Asunción	JA Guggiani-Chase	Spanish, Guarani				0	100	93	26	2966
Peru	Lima	P Chiarella	Spanish	65*	88	11	3558	37*	97	25	3158
Philippines	Metro Manila	F Cua-Lim	English, Filipino				0	67*	96	10	3207
Poland	Krakow (1993)	G Lis	Polish	100	94	40	2264	100	94	38	3750
	Krakow (1995)	G Lis	Polish	96	86	44	2710	100	92	39	2786
Portugal	Poznan	A Breborowicz	Polish				0	93	89	26	3631
	Funchal	FD Borges	Portuguese	100	74	63	1797	100	97	15	3532
	Lisboa	JE Rosado Pinto	Portuguese	100	95	120	2143	100	93	34	3030
	Portimao	C Nunes	Portuguese	100	96	24	1189	100	100	7	1058
Romania	Porto	JL dos Santos	Portuguese				0	95	92	19	3131
	Cluj	D Dumitrascu	Romanian				0	100	99	21	3396
Russia	Moscow	R Khaltov	Russian				0	100	85	21	3411
Singapore	Singapore	B-W Lee	English	73	94	11	2353	75	91	12	4205
South Africa	Cape Town	H Nelson	Afrikaans, Xhosa				0	97	83	33	5173

Appendix 1 (continued)

Country	Centre	Collaborators	Languages used in questionnaires	6-7-year-olds				13-14-year-olds			
				Response rates (%)		Achieved sample		Response rates (%)		Achieved sample	
				schools	children	schools	children	schools	children	schools	children
Spain	Barcelona	RM Busquets	Spanish		0			97	91	74	3031
	Bilbao	AD Rubio	Spanish	100	78	75	3019	100	90	57	3212
	Cartagena	L Garcia-Marcos	Spanish	100	68*	63	3335	100	91	63	3017
	Castellón	A Arnedo-Pena	Spanish	100	80	61	3594	100	94	63	3094
	Cádiz	AR Asensio	Spanish				0	82	96	72	3270
	Pamplona	F Guillén Grima	Spanish, Basque	96	73	52	2996	96	94	52	3040
	Valencia	MMM Suárez-Varela	Spanish	81	71	130	3940	100	100	31	3179
	Valladolid	AB Quiros	Spanish				0	100	100	59	3178
	Linköping	N-I Kjellman	Swedish				0	95	96	18	3377
	Stockholm & Uppsala	A Foucard	Swedish	85	91	76	3029	85	92	34	3075
Taiwan	Taipei	K-H Hsieh	Chinese	100	92	12	4806	100	93	10	11400
Thailand	Bangkok	P Vichyanond	Thai	100	91	14	3629	100	75*	13	3713
	Chiang Mai	M Trakulthakorn	Thai	100	86	16	3828	100	88	11	3927
United Kingdom	Anglia & Oxford	HR Anderson	English				0	70	88	7	2324
	Guernsey	D Jeff	English				0	100	91	8	1170
	Isle of Man	PV Powell	English				0	100	91	4	1467
	Jersey	CR Grainger	English				0	100	90	6	1135
	North Thames	HR Anderson	English				0	78	85	7	2220
	North West	HR Anderson	English				0	92	83	11	3029
	Northeast & Yorks	HR Anderson	English				0	65*	83	13	3709
	Scotland	HR Anderson	English				0	70	85	14	4444
	South Thames	HR Anderson	English				0	89	87	8	2297
	South & West	HR Anderson	English				0	100	91	9	2707
United States	Sunderland	MH Shamsain	English	88		78	1864	94	90	31	2092
	Surrey & Sussex	DP Strachan	English		70		0	71	91	27	2114
	Trent	HR Anderson	English				0	67*	89	8	2207
	Wales	HR Anderson	English				0	100	86	8	2351
	West Midlands	HR Anderson	English				0	80	85	8	2219
	Chicago (3)	V Persky	English				0	88	90	7	1422
	Chicago (4)	V Persky	English, Spanish				0	100	94	40	3756
	Seattle	G Hedding	English				0	43*	90	3	2330
	Montevideo	DH de Cuesta	Spanish			52	3071	100	93	16	3072
	Samarkand	T Aripova	Russian	100	62*		0	100	88	15	1758
Uzbekistan	Tashkent	T Aripova	Russian				0	100	97	24	2904

* Low response rate, prevalence estimates should be interpreted with caution

Excluded due to achieved sample size <1000

Appendix 2. Prevalence (%) of symptoms by centre and age group

Country	Centre	6-7-year-olds						13-14-year-olds					
		Sample size	Rhinitis		Itchy eyes*	Activities limited	Hay fever	Sample size	Rhinitis		Itchy eyes*	Activities limited	Hay fever
			ever	past year					ever	past year			
Albania	Tiranë	2981	16.4	13.1	4.1	10.5	2.9	2957	18.6	12.7	4.0	10.8	2.3
	Algiers	0	—	—	—	—	—	1173	46.5	37.9	18.2	28.1	24.3
	Buenos Aires	3005	47.8	38.3	8.7	16.3	15.9	2996	69.2	59.6	21.0	21.0	12.5
Argentina	Rosario	3007	50.4	41.8	10.5	20.4	15.7	3008	75.1	65.2	24.6	25.8	14.2
	Adelaide	3063	32.5	29.9	14.5	18.6	23.5	3030	45.0	39.5	22.6	27.2	54.4
	Melbourne	2840	25.7	23.0	9.8	14.1	14.9	2759	41.4	35.9	16.6	24.1	40.5
Australia	Perth	2192	32.1	28.6	14.9	17.2	20.6	3650	48.5	41.5	22.6	26.4	49.2
	Sydney	2804	27.4	24.1	9.4	13.7	12.2	2839	40.2	33.0	15.4	22.1	24.2
	Salzburg	3658	15.0	13.0	6.4	9.0	8.8	3371	28.5	22.1	11.5	8.7	20.0
Austria	Urfahr-Umgebung	2129	11.4	10.3	6.0	6.9	4.0	1515	25.3	21.0	9.2	14.1	14.1
	Antwerp	6533	19.0	14.7	4.9	9.6	5.0	1515	44.8	36.4	14.5	22.8	17.0
	Curitiba	0	—	—	—	—	—	3004	40.8	29.8	14.1	17.6	7.9
Belgium	Porto Alegre	2846	34.0	28.1	10.6	16.6	26.0	3195	53.4	40.8	17.6	24.2	24.4
	Recife	1410	33.0	22.8	10.3	17.5	11.3	3086	35.0	24.1	11.3	16.5	18.3
	Salvador	0	—	—	—	—	—	3162	68.2	55.0	25.0	15.1	24.7
Canada	Sao Paulo	3005	40.0	33.8	12.5	19.2	26.8	3007	45.3	34.0	12.6	20.5	31.7
	Hamilton	3337	30.5	28.6	14.3	16.2	10.7	3051	51.5	45.8	25.0	30.9	27.7
	Saskatoon	2418	25.6	22.6	8.2	12.7	7.2	1901	39.5	33.8	12.0	19.7	12.1
Chile	Central Santiago	1458	29.7	27.0	11.2	16.9	8.8	2944	35.1	27.9	15.7	20.7	10.8
	Punta Arenas	3060	28.3	23.3	8.8	17.1	11.3	3482	20.0	15.5	8.4	10.8	10.5
	South Santiago	3182	21.6	17.6	7.7	16.1	9.2	3051	34.5	23.3	12.7	19.0	10.6
China	Valdivia	3138	20.3	17.4	8.0	11.3	10.9	3231	20.6	17.1	9.8	9.7	10.2
	Beijing	0	—	—	—	—	—	4167	41.5	33.7	7.9	23.6	6.0
	Chongqing	0	—	—	—	—	—	4296	23.7	20.5	4.9	17.2	2.9
	Guangzhou	0	—	—	—	—	—	3855	46.3	39.5	8.4	26.0	2.9
	Shanghai	0	—	—	—	—	—	3483	26.8	21.9	5.0	17.0	3.2
	Wulumuqi	0	—	—	—	—	—	3207	43.2	36.7	10.1	28.7	8.1
Costa Rica	Nationwide	2942	32.7	26.6	11.6	15.4	5.4	3200	39.2	30.9	14.3	12.8	4.8
	Narva	0	—	—	—	—	—	1424	28.7	20.8	5.3	24.0	2.3
	Tallinn	3070	15.0	11.6	3.5	8.1	2.7	3560	33.1	22.9	4.7	14.2	14.7
Ethiopia	Addis Ababa	0	—	—	—	—	—	2951	50.0	29.5	10.6	21.6	7.5
	Jima	0	—	—	—	—	—	3027	4.2	3.2	1.8	2.2	4.0
	Helsinki	0	—	—	—	—	—	2855	55.1	45.5	22.9	32.7	30.9
Finland	Kuopio county	0	—	—	—	—	—	2878	46.6	36.2	15.3	26.9	29.0
	Lapland area	0	—	—	—	—	—	3077	43.9	33.3	14.9	24.2	23.2
	Turku & Pori county	0	—	—	—	—	—	3085	43.6	33.3	13.8	24.2	27.0
France	Marseille	0	—	—	—	—	—	3494	54.1	45.4	14.4	20.7	11.0
	Montpellier	0	—	—	—	—	—	3384	63.3	58.0	25.5	57.4	27.1
	Pessac	3202	25.8	22.2	5.9	9.9	9.1	3302	53.6	44.1	14.8	20.3	15.4
	Strasbourg	0	—	—	—	—	—	5403	54.7	44.5	13.6	18.5	14.8
	West Mame	0	—	—	—	—	—	2961	47.9	40.5	12.4	17.7	16.8

Appendix 2 (continued)

Country	Centre	6-7-year-olds						13-14-year-olds					
		Sample size	Rhinitis		Itchy eyes*	Activities	Hay fever	Sample size	Rhinitis		Itchy eyes*	Activities limited	Hay fever
			ever	past year					ever	past year			
Georgia (Republic)	Kutaisi	3356	10.8	8.0	3.9	5.9	5.7	3297	18.9	12.3	4.5	8.1	4.7
	Tbilisi	3414	8.8	6.6	2.3	4.4	4.3	3449	18.4	13.3	4.3	9.1	6.1
Germany	Greifswald	2853	11.8	10.4	4.5	7.0	2.9	3169	38.0	29.3	12.3	17.5	11.7
	Münster	3739	14.9	12.5	5.4	8.5	6.0	4003	36.5	28.7	14.4	15.0	21.1
Greece	Athens	1654	13.1	11.1	3.5	4.8	9.3	2561	17.2	14.4	6.3	5.9	12.7
Hong Kong	Hong Kong	3618	36.5	32.9	13.7	23.5	1.1	4666	52.1	44.5	24.0	35.3	4.7
India	Akola	2030	2.0	1.5	0.8	1.9	1.5	2138	4.4	3.4	1.4	2.2	2.0
	Bombay (16)	3967	10.0	8.1	2.6	8.2	5.1	4225	8.8	6.7	2.3	6.4	4.0
	Bombay (17)	1148	13.2	11.6	3.2	12.6	6.3	2226	17.3	14.2	7.1	14.9	14.7
	Bombay (18)	3568	7.4	5.9	1.5	5.6	2.9	3178	14.9	11.5	3.4	9.1	7.1
	Borivali	1672	11.4	9.4	3.2	8.7	13.3	3878	11.8	8.7	3.2	7.8	8.2
	Chandigarh	2891	11.1	10.2	4.6	9.9	7.2	3139	10.1	8.1	5.4	6.7	7.0
	Jodhpur	1104	10.5	8.9	2.4	11.5	6.6	1094	22.4	18.0	9.0	17.6	11.9
	Kottayam	2156	28.1	23.8	9.6	24.8	6.0	2047	47.9	37.7	21.4	36.0	15.8
	Madras (2)	1466	9.9	8.3	1.8	9.0	5.8	1903	14.0	11.4	4.5	10.6	7.0
	Madras (3)	2491	16.0	13.5	3.5	11.0	7.3	3086	23.8	11.7	3.2	16.4	7.3
	New Delhi	2938	15.2	13.2	3.4	13.3	5.9	3026	34.6	28.2	10.4	25.8	13.8
	Neyveli	1498	28.6	14.0	4.8	0.5	1.8	3281	35.1	16.3	8.2	9.5	9.0
	Orissa	1520	7.5	5.7	2.8	4.7	7.2	1248	7.8	6.3	3.4	4.9	0.6
	Pune	3248	7.3	6.0	1.6	5.0	2.9	2702	10.8	7.6	1.6	5.5	4.4
Indonesia	Bandung	1390	21.2	20.1	3.8	11.2	0.0	2249	61.7	32.6	5.3	24.3	0.0
Iran	Rasht	3013	7.8	5.2	1.2	3.4	2.3	3182	20.7	13.9	5.9	8.5	4.6
	Tehran	2456	9.8	7.6	1.9	4.3	0.5	2691	28.2	21.2	9.3	10.9	1.7
Irish Republic	Dublin	0	-	-	-	-	-	3147	48.6	41.8	19.3	24.4	24.8
Italy	Ascoli Piceno	0	-	-	-	-	-	1130	24.9	17.8	7.7	7.1	17.1
	Cosenza	0	-	-	-	-	-	1088	34.4	24.3	12.7	9.9	19.4
	Cremona	1392	15.8	11.6	4.4	3.7	4.2	1201	36.6	23.6	10.7	8.6	15.7
Emilia-Romagna		4472	18.8	12.9	5.4	4.5	5.9	3961	42.4	31.2	15.7	11.3	16.7
	Empoli	1434	20.4	12.9	4.4	5.2	7.6	1046	46.7	33.8	15.8	14.2	17.7
	Firenze	1138	21.2	15.9	6.3	6.2	6.7	1171	45.9	34.4	18.4	12.6	18.6
Frosinone		0	-	-	-	-	-	1147	38.7	27.0	13.4	9.9	16.6
Milano		3616	20.5	14.2	5.8	5.3	6.6	3373	45.2	32.4	16.4	11.7	21.0
	Roma	4027	19.3	13.4	5.1	4.8	6.6	3323	39.5	30.2	14.7	9.9	16.4
	Siena	0	-	-	-	-	-	1181	46.6	33.6	17.6	13.1	16.6
	Torino	1429	19.3	12.8	5.1	4.2	5.6	1242	42.1	29.1	15.1	10.1	18.6
Trento		0	-	-	-	-	-	4426	28.8	18.2	9.0	6.3	12.6
Verona		2076	16.4	13.6	4.3	5.3	0.9	2208	25.1	19.7	9.9	7.9	4.4
Viterbo		1231	16.1	11.5	5.0	4.1	4.7	0	-	-	-	-	-
Fukuoka		2900	30.8	25.6	7.8	17.0	9.8	2831	52.6	41.0	14.8	27.3	22.6
Japan	Eldoret	0	-	-	-	-	-	3024	32.4	20.5	12.1	13.2	15.9
Kenya	Nairobi	0	-	-	-	-	-	3243	44.0	31.0	16.1	26.7	25.3

Appendix 2 (continued)

Country	Centre	6-7-year-olds					13-14-year-olds						
		Sample size	Rhinitis		Itchy eyes*	Activities limited	Hay fever	Sample size	Rhinitis		Itchy eyes*	Activities limited	Hay fever
			ever	past year					ever	past year			
Korea (South)	Provincial Korea	5527	34.6	29.3	20.4	14.9	6990	35.3	28.8	10.0	16.7	7.2	
	Seoul	2582	37.7	33.5	22.0	15.5	2993	38.8	32.2	10.7	18.1	8.4	
	Kuwait	0	-	-	-	-	1056	42.1	31.0	12.5	38.4	17.5	
	Riga	3003	16.7	13.4	3.1	14.5	3004	29.0	21.4	5.3	20.1	3.5	
Latvia	Rural Latvia	0	-	-	-	-	3145	32.9	23.2	4.7	21.4	4.3	
	Beirut	0	-	-	-	-	2993	33.4	25.4	15.4	14.6	19.6	
	Abu Setar	2978	16.8	13.0	19.0	8.8	3298	48.6	37.4	16.7	39.2	33.7	
	Ipoth	2506	14.4	11.3	9.5	7.7	3313	50.3	40.0	18.0	30.9	13.5	
Malaysia	Klang Valley	3109	16.3	13.8	19.0	11.7	6079	46.5	35.4	14.6	36.5	19.8	
	Kota Bharu	3819	18.8	15.1	20.4	15.9	3113	38.2	29.3	9.6	33.7	20.0	
	Muar	2873	12.7	10.0	14.0	7.3	2833	39.4	25.4	8.0	27.9	15.8	
	Malta	3493	23.5	20.8	12.9	14.8	4184	52.7	47.4	28.9	29.0	32.3	
Mexico	Cuernavaca	3097	64.8	23.2	12.8	3.7	3102#	59.0	22.2	9.4	12.3	5.4	
	Casablanca	0	-	-	-	-	3183	36.1	26.6	15.5	25.4	27.4	
	Marrakech	0	-	-	-	-	2900	29.7	19.4	10.4	23.8	20.9	
	Rabat	0	-	-	-	-	3276	33.6	25.0	10.2	13.3	18.3	
New Zealand	Auckland	3526	27.8	24.8	17.7	12.4	3206	47.4	39.7	18.9	27.8	33.7	
	Bay of Plenty	2881	29.2	25.7	17.5	11.6	2813	49.3	41.2	18.7	31.1	32.6	
	Christchurch	3318	27.4	24.4	14.6	14.6	3191	42.5	36.9	19.4	24.7	40.4	
	Hawke's Bay	3338	27.5	24.8	15.9	12.9	3550	45.4	38.3	18.1	26.7	38.2	
Nelson	Nelson	1868	18.4	16.5	11.1	10.2	1839	43.2	36.0	17.4	24.7	36.1	
	Wellington	3638	29.3	25.4	15.2	12.7	4424	47.7	40.6	19.8	27.2	37.3	
	Ibadan	0	-	-	-	-	3057	55.2	45.3	39.7	38.2	16.1	
	Al-Khod	3891	22.0	15.0	13.3	7.5	3174	34.6	23.8	11.4	22.1	10.5	
Oman (Sultanate)	Karachi	0	-	-	-	-	1829	34.8	29.9	18.1	24.7	21.2	
	Pakistan	3043	28.1	20.5	18.2	3.8	2885	33.8	24.1	9.4	16.9	3.2	
	David/Panamá	0	-	-	-	-	2966	80.5	66.6	34.5	39.0	38.3	
	Paraguay	0	-	-	-	-	3198	41.9	34.5	19.3	32.4	32.5	
Peru	Lima	0	-	-	-	-	3207	35.9	27.0	15.3	24.0	32.5	
	Metro Manila	3558	21.6	18.4	15.2	26.2	3750	28.8	20.1	10.3	16.1	17.9	
	Krakow (1993)	0	-	-	-	-	2786	26.2	21.2	11.8	15.4	19.8	
	Krakow (1995)	2264	29.0	25.0	22.7	15.6	3631	19.0	13.7	6.4	11.6	12.0	
Poland	Poznan	2710	13.0	11.3	13.8	4.9	3532	29.8	21.1	7.7	11.0	8.9	
	Funchal	1797	23.9	20.6	14.1	15.9	3000	31.4	20.7	6.5	8.5	5.1	
	Lisboa	2143	26.9	23.4	13.7	2.9	1058	28.5	19.7	8.8	9.0	3.1	
	Portimao	1189	18.0	14.7	9.1	2.5	3131	29.8	22.7	6.2	11.6	4.2	
Portugal	Porto	0	-	-	-	-	3396	15.0	11.5	5.2	8.4	2.2	
	Cluj	0	-	-	-	-	3411	12.6	9.8	6.2	7.9	3.8	
	Romania	0	-	-	-	-	4206	50.0	41.2	15.1	29.9	3.7	
	Russia	0	-	-	-	-	5173	37.7	30.3	15.1	26.0	29.1	
Singapore	Moscow	2353	29.3	26.3	18.9	6.5	4206	50.0	41.2	15.1	29.9	3.7	
	Singapore	0	-	-	-	-	4206	50.0	41.2	15.1	29.9	3.7	
	South Africa	0	-	-	-	-	4206	50.0	41.2	15.1	29.9	3.7	
	Cape Town	0	-	-	-	-	5173	37.7	30.3	15.1	26.0	29.1	

Appendix 2 (continued)

Country	Centre	6–7-year-olds						13–14-year-olds					
		Sample size	Rhinitis		Itchy eyes*	Activities limited	Hay fever	Sample size	Rhinitis		Itchy eyes*	Activities limited	Hay fever
			ever	past year					ever	past year			
Spain	Barcelona	0	–	–	–	–	–	3031	35.4	26.1	11.7	9.7	8.5
	Bilbao	3019	26.9	18.8	6.5	4.8	6.6	3212	48.5	35.3	17.2	12.5	11.0
	Cartagena	3335	22.7	16.3	6.7	5.6	6.5	3017	43.8	32.7	16.8	12.3	7.2
	Castellón	3594	14.5	9.9	3.8	3.6	3.6	3094	42.4	29.8	13.4	11.6	6.7
	Cádiz	0	–	–	–	–	–	3270	47.9	37.6	21.8	16.0	13.0
Sweden	Pamplona	2996	15.6	10.6	3.6	2.5	4.8	3040	49.7	35.5	14.6	9.6	6.1
	Valencia	3940	17.4	11.8	4.4	3.3	5.1	3179	41.2	27.7	12.0	9.6	14.4
	Valladolid	0	–	–	–	–	–	3178	45.2	31.7	12.7	11.1	7.7
	Linköping	0	–	–	–	–	–	3377	25.4	19.2	11.3	12.5	23.4
	Stockholm & Uppsala	3029	17.1	14.1	5.9	8.5	7.5	3075	35.1	26.7	12.0	15.1	24.8
Taiwan	Taipei	4806	36.5	30.8	14.6	24.3	34.9	11400	35.1	28.8	11.3	21.5	33.2
Thailand	Bangkok	3629	36.3	32.6	10.0	28.1	29.0	3713	50.4	43.2	15.4	39.0	30.7
	Chiang Mai	3828	20.8	18.5	4.8	25.8	17.9	3927	47.0	38.3	15.6	37.1	24.8
United Kingdom	Anglia & Oxford	0	–	–	–	–	–	2324	46.0	37.1	18.2	27.5	38.6
	Guernsey	0	–	–	–	–	–	1170	43.8	33.9	17.7	25.1	35.2
	Isle of Man	0	–	–	–	–	–	1467	50.2	39.4	20.1	29.2	36.4
	Jersey	0	–	–	–	–	–	1135	45.8	36.9	16.9	22.8	36.3
	North Thames	0	–	–	–	–	–	2220	43.8	33.9	15.9	25.4	36.0
	North West	0	–	–	–	–	–	3029	49.8	40.8	18.5	29.2	33.2
	Northeast & Yorks	0	–	–	–	–	–	3709	49.1	39.6	19.4	29.1	33.1
	Scotland	0	–	–	–	–	–	4444	48.5	40.1	20.3	26.8	33.2
	South Thames	0	–	–	–	–	–	2297	46.9	37.2	16.6	27.2	38.4
	South & West	0	–	–	–	–	–	2707	44.9	36.2	16.8	24.2	36.0
	Sunderland	1864	23.7	21.2	9.8	13.3	10.6	2092	34.4	30.0	18.5	19.1	25.9
	Surrey & Sussex	0	–	–	–	–	–	2114	45.5	37.5	22.5	26.6	39.9
United States	Trent	0	–	–	–	–	–	2207	44.7	35.7	16.4	24.9	35.5
	Wales	0	–	–	–	–	–	2351	45.7	36.8	18.5	27.2	32.6
	West Midlands	0	–	–	–	–	–	2219	48.1	38.2	19.0	30.0	35.9
	Chicago (3)	0	–	–	–	–	–	1422	39.2	33.8	17.8	20.7	19.6
	Chicago (4)	0	–	–	–	–	–	3756	47.2	40.6	22.4	37.5	21.5
Uruguay	Seattle	0	–	–	–	–	–	2330	38.9	29.5	13.4	18.3	33.6
	Montevideo	3071	33.8	25.1	6.6	10.4	22.3	3072	51.5	34.5	16.0	13.2	25.1
	Samarqand	0	–	–	–	–	–	1758	24.1	17.3	10.4	14.1	4.6
	Tashkent	0	–	–	–	–	–	2904	14.8	8.8	3.8	4.9	5.3

* Rhinitis and itchy eyes in the past year (referred to in the text as "rhinoconjunctivitis")

Age range 11–14 years