Niger J Paediatr 2022; 49 (4):311 – 317

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Epidemiology and severity of bronchial asthma among school-aged children in Enugu State, South-East, Nigeria

DOI:http://dx.doi.org/10.4314/njp.v49i4.6

Accepted: 31th December 2022

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Abstract: *Background:* Bronchial asthma is a common chronic respiratory illness affecting all age groups but mainly children and constitutes a major global health problem. Higher prevalence has been noted in high-income countries with reports of increasing prevalence among the population in low-income countries of Asia and Africa.
Objective: To determine the epidemiology of bronchial asthma among school-aged children in rural and urban areas of Enugu State, Nigeria.
Methodology: A cross-sectional descriptive study of children aged 8 to 12 years selected by multistage sampling method from primary schools in the urban and rural communities in Enugu state of Nigeria was performed. Information was obtained from consenting parents/caregivers on probable asthma symptoms/signs using modified International Study of Asthma and Allergies in Childhood (ISAAC) questionnaire.
Result: An overall prevalence of bronchial asthma was 11.3%, with urban and rural areas respective prevalence of 13.1% and 11.2%. More males than females were affected in both communities (urban 13.4% vs 12.8% and rural 11.2% vs. 10.2%) respectively. Daytime wheezes (≤ 3 episodes per week) with school absence were the dominant cause of morbidity. History of atopic diseases was noted in 25.7% urban and 23.4% rural children.
Conclusion: There is a high prevalence of bronchial asthma among school aged children in our community particularly among the urban population. The need for more enlightenment programs for the public on the high prevalence of bronchial asthma in our locality as comparable with Western countries, some of its symptoms and its potential morbidity especially in our school-aged children. This may necessitate some general intervention like education on environmental modification to minimize trigger factors.

Keywords: Epidemiology, Severity, Bronchial asthma, School-aged children, Southeast Nigeria.

Introduction

Bronchial asthma is a chronic respiratory disease, which has significant morbidity among children globaly.[1,2] Global Burden of Asthma Report" estimates that nearly 50 million Africans currently have bronchial asthma,[3] the number could increase further to 100 million by 2025.

Epidemiologic surveys concerning the prevalence of bronchial asthma have documented that bronchial asthma is on the increase and is often not recognized especially at the mild end of the bronchial asthma spectrum. This increase is more in urban compared to rural areas and also in affluent compared to developing countries of the world.[2] For example: a study in Gambia in 1975 on over 1000 people had no case of bronchial asthma found; but a similar study in 1997 showed a prevalence of 3% in a rural Gambia population.[2]
This increase in prevalence informed the need for a "world asthma Day", currently held each year on the first Tuesday in May and sponsored by Global Initiative for Asthma (GINA).[3]

There has been increasing numbers of studies comparing prevalence of bronchial asthma worldwide. Recent studies reported that the prevalence of bronchial asthma and atopic diseases varied widely between and within countries, with affluent English speaking countries having the highest levels.[2,4] Above difference in prevalence was attributed to different allergen exposure, different environmental factors or different racial susceptibility.[5]Ethnic background, age, body mass index and residential area are significantly associated with atopic

symptoms and disease as shown in a Brazilian study done on adolescents.[6] Similarly in USA, a survey for risk factors of paediatric bronchial asthma was looked at for children 0 -17yrs, looking at race and environment and hypothesized that urban residence is an independent risk factor for childhood bronchial asthma after controlling for race, poverty and other environmental and demographic variables.[7,8]

Worldwide prevalence varies from one community to another; lower in rural areas. Oni and Erhabor in a cross-sectional study on 120 asthmatic patients in Bayelsa, Nigeria, noted bronchial asthma prevalence of 6.6% among respiratory unit patients;[9]Oviawe reported 0.7% among children in the rural community in Benin.[1,10] Case fatality rate is generally low, <1% worldwide, 0.83% in Benin series.[1,10] Girls are more often affected and whose ages are usually at or near puberty. Local airway resistance studies have also been done in Benin-city[10], Ibadan,[11] Lagos,[12] Sokoto[13]and Jos,[14]all of which support increase in airway resistance (bronchial asthma) of variable degrees across different regions of Nigeria.
This study aims to provide epidemiological information (prevalence, distribution and severity) on bronchial asthma among school-aged children residing in the urban and rural communities in Enugu State.

The advent of International Study of Asthma and Allergies in Childhood (ISAAC) and GINA started worldwide comparison studies with standardized instruments. These bodies have also been involved in advocacy and health education. They have brought to limelight the burden of bronchial asthma worldwide as to become of public health interest. Studies have shown great variability in the prevalence of bronchial asthma across regions of the same country and across countries of the world due to differential exposure to environmental factors, genetics, lifestyle and ambient air quality.[15, 16] It is likely that above variations may also exist between different settlements of the same region of a country i.e. rural and urban area especially from lifestyle and environment. Although interest has awakened for bronchial asthma studies in Nigeria, most studies have been done in the western and northern axis of the country. Little studies have been conducted in the eastern part of the country. There are no studies currently to the best of our knowledge that looked at local prevalence, demographics and severity of bronchial asthma, while comparing urban and rural settlements in Enugu or any other eastern sub region of Nigeria. The result is compared with similar studies done elsewhere in the world and trends determined.This invariably would help to improve the dearth of community based data available locally on childhood bronchial asthma.

Subjects and methods

Study area

This study was done in Enugu state, Nigeria. The State has a land area of approximately 8727.1 km², shares boundaries with Anambra, Ebonyi, Imo, Abia and Benue States, with an estimated population of 3,140,471 people who are predominantly of Igbo tribe.[17]Approximately 67.3% of economic activity in the state is centered on subsistence farming in the rural areas, while the urban population is essentially engaged in trading and public service employment.[17]

Study design

This was a cross-sectional, descriptive study of children aged 8 to 12 years who were selected from primary schools in the urban (Enugu city) and rural (Awgu) communities by multistage sampling technique. Information was obtained through parent/caregiver's administered modified ISAAC questionnaire.[15,18]The study was coincidentally conducted in harmattan season (January to February), when due to the dry, hot, extreme cold and dusty environment, bronchial asthma symptoms are expected to be evident. Using the sample size determination formula for proportions a total of 480 pupils distributed equally among the urban and rural communities were enrolled.

Selection methods

First, the seventeen (17) local government areas (LGAs) were stratified into two groups- urban and rural as earlier grouped. Then one urban (Enugu-North) and one rural (Agwu) LGAs were randomly selected by balloting.
In the second stage, two schools located in the urban area (Spring of Life and Bright Eyes Primary Schools) and two schools located in the rural area (Obodoakpu and Obute Memorial Primary Schools) were selected from the list of approved government and private primary schools.
In the third stage, the pupils aged 8-12yrs were drawn from classes 3-6, using the cluster sampling method. First simple balloting was used to choose one arm of 3A, 3B, 3C, 3D….etc, and then the whole class was sampled until the required number of 60 pupils (divided into 30 pupils for each of the two schools selected for each geo-location) was obtained. If one class is not up to 30 pupils in a particular school, another class from the remaining is obtained by repeat balloting and everyone in the class had equal chance of being chosen until the required number (30) was obtained. The same procedure was repeated for classes 4, 5 and 6 in each of the two schools selected, giving a total of 240 pupils for each of the selected LGAs.

The socioeconomic status of the families was determined using the methods described by Oyedeji.[17]The families were grouped into three categories: upper, middle and lower socioeconomic classes based on the father's occupation and mother's educational attainment. This initially gave groups one to five (I-V). Groups one and two(I &II) constituted the upper socioeconomic class; group three (III) constituted the middle socioeconomic class while groups four and five (IV & V) make

up the lower socioeconomic class.[19]

Study instrument and data collection

The study instrument was the parent/guardian administered modified International Study of Asthma and Allergies in Childhood (ISAAC) questionnaire. The ISAAC questionnaire is a standardized tool designed in 1991, validated in children[15,20]and adolescents[21]to promote standardized methodology and facilitate research into bronchial asthma, allergic rhinitis and eczema in childhood for worldwide uniformity and comparison. The questionnaires and consent forms were given to each child for their respective parents and retrieved on subsequent visits to the schools. Only those whose parents completed a written informed consent were recruited as participants. Where clarifications were needed contacts were made through visits or phone calls to address the issues raised. Ethical approval was obtained from the Health Research and Ethics Committee (HREC) of the University of Nigeria Teaching Hospital Enugu. For community and school entries written permissions were obtained from the Ministry of Education, the local government authorities and the school heads.

Data Analysis

Simple frequencies and proportions (percentages) were used for presentation of demographic data. Non-parametric, categorical variables like presence or absence of wheeze in the last 12 months, number of wheeze episodes in the last 12 months (categorized as 1-3; 4-12 &> 12 episodes) were compared between the urban and rural respondents, giving current bronchial asthma prevalence for age and geo-location, current bronchial asthma severity symptoms and morbidity pattern for geo-locations were compared using Chi-squared test corrected by Yates' method where necessary. Level of significance was regarded as less than 0.05 (< 0.05) at 95% confidence interval. The data collected was analyzed using the Statistical Package for Social Sciences (SPSS) version 16.0, by SPSS Inc. Chicago USA, 2007.

Results

In the urban area, of the three hundred and seventy (370) questionnaires distributed, only two hundred and forty-one (241) gave informed consent and completed the questionnaire, giving a participation rate of 65.1%, while in the rural area of the two hundred and sixty (260) questionnaires distributed, two hundred and forty-four (244) gave informed consent and completed the questionnaire, giving a participation rate of 93.9%. In all, 485 school children were enrolled, 241 from urban and 244 from rural communities.

Demographic and other characteristics of the study population

Table 1, shows nearly equal distribution of both sexes in the urban community while in the rural community there was a male preponderance to the ratio of 2.4:1. The mean ± (SD) age of the participants for urban was 8.53 ± 1.5 years, while it was 10.04 ± 2 years for rural subjects.

The parents/caregivers of the school children resident in the urban community had higher level of educational attainment with 90.1% of them having tertiary (post-secondary) education, 6% secondary, 3.4% primary and only 0.4% had no formal education while for the rural, 11.1% had post-secondary education, 25% secondary, 46.3% primary and 17.6% had no formal education ($p < 0.001$).

The socio-economic distributions of the urban study population were as follows: 57.6% in the upper class, 41.5% and 0.9% in the middle and lower socio-economic classes respectively. In the rural area the proportions of the different socioeconomic classes were as follows: 0%, 10.2% and 89.8% for the upper middle and lower classes respectively.

Table 1: Demographic Characteristics Distribution of Respondents

Demographic Characters	Urban N (%)	Rural N (%)
	118(49.0)	172(70.5)
	123(51.0)	72(29.5)
	1:1	2.4:1
Sex		
Mean Age (years ± S.D)	8.53 ± 1.5	10.04 ± 2.0
Total no of respondents. N (%)	241 (100)	244(100)

Atopy prevalence

Figure 1 shows individual distribution of some symptoms attributable to just allergy (atopy). As shown, 56 (23.3%) of the total urban respondents and 64 (26.3%) of the rural had current respiratory symptoms like cough, catarrh, sneezing, blocked nose with no statistically significant difference between geo-locations, ($p = 0.445$).

Among all the children studied 119 (24.53%) of them had probable atopic symptoms (one or more of the above atopic symptoms) with 62 (25.7%) in urban and 57 (23.4%) in rural respondents. The number of respondents that had ever wheezed (but not in the last 12months), was 21 (8.7%) in the urban and 21 (8.6%) in the rural with no statistically significant difference ($p = 0.856$), while dry cough at night without respiratory (breathing) problem like wheeze was reported in 39 (16.2%) of urban and 35 (14.3%) of rural participants, with no statistical difference, ($p = 0.783$).Further analysis to determine if any relationship exists between these atopic symptoms and the development of childhood asthma suggested no such relationship. For current respiratory symptoms/current asthma ($p = 0.602$); ever

wheezed (but not in the last 12 months) /current asthma (p =0.929)and dry cough at night without prior respiratory problem/current asthma (p =0.840).

Asthma prevalence

Overall, there were 55 children who were noted to have current asthma symptoms ('presence of wheeze in the last 12 months"), giving a general prevalence of 11.3%. Among the different communities, the prevalence was 13.1% and 12.2% respectively for the urban and rural populations respectively, as shown in Table 2. Asthma symptoms were more prevalent among the male population in the urban (13.4% vs 12.8%) and rural (11.2% vs 10.2%) areas (Table 3).

Table 4 shows that irrespective of areas of domicile and based on the total number of fifty five (55) children with symptoms suggestive of current bronchial asthma, "daytime symptoms of one to three episodes in the last 12 months" ranked highest amongst children with bronchial asthma with33 (60.0%) affectation. This was followed by symptoms after physical exercise with 26 (47.3%), speech difficulties due to difficulty in breathing in 19 (34.6%) and then night symptoms of 'less than one episode/week' in 18 (32.7%) of children with bronchial asthma.

The severity of bronchial asthma morbidity showed more statistical significance with sudden worsening of bronchial asthma symptoms requiring urgent medical attention (p=0.007)and school absenteeism (p=0.012) than any other measure of morbidity, as shown in Table 5. Sudden worsening of bronchial asthma symptoms, requiring urgent medical attention (acute severe asthma) in the preceding 12 months, had more statistically significant occurrence in the urban subjects 11 (39.3%) compared to 1 (3.7%) in rural subjects (p = 0.007). The average number of respondents with missed school days showed statistically significant difference more with the children in urban areas (1 to 3days) than those residing in the rural areas (4 to 12days) with p=0.012.. Hospital admissions as a result of bronchial asthma was seen in 6 (21.4%) urban respondents within the period but not seen in the rural counterparts.

Fig 1: Distribution of Atopic Symptoms by respondents

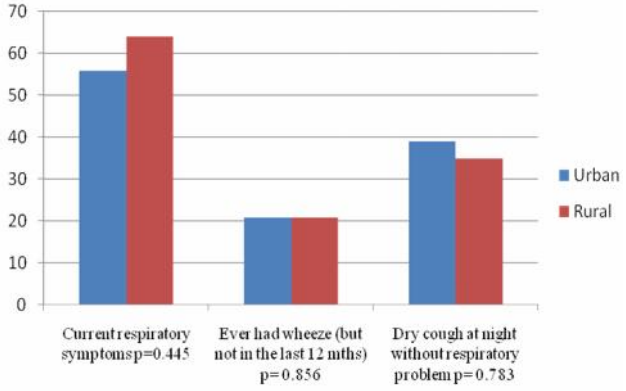

Table 2: Distribution of current bronchial asthma symptoms among different ages of children in geo-location

Age (years)	Geo-Location			
	Urban	n (%)	Rural	n (%)
8.00-8.99	54	7 (13.0)	31	5 (16.1)
9.00-9.99	55	5 (9.1)	35	4 (11.4)
10.00-10.99	53	10 (18.9)	57	2 (3.5)
11.00-11.99	48	4 (8.3)	44	6 (13.6)
12.00-12.99	2	0 (0.0)	53	9 (17.0)
Undocumented	2	2 (100.0)	1	1 (100.0)
Total	212	28 (13.1)	221	27 (12.2)

Table 3: Distribution of current asthma prevalence for sex and geo-location.

		Urban *Sex*		Rural *Sex*	
S/N	Characteristics of subjects.	Male	Female	Male	Female
1.	Total number of respondents to question (N)	97	102	169	69
2.	Number of respondents with current asthma (N)	13	13	19	7
3.	Prevalence of current asthma for sex (%)	13.4%	12.8%	11.2 %	10.2%

P-values(from X^2- chi square):
Male/Female (Urban) = 0.891
Male/Female (Rural) = 0.805
Male (urban/rural) = 0.602
Female (urban/rural) = 0.604

Table 4: Distribution of current asthma prevalence for severity and geo-location

Markers of asthma severity	Urban N (%)	Rural N (%)	p-value
No of wheeze episodes in the last 12 months (Day time)			
1-3 wheeze episodes	16 (57.1)	17 (63.0)	
4-12 wheeze episodes	3 (10.4)	6 (22.2)	0.049
>12 wheeze episodes	5 (17.9)	0 (0.0)	
No of night symptoms			
Less than 1 night/week	9 (32.1)	9 (33.3)	0.335
1 or more nights/week	10 (35.7)	5 (18.5)	
Symptoms (wheezes) causing speech difficulties in the last 12 months.	11 (39.3)	8 (29.6)	0.491
Symptoms (wheezes) after physical exercise in the last 12 months	14 (50.0)	12 (44.4)	1.000

NB: More severe symptoms of Asthma, including exercise induced asthma were noted more in the urban areas compared to rural areas

Table 5: Distribution of Asthma Morbidity Pattern.

Marker of asthma morbidity (frequency in days)	Urban N (%)	Rural N (%)	p-value
Limitation of physical activity like play in the last 12 months.			
1-3	6(21.4)	2 (7.4)	
4-12	4(14.3)	1 (3.7)	0.711
>12	1 (3.6)	1 (3.7)	
Everyday	0 (0.0)	0 (0.0)	
School absenteeism (missed school days) in the last 12 months.			
1-3	10(35.7)	1 (3.7)	
4-12	1 (3.6)	4(14.8)	0.012
More than 12 days	1 (3.6)	0 (0.0)	
Sudden exacerbation of symptoms requiring urgent medical attention in the last 12 months (acute severe asthma)			
1-2	8 (28.6)	0 (0.0)	
3-4	2 (7.1)	0 (0.0)	
5-10	0 (0.0)	1 (3.7)	0.007
> 10	1 (3.6)	0 (0.0)	
Hospital admission in the last 12 months (No of times)			
1-2	5(17.9)	0 (0.0)	Not
3-5	1 (3.6)	0 (0.0)	applica-
Others (>5)	0 (0.0)	0 (0.0)	ble
Total based	28(100)	27(100)	

Discussion

The overall prevalence of bronchial asthma among the study population is similar to current reports of asthma trend.[18,22,23] However, the prevalence in the rural community, though similar to 13.2% in 6-7 years and 11.0% in 13-14 years noted in rural Navarra, Spain[24] is higher than findings by most studies.[25-27] Other workers have found much lower prevalence among the rural community in Ghana, South Africa and in the middle East even as low as 0.14% and 0.7%.[23-25] Weinberg in South Africa, compare situations in urban and rural Zimbabwe, South Africa, Kenya and Ghana.[28]

The often-stated reason for the higher rates of bronchial asthma in the urban inhabitants relates to the presence of the known bronchial asthma triggers in the urban areas compared with the rural.[29,30] The hypothesis on the 'hygiene" effect on the prevalence of bronchial asthma[31,32] may partly be responsible for the comparatively higher figures in the urban community obtained in our study. The Hygiene Hypothesis was first described by Dr. David Strachan after observing that infants and toddlers were less susceptible to eczema and asthma compared to older siblings. He related this to increased transmission of infectious agents via unhygienic practices within a household. Later on, non-pathogenic commensal microorganisms were equally implicated leading to the term microbiota hypothesis as these produce immune-modulatory signals necessary to prevent immune-mediated chronic disorders like bronchial asthma. In as much as this hygiene hypothesis is supported by urbanization and epidemiological research of allergic diseases, it often fails to explain the new cases of bronchial asthma seen in poorer parts of the world.[31]

The reason for the high prevalence of childhood bronchial asthma in the present rural setting, even though corroborated in Spain[24], may not be obvious but may require a more robust in-depth (involving both gene and environmental analysis) study to unravel. There may be certain peculiarities like occupational activity, environmental pollutants in the present setting which a comparative study of rural communities may elucidate.

The male preponderance as shown in our study cuts across the localities of the respondents and is corroborated by findings in many other studies.[2,33,34] This male predominance has been speculated to be due to the genetic predisposition of males which increases their susceptibility to the development of bronchial asthma.[2,32] Generally, before the age of 15 years, the prevalence of bronchial asthma is more in males and reverses in favour of females after this age.[35] This could be attributed to the fact that males present with bronchial asthma symptoms early and sustain wheezing for a longer time making it more likely for them to be picked up as asthmatics.[36] However, there are prevalence studies like present study showing higher prevalence risk in males.[34,36,37] The higher number of male enrolled, particularly in the rural communities in our study could very well contribute to the male preponderance we observed. However, Brito and coworkers[37] in Brazil noted a higher male disposition to bronchial asthma among the younger age group which was not sustained after the age of 7 years.

Using the GINA classification for severity of bronchial asthma, majority of children studied had intermittent asthma. Place of domicile was associated with the status of the bronchial asthma symptoms. Nighttime symptoms, perceived to be more severe, was shown in our work to be more frequent among the children who live in urban areas as corroborated by other workers.[27,33] These differences in severity once more could be attributable partly to the hygiene hypothesis[31,32] which is thought to protect those who inhabit less hygienic areas, who due to early persistent exposure to allergens with consequent development of sensitization, are less likely to develop asthma symptoms. There is a high prevalence of atopic symptoms among the children in urban and rural areas similar to what was obtained by Faniran et al[18] in urban part of Nigeria and in Australia. However, in Turkeya lower prevalence of atopic symptoms was reported.[2] Our finding of no association of bronchial asthma with the common allergy symptoms is in alignment with the reports from other studies in Sweden, United Kingdom, United States of America and New

Zealand[38,39] The reason why having allergic symptoms does not significantly translate to developing bronchial asthma is not very clear but could be genetically mediated. Bronchial asthma may have a different gene locus even within the atopic spectrum as supported by Hernandez-Pacheco et al[40] validating fourteen(14) gene loci for asthma which include 17q21 locus, Zona pellucid binding protein 2 (ZPBP2), the risk (T)-allele and others. Considering the cluster of bronchial asthma symptoms (disease heritability) among relatives and even more in twins, genetic studies into bronchial asthma started about 44 years ago using linkage analysis and candidate-gene association studies until recently in the last 14 years when the newer method of Genome-wide association study (GWAS) was introduced. The results obtained by Hernandez-Pacheco et al[40] was based on GWAS done 4-5years ago.

Asthma Morbidity

This present study shows more of bronchial asthma morbidity in the urban community as school absenteeism, sudden exacerbation of asthma and even hospital admissions. The lower numbers of rural participants who sought medical attention or were hospitalized despite the presence of some symptoms connoting severity like night symptoms, speech difficulty and exercise induced symptoms among them, could be explained by the poor health seeking behavior, lack of facilities as well as alternate medical care.[32] The observation is similar to the findings of Faniran et al[18] who noted that urban Nigerian asthma patients are more likely to be managed in the acute form with more visits to hospital emergency units and more hospital admissions as compared to Australian counterparts who were on long term follow up as well as chronic controller medications when needed based on the asthma severity classification which the child falls into and reviewed at intervals with necessary adjustments.

Sampling school children may not give a true representation of the total population, thus household survey and indebt interview may be a better methodology though requiring lot of funding. Again with more funding, more communities could have been sampled and studied to correct for possible differences that may have occurred with our sampling and studying only one community each in the urban and rural areas.

Conclusion

This study has shown relatively high prevalence of childhood bronchial asthma in our community particularly among the urban population with varied modes of presentation. Health education and intervention measures should be targeted to these groups.

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