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The changing prevalence of asthma, allergic rhinitis and atopic eczema in African adolescents from 1995 to 2002

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The prevalence of asthma and allergic disease in children has been increasing in developed countries, but there is little information on these trends in Africa. The aim of this study was to assess time trends in the symptoms of asthma, allergic rhinitis, and atopic eczema among South African adolescents. The study was carried out by comparing cross-sectional data from two International Study of Asthma and Allergies in Childhood (ISAAC phase I and phase III) questionnaire based surveys conducted 7 yr apart of self-reported symptoms in 13- to 14-yr-old adolescents. In both surveys, schools in the same geographical area in Cape Town, South Africa, were randomly selected. A school-based sample of 5178 (in 1995) and 5037 (in 2002) pupils participated. The 12-month prevalence of wheezing (16% vs. 20.3%), exercise-induced wheeze (21.5% vs. 32.5%), nocturnal cough (23.6% vs. 36.6%), sleep disturbance due to wheeze (9.6% vs. 16%), or severe wheeze (5.1% vs. 7.8%) increased significantly, as measured by the written questionnaire. A rise in asthma symptoms was confirmed by the video questionnaire responses, in which the 12-month prevalence of wheezing (6.5% vs.11.2%), exercise-induced wheeze (11.5% vs. 13.9%), nocturnal wheeze (3.9% vs. 5.3%), nocturnal cough (11.6% vs. 19.2%), or severe wheeze (5% vs. 7%) also increased significantly. There was a small increase in the percentage of children diagnosed with asthma from 1995 to 2002 (13.1% vs. 14.4%), this was not significant. The 12-month prevalence of symptoms of allergic rhinitis (30.4% vs. 38.5%), rhino-conjunctivitis (17.6% vs. 24.3%) and eczema (11.8% vs. 19.4%) also increased significantly. An increase in the prevalence of allergic symptoms occurred in girls and boys. Limitation of daily activity from nasal symptoms (22.3% vs. 37.8%) and sleep disturbance because of eczema (8.4% vs. 15.7%) increasingly affected quality of life on the quality of life. Symptoms of asthma, allergic rhinitis and atopic eczema in adolescents have increased over the past 7 yr in this geographical area. Allergic diseases are common in this group of adolescents and increasingly impair their quality of life.

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The prevalence of asthma and allergic disease has been reported to be stabilizing or declining in many developed countries, but increasing in developing nations (1–3). The rise in prevalence of these diseases in the developing world has been associated with a number of environmental factors including diet, reduced incidence of infectious diseases, increased exposure to indoor allergens, sedentary behaviour, rapid socio-economic development and increase in air pollution (4,5). South Africa is a nation with a heterogenous population with features found in both developed and developing countries, among whom urbanization and changes in traditional

diet and lifestyle are occurring which are likely to affect the prevalence of allergic diseases (6).

Measurement of the changing prevalence of allergic diseases has been hampered by methodological problems related to comparability and generalisability of results. The International Study of Asthma and Allergies in Childhood (ISAAC) has provided a reliable method for assessing time trends in asthma and allergies in children (7). Using standard written and video-promoted questionnaires, the prevalence of childhood asthma and allergies in different populations has been studied and compared. ISAAC phase I and phase III, using identical questionnaires performed a number of years apart, have enabled the investigation of time trends in the symptoms of asthma and allergic diseases (1,8). In this study, we report trends in the symptoms of asthma, allergic rhinitis and eczema over a 7 yr period among adolescents in Cape Town, South Africa.

Methods

A cross-sectional study using the standardised ISAAC written and video questionnaire was carried out in Cape Town, South Africa in 1995 (ISAAC phase I), and repeated 7 yr later in 2002 (ISAAC phase III).

Population

Schools within the Cape Town metropolitan area were selected by stratified random sampling in both surveys so as to achieve a representative spread of pupils across the area. The three strata comprised schools with predominantly black (Xhosa speaking) pupils, mixed-race (majority Afrikaans speaking) pupils and white pupils (now integrated to varying degrees). For both surveys, schools were randomly selected from the same geographical area. All pupils in the two grades with the highest proportion of 13–14 yr old in the selected schools were surveyed. Each school was visited twice so that eligible children who were absent at the first visit could be enrolled.

Data collection

Surveys were administered in a standardised way. The written questionnaire was completed first, followed by the video questionnaire. The video questionnaire contained five sequences portraying the symptoms of asthma as follows: wheezing at rest, exercise-induced wheeze, nocturnal wheezing, nocturnal cough and severe wheezing with shortness of breath. The questions refer to 'ever', 'in the past 12 months' and 'monthly or more often'. In both surveys, information was collected over a similar period of the year (February–September), i.e. from late summer to early spring. The questionnaire was administered in the predominant language used at the school – English, Afrikaans or Xhosa. Translation of the English version of these questionnaires into Afrikaans and Xhosa was validated by back translation.

The studies were approved by the Research and Ethics committee of the University of Cape Town, South Africa. In ISAAC phase I, informed consent from a parent was obtained. In ISAAC phase III, informed consent from a parent as well as from each participant was obtained. Consent was also obtained from the Department of Education, Western Cape and from the principal of each school.

Statistical analysis

The data were analysed using Epi-Info version 6.04 (Centres for Disease Control, Atlanta, USA). Subjects were excluded if they were not aged 13–14 yr or if all core asthma, rhinitis and eczema questions were omitted. Prevalences were calculated by dividing positive responses by number of completed questionnaires. Prevalence differences were examined by using odds ratios and 95% confidence intervals. Comparison of prevalences between ISAAC phase I and phase III and by gender was done.

Results

In the 1995 ISAAC I survey, 6291 pupils from 33 schools were surveyed; 5178 completed the questionnaire. In the 2002 ISAAC III survey, there were 53 schools represented by 6036 pupils of whom 5037 responded. Gender data were available for 5161 respondents (2088, 40% male) in ISAAC phase I and for 5019 children (2025, 40.2% male) in ISAAC phase III.

Prevalence of symptoms of asthma by written questionnaire

The lifetime (33.1%) and 12-month (20.3%) prevalence of wheezing in 2002, increased significantly from 1995 (27.7% and 16% respectively). Similarly, the 12-month prevalence of night waking with wheeze, severe wheezing, exercise-induced wheeze and nocturnal cough all increased significantly from 1995 to 2002 (Table 1). The lifetime prevalence of asthma diagnosis increased from 1995 (13.1%) to 2002 (14.4%).

Table 1. Prevalence (n, %) of asthma symptoms and diagnosis by written questionnaire among South African adolescents, 1995 and 2002

	1995 (ISAAC I) n = 5178	2002 (ISAAC III) n = 5037	OR (95% CI)
Wheeze ever	1435 (27.7)	1670 (33.1)	*1.29 (1.19–1.41)
Wheezing last 12 months	833 (16.0)	1025 (20.3)	*1.33 (1.2–1.48)
Sleep disturbed by wheezing in last 12 months	499 (9.6)	806 (16.0)	*1.79 (1.58–2.02)
Severe attack of wheezing limiting speech, last 12 months	264 (5.1)	395 (7.8)	*1.58 (1.34–1.87)
Exercise-induced wheeze, last 12 months	1111 (21.5)	1641 (32.5)	*1.77 (1.62–1.93)
Night cough, last 12 months	1222 (23.6)	1846 (36.6)	*1.87 (1.72–2.04)
Diagnosis of asthma ever	678 (13.1)	725 (14.4)	1.12 (1.0–1.25)

*$p < 0.001$.

Table 2. Prevalence (n, %) of asthma symptoms by video questionnaire among South African adolescents, 1995 and 2002

	1995 (ISAAC I)	2002 (ISAAC III)	OR (95% CI)
Wheeze			
Ever	537 (10.3)	840 (16.9)	*1.75 (1.55–1.97)
Last 12 months	338 (6.5)	559 (11.2)	*1.8 (1.56–2.08)
At least monthly	222 (4.3)	351 (7.0)	*1.69 (1.41–2.01)
Exercise wheeze			
Ever	979 (18.9)	1070 (21.3)	**1.17 (1.06–1.29)
Last 12 months	593 (11.5)	692 (13.9)	*1.24 (1.1–1.4)
At least monthly	437 (8.4)	466 (9.4)	1.12 (0.97–1.28)
Nocturnal wheeze			
Ever	377 (7.3)	459 (9.2)	*1.29 (1.12–1.49)
Last 12 months	200 (3.9)	265 (5.3)	*1.39 (1.15–1.69)
At least monthly	179 (3.5)	194 (3.9)	1.13 (0.91–1.4)
Nocturnal cough			
Ever	1038 (20.1)	1501 (30.1)	*1.71 (1.56–1.88)
Last 12 months	599 (11.6)	957 (19.2)	*1.81 (1.62–2.03)
At least monthly	436 (8.4)	620 (12.5)	*1.54 (1.35–1.76)
Severe wheeze			
Ever	489 (9.4)	603 (12.1)	*1.32 (1.16–1.5)
Last 12 months	260 (5.0)	347 (7.0)	*1.41 (1.19–1.67)
At least monthly	225 (4.3)	216 (4.3)	0.99 (0.82–1.21)

*$p < 0.001$, **$p = 0.001$.

Table 3. Prevalence (n, %) of rhinoconjunctivitis and atopic eczema among South African adolescents, 1995 and 2006

	1995 (ISAAC I)	2002 (ISAAC III)	OR (95% CI)
Rhinitis			
Ever	1944 (37.6)	2466 (49)	*1.6 (1.47–1.73)
Last 12 months	1569 (30.4)	1939 (38.5)	*1.44 (1.33–1.56)
Rhinoconjunctivitis in last 12 months	910 (17.6)	1223 (24.3)	*1.5 (1.36–1.66)
Impact on daily activities			
Little	671 (13)	1321 (26.2)	*2.39 (2.15–2.65)
Moderate/severe	480 (9.3)	588 (11.6)	*1.29 (1.14–1.47)
Diagnosis of hayfever ever	1505 (29.1)	2088 (41.5)	*1.73 (1.59–1.88)
Eczema			
Itchy rash ever	802 (15.5)	1318 (26.2)	*1.93 (1.75–2.14)
Itchy rash in last 12 months	618 (11.8)	975 (19.4)	*1.77 (1.56–1.97)
Flexural rash	525 (10.2)	832 (16.5)	*1.75 (1.56–1.97)
Night waking			
Less than one time/wk	255 (4.9)	499 (9.9)	*2.12 (1.81–2.49)
More than one time/wk	181 (3.5)	292 (5.8)	*1.7 (1.4–2.06)
Diagnosis of eczema ever	498 (9.6)	839 (16.7)	*1.88 (1.67–2.12)

*$p < 0.001$.

Prevalence of symptoms of asthma by video questionnaire

There was a significant increase in the monthly, 12-month and lifetime prevalence of wheeze from 1995 to 2002 as measured by the video questionnaire (Table 2). The 12-month prevalence of exercise-induced wheeze also increased. Nocturnal symptoms including night waking with wheeze and nocturnal cough increased substantially as measured by 12-month and lifetime prevalence of these symptoms. In addition, a significant increase in the 12-month and lifetime prevalence of severe wheezing was found.

Prevalence of symptoms of allergic rhinitis by written questionnaire

The lifetime prevalence of allergic rhinitis symptoms increased significantly from 1995 (37.6%) to 2002 (49%) (Table 3). The 12-month prevalence of allergic rhinitis or rhinoconjunctivitis also increased over this time. Diagnosis of hayfever increased over this period, with 29.1% reporting this in 1995 compared with 41.5% in 2002. Symptoms of allergic rhinitis were reported to have a substantial impact on daily activities with the prevalence of both mild and moderate severe limitation increasing substantially from 1995 to 2002.

Prevalence of symptoms of atopic eczema by written questionnaire

The prevalence of all self-reported symptoms of eczema increased significantly from 1995 to 2002. In addition, symptoms of eczema were reported to result more frequently in disturbed sleep, with night waking more than once a week reported by 3.5% and 5.8% in 1995 and 2002 respectively (Table 3). The lifetime prevalence of a diagnosis of eczema also increased significantly from 9.6% in 1995 to 16.7% in 2002.

Table 4. Time trends in the prevalence (n, %) of asthma, allergic rhinitis or eczema by gender on written questionnaire

	Boys			Girls		
	1995 (n = 2088)	2002 (n = 2025)	OR (95%CI)	1995 (n = 3073)	2002 (n = 2994)	OR (95%CI)
12 month prevalence of asthma symptoms						
Wheeze	324 (15.5)	396 (19.6)	*1.32 (1.12–1.56)	505 (16.4)	626 (20.9)	*1.34 (1.18–1.53)
Sleep disturbance by wheeze	190 (9.1)	392 (19.4)	*2.4 (1.98–2.9)	307 (10)	601 (20.1)	*2.26 (1.95–2.63)
Severe attack wheeze, limiting speech	110 (5.2)	153 (7.6)	**1.47 (1.13–1.91)	115 (5.1)	239 (8)	*2.23 (1.76–2.82)
Exercise-induced wheeze	420 (20)	629 (31.1)	*1.79 (1.55–2.0)	686 (22.3)	1007 (33.6)	*1.76 (1.57–1.98)
Night cough	456 (21.8)	687 (33.9)	*1.84 (1.6–2.12)	762 (24.8)	1152 (38.5)	*1.9 (1.7–2.12)
12 month prevalence of rhinitis symptoms						
Rhinitis	582 (27.9)	735 (36.3)	*1.47 (1.29–1.69)	987 (32)	1198 (40)	*1.41 (1.27–1.57)
Rhinoconjunctivitis	279 (13.4)	417 (20.6)	*1.68 (1.42–1.99)	631 (20.5)	803 (26.8)	*1.42 (1.26–1.6)
12 month prevalence of eczema symptoms						
Itchy rash	192 (9.2)	313 (15.5)	*1.81 (1.48–2.2)	418 (13.6)	658 (22)	*1.79 (1.56–2.05)
Lifetime diagnosis						
Asthma	292 (14)	299 (14.8)	1.07 (0.89–1.27)	396 (12.8)	422 (14.1)	1.11 (0.95–1.29)
Hayfever	524 (25)	728 (36.0)	*1.68 (1.46–1.92)	981 (31.9)	1357 (45.3)	*1.77 (1.59–1.97)
Eczema	158 (7.6)	274 (13.5)	*1.91 (1.55–2.36)	340 (11.1)	559 (18.8)	*1.85 (1.59–2.14)

*$p < 0.001$; **$p = 0.003$.

Prevalence of asthma, allergic rhinitis and atopic eczema by gender

The 12-month point prevalence of asthma symptoms (wheezing, night waking with wheeze, severe wheezing, exercise-induced wheeze and nocturnal cough), rhinitis and eczema as measured by using the written questionnaire, increased from 1995 to 2002 in both boys and girls (Table 4) An increase in the 12-month prevalence of wheeze and nocturnal cough was confirmed in both groups by using the video questionnaire (Table 5). In addition, girls showed a significant increase in the 12-month prevalence of exercise-induced wheeze, nocturnal wheeze and severe wheeze as measured by the video questionnaire.

Discussion

This study has shown a rising prevalence over a 7 yr period in the symptoms of asthma, allergic rhinitis and atopic eczema in South African adolescents. There has been little previous information on time trends in allergic disease in developing countries. This is one of the first African studies to document an increase in the prevalence of allergic disease and its impact on daily living among adolescents using standardised ISAAC methodology. A number of South African studies have measured asthma prevalence among children; however, different methods and populations have made comparison of results difficult (9–11). The use of identical methodology in both ISAAC surveys and careful adherence to the study protocol makes a valid comparison over time possible.

One concern about questionnaire-based surveys is the possible impact of increased public awareness or diagnostic labelling on the prevalence of measured disease (12). However, we believe that the reported increase in allergic symptoms surveyed reflects a real increase in their prevalence and morbidity. Firstly, a consistent rise in prevalence was observed for all three conditions. Secondly, the observed increase in asthma symptoms was consistent for different symptoms and was reported both for the written and video responses and in both genders. Finally, an increase in diagnostic labelling of respiratory symptoms as asthma is unlikely, given that the increase in the percentage of children diagnosed as having asthma in 2002 compared with the situation 7 yr previously was smaller than for symptoms with a 95% confidence interval including unity i.e. no change.

The prevalence of asthma, allergic rhinitis or atopic eczema symptoms reported in Cape Town in 1995 and in 2002 was similar to, or higher than the global or overall African prevalence rates reported for ISAAC phase I and phase III respectively (1,7,13,14). The increased prevalence reported in 2002 represents a large burden of disease with associated morbidity. The burden of allergic diseases may be especially under appreciated in developing countries where health systems are overwhelmed by infectious diseases and by the human immunodeficiency virus epidemic. Nevertheless, this study suggests that in a developing country like South Africa, allergic diseases are highly prevalent, increasing and produce substantial morbidity. Moreover, recent estimates from the Global Burden of Asthma

Table 5. Time trends in the 12 month prevalence (n, %) of asthma symptoms by gender on video questionnaire

	Boys			Girls		
	1995 (n = 2088)	2002 (n = 1994)	OR (95%CI)	1995 (n = 3073)	2002 (n = 2969)	OR (95%CI)
Wheeze	112 (5.4)	185 (9.3)	*1.8 (1.4–2.32)	225 (7.3)	374 (12.6)	*1.82 (1.53–2.18)
Exercise-induced wheeze	229 (11)	253 (12.7)	1.18 (0.97–1.43)	363 (11.8)	438 (14.7)	*1.29 (1.11–1.5)
Nocturnal wheeze	76 (3.6)	92 (4.6)	1.28 (0.93–1.77)	124 (4.0)	173 (5.8)	**1.47 (1.15–1.88)
Nocturnal cough	184 (8.8)	254 (12.7)	*1.51 (1.23–1.86)	414 (13.5)	703 (23.7)	*1.99 (1.74–2.28)
Severe wheeze	89 (4.3)	107 (5.4)	1.27 (0.95–1.72)	170 (5.5)	240 (8.1)	*1.5 (1.22–1.85)

*$p < 0.001$; **$p = 0.001$.

report suggest an extremely high asthma mortality rate in South Africa. Although South Africa was ranked 25th worldwide in the prevalence of clinical asthma, it ranked fourth in asthma mortality among the 5- to 34-yr-old age group and fifth for asthma case fatality rates with an estimated rate of 18.5 per 100,000 asthmatics (15). Cross-sectional surveys of the prevalence of allergic disease in other English speaking African countries using the ISAAC methodology have confirmed high rates of asthma, allergic rhinitis and eczema among school children, particularly in urban areas (16–18).

There are many possible reasons for the increase in prevalence of allergic disease in this population over this period. The children in the study are from diverse socio-economic, racial and cultural backgrounds. Changes in diet, environmental influences and patterns of lifestyle have been associated with the global increase in allergic disease (4,5). Prior studies have shown an association between socio-economic status and allergic symptoms in children of Cape Town (13,14). The children enrolled in this study represent a spectrum from long urbanized to urbanizing populations. Children in populations undergoing social change may represent a group who are particularly vulnerable to the development of asthma, allergic rhinitis or eczema symptoms, as has been reported before in this population (13). A number of factors including exposure to new or high concentrations of allergens, pollution exposure, a decline in infectious diseases, changes in diet and lifestyle and improved education and literacy have been suggested as possible explanations (6). Further study of the factors associated with the observed increase in prevalence of allergic disease in this study population is currently in progress.

One of the striking findings of this study was the high and increased impact that allergic symptoms have on the quality of life. In the 2002 survey, 26% of the respondents reported that symptoms of rhinitis affected their daily activities a little, while 12% reported moderate impairment. Furthermore, approximately 6% of children reported night waking more than once a week because of the symptoms of eczema. The high prevalence of symptoms suggest underdiagnosis, over-reporting or inadequate treatment of these conditions. Although diagnosis of allergic rhinitis and eczema had increased among respondents over the 7 yr period, severity of symptoms and impairment of daily lives had also increased, suggesting inadequate treatment of these conditions. The effect of uncontrolled symptoms may adversely affect the quality of learning that such children are able to achieve.

The study, by using self-reported symptoms as a measure of disease, has some limitations. No objective measures of allergic disease were made. Cultural and language differences may limit the use and interpretation of specific terms such as 'asthma' or 'wheezing' (19). In the South African study, questionnaires were translated and conducted in three languages; nevertheless, translations for some of the terms and cultural understanding of symptoms may have influenced the response. However, use of the video questionnaire which was completed by almost all participants, should have obviated many of the language difficulties. The study was done in Cape Town, an urban centre in South Africa, and the results may, therefore, not be generalisable to other geographical areas particularly rural settings. Nevertheless, cross-sectional surveys of asthma prevalence in South Africa confirm an increasing and high prevalence in both urban and rural areas (9–11). Finally, the study measured changes in prevalence over a relatively short time period of 7 yr. Nevertheless, this was the average time period for the global time trends report (1) and the consistent increase in all three categories of allergic disease for both genders suggest a real increase in the burden of these diseases.

Conclusion

The prevalence of asthma, allergic rhinitis and eczema is increasing among South African

adolescents living in Cape Town. These diseases have a significant impact on the quality of the daily lives of these adolescents. Continued research of the factors responsible for the rise in prevalence is warranted. Greater awareness of the prevalence and impact of these diseases is needed for effective diagnosis and therapy.

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