Prevalence of symptoms of asthma, rhinitis and eczema in 13- to 14-year-old children in Africa: the International Study of Asthma and Allergies in Childhood Phase III


1International Union Against Tuberculosis and Lung Disease, Paris, France (ISAAC Regional Coordinator for Africa "French-speaking" countries); 2CDC/GAP, Nairobi, Kenya (ISAAC Regional Coordinator for Africa "English-speaking" countries); 3Centre for Public Health Research, Massey University, Wellington, New Zealand (ISAAC Executive Committee); 4University Hospital of Lome, Togo (ISAAC Principal Investigator Lome (Togo)); 5EPAR, U707 INSERM, Paris, France; UMR-S 707 UPMC Paris 6, Paris, France; Medical School St-Antoine National coordinator, Reunion Island (Reunion Island); 6Centre Hospitalo Universitaire Mustapha, Algiers, Algeria (Principal Investigator Algiers (Algeria)); 7Centre Hospitalo Universitaire, Casablanca, Morocco (Principal Investigator Benelouane, Bouhme, Casablanca, Marrakech (Morocco)); 8National Tuberculosis Program, Kinshasa, Democratic Republic of Congo (ISAAC National Coordinator Kinshasa (Democratic Republic of Congo)); 9Centre Hospitalo Universitaire Ignace Deen, Conakry, Guinea (ISAAC National Coordinator Conakry (Guinea)); 10DRASS, St Denis, [Principal Investigator, Reunion Island] (National Coordinator Reunion Island (Sudan)); 11Epilab Director, AMST, EPILAB, Khartoum (Sudan) (National Coordinator Khartoum (Sudan)); 12Department of Child Health and Paediatrics, Moi University [Principal Investigator Eldoret (Kenya)]; 13Hôpital Regional de Port-Gentil, Port-Gentil, Gabon [Principal Investigator Port Gentil (Gabon)]; 14Department of Internal Medicine, Faculty of Medicine, Addis Ababa University, Ethiopia (Principal Investigator Addis Ababa (Ethiopia)); 15Faculty of Medicine, National Ribat University [Principal Investigator Khartoum (Sudan)]; 16Centres for Disease Control & Prevention (CDC) [Principal Investigator Nairobi (Kenya)]; 17Department of Medicine, University College Hospital [Principal Investigator Ibadan (Nigeria)]; 18Faculty of Medicine, National Ribat University [Principal Investigator Khartoum (Sudan)]; 19Centre Hospitalo Universitaire, Sousse, Tunisia (Principal Investigator Sousse); 20Centre Hospitalo Universitaire, Kinshasa [Principal Investigator Kinshasa (Democratic Republic of Congo)]; 21Hopital de Cocody, Abidjan, Ivory Coast (Principal Investigator Urban Ivory Coast); 22Hopital d'Enfants, Tunis Jebbari, Tunisia (Principal Investigator Grand Tunis); 23Hôpital Jamot, Yaounde, Cameroon (Principal Investigator Yaounde); 24Centre Hospitalo Universitaire, Brazzaville, Congo (ISAAC Principal Investigator Brazzaville); 25Department of Environmental and Occupational Health, School of Health Systems and Public Health, University of Pretoria, South Africa; 26Centre Hospitalo Universitaire Ignace Deen, Conakry, Guinea (ISAAC National Coordinator Conakry (Guinea)); 27Centre Hospitalo Universitaire, Lome, Togo (ISAAC National Coordinator Lome); 28Red Cross Children's Hospital, University of Cape Town (Principal Investigator Cape Town), Cape Town, South Africa

Phase I of the International Study of Asthma and Allergies in Childhood has provided valuable information regarding international prevalence patterns and potential risk factors in the development of asthma, allergic rhinoconjunctivitis and eczema. However, in Phase I, only six African countries were involved (Algeria, Tunisia, Morocco, Kenya, South Africa and Ethiopia). Phase II, conducted 5–6 years later, enrolled 22 centres in 16 countries including the majority of the centres involved in Phase I and new centres in Morocco, Tunisia, Democratic Republic of Congo, Togo, Sudan, Cameroon, Gabon, Reunion Island and South Africa. There were considerable variations between the various centres of Africa in the prevalence of the main symptoms of the three conditions: wheeze (4.0–21.5%), allergic rhinoconjunctivitis (7.2–27.3%) and eczema (4.7–23.0%). There was a large variation both between countries and between centres in the same country. Several centres, including Cape Town (20.3%), Polokwane (18.0%), Reunion Island (21.5%), Brazzaville (19.9%), Nairobi (18.0%), Urban Ivory Coast (19.3%) and Conakry (18.6%) showed relatively high asthma symptom prevalences, similar to those in western Europe. There were also a number of centres showing high symptom prevalences for allergic rhinoconjunctivitis (Cape Town, Reunion Island, Brazzaville, Eldoret, Urban Ivory Coast, Conakry, Casablanca, Wilays of Algiers, Sousse and Eldoret) and eczema (Brazzaville, Eldoret, Addis Ababa, Urban Ivory Coast, Conakry, Marrakech and Casablanca).

The high burden of infectious diseases and particularly tuberculosis, AIDS and malaria in Sub-Saharan African countries where resources are scarce, has meant that asthma has not been considered as a health priority by governments, research funders and researchers. In addition, previous studies in Africa (1–11), based on limited and noncomparable methods, have generally indicated that asthma prevalence was relatively low in the majority of countries. The first random population survey conducted in adults using the same methodology within several centres in Europe and two centres in developing countries (Bombay and Algeria) showed large variation of asthma prevalence with the highest prevalence in industrialized countries. However, Bombay and Algiers showed similar asthma symptom prevalence to that observed in some European centres (12). Phase I of the International Study of Asthma and Allergies in Childhood (ISAAC) was conducted worldwide in 156 centres in 56 countries used standardized methodology (13). The use of a rigorous but simple methodology enabled investigators from developing countries to participate, including eight centres from six countries in Africa (14). A large variation of the prevalence of asthma, rhinoconjunctivitis and eczema symptoms within countries and within centres was observed (15–19), and the prevalence of symptoms found in the eight Africa centres was similar to that...
in many of the European centres.

The aims of ISAAC Phase III, conducted 6–7 years later using the same questionnaires and the same methodology as Phase I, were to estimate time trends (in those centres that had conducted to Phase I survey), and to include additional centres to yield a more complete world map of symptoms of asthma, rhinoconjunctivitis and eczema. An environmental questionnaire was added to investigate the role of a number of potential risk factors. Phase III has included a number of new centres in Africa, including new centres in Morocco, Tunisia, Democratic Republic of Congo, Togo, Sudan, Cameroon, Gabon, Reunion Island and South Africa. These centres are located in some of the poorest countries of the world and the findings are therefore of considerable interest globally, as well as within Africa. In this study, we present the new African maps for the prevalence of symptoms of asthma, rhinoconjunctivitis and eczema.

Methods

The methodology of ISAAC Phase III has been described elsewhere (19) and the core questionnaire used was detailed in the previous ISAAC Phase I publications (14-18). The ISAAC Phase III study involved both centres that had participated in Phase 1 (Phase IIIA centres) and 'Late Phase I' centres that conducted the survey too late to be included in the Phase I analysis. It also included new centres that had not previously participated (Phase IIIB centres). It was specified that each centre should involve a random sample of at least 3000, 13- to 14-year-old children, with the option of also recruiting 3000 6- to 7-year-old children.

Participating centres

The ISAAC Phase III study conducted in Africa, was coordinated by two regional coordinators - one for francophone Africa (Nadia Ait-Khaled) and one for Anglophone Africa (Joseph Odhiambho). Three types of centres are included.

• Phase IIIA centres: Five 'English-speaking' centres (Addis Ababa in Ethiopia, Nairobi and Eldoret in Kenya, Cape Town in South Africa, Ibadan in Nigeria), and four 'French-speaking' centres (Algiers in Algeria, Sousse in Tunisia, Casablanca and Marrakech in Morocco).

• Late Phase I centres: One 'French-speaking' centre (Conakry in Guinea).

• Phase IIIB centres: One 'English-speaking' centre (Polokwane in South Africa), and 11 'French-speaking' centres (Kinshasa in Republic Democratic of Congo, Lome in Togo, Khartoum in Sudan, Brazzaville in Congo, Yaounde in Cameroon, Port Gentil in Gabon, Reunion Island, Grand Tunis in Tunisia, Boulmene and Beni Slimane in Morocco, Urban Ivory Coast in Ivory Coast).

Thus, the study involved a total of 22 centres in 16 countries. The survey involved selecting a defined geographical area and taking a random sample of school children from that area. In most cases, these were urban centres. However, in Morocco a range of different geographic environments was chosen: two big cities (Casablanca and Beni Slimane), one centre in the desert (Marrakech) and one centre located in a rural area (Boulmene; 20). In Tunisia only one centre was included in Phase I and another centre located in the capital was also included in Phase III (21). In Kenya and in South Africa other centres than the capital were involved (Eldoret and Polokwane). Reunion Island has a total different environment because it is an island, with a relatively higher standard of living as a 'French overseas department'.
Table 1. Characteristics of participating centres ISAAC Phase III in Africa and response rates for children 13–14 year olds (written questionnaire)

<table>
<thead>
<tr>
<th>Countries (centres)</th>
<th>Period of data collection</th>
<th>Principal Investigator</th>
<th>Sampling frame</th>
<th>Number of schools</th>
<th>Selection of children</th>
<th>Number of grades/levels or years of age selected</th>
<th>Number of participants [response rate (%)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algeria</td>
<td>April–May 2002</td>
<td>Badia Benhabyles</td>
<td>A random sample of middle schools in Algiers Department. The sampling frame is exactly the same as the sampling frame in Phase I</td>
<td>20</td>
<td>Grade/level</td>
<td>1</td>
<td>4203 (89.6)</td>
</tr>
<tr>
<td>Cameroon</td>
<td>May 2003</td>
<td>C. Kuaban</td>
<td>All secondary and high schools in the Bafoussam Municipality</td>
<td>12</td>
<td>Grade/level</td>
<td>3</td>
<td>2383 (96.6)</td>
</tr>
<tr>
<td>Congo Brazzaville</td>
<td>November 2002–March 2003</td>
<td>J. M'Boussa</td>
<td>Some schools in Brazzaville region</td>
<td>16</td>
<td>Age group</td>
<td>1</td>
<td>1012 (87.3)</td>
</tr>
<tr>
<td>Ivory Coast Urban</td>
<td>May–June 2001</td>
<td>N. B. Koffi</td>
<td>All children in the schools except white children</td>
<td>9</td>
<td>Age group</td>
<td>3</td>
<td>3342 (82.5)</td>
</tr>
<tr>
<td>Ethiopia Addis Ababa</td>
<td>June 2003</td>
<td>K. Melaku</td>
<td>All schools in the city of Addis Ababa, the same sampling frame as Phase I</td>
<td>28</td>
<td>Grade/level</td>
<td>1</td>
<td>3195 (96.8)</td>
</tr>
<tr>
<td>Gabon Port-Gentil</td>
<td>May 2002–June 2003</td>
<td>I. E. Hypolite</td>
<td>All secondary schools and primary schools except one secondary and one primary schools where white children were the majority</td>
<td>21</td>
<td>Age group</td>
<td>2</td>
<td>3166 (78.7)</td>
</tr>
<tr>
<td>Kenya Eldoret</td>
<td>February–April 2001</td>
<td>F. O. Esamai</td>
<td>All schools in Aiwikoi, Kapsaret and Kessas Divisions in Uasin Gishu District. The same sampling frame as Phase I</td>
<td>72</td>
<td>Age group</td>
<td>2</td>
<td>3238 (100.0)</td>
</tr>
<tr>
<td>Nairobi</td>
<td>February–March 2001</td>
<td>L. Ng'ang'a</td>
<td>All Public schools under the jurisdiction of the school Board of the Nairobi City Council. The same sampling frame as Phase I</td>
<td>15</td>
<td>Grade/level</td>
<td>2</td>
<td>3023 (99.7)</td>
</tr>
<tr>
<td>Morocco Benslimane</td>
<td>November 1999</td>
<td>Z. Bouhayad</td>
<td>All junior high schools of Benslimane (which is a rural area)</td>
<td>5</td>
<td>Age group</td>
<td>2</td>
<td>1008 (100.0)</td>
</tr>
<tr>
<td>Boulme Casablanca</td>
<td>January–March 2002</td>
<td>Z. Bouhayad</td>
<td>All Junior High Schools in Bouleme</td>
<td>9</td>
<td>Age group</td>
<td>2</td>
<td>1254 (100.0)</td>
</tr>
<tr>
<td>Marrakech</td>
<td>February 2002</td>
<td>Z. Bouhayad</td>
<td>Some schools in Casablanca. The same sampling frame was used for both Phase I and Phase III</td>
<td>13</td>
<td>Age group</td>
<td>2</td>
<td>1777 (100.0)</td>
</tr>
<tr>
<td>Nigeria Ibadan</td>
<td>May 2001–June 2002</td>
<td>B. O. Ondeko</td>
<td>All secondary schools in Ibadan.</td>
<td>23</td>
<td>Grade/level</td>
<td>2</td>
<td>3142 (99.7)</td>
</tr>
<tr>
<td>Guinea Conakry</td>
<td>September 1996–December 1997</td>
<td>O. Sow</td>
<td>Public and Private schools in Conakry</td>
<td>44</td>
<td>Age group</td>
<td>2</td>
<td>3115 (96.1)</td>
</tr>
<tr>
<td>Democratic Republic of Congo Kinshasa Reunion Island</td>
<td>May 2003</td>
<td>I. Annesi Maesano,</td>
<td>Schools that had 13- to 14-year-old pupils</td>
<td>73</td>
<td>Age group</td>
<td>2</td>
<td>2330 (92.9)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Random sample of state junior high schools. Private junior high schools were not included</td>
<td>37</td>
<td>Grade/level</td>
<td>2</td>
<td>2362 (78.1)</td>
</tr>
</tbody>
</table>
Questionnaires

The ISAAC written questionnaire for the 13- to 14-year-old age group, was self-completed at school. The key question used for assessing asthma symptom prevalence ('current wheeze') was: ‘Have you had wheezing or whistling in the chest in the last 12 months?’ Asthma severity was assessed by three questions relating to symptoms in the last 12 months: the number of attacks of wheezing; sleep disturbed due to wheezing and wheezing severe enough to limit speech. The rhinitis questionnaire involved six questions; allergic rhinoconjunctivitis was defined by positive answers to two questions; ‘Have you had problems with sneezing or a runny or blocked nose when you did not have a cold or the flu in the last 12 months’? If yes, ‘Was this problem accompanied by itchy-watery eyes’? The question on ‘hayfever’ was not used, because of likely differences in diagnosis between countries; in particular this terminology is rarely used even by doctors and the pollen seasons are not very clear. Three key questions were used to assess the prevalence of eczema: ‘Have you ever had an itchy rash which was coming and going for at least 6 months?’ If yes: ‘Have you ever had this itchy rash at any time in the last 12 months’? If yes: ‘Has this itchy rash at any time affected any of the following places: the folds of the elbows, behind the knees, in front of the ankles, under the buttocks or around the neck, ears or eyes?’

The ISAAC Asthma Video Questionnaire showed five scenes of adolescents and adults with asthma symptoms: wheezing at rest, wheezing with exercise, waking with wheeze, waking with cough and a severe asthma attack. For each of the scenes, students were asked whether their breathing had ‘ever’ been like this. If yes: ‘in the last year’? If yes: ‘in the last month’?

Among ‘French-speaking Africa’, the centres used a French questionnaire already validated by a back-translation and used during Phase I in France and in Africa, except for the four centres of Morocco, and the centres of Tunisia and Khartoum (Sudan) which translated the English questionnaires into Arabic. The translation was underwent by bilingual local health workers and back-translated into English independently.. Among ‘English-speaking centres’, two in South Africa used the English original version and two added a validated questionnaire in local languages (Afrikaans and Xhosa in Cape Town; Africaans and North Sotho in Polokwane).
Ethical issues

In all centres the investigators obtained authorization from the Ministry of Health and from the Ministry of Education to conduct the study as well as the consent of the directors of schools. In the majority of countries, in absence of an ethics committee, agreement was obtained from the authorities of the investigators’ institutions (University or Hospital). Letters to parents were distributed via schools where appropriate and parents were requested to contact the school only if they did not wish their children to participate - no contact or action from the parents was to be taken as passive consent.

Data collection

All countries had a training session for the local health staff who were to be directly involved with the
implementation of the study. Data collection was carried out by local investigators under the guidance of the Regional Coordinator. Prior to the actual survey date, further visits to the schools served as final preparations to ascertain a manageable number of students per session as well as ensuring appropriate facilities for conducting the survey. Usually the survey was based on a random sample of schools in each centre, except for a few centres that conducted the survey in all schools (Table 1).

Table 3. Prevalence of symptoms of asthma (current wheeze and severe symptoms of asthma), rhinoconjunctivitis and eczema in the past 12 months in Africa, children 13–14 year olds (written questionnaire)

<table>
<thead>
<tr>
<th>Centre</th>
<th>Current wheeze, N (%)</th>
<th>Current symptoms of severe asthma, N (%)</th>
<th>Current symptoms of rhinoconjunctivitis, N (%)</th>
<th>Current symptoms of eczema, N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Africa (French speaking)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Algeria</td>
<td>367 (8.7)</td>
<td>69 (1.6)</td>
<td>871 (20.7)</td>
<td>275 (6.5)</td>
</tr>
<tr>
<td>Wilaya of Algiers (west Algiers)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cameroon</td>
<td>169 (5.7)</td>
<td>46 (1.5)</td>
<td>264 (8.9)</td>
<td>215 (7.2)</td>
</tr>
<tr>
<td>Yaoundé</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Congo</td>
<td>261 (19.3)</td>
<td>28 (2.8)</td>
<td>337 (33.3)</td>
<td>164 (16.2)</td>
</tr>
<tr>
<td>Brazzaville</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cote d’Ivoire</td>
<td>645 (19.3)</td>
<td>53 (1.6)</td>
<td>921 (27.6)</td>
<td>607 (18.2)</td>
</tr>
<tr>
<td>Urban Ivory Coast</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gabon</td>
<td>324 (10.2)</td>
<td>57 (1.8)</td>
<td>523 (16.5)</td>
<td>454 (14.3)</td>
</tr>
<tr>
<td>Port-Gentil</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Morocco</td>
<td>89 (8.8)</td>
<td>19 (1.9)</td>
<td>195 (19.3)</td>
<td>122 (12.1)</td>
</tr>
<tr>
<td>Morocco Benlimane</td>
<td>68 (5.4)</td>
<td>16 (1.4)</td>
<td>104 (8.2)</td>
<td>100 (8.0)</td>
</tr>
<tr>
<td>Morocco Boulimana</td>
<td>285 (16.0)</td>
<td>69 (3.9)</td>
<td>500 (28.1)</td>
<td>408 (23.6)</td>
</tr>
<tr>
<td>Morocco Casablanca</td>
<td>75 (4.4)</td>
<td>21 (1.2)</td>
<td>249 (14.7)</td>
<td>346 (20.5)</td>
</tr>
<tr>
<td>Morocco Marrakech</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Democratic Republic of Congo</td>
<td>221 (7.5)</td>
<td>27 (0.9)</td>
<td>346 (11.8)</td>
<td>320 (10.9)</td>
</tr>
<tr>
<td>Kinshasa</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reunion Island</td>
<td>507 (21.5)</td>
<td>53 (2.2)</td>
<td>645 (27.3)</td>
<td>324 (13.7)</td>
</tr>
<tr>
<td>Reunion Island</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Republic of Guinea</td>
<td>578 (18.6)</td>
<td>113 (3.6)</td>
<td>669 (21.5)</td>
<td>587 (18.8)</td>
</tr>
<tr>
<td>Conakry</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sudan</td>
<td>361 (12.5)</td>
<td>160 (5.5)</td>
<td>268 (7.2)</td>
<td>137 (4.7)</td>
</tr>
<tr>
<td>Khartoum</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Togo</td>
<td>520 (16.8)</td>
<td>51 (1.7)</td>
<td>450 (14.6)</td>
<td>332 (10.7)</td>
</tr>
<tr>
<td>Lome</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tunisia</td>
<td>944 (15.4)</td>
<td>318 (5.2)</td>
<td>897 (14.7)</td>
<td>793 (13.0)</td>
</tr>
<tr>
<td>Grand Tunis</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sousse</td>
<td>362 (11.5)</td>
<td>85 (2.8)</td>
<td>706 (23.2)</td>
<td>296 (9.4)</td>
</tr>
<tr>
<td>Total</td>
<td>5716 (13.0)</td>
<td>1187 (2.7)</td>
<td>7885 (17.9)</td>
<td>5470 (12.4)</td>
</tr>
<tr>
<td><strong>Africa (English speaking)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethiopia</td>
<td>290 (9.1)</td>
<td>66 (2.1)</td>
<td>316 (9.9)</td>
<td>606 (19.0)</td>
</tr>
<tr>
<td>Addis Ababa</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kenya</td>
<td>455 (13.8)</td>
<td>131 (4.0)</td>
<td>738 (22.4)</td>
<td>509 (15.5)</td>
</tr>
<tr>
<td>Eldoret</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nairobi</td>
<td>543 (18.0)</td>
<td>167 (5.5)</td>
<td>660 (19.8)</td>
<td>449 (14.9)</td>
</tr>
<tr>
<td>Nigeria</td>
<td>408 (13.0)</td>
<td>128 (4.1)</td>
<td>515 (16.4)</td>
<td>242 (7.7)</td>
</tr>
<tr>
<td>Ibadan</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South Africa</td>
<td>1025 (20.3)</td>
<td>252 (5.0)</td>
<td>1043 (20.7)</td>
<td>670 (13.3)</td>
</tr>
<tr>
<td>Cape Town</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polokwane</td>
<td>838 (18.0)</td>
<td>306 (6.6)</td>
<td>846 (18.2)</td>
<td>520 (11.2)</td>
</tr>
<tr>
<td>Total</td>
<td>3559 (15.8)</td>
<td>1053 (4.7)</td>
<td>4056 (18.2)</td>
<td>2996 (13.4)</td>
</tr>
</tbody>
</table>
Data management and analysis

Dates of data collection were documented. In the majority of centres all data were double-entered and the two files were compared using SAS. Any discrepancies between the first and second entry files were then resolved by referring to the paper questionnaire. For each centre, an ISAAC Centre Report was submitted to the IIDC. The Centre Report provided details of the local implementation of ISAAC Phase III addressing key issues including geographical definitions, sampling of schools and children, participation rates, translation of questionnaires, data management including its entry and formats during submission to the IIDC.

For the prevalence analyses, the asthma, rhinoconjunctivitis and eczema symptom prevalence for each centre were calculated by dividing the number of positive responses to each question by the number of completed questionnaires for the written and video questionnaires separately. The presented analysis will focus on the 23 centres in 16 countries coordinated by the two ISAAC regional coordinators for Africa. Except for Ibadan (Nigeria) and Polokwane (South Africa), which surveyed both 6- to 7- and the 13- to 14-year-old children, all other African centres surveyed only the 13–14 year olds. Thus, this study will focus on the findings for 13–14 year olds.

Figure 1. Prevalence of symptoms of wheeze in the past 12 months, 13–14 year age group in Africa.
Table 4. Prevalence of asthma symptoms in all African countries ISAAC Phase III for children 13–14 year olds (video questionnaire)

<table>
<thead>
<tr>
<th>Video questionnaire scene</th>
<th>Nairobi, N (%)</th>
<th>Benslimane, N (%)</th>
<th>Boulmene, N (%)</th>
<th>Casablanca, N (%)</th>
<th>Marrakech, N (%)</th>
<th>Ibadan, N (%)</th>
<th>Cape Town, N (%)</th>
<th>Total, N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheezing (while at rest)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ever</td>
<td>446 (14.8)</td>
<td>175 (17.4)</td>
<td>156 (12.4)</td>
<td>294 (16.6)</td>
<td>211 (12.5)</td>
<td>437 (15.1)</td>
<td>639 (16.8)</td>
<td>2560 (15.4)</td>
</tr>
<tr>
<td>In the last year</td>
<td>326 (16.0)</td>
<td>105 (16.4)</td>
<td>89 (7.1)</td>
<td>229 (12.9)</td>
<td>146 (8.7)</td>
<td>295 (16.2)</td>
<td>559 (11.2)</td>
<td>1749 (16.5)</td>
</tr>
<tr>
<td>In the last month (one or more times)</td>
<td>179 (5.3)</td>
<td>71 (7.1)</td>
<td>52 (4.1)</td>
<td>106 (10.5)</td>
<td>112 (6.6)</td>
<td>256 (8.8)</td>
<td>351 (7.0)</td>
<td>1207 (7.3)</td>
</tr>
<tr>
<td>Wheezing after exercise</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ever</td>
<td>617 (20.4)</td>
<td>204 (20.3)</td>
<td>166 (13.2)</td>
<td>402 (22.7)</td>
<td>258 (15.3)</td>
<td>810 (27.9)</td>
<td>1070 (21.5)</td>
<td>3527 (21.2)</td>
</tr>
<tr>
<td>In the last year</td>
<td>512 (16.9)</td>
<td>114 (11.3)</td>
<td>112 (8.9)</td>
<td>298 (16.9)</td>
<td>174 (10.3)</td>
<td>614 (21.2)</td>
<td>852 (13.9)</td>
<td>2517 (15.1)</td>
</tr>
<tr>
<td>In the last month (one or more times)</td>
<td>305 (10.1)</td>
<td>70 (7.0)</td>
<td>75 (6.0)</td>
<td>233 (13.2)</td>
<td>137 (6.1)</td>
<td>548 (18.9)</td>
<td>468 (5.3)</td>
<td>1835 (11.0)</td>
</tr>
<tr>
<td>Waking with wheeze</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ever</td>
<td>313 (10.4)</td>
<td>88 (8.8)</td>
<td>58 (4.7)</td>
<td>192 (10.8)</td>
<td>114 (6.8)</td>
<td>225 (7.8)</td>
<td>459 (9.2)</td>
<td>1451 (8.7)</td>
</tr>
<tr>
<td>In the last year</td>
<td>237 (7.8)</td>
<td>59 (5.9)</td>
<td>32 (2.6)</td>
<td>128 (7.2)</td>
<td>80 (4.7)</td>
<td>166 (5.7)</td>
<td>265 (5.3)</td>
<td>967 (5.8)</td>
</tr>
<tr>
<td>In the last month (one or more times)</td>
<td>121 (4.0)</td>
<td>32 (3.2)</td>
<td>20 (1.6)</td>
<td>103 (5.8)</td>
<td>53 (3.1)</td>
<td>135 (4.7)</td>
<td>194 (3.9)</td>
<td>658 (4.0)</td>
</tr>
<tr>
<td>Waking with cough</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ever</td>
<td>963 (28.9)</td>
<td>212 (21.1)</td>
<td>246 (19.6)</td>
<td>438 (24.7)</td>
<td>390 (23.1)</td>
<td>746 (25.7)</td>
<td>1501 (30.1)</td>
<td>4436 (26.7)</td>
</tr>
<tr>
<td>In the last year</td>
<td>708 (23.4)</td>
<td>102 (16.1)</td>
<td>154 (12.3)</td>
<td>312 (17.6)</td>
<td>281 (16.7)</td>
<td>546 (18.8)</td>
<td>957 (19.2)</td>
<td>3060 (18.4)</td>
</tr>
<tr>
<td>In the last month (one or more times)</td>
<td>369 (12.2)</td>
<td>62 (6.2)</td>
<td>86 (6.8)</td>
<td>194 (11.0)</td>
<td>160 (9.5)</td>
<td>420 (14.5)</td>
<td>620 (12.4)</td>
<td>1910 (11.5)</td>
</tr>
<tr>
<td>Severe wheeze</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ever</td>
<td>292 (3.7)</td>
<td>108 (16.7)</td>
<td>87 (6.9)</td>
<td>268 (15.0)</td>
<td>184 (10.9)</td>
<td>224 (7.7)</td>
<td>603 (12.1)</td>
<td>1764 (10.6)</td>
</tr>
<tr>
<td>In the last year</td>
<td>216 (7.1)</td>
<td>70 (7.0)</td>
<td>46 (3.6)</td>
<td>194 (11.0)</td>
<td>127 (7.5)</td>
<td>161 (5.6)</td>
<td>347 (7.0)</td>
<td>1160 (7.0)</td>
</tr>
<tr>
<td>In the last month (one or more times)</td>
<td>116 (3.8)</td>
<td>46 (4.6)</td>
<td>26 (2.1)</td>
<td>152 (8.6)</td>
<td>100 (5.3)</td>
<td>138 (4.8)</td>
<td>216 (4.3)</td>
<td>794 (4.8)</td>
</tr>
<tr>
<td>Total participants for video questionnaire</td>
<td>3023</td>
<td>1000</td>
<td>1254</td>
<td>1771</td>
<td>1687</td>
<td>2800</td>
<td>4880</td>
<td>16 627</td>
</tr>
</tbody>
</table>

Figure 2. Prevalence of symptoms of allergic rhinoconjunctivitis in the past 12 months, 13–14 year age group in Africa
Results

Participating centres and response rates

Table 1 shows the characteristics of participating centres including sampling frames, number of schools, selection criteria for children, age groups and levels or years selected for children’s participation. All centres were registered with the ISAAC International Data Centre (IIDC) through the Regional Coordinators. Table 1 also shows the response rates among school children in the countries that participated in ISAAC Phase III and dates of data collection. The response rates varied from 78.1% to 100%, with an average response rate of 93.1%.

Demography

Table 2 presents the participant characteristics for surveys in 13–14 year olds. Of the 66,335 school children that participated, 9% were outside the 13–14 year old range. Overall, 51% of the participants were female, but this proportion varied from 40.2% in Boulmene (Morocco) and Urban Ivory Coast to 59.6% in Cape Town (South Africa).

Prevalence of reported symptoms of asthma

Table 3 presents the (written questionnaire) prevalence findings for current symptoms of asthma, severe asthma, allergic rhinoconjunctivitis and eczema symptoms among 13-14 year olds. Overall, 13% of the participants in French-speaking centres had wheezing in the last 12 months and 15.9% in ‘English-speaking’ centres. The variation in current wheeze within countries and within centres in the same country is illustrated in Fig. 1. Several centres, including Cape Town (20.3%), Polokwane (18.0%), Reunion Island (21.5%), Brazzaville (19.9%), Nairobi (18.0%), Urban Ivory Coast (19.3%) and Conakry (18.6%) showed relatively high asthma symptom prevalences similar to those in western Europe, whereas several centres showed low prevalence including Marrakesh (4.4%), Yaounde (5.7%) and Kinshasa (7.5%) or intermediate prevalence as Addis Ababa (9.1%) and Algiers (8.7%). The prevalence of severe asthma symptoms varied among centres from 0.9% in Kinshasa to 6.6% in Polokwane.

Table 4 presents the responses to the video questionnaire for asthma symptoms from the seven centres that included it. There was less variation in symptom prevalence than was observed with the written questionnaire. The lowest prevalence for current wheeze is for Marrakesh (8.7%) and all other centres have prevalence among 10%.

Prevalence of reported symptoms of allergic rhinoconjunctivitis

As shown in Fig. 2, there was large variation of rhinoconjunctivitis prevalence within centres, and the pattern of symptom prevalence across centres was different from current wheezing. Several centres have a high prevalence of rhinoconjunctivitis (>20%), including Cape Town and Reunion Island (which also have the highest prevalence of current wheezing) and also three centres in North Africa (Algiers, Casablanca and Sousse) and three centres in Sub-Saharan Africa (Urban Ivory Coast, Conakry and Eldoret). Only four centres had a low prevalence of rhinoconjunctivitis (<10%; Khartoum, Yaounde, Addis Abeba and Boulmene). Except in the two centres with the highest asthma symptom prevalence levels (Cape Town and Reunion Island), the prevalence of rhinoconjunctivitis was always higher than the prevalence of current wheeze.
Prevalence of reported symptoms of eczema

As shown in Fig. 3, the distribution of prevalence of eczema symptoms is very different from current wheeze, and more similar to the map for rhinoconjunctivitis (Fig. 2). The highest prevalence of eczema (‡15%) was found in the same centres with high prevalence of rhinoconjunctivitis in Urban Ivory Coast, Conakry and Casablanca. Two other centres had a high prevalence of eczema symptoms: Addis Ababa with intermediate prevalence of wheezing (9.1%) and low prevalence of rhinoconjunctivitis (9.9%); and Marrakech which had the lowest prevalence of current wheeze (4.4%) and a markedly higher prevalence of rhinoconjunctivitis. However, the two centres with the highest prevalence of wheeze and rhinoconjunctivitis (Cape Town and Reunion Island) had only intermediate prevalence levels for eczema symptoms, respectively, 13.7% and 13.3%.

Comorbidity

Table 5 presents the comorbidity of the three conditions. The prevalence of the combination of wheeze and rhinoconjunctivitis is relatively high with an average of 3.4% in the Africa centres; the highest rates were observed in Reunion Island (6.6%), Brazzaville (6.0%) and Cape Town (5.8%).
Discussion

The ISAAC Phase III in Africa has determined the prevalence of asthma, allergic rhinoconjunctivitis and eczema symptoms in 22 centres among 16 countries using standardized methodology and instruments. The large involvement in ISAAC of centres in Africa demonstrated the possibility to involve clinicians of Africa in an international survey and provided an opportunity to establish an environment for health research in the participating countries (14). The large variation within countries and within centres in the same country demonstrated worldwide by the ISAAC Phase I results has also been shown for the Africa centres involved in Phase III. Furthermore, the patterns of symptom prevalence for asthma symptoms is different from the other two conditions, and the comorbidity of asthma and rhinoconjunctivitis is high in all centres.
The prevalence of current wheeze is generally intermediate or high in the majority of centres. The lowest prevalence of current wheeze was found in two centres of a middle-income country of North Africa (Marrakech located in the desert and Boulmene located in a rural area of Morocco) and in Kinshasa, which is located in one of the poorest countries of Sub-Saharan Africa. Several centres, including Cape Town (20.3%), Polokwane (18.0%), Reunion Island (21.5%), Brazzaville (19.9%), Nairobi (18.0%), Urban Ivory Coast (19.3%) and Conakry (18.6%) showed relatively high asthma symptom prevalences similar to those in western Europe. The highest prevalence of current wheeze was found in Reunion Island where a large part of the population has a higher standard of life than in other African countries. As suggested by previous studies conducted in Africa (22–25), the prevalence of current asthma was higher in urban than in rural areas. In countries where several centres were involved, the prevalence of current wheeze was generally the highest in urban centres (Casablanca in Morocco, Grand Tunis in Tunisia, Nairobi in Kenya, Cape Town in South Africa). This could be explained by several environmental factors linked with urbanization and the adoption of 'western life style' (26) by a part of the population with the highest socioeconomic level living in urban centres.

The intermediate levels of prevalence of current wheeze found in several centres located in countries of Sub-Saharan Africa (Conakry, Urban Ivory Coast, Brazzaville, Khartoum, Nairobi, Polokwane) with high levels of parasites, and infections (particularly tuberculosis and HIV/AIDS) are particularly surprising and are not in concordance with the protective role of parasites (27, 28) or with the ‘hygienic hypothesis’ (29).

The pattern of variation in prevalence of severe asthma within countries is not strongly correlated with the prevalence of current wheeze, and could be explained more by the awareness of the disease and the level of asthma management than by specific asthma risk factors.

The high or intermediate prevalence of rhinoconjunctivitis and eczema symptoms found in the majority of the centres of Africa is raises a number of questions. One hypothesis emerging from the preliminary findings of ISAAC Phase II is that, in centres located in developing countries, a large proportion of chronic rhinoconjunctivitis and eczema cases are caused by nonallergic factors (30). The high reported prevalence of eczema must also be regarded with caution, taking into account the possible confusion of eczema symptoms with other itchy diseases that are common in Africa.

In conclusion, ISAAC Phase III in Africa has expanded on the findings of ISAAC Phase I. The findings are of particular interest, as many countries have to some extent retained their traditional diet and lifestyles but are becoming increasingly 'westernized', particularly in 'urban' areas. There are also, except in North Africa, very high prevalences of tuberculosis, HIV/AIDS, parasites and infections in young children, and other risk factors (e.g. particular allergens and endotoxin) that may be 'specific' to Africa. Overall, the prevalence estimates are relatively high, with a number of centres showing prevalences for current wheeze that are similar to those that have been reported in European countries (31). These findings have demonstrated for the first time that asthma is an emerging public health problem in Africa. This epidemiological evidence could be an important first step to increasing political involvement of decision-makers, researchers and potential research funders to invest more in asthma research projects and in the prevention and management of asthma in Africa.
References


