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ORIGINAL RESEARCH

Urban–Rural Differences in the Epidemiology of Asthma and Allergies in Nigeria: A Population-Based Study

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Purpose: Urbanization is associated with the risk of developing allergic conditions. Few studies have evaluated the urban–rural disparity of allergic diseases in sub-Saharan Africa.

Objective: To compare the epidemiology of adult asthma and allergies in urban and rural Nigeria.

Subjects and Methods: A population-based cross-sectional study was performed among 910 subjects in Kwara State, North Central Nigeria, comprising 635 urban and 275 rural adults who were randomly selected. We used standardized questionnaires for data collection.

Results: The age-adjusted prevalence of adults reporting a previous "asthma attack" or "currently taking asthma medication" within the preceding 12 months (ECRHS asthma definition) was 3.4% urban, 0.5% rural, current allergic rhinoconjunctivitis (26.2% urban, 22.2% rural), and current skin allergy (13.9% urban, 10.5% rural). The age-adjusted prevalence of "physician-diagnosed allergic conditions": asthma (3.3% urban, 1.5% rural), allergic rhinoconjunctivitis (4.9% urban, 3.2% rural), and skin allergy (4.8% urban, 4.6% rural) were higher in urban areas than in rural areas. Urban areas recorded a higher age-adjusted 12 months prevalence of wheezing, night waking by breathlessness, night waking by chest tightness, asthma attack (p=0.042), and current use of asthma medication (p=0.031) than the rural areas. In the urban areas, 81% of those with asthma significantly had current allergic rhinoconjunctivitis, and 40.5% had current skin allergy, whereas in the rural areas, all subjects with asthma had current allergic rhinoconjunctivitis and 12.5% had current skin allergy (p=0.482). The most common trigger for asthma attack/respiratory symptoms among the urban household was exposure to environmental smoke (17.2%), and among the rural household, it was dust exposure (18.2%). Living in urban areas significantly increased the odds of having asthma [aOR: 5.6 (95% CI:1.6–19.6)] and allergic rhinoconjunctivitis [aOR: 1.7 (95% CI: 1.2–2.4)].

Conclusion: This study shows that urban residents frequently reported more allergic and respiratory symptoms and were at risk of having asthma and allergic rhinitis compared to rural residents. The findings would assist the physicians in understanding the urban–rural differences in the occurrence of allergic conditions, symptom triggers, and comorbidity, which are relevant in patient's clinical evaluation, treatment, and disease prevention.

Keywords: urbanization, rural areas, asthma epidemiology, allergy, Nigeria

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Introduction

Asthma and other allergic diseases are rapidly increasing worldwide, especially in low and middle-income countries (LMIC), and require a pragmatic intervention plan.[1] Allergic diseases cause significant morbidity and

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a considerable burden on the health and medical systems of both developed and emerging economies.[2] Globally, 339 million people of all ages have asthma, and this estimate is expected to rise by 2025 with the majority of deaths in LMIC, while 400 million people suffer from rhinitis.[1] In Nigeria, the prevalence of asthma was 6.4%, atopic eczema (skin allergy) was 26.1%, and allergic rhinitis varied from 22.8–29.6% depending on the operational definition.[3–6] Greater than two-thirds of those with asthma suffer from allergic rhinitis.[4] Some genetic and environmental factors that influence a person's risks of developing allergic disorders have been identified.[1,7,8] In sub-Saharan Africa, urbanization has been reported as a risk factor for the development of allergic conditions.[9–11] Epidemiological studies have shown that endotoxins exposure theory is "possibly" a reason for the lower allergic asthma rates in children who grew up on traditional farms and rural settings.[12,13]

These observations support the "hygiene hypothesis," which suggests that exposure to infections early in life influences the development of a child's immune system along a "non-allergic" pathway, leading to a reduced risk of allergic diseases.[1] The process of urbanization, including changes in diet, sedentary, reductions in childhood infections, smaller families, and use of antibiotics, environmental pollution, and migration, has been associated with the higher prevalence of allergic conditions.[14] Other studies in high-income countries have attributed this observation to under-diagnosis in rural areas.[15,16] In contrast to the increasing role of urbanization, another study in the Niger Delta region of Nigeria found that urban children had a lower risk of rhinitis and asthma.[17] Except for the latter mentioned study, most asthma studies in the country were conducted in the urban academic hospitals, excluding the rural settings, which are an important segment of the health system.[18] To institute appropriate public health policies, intervention programs and reduce the impact of an allergic condition, there is a need to understand the epidemiology of allergic illness from different segments of society. This study evaluated the prevalence of allergic conditions, respiratory symptoms and triggers, and the association between urban residence and allergic diseases in an adult Nigerian population.

Methods

Study Design

This was a cross-sectional study carried out between June 2017 and March 2018. We obtained approval for the study protocol from the Kwara State Health Research Ethics Committees on 10th October 2017 with Ref no: MOH/KS/EC/777/120. This study was conducted in accordance with the Declaration of Helsinki. The community entry protocol involved notification of the Local Community Development Associations (LCDA), obtaining permissions from community leaders and key stakeholders to create awareness before study commencement. The community sensitization of the intended study was performed through the LGA representatives before study commencement. Furthermore, informed consent was obtained from the head of the household to gain access into their homes. Verbal and written consent through signature or thumbprint from those with no formal education were obtained from all the participants before data collection.

Study Setting

The study sites were urban and rural areas in Kwara state located in the Middle Belt, Nigeria. The urban population was Ilorin city consisting of Ilorin West and Ilorin East local government areas (LGA) and is the state capital of Kwara State. The LGAs were divided into enumeration areas (EAs) based on the census. The city has a population of 820,153 inhabitants based on the 2018 census estimation, making it the 7th largest city by population in Nigeria. Ilorin is a city that has two universities, one college/polytechnic, an international airport, several factories, and tourist attractions. Most of the inhabitants earn their living by artisanship, trading, and working in civil service. The rural study population consists of hamlets and villages in Ifelodun and ASA LGAs. The two rural LGAs have a population of 389, 918 with few towns and more than 80 villages. The majority of the people of this LGA practiced subsistence crop farming, animal husbandry, and petty trading to earn their living.[19]

Participants' Selection

The eligible participants must have continuously resided in either rural or urban areas for at least 12 months and consented to the study. Those who recently migrated were excluded from the study. Figure 1 shows the stratified random cluster sampling method used to obtain

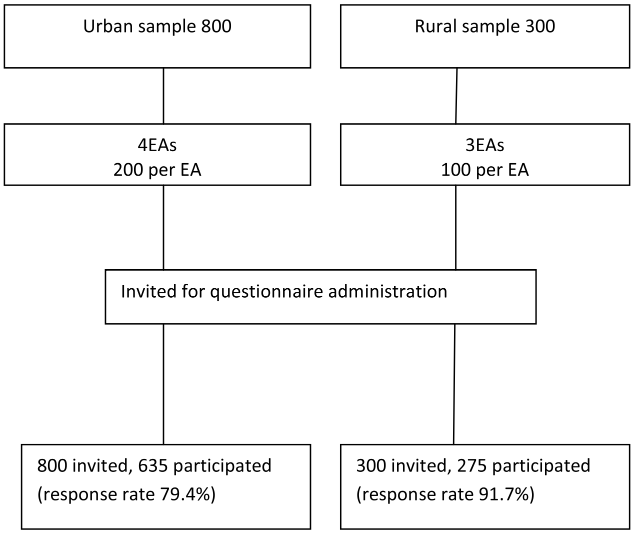

Figure 1 Sampling approach for participant selection.

a representative sample in the rural and urban areas. In Nigeria, an urban area is based on demographic criteria, referring to any settlement with a population greater than 20,000 persons or more and whose occupations are not mainly agrarian.[20] The sampling process was stratified into an urban and rural area, four urban EAs and three rural EAs were randomly selected, and then streets and villages were drawn from each of the selected urban and rural EAs proportional to the population of the study location. Five households were randomly chosen from the selected streets/villages, of which 2–3 subjects were selected per household, and the sampling was done in the morning and early afternoon. In one of two remote villages, due to security concerns and the safety of the field workers, the inhabitants and households were directed to assemble in a village meeting area, and the subjects were randomly selected. It is important to note that this particular village constitutes less than 10% of the total sample of the rural areas. See Supplementary Materials for the sample size calculation derived from previous study using an online calculator.[21,22]

Data Collection

We used the European Community Respiratory Health Survey (ECRHS) questionnaire to screen subjects aged ≥ 18 years for asthma, respiratory symptoms, and the International Study of Asthma and Allergies in Childhood (ISAAC) questionnaire for allergic rhinoconjunctivitis and eczema. Additional items on socio-demography and asthma trigger prevalent in the environment were included.[5,23–25] The questionnaires were translated and back-translated from English into the three major local Nigerian languages (Hausa, Igbo, and Yoruba) using a standard protocol, and piloted interviews were conducted within the households in English or any of the local languages. Data were collected face to face by trained fieldworkers who participated in data collection of previous asthma prevalence studies among university graduates.[26] Also, the field workers were given different audio recordings of wheezing stored on their mobile phones to verify reported wheezing and remove the variability in intercultural responses to the descriptive terms used for wheezing.

Operational Definitions

The lack of a uniform definition makes it impossible for accurate estimation of disease burden and international comparison of research findings.[26] We adopted broad operational definitions for asthma, allergic rhinoconjunctivitis, and skin allergy.[6,23–25] For asthma, we adopted the European Community Respiratory Health Survey (ECRHS) standard asthma screening questionnaire and criteria 1) asthma was defined as reporting an "attack of asthma" in the last 12 months or "currently taking any medicines" including inhalers, aerosols, or tablets. 2) World Health Organization (WHO) clinical asthma was defined as reporting any previous "physician-diagnosed asthma", or reporting an "attack of asthma" in the last 12 months or "currently taking any medicines". Wheezing was defined as the presence of symptoms of recurrent "wheezing or whistling" in the last 12 months preceding the study. Current allergic rhinoconjunctivitis was determined based on positive answers to both these questions: "In the past 12 months, have you had a problem with sneezing or a runny or blocked nose when you did not have a cold?" and if yes, "In the past 12 months, has this nose problem been accompanied by itchy watery eyes?" Current skin allergy (eczema) were estimated based on positive answers to two questions: "Have you had this itchy rash at any time in the past 12 months?" and "Has this itchy rash at any time affected any of the following places: the folds of the elbows; behind the knees; in front of the ankles; under the buttocks; or around the neck, ears, or eyes?" The physician-diagnosed allergic diseases were defined as a self-report of previous physician diagnosis of asthma, skin allergy, or rhinoconjunctivitis/nasal allergy. "Ever had an allergic disease" was defined as a positive affirmation to the question, have you ever had asthma, skin allergy, or rhinoconjunctivitis/nasal allergy? Allergic multi-morbidity was defined as a self-report of two or more allergies. Smoking was defined as smoking at least 100 sticks of cigarettes in a lifetime or at least one cigarette per day or one cigar a week for one year. Parental smoking was defined as having a father or mother, or guardian who smoked regularly at home.[3,6,23–25]

Data Analysis

All analyses were performed using Statistical Package for Social Sciences (SPSS)/IBM version 23. Missing values were limited to a small number of observations and less than 2% and were excluded from the analyses. Descriptive and frequency statistics were generated to examine demographic and other clinical variables. We calculated prevalence for asthma, allergic rhinoconjunctivitis, and skin allergy and respiratory symptoms by dividing the number of positive responses to each question on respiratory symptoms or the number that met the allergic disease definition by the number of completed questionnaires. The National Population Commission of Nigeria, Kwara state age and sex composition were used as the standard population.[27] Prevalence estimates were age-adjusted for comparison between UAs and RAs. To determine the sex-adjusted prevalence estimates, we used the gender distribution from the standard population. After deriving the prevalence estimates, 95% confidence intervals were calculated by the Wilson score interval method. The data set were stratified for potential confounding variables. Logistic regression analysis was performed to obtain the adjusted odds ratios (OR) and 95% confidence interval (95% CI) to predict the risk of allergic disease in different settings. A p-value less than 0.05 was considered statistically significant.

Results

General Characteristics of the Subjects

One thousand and one hundred subjects (300 rural and 800 urban) were invited to participate in the survey, out of whom 910 subjects were enrolled giving an overall response rate of 82.7% (91.7% rural and 79.4% urban). There was no significant difference in sociodemographic variables, smoking status, and asthma medication use between excluded and enrolled participants. Of 910 subjects, 635 were from urban areas, 275 were from rural areas, and the mean age was 33±13 years. Almost two-thirds of the respondents were females. The subjects selected from the rural areas were significantly older, less educated, smoking tobacco, and married than those recruited from the urban areas. Participants' baseline characteristics are shown in Table 1.

Age-Adjusted Prevalence of Asthma and Allergic Conditions

Table 2 shows that the prevalence of asthma defined by different definitions (ECRHS, WHO, and physician-diagnosed asthma), allergic rhinitis, and skin allergy was higher in the urban areas (UAs) than in the rural areas (RAs). Asthma, allergic rhinitis, and skin allergy were more common below the age of 40 and decreased with increasing age in both the UAs and RAs. Also, the prevalence of asthma and skin allergy was slightly higher among women in the RAs; these figures, however, were not statistically significant (Table 3).

Prevalence of Age-Adjusted Respiratory Symptoms

Regarding respiratory symptoms, we found that except for nocturnal cough in the last 12 months, respiratory symptoms were frequently higher in the UAs than in the RAs. In the last 12 months, asthma attacks and the use of current asthma medication were significantly higher in the UAs than in the RAs (Table 4). Environmental smoke, dust, and tobacco smoke exposure were the leading three triggers of respiratory symptoms in both UAs and RAs. Dust exposure was the most common trigger of asthma attack/ respiratory symptoms in the RAs, while exposure to environmental smoke was reported as the most common trigger in the UAs (Figure 2).

Allergic Multimorbidity

In the UAs, 80.6% of subjects who met WHO defined asthma had current allergic rhinoconjunctivitis, $p<0.01$, and 40.5% had current skin allergy, $p<0.01$. Furthermore, of those that met the ECRHS definition of asthma, 80.6% had current allergic rhinoconjunctivitis, $p<0.01$, and 41.9% had current skin allergy, $p<0.01$. In the RAs, 100% of subjects with asthma had current allergic rhinoconjunctivitis ($p<0.001$) irrespective of the definitions, while 12.5% had current skin allergy ($p=0.482$).

Association Between Allergic Disease and Urbanization

Table 5 shows that living in UAs was associated with asthma using the ECRHS definition, with an adjusted odd ratio (OR) of 5.6 (95% CI: 1.6–19.6). Similarly, the other asthma

Table 1 General Characteristics of the Subjects

Characteristics	Urban N=635	Rural N=275	Total N=910	p values
Mean (yr) Age ± Std	31±12	38±16	33±13	<0.001
Sex				
Male	266 (41.9)	100 (36.4)	366 (40.2)	0.118
Female	369 (58.1)	175 (63.6)	544 (59.8)	
Educational level				
No formal	27 (4.3)	44 (16.0)	71 (7.8)	<0.001
Primary	82 (12.9)	82 (29.9)	164 (18.0)	
Secondary	200 (31.5)	103 (37.5)	303 (33.3)	
Tertiary	326 (51.3)	46 (16.7)	372 (40.9)	
Marital Status				
Married	313 (49.3)	171 (62.2)	484 (53.2)	<0.001
Single/divorced	322 (50.7)	104 (37.8)	416 (46.8)	
Tribe				
Yoruba	544 (85.7)	197 (71.6)	741 (81.4)	<0.001
Hausa	19 (3.0)	45 (16.4)	64 (7.0)	
Igbo	16 (2.5)	5 (1.8)	21 (2.3)	
Others	56 (8.8)	28 (10.2)	844 (9.2)	
Multi-allergy				
One	180 (28.3)	93 (33.8)	273 (52.3)	0.030
Two	96 (15.1)	52 (18.9)	148 (16.3)	
Three	12 (1.9)	1 (0.4)	13 (1.4)	
Ever asthma	39 (6.1)	8 (2.9)	45 (5.2)	0.043
Ever nasal allergy	162 (25.5)	103 (37.5)	265 (29.1)	<0.001
Ever skin allergy (eczema)	131 (20.6)	73 (26.5)	204 (22.4)	0.049
Physician diagnosed asthma	31 (4.9)	8 (2.9)	39 (2.3)	0.177
Physician diagnosed allergic rhinoconjunctivitis	46 (7.2)	19 (6.9)	65 (7.1)	0.857
Physician diagnosed skin allergy (eczema)	43 (6.8)	28 (10.2)	71 (7.8)	0.078
Cigarette smoking	38 (6.0)	28 (10.2)	66 (7.3)	0.025
Parental smoking	53 (8.3)	30 (10.5)	83 (9.1)	0.218
Use of alcohol	51 (8.1)	32 (11.6)	83 (9.1)	0.085

Note: Results are expressed in number and % in parentheses.

definitions were all significantly associated with living in urban areas. The risk of allergic rhinoconjunctivitis defined by either current symptom of AR or previous physician diagnosis was not increased by living in the urban areas; however, the odd was increased with ever had allergic rhinoconjunctivitis, the adjusted OR was 1.7 (95% CI: 1.2–2.4). Urbanization was not associated with skin allergy irrespective of the adopted definitions of skin allergy.

Discussion

The results show that the age-adjusted prevalence of asthma, allergic rhinoconjunctivitis, and skin allergy by different definitions were higher in UAs than in RAs. A significant proportion of asthma subjects had current allergic rhinoconjunctivitis in urban and rural areas and current skin allergy in the UAs. Living in UAs significantly increased the risk of having asthma and allergic rhinoconjunctivitis.

Table 2 Age-Adjusted Prevalence of Allergic Disorders by Sites

Characteristics	Urban N=635	Rural N=275	Total N=910	*p* values
Possible asthma	11.7 (9.2–14.2)	10.2 (6.6–13.7)	12.7 (10.5–14.9)	0.511
WHO clinical asthma	4.0 (2.0–4.7)	1.5 (0.7–3.0)	3.8 (2.5–5.1)	0.050
ECRHS asthma definition	3.4 (2.5–5.5)	0.5 (0–1.4)	2.9 (1.8–3.9)	0.011
Current allergic rhinoconjunctivitis	26.2 (22.7–29.6)	22.2 (17.3–27.1)	28.4 (25.5–31.3)	0.201
Current skin allergy (eczema)	13.9 (11.2–16.6)	10.5 (6.9–14.2)	14.5 (12.2–16.8)	0.160
Physician diagnosed asthma	3.3 (1.9–4.6)	1.5 (0.7–3.0)	3.7 (2.5–4.9)	0.128
Physician diagnosed allergic rhinoconjunctivitis	4.9 (3.2–6.6)	3.2 (1.1–5.3)	5.0 (3.6–6.4)	0.250
Physician diagnosed skin allergy (eczema)	4.8 (3.2–6.5)	4.6 (2.1–7.0)	5.4 (3.9–6.9)	0.896

Notes: Results are expressed in adjusted odd ratio with 95% CI in parentheses. ECRHS asthma definition: reporting a previous asthma attack or currently taking asthma medication within the preceding 12 months. Possible asthma: reporting shortness of breath or asthma attack in the preceding 12 months or currently taking asthma medication. ISACC Current allergic rhinoconjunctivitis: reporting sneezing or a runny or blocked nose in the absence of a cold accompanied by itchy watery eyes in the past 12 months. ISACC Current skin allergy (eczema): reporting rash at any time in the past 12 months and has affected any of the following places: the folds of the elbows; behind the knees; in front of the ankles; under the buttocks; or around the neck, ears, or eyes.

Table 3 Age-Adjusted Prevalence of Allergic Disorders by Site and Sex

Age group (in years)	Asthma urban	Asthma rural	AR urban	AR rural	Skin allergy urban	Skin allergy rural
18–19	1.4	–	9.9	–	5.2	–
20–29	0.8	0.2	6.4	8.9	4.2	5.3
30–39	0.3	–	4.4	4.8	2.0	2.1
40–49	0.3	0.2	3.1	3.2	1.5	0.9
50–59	0.1	0.2	1.9	3.0	1.0	1.2
60–69	0.1	–	0.5	0.7	0.1	0.5
70–79	–	–	–	0.9	–	–
80+	–	–	–	0.7	–	0.7
Sex						
Male	2.5	1.0	19.3	24.8	10.0	9.9
Female	2.6	1.7	18.4	22.9	10.7	13.1

Note: Results are expressed in %.
Abbreviations: AR, Allergic Rhinitis.

Table 4 Age-Adjusted Prevalence of Asthma and Respiratory Symptoms by Site

Asthma and respiratory symptoms	Urban N= 635	Rural N=275	Total N=910	*P* values
Wheezing in last 12 months	10.1 (7.8–12.4)	7.8 (4.6–10.9)	10.8 (8.8–12.8)	0.275
Woken by SOB in last 12 months	10.7 (8.3–13.1)	10.0 (6.5–13.5)	11.8 (9.7–13.9)	0.787
Woken by cough in last 12 months	13.4 (10.8–16.1)	13.6 (9.5–17.7)	14.7 (12.4–17.0)	0.935
Woken by chest tightness in last 12 months	9.6 (7.3–11.9)	7.6 (4.5–10.8)	10.1 (8.2–12.1)	0.333
Asthma attack in last 12 months	2.5 (1.3–3.7)	0.5 (0–1.4)	2.1 (1.2–3.0)	0.042
Current asthma medication	2.7 (1.4–3.9)	0.5 (0–1.4)	2.3 (1.3–3.3)	0.031
Current nasal allergy	26.2 (22.7–29.6)	22.2 (17.3–27.1)	28.4 (25.5–31.3)	0.201

Notes: Results are expressed in adjusted odd ratio with 95% CI in parentheses. Current nasal allergy – Do you have any nasal allergies?

We found that UAs had an age-adjusted prevalence of asthma of 3.4% compared to less than 1% in the RAs. Also, a similar trend in urban–rural disparity was noted for allergic rhinoconjunctivitis and skin allergy, and these results were regardless of disease definitions used in the study. This pattern was significant for asthma than the other allergic conditions and is in keeping with other studies in low and high-income countries.[9–11,15,28–32] The urban–rural gradient might be attributed to several factors like westernized diet, obesity, sedentary lifestyle, outdoor pollutants, and indoor pollutants from

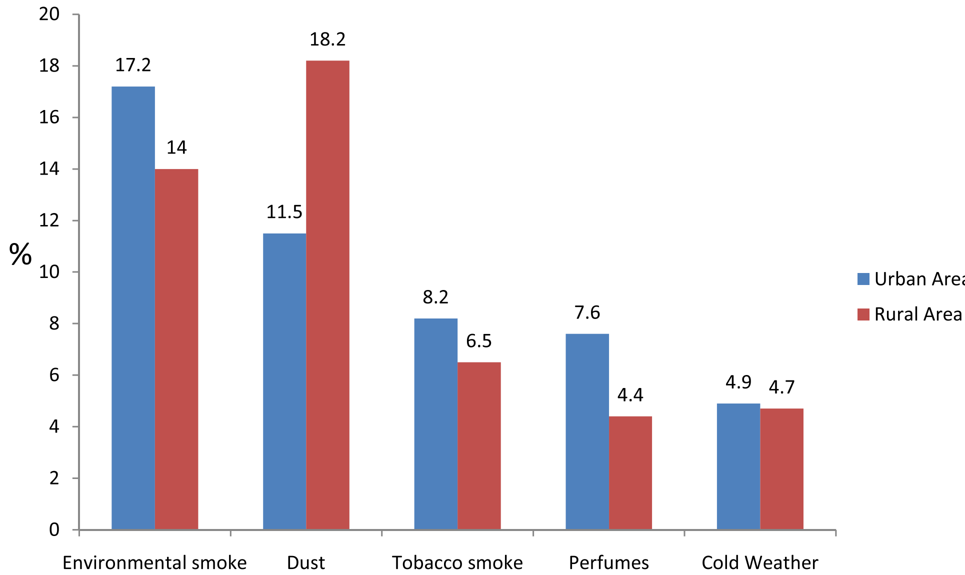

Figure 2 Asthma/allergic respiratory symptoms triggers.

increasing industrialization and migration. Some of these characteristics of urbanization were associated with asthma in a previous study in the same urban setting more than ten years ago.[8] Alternatively, it has been postulated that those who resided solely in UAs have reduced early life exposure to environmental agents, which may lead to a lowered allergic response.[1,2,31,32] On the other hand, another previous study in high-income countries noted a contrasting result and concluded that this discrepancy is due to the underdiagnosis of allergic conditions due to poor access to medical care.[33]

Regarding allergic respiratory symptoms, until recently, few epidemiological studies in Africa and other parts of the world have observed that symptoms were higher among the urban households than the rural ones,[9,11,34,35] and the results from the present study are similar. These differences were significant for an asthma attack in the last 12 months and current asthma medication. Contrary to these reports, two different studies conducted in Turkey reported a higher prevalence of symptoms for asthma, rhinitis, and eczema.[33,36] It has been argued that having close animal contact and feed exposure, living in houses with mud flooring, and exclusively breastfeeding an infant for at least six months as it is found in the most rural areas,[37,38] may protect against respiratory allergies and atopic sensitization even in adulthood provided they continue to reside in those areas.[1,30]

In this study, the most common trigger for asthma attack /respiratory symptoms among urban households was exposure to environmental smoke, while dust exposure was for rural households. The predominance of environmental smoke in the UAs can be due to traffic and industry-related air pollution, which cause airway inflammation, sensitization, and frequent asthma attacks and respiratory symptoms than in the rural areas. This observation supports a previous study that found an association between allergic conditions and outdoor and indoor pollution.[8] Dust exposures in the RAs can be attributed to dusty grains from agricultural produce processing and dust from sweeping house floors that are not fully cemented.[38]

Our study also showed that those living in the UAs significantly had increased odds of developing asthma by nearly six-folds and that of rhinitis by roughly two folds compared to those living in the RAs. These findings are highly consistent with other studies from sub-Saharan Africa, Latin America, and high-income

Table 5 Association between Urbanization and Allergic Disease

Residence of subjects	Asthma	Allergic rhinitis	Skin allergy
Residing in urban areas	5.6 (1.9-19.6)	1.7 (1.2–2.4)	1.01 (0.7–1.8)
Residing in rural areas	1	1	1

Notes: Results are expressed in adjusted odd ratio with 95% CI after adjusting for cofounders. Asthma was defined by ECRHS asthma definition. AR and skin allergy was defined as Ever AR and EC, respectively.

countries.[9,11,30–32] Rodriguez et al, in a recent systematic review of the urban–rural differences in asthma prevalence, reported that urban residence has a higher prevalence and two-fold risk of having asthma, regardless of the operational definitions.[13] Our findings are in contrast to previous studies in Turkey.[33,36] Neither residing in the UAs nor the RAs seems to make much difference in the development of skin allergy. This observation may warrant further studies to corroborate this finding.

Study Limitation

There were some limitations associated with this study that need to be considered. Firstly, the major limitation of this study is the cross-sectional design, which precludes inferring causality of asthma due to urbanization, except through a longitudinal study. Secondly, the self-reported outcome measures depend on subjects' ability to recall symptoms, their level of literacy, and health care accessibility. These factors may cause over/underestimation and must be considered in interpreting results, for example, physician-diagnosed asthma. Also, asthma might have been misclassified because taking inhalers, aerosols, or tablets does not mean that the patient has allergic conditions. Misclassification cannot be ruled out without any objective measure to test airway hyperresponsiveness, such as methacholine challenge tests and skin allergy tests. Thirdly, the ECRHS and ISAAC questionnaires and urban and rural residency definitions were not validated in our setting. The validation might be warranted in a future study to determine the subject's actual residency because of the back and forth migration from urban to rural areas and vice versa and their responses to question items. In addition, we could not obtain door to door sample of the households in one out of 2 remote villages selected due to safety concerns. As a result, the inhabitants were assembled in a village meeting area and randomly selected.

Consequently, sick or more isolated individuals might not walk to the village center. Likewise, some elites denied the field workers entry into their homes for safety concerns in UAs; they constitute less than 5% study population. These drawbacks might have contributed to the differences in the sampled population of rural and urban areas and bias. Finally, we did not determine the remoteness of the location, eg, hamlets, villages, some risk factors for allergic conditions such as pollution from indoor cooking (without good ventilation), housing condition, obesity that might give more insight into the interpretation of the results. Despite these limitations, this study has provided an overview of the epidemiology and association of urban residence with allergic diseases. It would serve as a template for further research that would examine the specific characteristics of the urbanization process responsible for allergic disorders.

In conclusion, this study shows that urban residents frequently reported more allergic and respiratory symptoms and were at risk of having asthma and allergic rhinitis compared to rural residents. The result of this study would add to the existing knowledge on the epidemiology of allergic disease and assist in formulating appropriate public health policies. In medical practice, it would assist the physicians to understand the urban–rural differences in the occurrence of asthma and allergies, symptoms triggers, and comorbidity which are relevant in clinical evaluation, treatment, and disease prevention.

Disclosure

The authors report no conflicts of interest in this work.

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