Global Asthma Network Phase I surveillance: geographical coverage and response rates.

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Abstract

Background – The Global Asthma Network (GAN) Phase I is surveying school pupils in high-income and low- or middle-income countries using International Study of Asthma and Allergies in Childhood (ISAAC) methodology.

Methods – Cross-sectional surveys of participants in two age groups in randomly selected schools within each centre (2015-2020). 13-14 years (adolescents) are the compulsory age group, optionally including parents or guardians. 6-7 years (children) and their parents are also optional. Adolescents completed questionnaires at school, and took home adult questionnaires for parent/guardian completion. Children took home questionnaires for parent/guardian completion about the child and also adult questionnaires. Questions related to symptoms and risk factors for asthma and allergy, asthma management, school/work absence and hospitalisation.

Results – 53 centres in 20 countries completed quality checks by 31 May 2020. These included 21 centres that previously participated in ISAAC. There were 132,748 adolescents (average response rate 88.8%), 91802 children (average response rate 79.1%), and 177,622 adults, with >97% answering risk factor questions and >98% answering questions on asthma management, school/work absence and hospitalisation.

Conclusion – The high response rates achieved in ISAAC have generally been maintained in GAN. GAN Phase I surveys, partially overlapping with ISAAC centres, will allow within-centre analyses of time-trends in prevalence.
Introduction

The Global Asthma Network (GAN) [1,2] was formed in 2012 as a joint initiative by members of the International Study of Asthma and Allergies in Childhood (ISAAC) and the International Union Against Tuberculosis and Lung Disease, following their co-production of the first Global Asthma Report (GAR), launched in 2011 at the time of the United Nations high-level meeting on non-communicable diseases [3]. Estimates of the worldwide burden of asthma in that report were based very largely on the ISAAC Phase III surveys (2001-2003) of 13-14-year-olds (adolescents) and 6-7-year-olds (children) [4], with time trends from centres which also participated in ISAAC Phase I (1994-1995) [5], plus the World Health Surveys of adults (2002-2003) [6]. The need for updated surveillance of asthma prevalence, severity, diagnosis and management, highlighted in GAR 2011 [3], has become more pressing since then [7], as very few studies anywhere in the world have evaluated trends in asthma prevalence and related risk factors over the last decade [8].

GAN Phase I was developed to address this information gap, with these hypotheses:

1) globally, the burden of asthma is changing in adults and children;
2) there is large variation in the diagnosis of asthma;
3) in many locations, asthma is under-diagnosed and its management is suboptimal; and
4) there are potentially modifiable risk factors for asthma.

Its aims were:

1) to conduct asthma surveillance around the world in two age groups of school pupils, and their parents, measuring prevalence, severity, management and risk factors, following the methods of ISAAC Phase III;
2) to examine time trends in prevalence, severity, management and risk factors from centres which completed ISAAC Phase III; and
3) to evaluate the appropriateness of asthma management, especially access to quality-assured essential asthma medicines, as defined by WHO [9].

Although modelled closely on the study design and methodology of ISAAC Phase III, GAN Phase I has extended its scope to include adults, for whom there are limited global data on asthma prevalence [8], severity and risk factors, and to assess asthma management, which is commonly suboptimal in low-income settings [7]. This paper summarises the progress of GAN Phase I at 31 May 2020, when the dataset was temporarily frozen for the first round of analyses including centres which completed the quality checks by this date.

Methods

GAN has collaborators from 383 centres in 137 countries all of whom answered the call for an Expression of Interest (EOI). Of the EOIs, 136 centres in 58 countries registered to participate in GAN Phase I. Of these registered centres some have completed GAN Phase I and provided data to this study, while some, because of timing, will be included in later publications. Other centres have been unable to undertake Phase I at all because of unforeseen circumstances. Many centres in each of these categories have contributed to other published GAN surveys [10-13].

GAN Phase I is a cross-sectional, multi-centre, multi-country study undertaken between 2015-2020. Its methodology has been described and justified elsewhere [2] and detailed in an online manual [14]. Each centre was required to obtain approval from their local ethics committee prior to the start of their study.
Briefly, each GAN centre is based on a defined geographical area, within which a minimum of 10 schools were selected at random (or all schools, if less than ten). All students of a specified age within these schools were studied, selected by grade/level/year, or by chronological age. The sample size estimates of 1000-3000 are stringent because of the number of hypotheses being tested, and high response rates are sought. As in ISAAC, two age groups of school pupils participated: adolescents and children. Centres that undertook ISAAC Phase III and/or ISAAC Phase I were expected to use the same study design and sampling frame in GAN. As in ISAAC Phase III, translations into the local language were required and centres followed the ISAAC protocol for translation, back translation to English, and comparison between the two [15].

The compulsory age group was adolescents, who self-completed written questionnaires at school. Additionally, in some centres, the ISAAC international video questionnaire showing different scenes of asthma in children of a variety of ethnicities was shown [16]. A self-completed risk factor questionnaire, developed for ISAAC Phase III, was strongly recommended in this age group. In ISAAC surveys, there was no contact with the parents of the adolescent age group, but for GAN, it was recommended (but not essential) that the parents/guardians of the adolescents were also surveyed.

This optional parental questionnaire obtained information on the prevalence of asthma, rhinitis and eczema symptoms among adults, plus questions on asthma management and risk factors. The adult symptoms questionnaire combined items from ISAAC and the European Community Respiratory Health Survey (ECRHS) [17] to cover the range of chest symptoms and diagnoses that might be related to asthma in young and middle-aged adults.

Optional was inclusion of children, as with ISAAC Phase III, who took written questionnaires home to be completed by their parents. These included the ISAAC questionnaire on the child’s symptoms used in Phases I and III, and the risk factor questionnaire used in Phase III. In GAN it was recommended (but not essential) to add the parental questionnaire to ascertain the prevalence of asthma, rhinitis and eczema symptoms among adults in the household.

Data from each centre were submitted to the GAN Global Centre (Auckland, New Zealand) together with a descriptive centre report. Following initial quality control checks in Auckland, the data were transferred to one of two designated GAN Phase I data centres for checking and analysis: Murcia (Spain) for Spanish- and Portuguese-speaking centres, and London (United Kingdom), for centres using all other languages. A harmonised approach to data processing, checking and analysis was developed, using Stata versions 13-15.

Estimation of participation rates among children and adolescents followed the conventions previously adopted in ISAAC Phase III. High levels of participation are sought as it is a concern that absent school pupils may be away from school due to symptoms of asthma, rhinitis or eczema. A participation rate of at least 80% for the adolescents and 70% for the children is desirable [2,14]. The denominator was the number of pupils in the cluster sample and the numerator was the number of core symptom questionnaires returned with at least some symptom data.

We were unable to calculate a conventional response rate for the adults as it was not known how many adults received questionnaires (because some schoolchildren have only one parent or guardian). Therefore, a “per child” approach was taken to estimate adult response rate, as follows. The denominator was the number of school-aged respondents (index schoolchildren) to whom one or more adult questionnaires were distributed. The numerator was the number of index schoolchildren for whom one or more adult questionnaires were returned. For centres which distributed adult questionnaires to both age groups of schoolchildren, the numerators and denominators were combined to derive a single estimate of “per child” adult response rate.
It was not possible to derive this measure of adult response rate for three centres (Costa Rica (whole country study), Guatemala City, Guatemala; Tegucigalpa, Honduras) where adult responses were not linked to the child identifier.

**Results**

By 31 May 2020, 53 centres in 20 countries had submitted and completed quality checks of data and methodology. Figure 1 shows the location of these centres, also 84 centres in 38 countries which formally registered an intention to complete GAN Phase I but were unable to do so, and the remaining GAN collaborating centres. Most centres completed their fieldwork before the onset of the COVID-19 pandemic, but surveys were still active in Iran (Yazd and Karaj) and Greece (Athens) in spring 2020, where fieldwork was truncated due to school closures in the pandemic lockdown.

Twenty-one of the 53 centres had previously participated in ISAAC Phase III (including 17 contributing data on both age groups) and 12 had previously participated in ISAAC Phase I (including 9 with data on both age groups). All of the 12 ISAAC Phase I centres except for Athens also participated in ISAAC Phase III. The geographical overlap between ISAAC and GAN centres is shown in Figure 2. Forty of the 53 GAN centres also contributed data on adult symptoms, risk factors and disease management, as summarised in Table 1.

Table 2 summarises the numbers of pupils and number of schools for which responses were received in GAN Phase I, by age group and questionnaire section (symptoms, risk factors, management and morbidity). When deriving the number of valid responses to the asthma management and asthma-related morbidity questions, respondents who legitimately skipped these sections because they had answered negatively to asthma symptoms were included in the count of responders.

Overall, responses were received for 132,748 adolescents attending 1260 schools (with risk factor information on 99.3% and management/morbidity information on 98.8%) and 91802 children attending 1506 schools (with risk factor information on 99.3% and management/morbidity information on 99.5%). Additionally, there were responses for 177,622 adults, with risk factor information on 97.7% and 98.2% providing information on asthma management, work absence, or hospitalisation. These 177,622 adults relate to 100,011 school pupils that returned adult questionnaires, comprising 50,416 adolescents and 49,595 children.

The stringent response criteria were able to be met by 45 (85%) of the 53 GAN Phase I centres for adolescents, 33 (80%) of the 41 GAN Phase I centres for children and by 24 (65%) of the 37 GAN Phase I centres for adults. Lower rates in some centres occurred due to schools closing because of the COVID-19 pandemic. Table 3 compares the response rates for the core symptom questionnaires by age group for each GAN Phase I centre and the corresponding response rates in earlier ISAAC surveys, where relevant. Across all GAN centres, the mean participation rate was 88.8% for adolescents and 79.1% for children (compared to 88.0% and 84.5%, respectively, in ISAAC Phase III). For GAN Phase I centres which were also ISAAC Phase III centres, mean response rates were 90.0% for adolescents and 79.0% for children in GAN compared with 89.3% and 84.4% respectively in ISAAC Phase III. One or more responses to the adult symptom questionnaire were received from an average of 73.2% of households contacted.

**Discussion**

GAN Phase I has completed fieldwork with data and methodology quality checks in a large number of centres in both high-income and low- or middle-income countries including representation from all inhabited continents. This broad geographical coverage is expected to expand as a number of centres
have commenced fieldwork but not yet submitted completed data. However, four countries (India, Kosovo, Mexico and Spain) account for two-thirds of the datasets received by 31 May 2020 which may limit the international generalisability of the findings.

Overlap between ISAAC and GAN is less extensive than anticipated, but 21 diverse centres will provide local time-trends in disease prevalence. These within-centre trends can be used, with caution, to inform projections of trends in prevalence among the remaining centres in ISAAC Phase III, which offer a much more widespread international representation than has been achieved so far in GAN.

Careful checks of the methodology used (centre report and data checks), as with ISAAC, ensured clarity on how the study was actually done and any variations encountered. The high levels of responses achieved in ISAAC have generally been maintained in GAN, suggesting that estimates of prevalence and severity of asthma will be representative of the populations surveyed. Sample sizes in most centres achieved the recommended target of 3000 children per age group, leading to precise estimates of disease prevalence, but in a few centres the numbers of respondents are substantially lower (Table 2).

The response rate in both age groups in Guatemala was unusually low (Table 3) and we explored the possible reasons for this. In both age groups, questionnaires were sent home for completion by the parents, whereas in other centres, the adolescents self-completed the questionnaires in class. This probably explains the exceptionally low response rate among 13-14-year-olds in Guatemala.

Extension of ISAAC methodology to include questions about parental symptoms was an attempt to fill gaps in knowledge about the prevalence, severity, diagnosis and management of asthma and related risk factors among young and middle-aged adults. Parents of schoolchildren are not a random or representative sample of the adult population, but the high response rates achieved in many of the study centres suggest that useful results could be obtained in this manner. The total number of adult respondents in GAN (177,622) is comparable with two previous international studies of young and middle-aged adults, discussed below.

The ECRHS, (1991-1993) recruited 137,619 participants aged 20-44 years in 48 centres in 22 countries (including 5 non-European countries: Algeria, Australia, India, New Zealand, USA) [17]. The GAN adult questionnaire incorporates core ECRHS items, but the geographical overlap with ECRHS countries is limited. The World Health Survey (WHS, 2002-2003) interviewed 178,215 adults aged 18-45 years from 70 countries and included a few questions about asthma and related symptoms among a general health questionnaire [6]. Although there is better geographical overlap with GAN, at least at the country level, the WHS questionnaire lacks detail which limits the scope for historical comparisons with GAN data on asthma severity.

Among adolescents and children, ISAAC offered a global perspective on time trends in asthma prevalence from the mid-1990s to the early 2000s [5, 18] but very few ISAAC centres have repeated their local surveys subsequently, prior to GAN. In Brazil, adolescents in Curitiba, Recife and São Paulo were studied in ISAAC Phases I (1994) and III (2003) and again in 2012 [19] and in South Santiago, Chile, ISAAC Phases I and III were completed, and a further survey of asthma in adolescents completed in 2015 [20]. Three GAN Phase I studies with previous ISAAC data have been published: in Bangkok, Thailand, [21] and four Mexican centres [22, 23]. Time trends in these centres have been summarised elsewhere [8].

With the closure of this first round of data in GAN Phase I, these temporal and geographical comparisons can now be extended to a wider and more diverse range of study centres. These results will form the basis of analyses for journal publications in the near future. However, GAN centres that
were unable to meet the criteria for this first data compilation can still contribute results to future analyses and publications.

In summary, GAN Phase I offers, for the first time in nearly two decades, new standardised worldwide data on prevalence and severity of asthma in adolescents, children and adults. This will enable comparisons to be made over time, and contribute a new picture of the global burden of asthma, rhinoconjunctivitis and eczema. Not only will risk factors be examined, but also time trends in these, and global variation, shedding light on causation. The methodology which ISAAC started has a proven track record of over nearly 30 years, and now extends to adults (parents) as well as adolescents and children. The high response rates achieved in a range of settings are testimony to the feasibility of the approach and give confidence in the estimates obtained.

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Figure legends

Figure 1 Global Asthma Network Centres
Centres registered with GAN identifying those that completed data collection before end of May 2020 (red); registered centres expected to complete GAN Phase I later (green); centres collaborating with GAN but not expected to contribute Phase I data (yellow).

Figure 2 Overlap of GAN and ISAAC Centres
Centres that completed GAN Phase I checks before 31 May 2020 (red); GAN Phase I centres included in ISAAC Phase III but not ISAAC Phase I (blue); GAN Phase I centres included in ISAAC Phase I and ISAAC Phase III (black*); ISAAC Phase III only centres (white).
* Athens, Greece contributed data to GAN and ISAAC Phase I, but not ISAAC Phase III.
| Questionnaire module | GAN Phase I centres | ISAAC Phase III centres* | ISAAC Phase I centres* |
|----------------------|---------------------|-------------------------|------------------------|
|                      | 6-7 | 13-14 | Adults   | 6-7 | 13-14 | 6-7 | 13-14 |
| Symptoms:            |     |       |          |     |       |     |       |
| Asthma (written)     | 41  | 53    | 40       | 144 [17] | 233 [21] | 91 [9] | 155 [12] |
| Asthma (video)       | NA  | 29    | NA       | NA   | 139 [8]    | NA   | 99 [3]     |
| Rhinoconjunctivitis  | 41  | 53    | NA       | 144 [17] | 233 [21] | 91 [9] | 155 [12] |
| Eczema               | 41  | 53    | 40       | 142 [17] | 231 [21] | 91 [9] | 155 [12] |
| Risk factors:        |     |       |          |     |       |     |       |
| ISAAC Phase 3 questions | 40 | 52    | 38       | 75 [17] | 122 [21] | ND   | ND     |
| Active smoking       | NA  | 52    | 38       | ND   | ND     | ND   | ND     |
| Perinatal questions  | 39  | NA    | NA       | ND   | ND     | ND   | ND     |
| Indoor environment   | 39  | NA    | 38       | ND   | ND     | ND   | ND     |
| Asthma-related:      |     |       |          |     |       |     |       |
| Management (now)     | 41  | 53    | 40       | ND   | ND     | ND   | ND     |
| Management (infancy) | 39  | NA    | NA       | ND   | ND     | ND   | ND     |
| School absence       | 41  | 53    | 40       | ND   | ND     | ND   | ND     |
| Work absence         | NA  | NA    | 40       | ND   | ND     | ND   | ND     |
| Hospitalisation      | 41  | 53    | 40       | ND   | ND     | ND   | ND     |

* Numbers of centres also participating in GAN Phase I in parentheses.
NA Not applicable (module not included for that age group)
ND No data (module not included in ISAAC data collection)
Table 2  Number of participants (P) and number of schools (S) responding to each GAN module by study centre and age-group.

| Centre name       | Symptoms 6-7-year-olds | Symptoms 13-14-year-olds | Symptoms Adults | Risk factors | Management | Risk factors | Management | Risk factors | Management |
|-------------------|------------------------|--------------------------|-----------------|--------------|------------|--------------|------------|--------------|------------|
|                   | P S                    | P S                      | P S             | P S          | P S        | P S          | P S        | P S          | P S        |
| Yaounde           | 722 27                 | 1066 22                  | 860 32          | 2312 23      | 2321 23    | 2217 23      |
| Ibadan            | 0 0                    | 2897 23                  | 2810 23         | 2321 23      | 2321 23    | 2217 23      |
| Cape Town         | 0 0                    | 3979 29                  | 3879 29         | 0 0          | 0 0        | 0 0          |
| Taipei            | 3036 25 3034 25        | 3474 24                  | 9689 49         | 9673 49      | 9594 49    |
| Bangkok           | 3067 7 3067 7 3063 7  | 3206 6 3201 6 3084 6  | 5418 13         | 5416 13      | 5311 13    |
| Yazd              | 0 0                    | 5141 48 5141 48          | 5141 48         | 0 0          | 0 0        | 0 0          |
| Karaj             | 572 39 0 0 572 39      | 754 42 0 0 754 42      | 1175 75        | 0 0          | 1175 75    |
| Lattakia          | 1115 9 1078 9 1111 9  | 1215 10 1214 10 1203 10 | 0 0          | 0 0          | 0 0        |
| Damascus          | 0 0 0 0 0 0            | 1100 11 1100 11 1100 11 | 0 0          | 0 0          | 0 0        |
| Kottayam          | 2099 50 2099 50 2085 50 | 2090 20 2088 20 2050 20 | 6940 69         | 6937 69      | 6743 69    |
| New Delhi         | 2516 54 2516 54 2516 54 | 3024 59 3024 59 3024 59 | 9449 113        | 9449 113     | 9010 113  |
| Chandigarh        | 2473 57 2473 57 2473 57 | 3000 54 3000 54 2999 54 | 10386 111       | 10386 111  | 10384 111 |
| Bikaner           | 2600 45 2600 45 2551 45 | 2702 33 2702 33 2702 33 | 10495 78       | 10495 78    | 10473 78  |
| Jaipur            | 2296 44 2296 44 2250 44 | 3060 57 3057 57 2977 57 | 8933 101       | 8902 101    | 8524 101  |
| Lucknow           | 2969 32 2969 32 2931 32 | 2968 31 2969 31 2933 31 | 11820 63     | 11786 63    | 11405 63  |
| Kolkata           | 0 0 0 0 0 0            | 2998 37 2998 37 2886 37 | 7823 91        | 7818 91     | 7547 91  |
| Pune              | 2404 26 2404 26 2403 26 | 3030 34 3030 34 3021 34 | 8000 60       | 7994 60     | 7909 60  |
| Mysuru (Mysore)   | 2730 30 2730 30 2730 30 | 3051 29 3051 29 3051 29 | 11178 59      | 11178 59    | 11177 59  |
| Peradeniya        | 1492 12 1492 12 1455 12 | 1696 11 1696 11 1547 11  | 0 0          | 0 0          | 0 0        |
| Anuradhapura      | 2180 10 2180 10 2120 10 | 2986 10 2989 10 2638 10 | 0 0          | 0 0          | 0 0        |
| Uruguaiana        | 0 0 0 0 0 0            | 1058 17 1052 17 1057 17 | 896 17         | 896 17      | 884 17     |
| Costa Rica        | 1936 34 1936 34 1936 34 | 1338 33 1338 33 1316 33 | 3272 67       | 3272 67     | 3102 67    |
| Guatemala City    | 1072 39 1072 39 1071 39 | 1420 42 1408 42 1400 42 | 1078 30        | 1078 30     | 1055 29    |
| Tegucigalpa       | 361 22 361 22 359 22  | 1431 65 1431 65 1415 65  | 254 10        | 254 10      | 252 10    |
| Mexico City North | 2515 58 2515 58 2498 58 | 3375 9 3370 9 3375 9  | 5231 66       | 5219 66     | 5104 66   |
| Guadalajara       | 2082 21 2082 21 2075 21 | 2519 13 2518 13 2516 13 | 489 20        | 487 20      | 483 20    |

13
|               | 2001 | 37 | 2001 | 37 | 1999 | 37 | 2479 | 20 | 2464 | 20 | 2469 | 20 | 2436 | 41 | 2427 | 41 | 2427 | 41 |
|---------------|------|----|------|----|------|----|------|---|------|---|------|---|------|---|------|---|------|---|
| Mexicali      | 2001 | 37 | 2001 | 37 | 1999 | 37 | 2479 | 20 | 2464 | 20 | 2469 | 20 | 2436 | 41 | 2427 | 41 | 2427 | 41 |
| Ciudad Victoria| 2444 | 20 | 2444 | 20 | 2439 | 20 | 2468 | 8  | 2465 | 8  | 2467 | 8  | 6239 | 28 | 6202 | 28 | 6149 | 28 |
| San Luis Potosi| 2108 | 28 | 2108 | 28 | 2108 | 28 | 2580 | 19 | 2580 | 19 | 2579 | 19 | 2835 | 27 | 2833 | 27 | 2801 | 27 |
| Tijuana       | 2082 | 47 | 2082 | 47 | 2072 | 47 | 2601 | 13 | 2595 | 13 | 2577 | 13 | 1397 | 26 | 1395 | 26 | 1376 | 26 |
| Toluca Urban  | 2712 | 21 | 2712 | 21 | 2702 | 21 | 2650 | 6  | 2642 | 6  | 2643 | 6  | 6162 | 27 | 6122 | 27 | 6072 | 27 |
| Toluca Rural  | 2975 | 17 | 2986 | 17 | 2974 | 17 | 3122 | 16 | 3114 | 16 | 3091 | 16 | 7587 | 33 | 7583 | 33 | 7470 | 33 |
| Chihuahua     | 1969 | 33 | 1969 | 33 | 1962 | 33 | 2180 | 7  | 2103 | 7  | 2161 | 7  | 0     | 0    | 0    | 0   | 0    | 0   |
| Ciudad Juárez | 2117 | 39 | 2118 | 39 | 2114 | 39 | 2443 | 16 | 2439 | 16 | 2426 | 16 | 2610 | 37 | 2598 | 37 | 2601 | 37 |
| Michoacán     | 2166 | 39 | 2166 | 39 | 2156 | 39 | 2504 | 14 | 2502 | 14 | 2503 | 14 | 2232 | 39 | 2232 | 39 | 2206 | 39 |
| Xalapa        | 3716 | 83 | 3717 | 83 | 3712 | 83 | 3339 | 21 | 3335 | 21 | 3327 | 21 | 0     | 0    | 0    | 0   | 0    | 0   |
| Córdoba       | 2746 | 60 | 2746 | 60 | 2738 | 60 | 2991 | 25 | 2980 | 25 | 2989 | 25 | 2839 | 35 | 2833 | 35 | 2829 | 35 |
| Puerto Vallarta| 2241 | 46 | 2241 | 46 | 2238 | 46 | 2439 | 15 | 2439 | 15 | 2428 | 15 | 0     | 0    | 0    | 0   | 0    | 0   |
| Aguascalientes| 3715 | 19 | 3716 | 19 | 3165 | 19 | 3336 | 19 | 3334 | 19 | 3331 | 19 | 2907 | 33 | 2898 | 33 | 2861 | 33 |
| Matamoros     | 806  | 24 | 806  | 24 | 799  | 24 | 2892 | 12 | 2882 | 12 | 2865 | 12 | 1315 | 24 | 1306 | 24 | 1298 | 24 |
| Managua       | 3162 | 59 | 3162 | 59 | 3127 | 59 | 3131 | 50 | 3126 | 50 | 2973 | 50 | 0     | 0    | 0    | 0   | 0    | 0   |
| Pristina      | 0    | 0  | 0    | 0  | 0    | 0  | 1054 | 14 | 1056 | 14 | 1052 | 14 | 2006 | 14 | 2006 | 14 | 1977 | 14 |
| Gjakova       | 0    | 0  | 0    | 0  | 0    | 0  | 676  | 5  | 676  | 5  | 676  | 5  | 1352 | 5  | 1352 | 5  | 1350 | 5  |
| Prizren       | 0    | 0  | 0    | 0  | 0    | 0  | 1427 | 10 | 1427 | 10 | 1427 | 10 | 2712 | 10 | 0     | 0   | 2699 | 10 |
| Gijilan       | 0    | 0  | 0    | 0  | 0    | 0  | 1200 | 6  | 1200 | 6  | 1200 | 6  | 1835 | 6  | 1835 | 6  | 1834 | 6  |
| Ferizaj       | 0    | 0  | 0    | 0  | 0    | 0  | 890  | 9  | 890  | 9  | 885  | 9  | 1371 | 9  | 1372 | 9  | 1328 | 9  |
| Katowice      | 1462 | 36 | 1462 | 36 | 1460 | 36 | 3185 | 29 | 3184 | 29 | 3180 | 29 | 2220 | 35 | 2219 | 35 | 2201 | 35 |
| Auckland      | 1538 | 22 | 1538 | 22 | 1538 | 22 | 1885 | 7  | 1885 | 7  | 1860 | 7  | 3002 | 29 | 2994 | 29 | 2986 | 29 |
| Athens        | 0    | 0  | 0    | 0  | 0    | 0  | 1934 | 20 | 1934 | 20 | 1934 | 20 | 1987 | 20 | 1897 | 20 | 1897 | 20 |
| Cartagena     | 3509 | 61 | 3509 | 61 | 3496 | 61 | 3436 | 26 | 3430 | 26 | 3428 | 26 | 6961 | 60 | 6956 | 60 | 6832 | 60 |
| Salamanca     | 2388 | 51 | 2388 | 51 | 2387 | 51 | 3485 | 31 | 3484 | 31 | 3481 | 31 | 0     | 0    | 0    | 0   | 0    | 0   |
| Cantabria     | 2841 | 75 | 2841 | 75 | 2836 | 75 | 4381 | 47 | 4372 | 47 | 4374 | 47 | 0     | 0    | 0    | 0   | 0    | 0   |
| A Coruña      | 3407 | 48 | 3407 | 48 | 3407 | 48 | 3462 | 26 | 3461 | 26 | 3455 | 26 | 0     | 0    | 0    | 0   | 0    | 0   |

| All centres   | 91802 | 1506 | 91197 | 1467 | 91365 | 1506 | 132748 | 1260 | 131777 | 1218 | 131179 | 1260 | 177622 | 1685 | 173452 | 1600 | 174367 | 1684 |
| Country                   | Centre name  | GAN Phase I | ISAAC Phase III | ISAAC Phase I |
|---------------------------|--------------|-------------|-----------------|---------------|
|                           |              | Survey years | Response (%)    | Survey years | Response (%) | Survey years | Response (%) |
|                           |              | 6-7         | 13-14          | Adult*        | 6-7          | 13-14        | 6-7          | 13-14        |
| Cameroon                  | Yaounde      | 2018-19     | 53.8            | 99.9          | 34.6 a        |              |              |              |
| Nigeria                   | Ibadan       | 2018        | -               | 85.0          | 79.5 c        | 2001-02      | 99.7          | 1995         | 76.4          |
| South Africa              | Cape Town    | 2017        | -               | 84.4          | d            | 2002         | 83.4          | 1995         | 82.8          |
| Taiwan                    | Taipei       | 2016-17     | 76.3            | 93.0          | 84.5 a        | 2001-02      | 96.8          | 1995         | 92.2 93.2     |
| Thailand                  | Bangkok      | 2017-18     | 86.3            | 97.9          | 86.1 a        | 2001         | 72.8          | 1995-96      | 90.8 74.8     |
| Iran                      | Yazd         | 2020        | -               | 71.3          |              |              |              |              |               |
| Iran                      | Karaj        | 2019-20     | 72.0            | 71.9          | 88.6 a        |              |              |              |               |
| Syrian Arab Republic      | Lattakia     | 2019        | 93.0            | 99.6          |              | 2001-03      | 99.1          | 99.8         |               |
| Syrian Arab Republic      | Damascus     | 2018        | -               | 91.7          |              |              |              |              |               |
| India                     | Kottayam     | 2017-18     | 68.4            | 85.3          | 97.5 a        | 2001-03      | 96.4          | 98.5         | 1994-95 78.1 90.7 |
| India                     | New Delhi    | 2017-18     | 80.9            | 100.0         | 85.7 a        | 2001-02      | 82.4          | 86.7         | 1994-95 99.2 100 |
| India                     | Chandigarh   | 2017-18     | 100.0           | 100.0         | 95.5 a        | 2001-02      | 99.4          | 1994-95      | 94.0 97.4     |
| India                     | Bikaner      | 2017-18     | 86.7            | 90.1          | 99.8 a        | 2001         | 95.4          |              |               |
| India                     | Jaipur       | 2017-18     | 75.8            | 98.7          | 84.4 a        | 2001         | 75.4          | 87.4         |              |
| India                     | Lucknow      | 2017        | 91.3            | 94.0          | 99.7 a        | 2001-02      | 85.7          | 75.0         |              |
| India                     | Kolkata      | 2017-18     | -               | 99.9          | 80.2 c        |              |              |              |               |
| India                     | Pune         | 2017-18     | 79.8            | 99.6          | 81.4 a        | 2001-02      | 90.4          | 70.8         | 1994-95 99.6 99.8 |
| India                     | Mysuru (Mysore) | 2017-18 | 90.9          | 99.5          | 97.4 a        |              |              |              |               |
| Sri Lanka                 | Peradeniya   | 2018        | 74.6            | 80.8          |              |              |              |              |               |
| Sri Lanka                 | Anuradhapura | 2018        | 72.7            | 85.4          |              |              |              |              |               |
| Brazil                    | Uruguaiana   | 2016-18     | -               | 88.2          | 76.7 c        |              |              |              |               |
| Costa Rica                | Costa Rica   | 2017-18     | 64.5            | 66.9          |              | 2001-02      | 80.9          | 69.6         | 1994-95 84.1 91.4 |
| Guatemala                 | Guatemala City | 2018 | 32.2          | 40.6          |              |              |              |              |               |
| Honduras                  | Tegucigalpa  | 2017-18     | 76.5            | 98.0          |              |              |              |              |               |
| Mexico                    | Mexico City North | 2015-16 | 86.7          | 93.8          | 55.9 a        | 2002-03      | 91.6          | 99.8         |               |
| Mexico                    | Guadalajara  | 2016        | 83.3            | 90.0          | 12.1 b        |              |              |              |               |
| Country | City               | Year | Adult Response Rate % | Child Response Rate % | Year Span | Adult Rate % | Child Rate % |
|---------|--------------------|------|------------------------|-----------------------|-----------|--------------|--------------|
| Mexico  | Mexicali           | 2015-16 | 77.0                  | 83.7                  | 2002-03   | 74.3         | 93.6         |
| Mexico  | Ciudad Victoria    | 2015-16 | 81.5                  | 82.3                  | 2003      | 73.1         | 79.5         |
| Mexico  | San Luis Potosi    | 2015-16 | 99.4                  | 97.3                  | 2002      | 77.0         | 83.7         |
| Mexico  | Tijuana            | 2015-16 | 83.3                  | 86.7                  | 2002      | 41.4         |             |
| Mexico  | Toluca Urban       | 2015-16 | 95.7                  | 98.1                  | 2002      | 65.5         |             |
| Mexico  | Toluca Rural       | 2015-16 | 93.0                  | 94.6                  | 2002      | 69.1         |             |
| Mexico  | Chihuahua          | 2015-16 | 87.5                  | 87.2                  | 2002      |              |         |
| Mexico  | Ciudad Juárez      | 2016-17 | 84.7                  | 88.8                  |           | 36.7         |             |
| Mexico  | Michoacán          | 2016    | 90.3                  | 92.7                  | 2002      | 75.8         |             |
| Mexico  | Xalapa             | 2016-17 | 92.9                  | 90.2                  |           |              |             |
| Mexico  | Córdoba            | 2016    | 91.5                  | 93.5                  |           | 30.2         |             |
| Mexico  | Puerto Vallarta    | 2015-17 | 93.4                  | 90.3                  |           |              |             |
| Mexico  | Aguascalientes     | 2015-16 | 90.7                  | 95.3                  |           | 44.0         |             |
| Mexico  | Matamoros          | 2015-17 | 80.6                  | 93.3                  |           | 93.7         |             |
| Nicaragua | Managua          | 2018    | 87.9                  | 90.5                  |           |              |             |
| Kosovo | Pristina           | 2017    | -                     | 99.9                  | 2002      | 96.0         | 94.5         |
| Kosovo | Gjakova            | 2018    | -                     | 90.1                  |           | 100.0        |              |
| Kosovo | Prizren            | 2017    | -                     | 89.0                  |           | 99.7         |              |
| Kosovo | Gjilan             | 2017    | -                     | 80.0                  |           | 81.5         |              |
| Kosovo | Ferizaj            | 2017    | -                     | 99.9                  |           | 85.1         |              |
| Poland | Katowice           | 2017-18 | 36.8                  | 79.1                  |           | 85.6         |             |
| New Zealand | Auckland    | 2018-19 | 63.7                  | 85.5                  | 2001      | 84.6         | 92.3         |
| Greece | Athens             | 2020    | -                     | 75.5                  | 1994-95   |              | 87.0         |
| Spain  | Cartagena          | 2015-16 | 65.9                  | 73.8                  | 2001-02   | 72.3         | 79.6         |
| Spain  | Salamanca          | 2017-18 | 73.7                  | 95.0                  |           |              |             |
| Spain  | Cantabria          | 2017-18 | 56.2                  | 77.4                  |           |              |             |
| Spain  | A Coruña           | 2018-19 | 71.0                  | 92.1                  | 2003      | 73.8         | 93.6         |

* Adult response rate per child, derived as the percentage of schoolchildren that had one or more adult questionnaires returned, combined across age groups when both age groups were studied:
  a) both age groups;  b) 6-7-year-olds only;  c) 13-14-year-olds only;  d) neither age group;
e) adult responses not linked to child identifiers, so no response rate for adults can be derived.
Figure 1  Global Asthma Network Centres

Centres registered with GAN identifying those that completed data collection before end of May 2020 (red); registered centres expected to complete GAN Phase I later (green); centres collaborating with GAN but not expected to contribute Phase I data (yellow).
Centres that completed GAN Phase I checks before 31 May 2020 (red); GAN Phase I centres included in ISAAC Phase III but not ISAAC Phase I (blue); GAN Phase I centres included in ISAAC Phase I and ISAAC Phase III (black*); ISAAC Phase III only centres (white).

* Athens, Greece contributed data to GAN and ISAAC Phase I, but not ISAAC Phase III.