Original article

CHANGES IN RESPIRATORY AND ALLERGIC SYMPTOMS IN SCHOOLCHILDREN FROM 1996 TO 2002, RESULTS FROM THE ISAAC SURVEYS IN ANTWERP (BELGIUM)

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Key words: ISAAC, asthma, allergies, time trend, Belgium

ABSTRACT

Two cross sectional surveys (1995/1996 and 2001/2002) were carried out according to the ISAAC protocol among 6-7 and 13-14 year old schoolchildren in Antwerp, Belgium. A total of 8244 children participated in 1996 and 8159 children in 2002.

No significant differences in current prevalence of asthma and asthma medication was found in 6-7 year olds and 13-14 year old girls. Significantly less asthma and asthma medication was reported by 13-14 year old boys in 2002. Symptoms of wheeze had lower occurrence in all groups in 2002, which was significant for older age group. Current prevalence of rash was significantly higher in the 6-7 year olds in 2002. No such increase was found for rash in the older age groups but they reported significantly more rhinitis. No differences were found between urban and suburban Antwerp in either survey.

No clear changes in the occurrence of asthma were found for school children in Antwerp while wheeze was reported less in 2002 compared to 1996. Allergic disorders had higher occurrences in schoolchildren in 2002.

INTRODUCTION

Asthma and allergies are some of the major causes of morbidity in the western world and the prevalence of symptoms is reported to be still increasing(1). However, the evidence for a real increase in prevalence of asthma and wheezing is weak according to a review of Magnus et al. (2) as the disease measures used are susceptible to systematic errors. To introduce a more standardised assessment of the prevalence of asthma and allergies, the ISAAC study was set up as an international multicentre study in which identical (core) questionnaires on asthma and allergic disorders were used(3;4). The first ISAAC study showed substantial variation between countries(5;6). In order to assess time trends in asthma prevalence, phase 3 of the ISAAC study was set up. This paper reports on the prevalence estimates of respiratory symptoms, rhinitis and rash of schoolchildren in two centres (urban and suburban) at two sample moments (1996 and 2002) in Antwerp.

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MATERIAL AND METHODS

Study population and design

Methods of the international ISAAC surveys I and III have previously been described in detail elsewhere(7). In short, this study analyses the information collected in two cross sectional samples (ISAAC I in 1996 and ISAAC III in 2002) using questionnaires with identical questions on symptoms of asthma and allergies performed in two age groups referred to as 6-7 year olds and 13-14 year olds. Two study areas were defined: Antwerp centre, an urban area enclosed by the ring road, and Antwerp south, a suburban area of 13 municipalities south of Antwerp city. Antwerp is a city of 0.5 million inhabitants with one of the worlds biggest port.

All primary schools in Antwerp were on both occasions invited to participate in the study. In 1996 screening questionnaires (core) were distributed by the teachers to the parents of the 6-7 year old children of the participating schools. A random subsample of children was approached to fill in an extended questionnaire by phone or personal interview.

In 2002 teachers of participating schools (6-7 year age group) distributed the (extended) questionnaires with an accompanying letter to the parents. The questionnaires were filled in at home and returned to the school within 3 working days.

In the 13-14 year age group, in both surveys, a random sample including half of the secondary schools in Antwerp was approached. Field workers introduced the study to the children in a standardised manner and according to the ISAAC protocol. The fieldworkers supervised the children while filling in the questionnaire during one school lesson period.

Questionnaires

The translated versions of the validated ISAAC questionnaires for the two study groups included the complete set of ISAAC modules (core and environmental) regarding symptoms of asthma and allergies, other respiratory symptoms and several (environmental) risk factors. However, the 6-7 year olds in ISAAC I first received a screening questionnaire (core) after which a selected sample filled in the extended questionnaire, including all ISAAC phase I questions. Screening questionnaires were distributed for Phase I of the ISAAC in the 6-7 year olds between December 1994 and June 1996, one year later the random sample was approached for the extended questionnaire. Data collection in the 13-14 year olds was carried out from September 1995 to April 1996. Phase III of the ISAAC study was carried out from March to May 2002. Data were collected simultaneously in both age groups.

The outcome measures were obtained from core questions on the presence of wheezing, exercise induced wheeze, dry nocturnal cough, asthma, asthma medication, sneezing or a runny/blocked nose when the child did not have a cold or flu, itchy rash and eczema.

Analysis

All children aged >5 and <8 years were included in the analysis for the 6-7 year age group and >12 and <15 for the 13-14 year age group. Children without information on age or gender were excluded from further analysis. In order to detect time trends of symptoms of asthma and allergies in a culturally dynamic population (see also differences in non-Belgian population from 1996 to 2002), further analysis was restricted to participants of Belgian nationality; details of nationality were only included in the description of the population.

Prevalence estimates were calculated by dividing the number of positive answers by the total number of responders to a question. Questions answered as 'don't know' were regarded as negative answers.

Prevalence estimates were calculated for wheeze, nightly cough, exercise induced wheeze, asthma, asthma medication, rhinitis, rhino-conjunctivitis, hay fever, rash, and eczema. Unless specifically stated otherwise, described prevalences are 12 month (current) prevalences.

For each age group cross-tabulations of contingency tables were used to compare the two surveys. Prevalence odds ratios (POR) with 95% confidence intervals (95% CI) were calculated. Analysis was performed using SPSS 11.5 for Windows. Statistical significance was reached if $p<0.05$ or the 95% confidence interval of the odds ratio did not include 1.

RESULTS

6-7 year age group

A total of 137 primary and 44 secondary schools participated in the ISAAC 1996 survey (table 1). All initially selected schools were again invited to par-

Table 1: Descriptive statistics of the study population, numbers (%)

		6-7 year olds		13-14 year olds	
		ISAAC 1996	ISAAC 2002	ISAAC 1996	ISAAC 2002
Schools		137	123	44	37
	Centre	71 (51.8%)	62 (50.4%)	28 (63.6%)	22 (59.5%)
	South	66 (48.2%)	61 (49.6%)	16 (36.4%)	15 (40.5%)
Children	Total	5548	5448	2696	2711
Gender girl	Total	2797 (50.5%)	2604 (49.3%)	1307 (48.9%)	1406 (51.9%)

ticipate in the 2002 survey and 123 primary schools (of which 87% also participated in 1996) and 37 secondary schools (one refused) participated. Further differences in the number of schools participating in 1996 compared to 2002 were because of reorganisation and merging of schools.

In the primary schools 5548 children participated in 1996 of whom 1466 were included in the second random subsample and 5448 children were included in the ISAAC 2002 analysis. For the secondary school children 2696 participated in the 1996 sample and 2711 in the 2002 sample. The number of schools situated in the centre and the south of Antwerp was comparable in both surveys as was the gender ratio.

Overall response rates were 86% in 1996 and 78% in 2002 for the primary schools and 97% for both study periods in the secondary schools.

In ISAAC 1996 as well as ISAAC 2002 84% of the primary school children were of Belgian nationality. However, the composition of nationalities included in the non-Belgian group was different, with children of mainly Turkish and Moroccan descent in 1996 and mainly Eastern European descent in 2002. Of the 13-14 year old children 89% had Belgian nationality in ISAAC 1996 against 93% in ISAAC 2002. Again, the composition of the non-Belgian nationalities differed greatly between 1996 and 2002, which is why only Belgians were included in the analysis.

Table 2: Symptoms of wheeze, asthma, rhinitis and rash among 6-7 year old boys and girls in ISAAC 1 and 3 in Antwerp. Prevalence odds ratios (POR), 95% Confidence interval (CI) between brackets and corresponding p-values.

Antwerp, 6-7 year olds								
	Boys				Girls			
	1996	2002			1996	2002		
N	2313	2225			2359	2196		
	%	%	POR (95% CI)	p	%	%	POR (95% CI)	p
12m prevalence								
Wheeze	9.1	8.3	0.9 (0.7-1.1)	0.36	6.1	4.9	0.8 (0.6-1.0)	0.07
Night cough	16.8	15.1	0.9 (0.8-1.0)	0.13	14.4	15.4	1.1 (0.9-1.3)	0.33
Exercise induced wheeze	4.2	3.6	0.9 (0.6-1.2)	0.30	2.8	2.0	0.7 (0.5-1.1)	0.12
Asthma	2.2	2.7	1.3 (0.9-1.8)	0.24	1.4	1.8	1.3 (0.8-2.1)	0.26
Asthma medication	6.9	7.3	1.1 (0.8-1.3)	0.63	4.4	5.1	1.2 (0.9-1.5)	0.30
Rhinitis	16.6	17.8	1.1 (0.9-1.3)	0.25	13.9	14.3	1.0 (0.9-1.2)	0.70
Rhino-conjunctivitis	5.6	6.1	1.1 (0.9-1.4)	0.48	4.4	4.5	1.0 (0.8-1.3)	0.93
Rash	8.5	11.4	1.4 (1.1-1.7)	0.00	11.9	14.7	1.3 (1.1-1.5)	0.01
Lifetime prevalence								
Wheeze	23.7	22.2	0.9 (0.8-1.1)	0.21	17.0	15.4	0.9 (0.8-1.0)	0.15
Asthma	5.2	6.8	1.3 (1.0-1.7)	0.02	3.1	3.5	1.1 (0.8-1.6)	0.49
Asthma medication	16.7	22.7	1.5 (1.3-1.7)	0.00	11.1	16.3	1.6 (1.3-1.8)	0.00
Hay fever	5.0	5.2	1.0 (0.8-1.3)	0.81	3.6	3.7	1.0 (0.8-1.4)	0.81
Rash	12.9	18.4	1.5 (1.3-1.8)	0.00	15.7	19.8	1.3 (1.1-1.5)	0.00
Eczema	18.5	20.8	1.2 (1.0-1.3)	0.06	19.1	22.4	1.2 (1.1-1.4)	0.01

Table 3: Symptoms of wheeze, asthma, rhinitis and rash among 13-14 year old boys and girls in ISAAC 1 and 3 in Antwerp. Prevalence odds ratios (POR), 95% Confidence interval (CI) between brackets and corresponding p-values.

Antwerp, 13-14 year olds								
	Boys				Girls			
	1996	2002			1996	2002		
N	1240	1215			1150	1318		
	%	%	POR (95% CI)	p	%	%	POR (95% CI)	p
12m prevalence								
Wheeze	11.0	6.8	0.6 (0.4-0.8)	0.00	12.8	8.6	0.6 (0.5-0.8)	0.00
Night cough	18.7	15.2	0.8 (0.6-1.0)	0.02	23.1	18.7	0.8 (0.6-0.9)	0.01
Exercise induced wheeze	12.0	8.3	0.7 (0.5-0.9)	0.00	16.4	9.1	0.5 (0.4-0.7)	0.00
Asthma	4.7	3.1	0.7 (0.4-1.0)	0.05	3.9	3.9	1.0 (0.7-1.5)	0.97
Asthma medication	6.0	4.4	0.7 (0.5-1.0)	0.06	4.6	5.5	1.2 (0.8-1.7)	0.33
Rhinitis	36.6	39.4	1.1 (1.0-1.3)	0.15	39.0	44.2	1.2 (1.1-1.5)	0.01
Rhino-conjunctivitis	12.6	14.9	1.2 (1.0-1.5)	0.09	17.0	19.3	1.2 (1.0-1.4)	0.13
Rash	9.7	8.5	0.9 (0.7-1.1)	0.30	13.3	13.6	1.0 (0.8-1.3)	0.84
Lifetime prevalence								
Wheeze	18.7	14.5	0.7 (0.6-0.9)	0.01	19.7	16.2	0.8 (0.6-1.0)	0.02
Asthma	8.8	7.3	0.8 (0.6-1.1)	0.18	6.6	8.4	1.3 (1.0-1.8)	0.09
Asthma medication	11.0	9.5	0.8 (0.7-1.1)	0.22	7.9	11.1	1.5 (1.1-1.9)	0.01
Hay fever	17.8	19.8	1.1 (0.9-1.4)	0.20	19.0	20.6	1.1 (0.9-1.4)	0.30
Rash	15.7	13.3	0.8 (0.7-1.0)	0.09	19.0	20.3	1.1 (0.9-1.3)	0.39
Eczema	23.4	21.1	0.9 (0.7-1.1)	0.17	27.8	29.7	1.1 (0.9-1.3)	0.30

Table 2 and 3 give the prevalences of wheeze, asthma, rhinitis and rash among 6-7 and 13-14 year old Antwerp school children.

The prevalence of wheeze decreased in the 6-7 year old children, however, only significant in girls. Nightly cough decreased significantly for boys. Exercise induced wheeze did not show any difference from 1996 to 2002 in 6-7 year olds. For the 13-14 year olds, wheeze, nightly cough and exercise induced wheeze was significantly higher for boys and girls from 1996 to 2002. Similar conclusions could be made for lifetime prevalence of wheeze.

The prevalences of asthma and asthma medication did not change for 6-7 year old children or 13-14 year old girls. For 13-14 year old boys the prevalence was higher for both asthma and asthma medication from 1996 to 2002.

In 6-7 year old boys all respiratory symptoms (with the exception of nightly cough in 2002) have a higher occurrence in boys then in girls in both surveys. In 1996 only the prevalence of wheeze was lower in 13-14 year old boys compared to girls while asthma prevalence was much higher. In 2002 the prevalence of all respiratory symptoms was lower in 13-14 year old boys compared to girls.

Lifetime prevalence of asthma and asthma medication increased in all groups except for the 13-14 year old boys, probably in analogy with the decrease in the 12 month prevalence.

The prevalence of rhinitis and rhino-conjunctivitis in 13-14 year olds has risen significantly from 1996-2002. No differences were found for lifetime prevalence of hay fever between the two surveys. In the 6-7 year old age group, no differences were found in either current or lifetime rhinitis symptoms and hay fever.

Rash and (lifetime) eczema show a significant rise in prevalence for the 6-7 year olds. No differences were found in the older age groups.

Finally, no consistent differences in prevalences of symptoms could be detected between Antwerp Centre and Antwerp South in either age or gender group (results not shown).

DISCUSSION

Among Belgian 6-7 and 13-14 year old schoolchildren examined in two consecutive ISAAC surveys (1996 and 2002) the current prevalences of asthma and asthma medication did not show significant changes except in older boys. However, the prevalence of wheeze showed a decrease over the same period. Rhinitis showed a general increase which was significant in the older age groups while rash increased significantly from 1996 to 2002 in the younger age group.

The prevalence of wheeze decreased from 1996 to 2002, which was significant in the older age group. The severity profile, described in nightly cough and exercise induced wheeze, also decreased significantly in the 13-14 year old age group. Asthma and asthma medication increased in the 6-7 year old age group as well as in 13-14 year old girls, however not significantly, but decrease significantly from 1996 to 2002 in the older boys. The pattern seen here is different from the German study by Maziak et al. (8) which reported a clear increase in all asthma (including wheeze), rhinitis and eczema symptoms in each age and gender group and conclude that symptoms of asthma and allergies continue to show an increasing trend in their population. The homogenous increase of all symptoms (asthma and wheeze) in their population argues in favour of a genuine increase. A recent study from Hong Kong where the ISAAC study was repeated (1995-2001) for 6-7 year old school children no difference in wheeze or exercise induced wheeze was detected but nightly cough increased significantly. No results were given for current asthma in this group nor were the results presented separately for boys and girls.

In the Italian repeated survey (with the use of ISAAC questionnaires) among school children in Rome, no prevalences of wheeze were given, only of asthma. The authors of this paper do however conclude that the prevalence of asthma remained stable from 1992 to 1998 (9). Even though the different studies do use similar protocols and questionnaire, results are still difficult to compare as they are presented in different ways. The conclusion of the Italian study, no increase in asthma in schoolchildren, the Hong Kong study, an increase in asthma but not wheeze, and the German study, increase in asthma and wheeze, do not compare with our lack of general differences in the prevalence of asthma but overall decrease in prevalence of wheeze.

The increase in lifetime prevalence of asthma and asthma medication, but not wheeze, in Antwerp might lie in the increased public awareness, due to more media attention and the increased prescribing behaviour of asthma medication by doctors (10;11). Especially as this increase in prevalence of lifetime symptoms is not seen (and even reversed) in current symptoms, it supports the believe this reflects a change in diagnostic behaviour.

Concerning allergic disorders, a higher prevalence of current rhinitis symptoms in the 2002 survey compared to 1996 was found for all groups but only significant in the 13-14 year olds. The current prevalence of rash symptoms increased significantly in the 6-7 year olds but not in 13-14 year olds.

The occurrence of rhinitis symptoms, current and lifetime, can be influenced by a recall bias due to the season of questioning (12). ISAAC 2002 was carried from March to May 2002, this period lies within the period in which ISAAC 1996 was carried out (December to June for 6-7 year olds and September to April for 13-14 year olds). Even though this might have contributed to the increase between the two surveys, this increase is more than a seasonal effect as it differs between age groups and gender. Additionally, rash, which also has a seasonal component, does not show a similar pattern. The increase in rhinitis and rash seems therefore unlikely to be caused by seasonal differences. Interesting in the light of increasing prevalence of rhinitis is a recent study in Taiwan in which was shown that asthma would not increase with increasing air pollution but symptoms of rhinitis do (13). Additionally, a survey in East and West Germany(14) in which the prevalence of eczema was higher in East (17.5%) than West (11.4%) for preschool children, concluded that "environmental factors from the physical, chemical, biological, and psychological environment (characteristic of a 'modern' or 'western' society) do influence the development of eczema". These studies indicate a possible influence of air quality on the occurrence of allergic symptoms like rhinitis and rash. For rhinitis in the 6-7 year olds as well as for rash in 13-14 year olds, similar increasing trends can be detected for current and lifetime prevalence of symptoms. It was argued before that differences in respiratory diseases and asthma between Antwerp Centre and South were due to differences in air quality, but this was only confirmed for adults living in these regions and not for children. Also, the differences in rhinitis and rash were not further analysed. Besides dealing with relatively small geographic areas and interchangeable traffic between the areas for schooling

and living, it was suggested that the influence of air quality could be a result of an increasing effect over time. Further research into possible differences in air quality as well as accurate outcome measures in children between these areas has therefore been initiated.

The increased prevalence of rash for all groups except 13-14 year old boys corresponds with the higher prevalence of and increase in rash symptoms in girls already described in the 1996 survey (15). Additionally, wheeze, asthma and rhinitis had lower prevalences in 6-7 year old girls than boys which inversed by the age of 13-14 years. But, in contrast with the results of ISAAC 1996, a higher occurrence of asthma and asthma medication was reported by the 13-14 year old girls in 2002. Wieringa et al (16) suggested a possible underreporting of asthma symptoms in 13-14 year old boys in 1996. This higher prevalence of asthma in 13-14 year old boys in 1996 may also have resulted in a higher prescription rate of asthma medication for boys.

The reverse in gender ratio from childhood to adolescence has previously been described (17-19). The results of ISAAC 2002 in Antwerp are consistent with these findings: higher occurrence rates in 13-14 year girls than boys for all symptoms. The smaller differences between 13-14 year old boys and the consistency with international literature, might suggest an M in the results from 1996. The more pronounced increase in girls of the prevalence of wheeze, asthma, allergic rhinitis and atopic eczema compared to boys, as described by Maziak et al (20) in the German study, cannot be detected in the presented study.

In comparison with other recently published studies (21-27) in which the ISAAC questionnaires were used, the point prevalence from ISAAC 2002 for 6-7 year old boys and girls in Antwerp was generally lower or similar for all asthma-like, asthma and rhinitis symptoms, but higher for rash. For 13-14 year olds, the prevalence in Antwerp in 2002 was lower for asthma and asthma-like symptoms, similar or slightly higher for rhinitis symptoms and considerably higher (more than double) for rash. Similar results were obtained in the 1996 survey.

The ISAAC studies were designed as hypothesis generators (28) for possible risk factors of asthma and allergy as well as an instrument to detect time trends in the occurrence of asthma and allergy symptoms. This was made possible with repeated surveys, using international protocols and identical (standardised) questions. From the presented results it can be concluded that the prevalence of current asthma does not show clear trends even though an increase in the younger and decrease in the older age group could be recognised. The prevalence of symptoms of wheeze are however clearly decreasing in all groups. Asthma medication shows a tendency to increase over the past six years in all groups but the older boys. Prevalence of symptoms of rhinitis and rash are generally still increasing. Underlying patterns to explain the discrepancies between the groups need to be further explored.

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