Asthma prevalence in Nigerian adolescents and adults: systematic review and meta-anaylsis

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Introduction

The morbidity and mortality of bronchial asthma has been rising in recent decades across all ages and races. This has been noted in different proportions and at varying rates across diverse geographical areas in the world.[1,2] The World Health Survey (WHS) on asthma, championed by the World Health Organization (WHO) estimates the global burden of asthma in adults to be 4.3%,[3,4] with the highest burden in developed countries.[4] The burden of asthma is of public health concern because asthma is a major cause of infirmity, depletes scarce health resources, and reduces the quality of life of affected individuals. This burden is even more profound in developing countries like Nigeria, where health costs are largely borne by the individual pateint.[5]

There are several studies highlighting the burden of asthma in children in Nigeria, with a prevalence ranging from 5.1% to 14.3%.[6,8] Nevertheless, there remains a dearth of literature on the burden of asthma in adults in Nigeria. There have been attempts at championing the global study of the burden of asthma by the International Study of Asthma and Allergies in Childhood (ISAAC) group,[9] which included Nigerian participants.[8] This study has created a portfolio of studies that have enriched our knowledge of the global epidemiology of asthma in children.

In order to enhance the reliability of available data on the prevalence of asthma in adults in Nigeria, there should be a large community-based survey. However, in the interim, techniques of meta-analysis of observational studies in epidemiology (MOOSE) could be used to aggregate the available data on the subject. Meta-analysis is a technique that increases the power and precision of solitary studies by increasing the sample size.[10] The use of meta-analysis will offer a benchmark estimate of the burden of asthma in adults in Nigeria that can be utilized by health policy makers and policy implementers.[11,12] Therefore, considering the myriad studies done on diverse target populations with extensive heterogeneity, this study aims to estimate an overall prevalence of asthma in Nigerian adolescents and adults.

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Methods

This review and meta-analysis is based on the MOOSE guidelines.[11] We searched for relevant articles in international databases, including PubMed, ISI, Google Scholar, Scopus, and African Journals Online (AJOL), from 1990 to 2013. We searched Nigerian journals that are not indexed and also contacted Nigerian experts in respiratory diseases for potential articles. The keywords included in the research were: 'asthma', 'prevalence', 'adults', and 'Nigeria'.

In order to reduce the risk of bias, two independent reviewers selected the studies that were finally collated to form the list included in this review.

This first search yielded 591 articles. Reference lists of the articles obtained were then reviewed to find other eligible studies. The inclusion criteria included: usage of the International Study of Asthma and Allergies Among Children (ISSAC) questionnaire (or a modified version) or other similar questionnaire as the data capturing tool; a sample size equal to at least 500 persons; and adolescents or adults of age 13 years and above as the study population. Studies were included if they were published between 1990 to 2013. Exclusion criteria included: articles written in languages other than English, and study population inclusive of persons less than 13 years of age.

In the second stage, all the articles identified were independently reviewed by two investigators. Favorable studies were reviewed and summarized. Ultimately, five relevant studies were selected and used for the final analysis.

Studies were pooled using the DerSimonian-Laird method of random effects meta-analysis to estimate overall and sub-group specific prevalence.[13] The primary outcome measure was the prevalence of asthma, based on participant response to the question 'ever asthmatic?' or 'wheezing in the last 12 months?' The standard error of prevalence was determined by binomial probability distribution. Between-study heterogeneity was evaluated using the Cochran test. The level of significance for the Cochran test was set as 0.05. . A low, medium, and high heterogeneity was predefined as a Cochrane Q of 25%, 50%, and 75%, respectively. Publication bias was appraised by a funnel plot and Begg as well as Egger regression tests. All analyses were performed using STATA statistical package version 11. . Results were expressed as percentages with 95% confidence intervals. The level of significance was set at $p<0.05$. The null hypothesis of

this study assumes that the all the studies have the same prevalence in the various populations studied.

Several studies have compared responses to the ISAAC asthma cognate questions to other questionnaires and determinants of asthma, like physician diagnosis, and lung function assessments. These comparisons have shown that the ISAAC questionnaire is robust with high sensitivity and specificity, and that it can be utilized for cross-study comparisons.[14]

Results

Of the 591 studies that were found, 456 were left after removal of duplicates. 103 articles remained after the others were found not usable for the following reasons: data not extractable (1), articles addressed issues other than our research question (35), no desirable effect measure (1), no relevant information (6), and inclusion of person aged less than 13 (2). After full assessment 53 articles were excluded because the studies were done on children. A total of 5 studies satisfied the inclusion criteria and were used for meta-analysis, as shown in Table 1 and Figure 1. All the studies were cross-sectional in design and used either the ISAAC tool or proforma similar to it. Two studies included spirometry and one used peak flow estimation. All selected studies included adolescent and older adults (age 13-65 years).

There was high variability among studies (Q = 123.05, degree of freedom = 4, $p<0.0001$; $I^2 = 96.7\%$), hence the random effect model was adopted for data analysis.

The prevalence of asthma in the included studies ranged from 5.12% to 14.7%. The overall pooled estimate was 10.2%, with a 95% confidence interval (CI) of 7.0-13.4% (Figure 2).

We stratified the pooled prevalence by gender, and found a pooled prevalence of 28.4% (5.2-51.1%) and 24.3% CI (0.3-49.0%) for males and females respectively. The pooled estimates of studies that used the ISAAC tool were 7.9%, 95% CI (2.5%-13.4%) and 11.9% (95% CI (5.7-18.2%) for studies that used 'other' tools. There was high heterogeneity (ISAAC vs 'other' types) 98.15 and 97.1%, respectively. Publication bias was assessed using Begg's and Egger's test with graphic output in form of a funnel plot. Although the funnel plot appeared asymmetric, there was no quantitative evidence of bias; the Begg's and Egger's tests were not significant for publication bias (p=0.142 and 0.113, respectively) (Figure 3).

The influence of individual studies on the summary effect (prevalence estimate) showed the meta-analysis was dominated by the Alexander et al and Oluwole et al studies[18,19] (Figure 4).

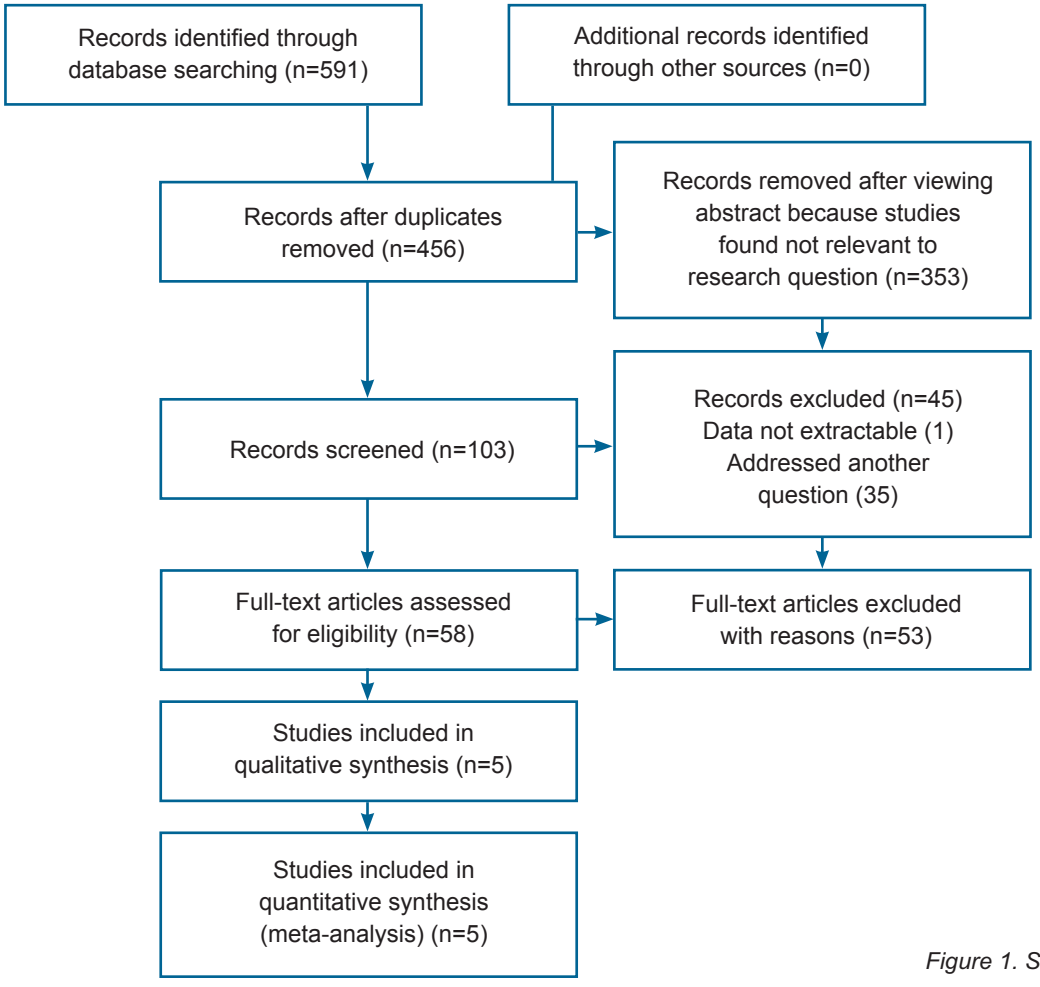

Figure 1. Study flow chart

Author	City	Year	Age (years)	Study instrument	Study design	Diagnostic criteria	Sample size	Male	Female	Total prevalence	Numerator
Falade et al[15]	Ibadan	1998	13–14	SAAC questionnaire phase 1	Cross-sectional	Presence of recent wheeze (last 12 months)	3058	1390	1668	10.7%	327
Erabor et al[16]	Ile-Ife	2006	15–35	Self-completed questionnaire	Cross-sectional	'Probable asthma' based on the presence of three or more symptoms or past diagnosis of asthma	903	49	78	14.1%	127
Desalu, et al[17]	Ilorin	2009	18–65	ECRHS screening questionnaire, 15.2% diagnosis of asthma based on two or more recurrent spirometry, PEFR cariability	Cross-sectional	Diagnosis of asthma based on two or more recurrent asthma symptoms or physician diagnosed asthma or PEFR variability ≥10%	733	488	245	14.7%	124
Alexander et al[18]	Benin	2010	18+	Clinical asthma control questionnaire and spirometry	Cross-sectional	*Presence of recent wheeze (last 12 months)	3000	80	120	6.6%	198
Oluwole et al[19]	Ibadan	2013	13–14	ISAAC questionnaire	Cross-sectional	Presence of recent wheeze (last 12 months)	1736			(89) 5.12%	
Total effect size							**9430**	**28.4%**	**24.3%**	**11.5%**	

ECRHS, ISAAC. *Juniper, et al. Development and validation of a questionnaire to measure asthma control. *EUR Respir J* 1999; 14(1): 902-7.

Table 1. Summary of studies of prevalence of bronchial asthma in adult Nigerians

Discussion

This study summarised the prevalence of asthma in adolescent and adult Nigerians over a 15-year period, (1998 to 2013). The pooled prevalence estimate of 10.2%, with a 95% CI of 7.0–13.4% shows there is a high prevalence of asthma among adolescent and adult Nigerians while the confidence interval alludes to the presence of high variability between studies. The sex differences in prevalence (28% in males vs. 24% in females), reflect the innate genetic inter-gender diversity usually seen in asthma. Whereas asthma is generally reported to be more common in females, some studies have shown it to be more common in pre-pubertal males.[15,16] There was also wide variation in reported prevalence between studies depending on the tool used as the evaluating questionnaire (ISAAC vs others). Both sub-groups had high inter-study variability.

The wide variation noted between studies could be due to innate gender differences and unmeasured socio-economic and environmental factors across Nigeria. The most extensive topographical pattern is that of the River Niger and Benue valleys; which are flanked by plains to the north of the valleys, and highland to the south, with coastal plains to the southwest and the southeast. This scenario allows for differences in exposure to environmental triggers of asthma like pollen and dust. Socioeconomic factors like indoor cooking practices, tobacco smoking, dietary choices, and urban outdoor pollution associated with industrial and vehicular emissions could also play a role.

We found a skewed funnel plot, which suggests a publication bias that may be due to wide variability in the reported prevalence, and gaps for unreported prevalence in other sub-populations. However, the finding may also be due to other reasons, such as variation in the quality of the studies and in study sample sizes. Furthermore, the bias may be due to variation in the prevailing risk for asthma among the population of the primary studies and chance occurrence. However, we are of the opinion that the difference in the prevailing risk among the studied populations likely accounts

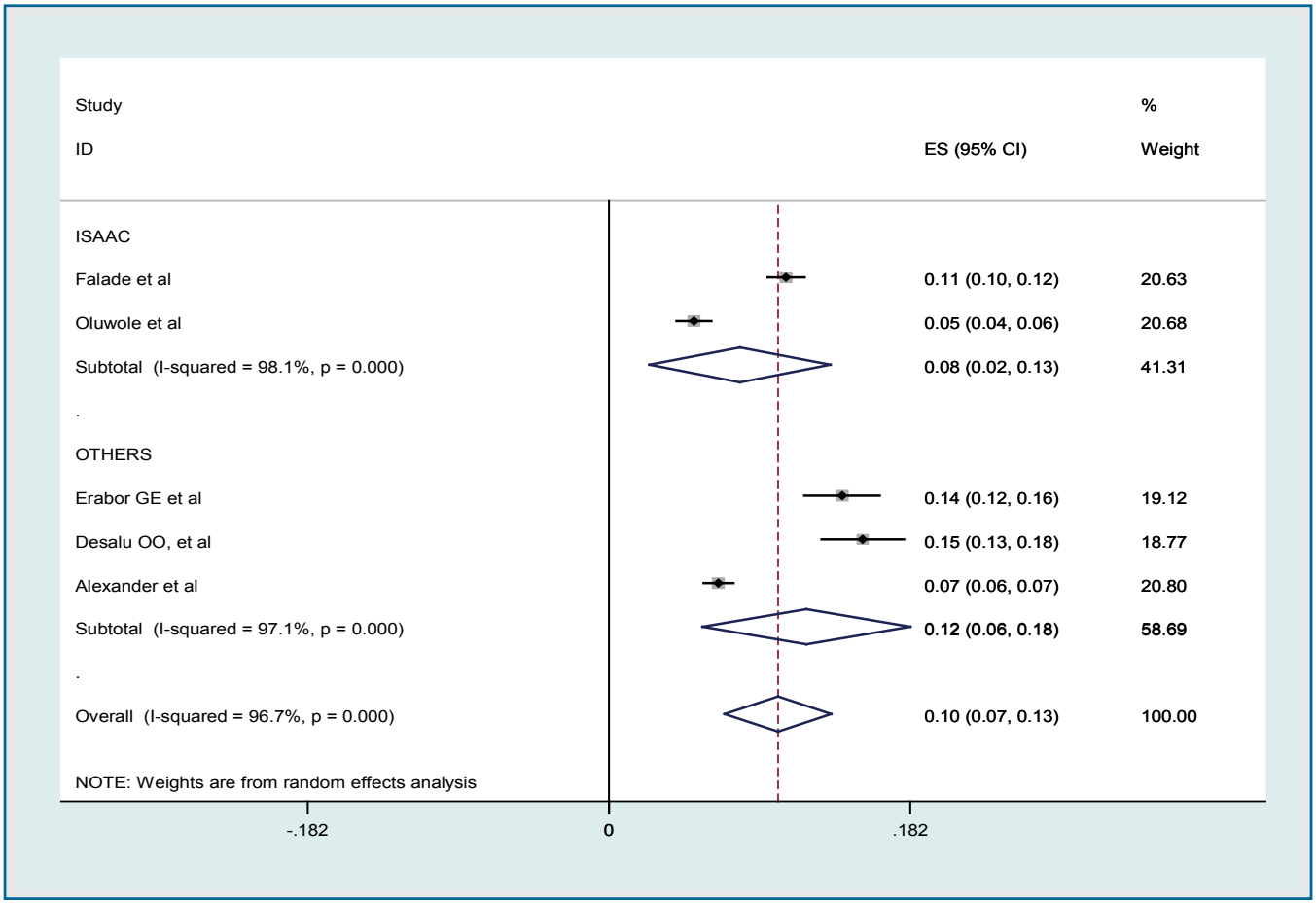

Figure 2. Forest plot showing overall asthma prevalence and stratified [type of study instrument] effect size.

for the skewing of the funnel plot.[17]

To our knowledge this is the first meta-analysis of prevalence of asthma in Nigerian children , our findings cannot therefore be readily compared with similar studies, as none exists. Nevertheless, the ISAAC study included a fairly large population, and found a prevalence of 5.1% among children between 6 and 7 years of age. Comparing their findings with our study it would appear that the prevalence is higher in adolescent and adults.[18] This is however in contrast to what is reported in other studies which show the prevalence of asthma decreasing with age.[19] This discrepancy may be due to sensitivity differences between evaluation tools used for children and adults. Studies using a more liberal approach are likely to report higher values.[20]

The global prevalence of doctor-diagnosed asthma in adults was estimated to be 4.3% (95% CI 4.2-4.4%); a value lower than that found in our study. This global variation is also reflected in the country-specific prevalence with wide variation between countries ranging from 0.2% in China to 21.0% in Australia.[19] The WHO survey on global prevalence of asthma revealed that a wide variety of tools are used for asthma surveys. It is thus expected that variations between reported prevalence will occur. Moreover, the WHO global value reported is based on doctor-diagnosed asthma which is expected to be lower than true asthma prevalence, considering that some people with asthma may not have access to doctors.

The pooled prevalence of clinical asthma in Africa was reported as 4.19%; ranging from 2% in Ethiopia to 8.74% in Swaziland.[19] The value from our study is higher than the highest value reported for doctor-diagnosed asthma for other African countries. Nigerian studies have largely relied on the ISAAC asthma questionnaire, which assess the presence of wheezing in the last 12 months. This approach would inadvertently include people who are wheezing from causes other than asthma, and thus increase the apparent asthma prevalence.

Overall, the result of our systematic review shows no reduction in the global trend of asthma in adults and children; a trend that is similarly observed in Africa and Nigeria.[17] Asthma is likely to increase with increasing rural to urban migration, increasing urbanisation, and rapid lifestyle and dietary changes. Occupation-related asthma could also play a role, due to increased exposure to industrial fumes driven by the heightened quest for industrialisation.[20]

The strengths of this study include: its desegregation of prevalence by gender, rigorous adherence to MOOSE criteria, and being the first meta-analysis aimed at determining the cumulative prevalence of asthma in adolescent and adult Nigerians. This study has limitations.

Most of the selected studies were from southwestern Nigeria, which limits the generalisability of the findings. Nigeria is a diverse country with differences in culture, climate, population genetics and geography.

Conclusions

In conclusion, we found a higher prevalence of asthma among Nigerian adolescents and adults compared with regional and global averages. This difference could be due to the variation in genetics, race, and socio-cultural/environmental factors. Findings from this meta-analysis can be used to guide the development of a national asthma prevalence survey and assist policymakers in Nigeria in instituting system-wide mechanisms for early detection and prompt treatment of persons with asthma.

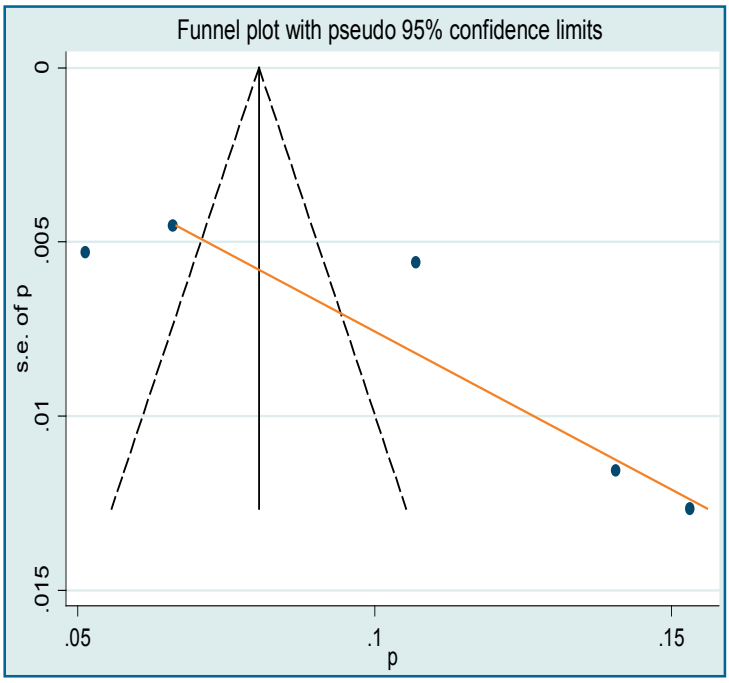

Figure 3. Funnel plot for publication bias in included studies (red line represents Egger's regression line).

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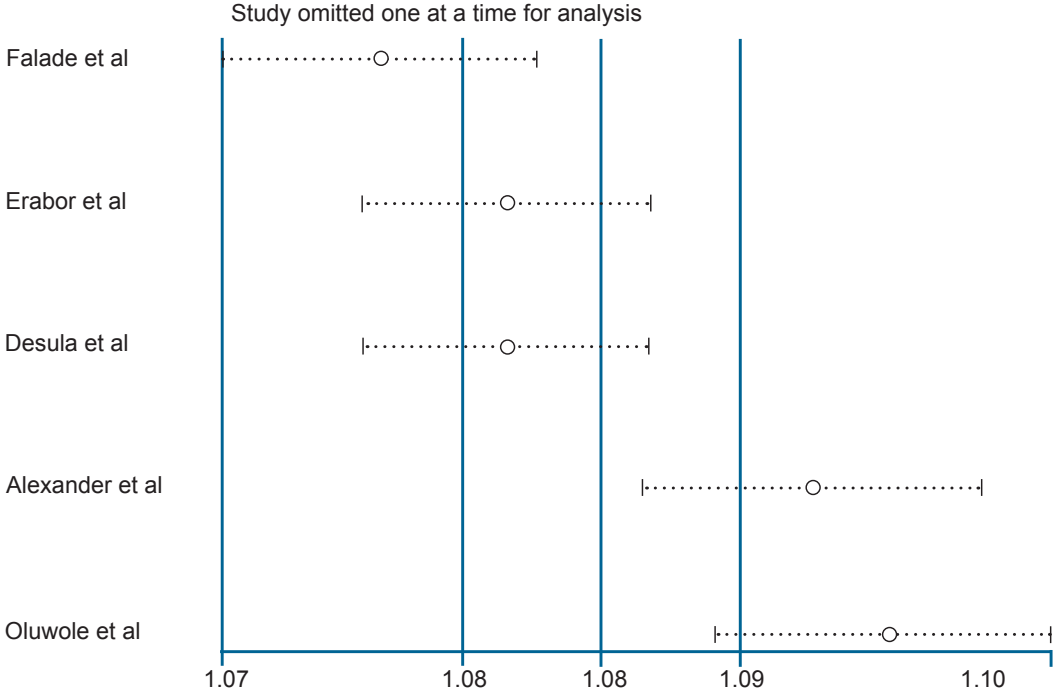

Figure 4. Shows single study influence on overall pooled prevalence estimate (values exponentiated).

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