

## Original Article

# The Prevalence of Allergic Diseases among Children with Asthma: What is the Impact on Asthma Control in South East Nigeria?

AC Ayuk<sup>1,2</sup>, JN Eze<sup>1</sup>, BO Edelu<sup>1</sup>, T Oguonu<sup>1</sup>

<sup>1</sup>Department of Pediatrics, College of Medicine, University of Nigeria Enugu Campus, University of Nigeria Teaching Hospital, Ituku-Ozalla, Enugu, Nigeria,  
<sup>2</sup>Division of Pediatric Pulmonology, Red Cross Children Hospital, University of Cape Town, Cape Town, South Africa

### ABSTRACT

**Background:** Allergic diseases are known to occur in children with asthma and its coexistence with asthma may impact on asthma control in affected children living in a low-income country. The study is to determine the allergic profile of children with asthma and the association with asthma control and attendant social risk factors. **Materials and Methods:** This was a cross-sectional study of consecutively enrolled children with physician diagnosed asthma, attending clinics in a tertiary center in Nigeria. The presence of asthma, allergy types, and asthma control levels were determined using the Global initiative on asthma (GINA), international study of asthma and allergy in childhood and asthma control test questionnaires, respectively. **Results:** There were 207 children with asthma enrolled from the Pediatric Asthma Clinic at University of Nigeria Teaching Hospital, Enugu. The median age was 10 years and interquartile range of 7–11 years. There were 127 (61.4%) from middle and high socioeconomic class and 86.5% who lived in the urban areas. Of the study participants, 41.5% had one or more allergy symptoms; rhinitis (33.3%), conjunctivitis (29.0%), and dermatitis (7.2%). Allergy symptoms persisted from infancy in 55.9%. Children from large families had a lower prevalence of allergies. Having any allergy symptom and belonging to a small-sized family were both associated with asthma exacerbations. Most children studied, (69.1%) had their asthma under control. Allergy persistence from infancy and type of allergy were not significantly associated with the level of asthma control. **Conclusion:** Allergic diseases are common in children with asthma in our environment, but did not significantly impact on asthma control. Socioeconomic factors such as urbanization and family size had effects on the achievement of asthma control but not on allergy status.

**KEYWORDS:** Allergy, asthma, children, control, severity

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## INTRODUCTION

In the last decade, the prevalence of allergic diseases in childhood has increased considerably worldwide,<sup>[1-4]</sup> and a sizeable proportion of the children with allergies develop asthma in the course of their lives.<sup>[2]</sup> Atopic diseases, including atopic dermatitis, allergic rhinitis, and asthma, affect approximately 20% of the global population.<sup>[5]</sup> In Africa, there has been an increase in the prevalence of asthma and allergy between the international study on asthma and allergy in childhood (ISAAC) Phase I and III studies done 7 years apart.<sup>[1,6-8]</sup> Although the 12-month prevalence of allergic rhinoconjunctivitis


and allergic dermatitis between Phase I and III studies in Nigeria, decreased significantly from 39.2% to 9.9%, and from 22.4% to 3%, respectively, in the 13–14-years age group,<sup>[9,10]</sup> a recent study by Oladeji *et al.*<sup>[11]</sup> suggests higher prevalence rates, 35.1% for allergic rhinitis and 15.3% for atopic dermatitis, respectively.

**Address for correspondence:** Dr. AC Ayuk, Department of Pediatrics, College of Medicine, University of Nigeria Enugu Campus; University of Nigeria Teaching Hospital, Ituku-Ozalla Enugu, Nigeria.  
E-mail: [adaraymond@yahoo.com](mailto:adaraymond@yahoo.com)

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Children who have allergic asthma bear the double burden of the effects of the allergies and that of asthma.<sup>[3-7]</sup> and this constitutes a significant burden to the child, parents, and society.<sup>[12]</sup> Risk factors for asthma and allergy in previous studies have included urban versus rural domicile, variability in the attendant microbiome, family size, and social circumstances.<sup>[13-15]</sup> The search for a concomitant existence of the two associated conditions become imperative to help improve the quality of life of children with asthma, through optimal symptom control.

This study set out to determine the burden of allergic disease in children with asthma in the University of Nigeria Teaching Hospital (UNTH), Enugu and how this impacts on their asthma control while ascertaining the influence of social risk factors such as urban versus rural dwelling, overcrowding, family size, and socioeconomic class (SEC) which could affect allergy status or asthma control in a developing economy like ours.

## MATERIALS AND METHODS

### Study setting and design

This was a hospital-based descriptive cross-sectional study whereby children who had been previously diagnosed with asthma and registered in the Pediatric Asthma Clinic of the UNTH, Ituku/Ozalla, Enugu Nigeria, were recruited using consecutive sampling. The clinic holds weekly and reviews old patients and new cases referred to it from other clinics and facilities in Enugu and beyond. The diagnosis of asthma was made based on the global initiative on asthma (GINA) recommendation of the presence of recurrent symptoms such as wheezing, shortness of breath, chest tightness, and cough with associated airflow limitation.<sup>[16]</sup> The pediatric asthma clinic attends to about an average of 15 children on each clinic day and had registered 1030 children, over a 3-year period (August 2012 and July 2014). This pool included referrals of postemergency room asthma exacerbation follow-up, inpatients, and outpatient referrals, who had asthma symptoms at the time of referral. The study participants were enrolled consecutively for 1 year from this group of children and interviewed by trained research assistants. The sample size was determined using the formula for the determination of sample size in a finite population of 1030 asthma clinic registered children, where the outcome variable is the proportion of asthma children with allergic diseases.<sup>[17]</sup> The following parameters were used for sample size calculation: asthma prevalence of 13%,<sup>[10]</sup> 95% of confidence level, and 5% of accuracy level. A sample size of 173 children from the population of 1030 registered children was calculated and was expanded to 207 allowing for 20% of potential missing data.

Ethical approval was obtained from the Health Research and Ethics Committee of the (UNTH) Ituku/Ozalla (NHREC/05/01/2008B), Enugu Nigeria. The individual consent/assent of children older than 7 years with asthma attending the clinic was obtained before recruitment.

### Enrolment was based on the following criteria

Able to use the study questionnaires (the childhood asthma control test (C-ACT) and ACT, the ISAAC questionnaires and regular attendance to the clinic for more than 1 year. The validated interviewer-administered questionnaires used were pretested, and consenting caregiver/participant dyad were recruited as they attended asthma follow-up clinics. Proxy answers were obtained from caregivers who accompanied the child and had lived with the child for the past 1 year. Children who met GINA criteria for asthma diagnosis,<sup>[16]</sup> were interviewed and history of allergy obtained based on the recommendations in the ISAAC guidelines,<sup>[18]</sup> and adaptations from the ISAAC III questionnaire<sup>[19]</sup> as a hospital-based study using the parent-proxy report as previously documented.<sup>[15]</sup> The questions enabled determination of allergic rhinitis, dermatitis, and conjunctivitis as well as common environmental triggers such as dust, aerosols from insecticides, and fumes of cooking oil. Further skin prick test or blood ImmunoCAP specific antigen quantifying studies were not done. Control of asthma in the preceding 4 weeks was then determined using the C-ACT, for children 4–11 years; and ACT questionnaires for children older than 11 years.<sup>[20,21]</sup> Asthma control scores based on the cutoff point of 19 were used to categorize the children as controlled and uncontrolled.<sup>[20,21]</sup> Frequency of exacerbation that required an emergency visit, were assessed for and one or more visit per month was used as a marker of asthma severity.<sup>[16]</sup> Other historical information gathered were family history of asthma and allergies; history of allergic diseases in infancy and the history of local triggers of “allergies” or asthma symptoms. Children <4 years old or participant pairs from whom assent/consent could not be obtained, were excluded from the study. The following definitions and categorizations were used in the assessment of participants: a large family was defined as having more than four children in a household<sup>[22]</sup>, and overcrowded households were defined as those in which three or more other people slept in the same room with the study participants.<sup>[23-28]</sup> The children’s ages were grouped into two as follows: 4–11 years and more than 11 years, based on the ability to be assessed with the C-ACT and ACT questionnaires. Socioeconomic status was determined using validated methods described by Ogunlesi *et al.*<sup>[29]</sup> and categorized into lower (SEC 4 and 5), middle (SEC 2 and 3), and upper

(SEC 1). Categorization of places of domicile into urban and rural was based on the Nigerian national criteria for the definition of communities.<sup>[30]</sup> The SEC, place of domicile, family size, and overcrowded living conditions were assessed as possible risk factors that could also affect either allergy status or asthma control.

### Statistical analyses

Data collected was analyzed using the SPSS software version 19 (IBM Inc. Chicago, IL, USA, 2010). Chi-square goodness of fit was used to determine the relationship of the variables to the normal population dispersion. Normality of distribution was checked using the Kolmogorov–Smirnov test (K–S test). Chi-square (or Fisher’s exact test where applicable),<sup>[15]</sup> were used to determine any association between the presence of allergy or not and risk factor variables such as SEC, family size, place of domicile, and outcome variables such as monthly exacerbations and level of asthma control. Where data were non-parametric for two ordinal variables (frequency of asthma exacerbation and frequency of allergy symptoms, Spearman correlation statistics was applied. Significant level was taken as  $P \leq 0.05$ .

## RESULTS

### Descriptive data

A total of 207 children who were between the ages of 4 and 18 years that met the inclusion criteria were enrolled from the pediatric asthma clinic; 60% (124/207) of them were males giving a male-to-female ratio of 1.5:1 [Table 1]. The median age inter-quartile range was 10 (7–11) years. Children whose ages were between the ages of 4 and 11 years, constituted 67% (138/207) of the study population [Table 1].

A greater proportion of the children (61.4%, 127/207) were from middle and high SEC. Most of the children (86.5%) lived in the urban areas. Historic information on family size and living condition was obtained from 172 children. The children with some missing data were either not accompanied by knowledgeable caregivers to give all relevant information, or in some cases, questionnaires were returned with such missing variables. Among these children, 40.6% (70/172) were from large families; and 66.2% (114/172) were living in overcrowded conditions and in the urban community.

### Allergy status

There were 41.6% (86/207) of the children who had allergy symptoms with the majority of them, 83.7% (72/86), inhabiting the urban areas. More than half, 53.6%, (111/207) of the children were reported to have had allergic symptoms in infancy. Among

**Table 1: Age and sex distribution of children with asthma attending University of Nigeria Teaching Hospital Enugu**

Age group (years)	Frequency (percentage of age group)		
	Males	Females	Total
4-11	88 (63.8)	50 (36.2)	138 (100)
12-18	36 (56.2)	33 (47.8)	69 (100)
Total	124 (59.9)	83 (40.1)	207 (100)

**Table 2: Allergy status and socioeconomic class of children with asthma attending University of Nigeria Teaching Hospital Enugu**

SEC	Frequency (%)		
	Allergy present	Allergy absent	Total
Upper	20 (58.8)	14 (41.2)	34 (100)
Middle	33 (35.4)	60 (64.6)	93 (100)
Lower	33 (41.3)	47 (58.7)	80 (100)
Total	86 (41.6)	121 (58.4)	207 (100)

$\chi^2=5.58, P=0.062$ . SEC=Socioeconomic class

**Table 3: Prevalence of asthma trigger factors among study participants (n=207)**

	n (%)
Particulate matter (trigger factors)	
Dust	99 (47.8)
Aerosol	62 (30.0)
Cooking oil fumes	61 (29.5)
Biofuel	46 (22.2)
Pollen	21 (10.1)
Tobacco	17 (8.2)
Nonparticulate matter (trigger factors)	
Exercise	99 (47.8)
Cold weather/ARI	54 (26.1)

ARI=Acute Respiratory Infection

**Table 4: Allergy status and asthma control among children from urban and rural areas attending University of Nigeria Teaching Hospital Enugu**

Current allergy status by place of domicile	Children with uncontrolled asthma, n (%)	Children with controlled asthma, n (%)	Total, n (%)
Urban			
No	31 (28.3)	76 (71.7)	107 (100)
Yes	25 (33.3)	48 (66.7)	73 (100)
Rural			
No	7 (50.0)	7 (50.0)	14 (100)
Yes	2 (14.3)	12 (85.7)	14 (100)
Total	64 (30.9)	143 (69.1)	207

Fisher’s exact test=2.076,  $P=0.17$

children with allergy symptoms, 55.9% (62/111) had their allergy symptoms persisting beyond infancy, ( $\chi^2 = 20.2, P < 0.001$ ). Fewer children, 27.9% (24/86), with current allergies had initial allergy symptoms after

infancy. Positive family history of asthma or allergy in 48.6% (103/207) was noted among the first-degree relatives of the children.

Allergy was more among children from small than those from large families, 64% and 36% respectively, ( $\chi^2 = 32.9$ ,  $P = 0.001$ ). Consideration of presence of allergy within each of the SECs showed a higher proportion of children with allergy among those from the high SEC (59%)  $P = 0.06$  [Table 2].

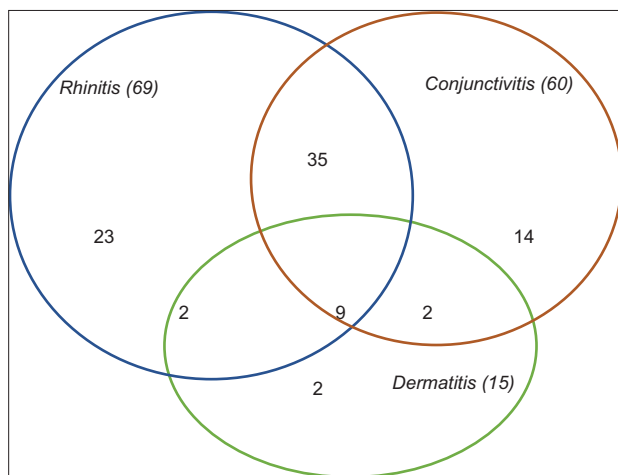
The common types of allergy observed were allergic rhinitis (33.3%, 69/207), allergic conjunctivitis; (29%, 60/207), and allergic dermatitis (7.2%, 15/207). Nine children had concurrent symptoms of the three common allergies, while 35 (16.9%) of the participants had rhinoconjunctivitis [Figure 1].

The most common allergens were dust (47.8%), aerosols from insecticides (30%), and fumes of cooking oil 29.5%) [Table 3].

### Allergy and asthma control

Most of the children (69.1%) had their asthma controlled. Within each community (rural and urban) the following proportion of children with current allergies had their asthma controlled 50% (7/14) and 66.7% (48/72), respectively, (Fisher's exact test = 2.08,  $P = 0.17$ ) [Table 4].

There was no significant association between the type of allergy and asthma control, although more children with current allergy had more frequency of visit to the emergency room due to asthma exacerbation ( $\chi^2 = 10.09$  [df 1]  $P = 0.002$ ; Spearman's  $R = 0.22$ ,  $P = 0.001$ ). Family size had no significant relationship with the frequency of exacerbation requiring emergency room attendance.



**Figure 1:** Distribution of allergic disorders among the asthmatic children with current allergies attending University of Nigeria Teaching Hospital Enugu

## DISCUSSION

This study has shown that allergic diseases, namely, allergic rhinitis, conjunctivitis, and dermatitis, which have been shown by other studies to be highly associated with asthma in children,<sup>[2-8,11,12]</sup> were also highly prevalent among children with asthma in our study. Oladeji *et al.*<sup>[11]</sup> reported high prevalence rates among a study population with age range of 14–34 years (mean 19 years), of 35.1% and 15.3% for allergic rhinitis and atopic dermatitis, respectively, which were similar to our finding. Similar prevalence has been reported among asthmatic children in both the high<sup>[3,4]</sup> and medium/low-income countries.<sup>[31,32]</sup> Related to this prevalence and the significant association with frequent asthma exacerbations suggest a possible role of allergy as a pathogenic factor in asthma and to asthma control.<sup>[4-6]</sup> The preponderance of cases of allergic rhinitis may suggest that the proximity of the nasopharynx to the lungs may be a significant factor in asthma symptoms more than other types of allergies such as allergic conjunctivitis and dermatitis.<sup>[33,34]</sup> Allergic reactions in nasal mucosa can potentially worsen asthmatic inflammatory processes in lower airways, due to what is described as the “unified airways.”<sup>[34,35]</sup> With the majority of our participants showing a progression/persistence of varied atopy symptoms from infancy further alludes to the possibility of “the allergic march” occurring in these children.<sup>[36,37]</sup>

Although the presence of genetic factors plays some role in asthma, many other factors such as social status and family size seem to interplay to determine asthma exacerbation frequency. The larger the family size, the lower prevalence of allergy and this may suggest a possible protective advantage due probably to repeated exposure to allergens among siblings and birth order.<sup>[36-41]</sup> Allergic diseases usually cluster in the same family,<sup>[9,42-44]</sup> and this was evident in our study population. Similar findings have been reported by Kalyoncu *et al.*<sup>[45]</sup> as well as Tabbara *et al.* in Bahrain.<sup>[46]</sup> The latter attributed this to the high incidence of consanguineous marriage, a practice which is not common in the studied population. The probable reason for the finding in this study could be the natural Mendelian transmission of disease with a variable degree of penetrance. Furthermore, the presence of atopy in many descendants (about a third of the children had family members with atopy and asthma history) seems to support this.

With regard to the impact of socioeconomic status on allergy with asthma, previous studies have been divergent in their views, while some support the finding in this study of the higher prevalence of allergy among the higher SEC,<sup>[47,48]</sup> which was in contrast to findings by other workers.<sup>[49,50]</sup> The preponderance

of allergy symptoms among children from smaller families and those from high SEC may suggest the effect of urbanization and adoption of “western habits.” Urbanization has been cited as a major risk factor for the increase in prevalence in developing countries.<sup>[51,52]</sup> This may also be the outplay of the “hygiene hypothesis” where lack of early childhood exposure to infectious agents and to symbiotic microorganisms and parasites are said to increase susceptibility to allergic diseases by suppressing the natural development of the immune system.<sup>[53]</sup> In particular, this lack of exposure is thought to lead to defects in the establishment of immune tolerance. Thus, with urban migration and urbanization of communities, there is a preponderance of allergic diseases and asthma. Irrespective of the study site being in the rural area (Ituku/Ozalla), there were proportionately more children from higher social class from urban areas with allergy. The skewness may suggest that the higher prevalence of allergy and asthma may be related to the impact of urbanization or a problem of access (financial) or possible poor health-seeking behavior of the rural dwellers.

The poor association between asthma control and allergy has been noted in other studies, and this suggests the possibility of other factors in asthma control.<sup>[37,52-57]</sup> Such factors as access to medication, environmental conditions which play some role in the treatment and control of the disease should be considered. In contrast, however, a study among children showed that allergic rhinitis worsens asthma control.<sup>[54]</sup> Moonie *et al.*<sup>[56]</sup> and Arabkhazaeli *et al.*<sup>[57]</sup> observed that children who had early onset wheezing episodes are associated with atopic asthma. Moonie *et al.*<sup>[56]</sup> and Arabkhazaeli *et al.*<sup>[57]</sup> studied patients from the USA and the Netherlands, respectively, where access to medications and care are better organized and could have been a reason for the contrast with our finding.

The significance of this study finding is the recognition of the high prevalence of allergy among children with asthma, which may play a role in informed pro-active prevention and control of asthma flare-ups. This study noted a higher percentage of children with allergic asthma among the urban population which further tends to support the effects of urbanization in the prevalence of asthma. This displays the role of population dynamics in the prevalence of diseases as low/middle countries move toward industrialization. Furthermore, the study showed that there are multi-lateral factors such as SEC and overcrowding, associated with asthma control besides allergic diseases.

The problem with recall bias where parents have to remember infancy history of their children and the

inability to objectively test for the allergens are noted limitations in this study. However, the use of ISAAC guidelines to ascertain the presence of allergies is an acceptable alternative for prevalent research. Furthermore, the limited sample size due to study population and selection method (from an existing asthma register), may have introduced some bias and therefore will require a larger prospectively designed community-based study to corroborate the findings and for a wider application.

## CONCLUSION

Allergic diseases are common in children with asthma in our environment, similar to what obtains in highly developed economies, but this did not significantly impact on asthma control. Socioeconomic factors such as urbanization and family size affect achievement of asthma control.

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## Conflicts of interest

There are no conflicts of interest.

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