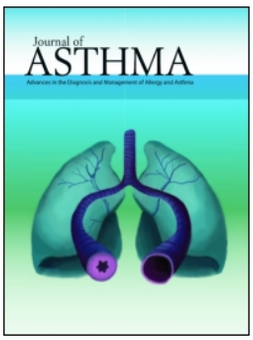

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Prevalence of asthma and respiratory symptoms during pregnancy in the middle belt of Nigeria

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ABSTRACT

Background: Information about the burden of asthma during pregnancy in Africa is scarce.
Objectives: To determine the prevalence of asthma and respiratory symptoms in pregnancy in Ilorin, Nigeria.
Methods: This study uses the European Community Respiratory Health Survey (ECRHS) questionnaire and definitions to screen 870 pregnant women attending three hospitals for asthma.
Results: The prevalence of possible asthma (i.e. awakened by shortness of breath, asthma attack(s) in the last 12 months, or currently taking asthma medication) was 2.1% (95% CI: 1.3–3.1%), physician-diagnosed asthma was 1.0% (95% CI: 0.5–1.7%), and current asthma (asthma attack in the last 12 months and currently taking asthma medication) was 0.7% (95% CI: 0.2–1.3%). The prevalence of respiratory symptoms ranged from 0.6% (95% CI: 0.1–1.1%) for wheezing without cold to 12.9% (95% CI: 10.7–15.2%) for nasal allergies. Less than 1% reported an asthma attack and using asthma medication in the last 12 months. None of the pregnant women smoked tobacco during pregnancy. Pregnant women with possible asthma experienced more respiratory symptoms and worsening symptoms than those without asthma (15.8% vs. 3.9%), and the most reported symptom was being awakened by shortness of breath. The majority (55.6%) with physician-diagnosed asthma had suffered an asthma attack in the current pregnancy with a median of two attacks.
Conclusion: The prevalence of asthma and respiratory symptoms in pregnancy in this sample was low, but we observed an increase and worsening of respiratory symptoms during pregnancy in those with asthma. Hence, the priority of clinicians should be disease control to prevent feto-maternal morbidity and mortality.

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Asthma; pregnancy; respiratory symptoms; wheezing; asthma attack; asthma medication; Africa

Introduction

Asthma is by far the most common respiratory disease experienced during pregnancy (1). Globally, it is a chronic respiratory disease affecting 1–18% of the population in various countries. In Nigeria, the prevalence rates range from 3–18% (2–10). This wide variation is attributed to inconsistent operational definitions and various study populations (11). The burden of asthma has been growing over the past three decades, particularly in low- and middle-income countries (2).

If it is severe and not well managed, asthma in pregnancy may be associated with significant risk for feto-maternal morbidity and mortality (1,2,12). Uncontrolled asthma in pregnancy is associated with hyperemesis, preeclampsia, preterm birth, low birth weight, intrauterine growth restriction, congenital malformations, and perinatal mortality (13,14). If asthma in pregnancy is well managed, the perinatal prognosis for children born to women with asthma is comparable to women without (2). However, the course of asthma may worsen, improve, or remain unchanged during pregnancy, and several reports have revealed that these various courses occur with approximately equal frequency (15–17).

The pathophysiologic mechanisms responsible for the altered course of asthma during pregnancy are

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unknown, however, may be due to mechanical or hormonal changes during pregnancy. The altered course of asthma during pregnancy may also be due to safety issues that arise from concerns that some asthma medications, such as inhaled corticosteroids (ICS) and β-agonists affect pregnancy outcomes, which has been disapproved by many studies (18–21). Notwithstanding, most pregnant women and physicians either stop or reduce asthma medications due to safety concerns and physicians' inadequate knowledge of asthma management and the perceived safety of most asthma medications (22–23).

Asthma complicates 8% of pregnancies in the United States (US) and 4.1% of them experience an asthma attack (24). In fact, most pregnant women who visit a pulmonologist as a result of dyspnea are asthmatics or probable asthmatics (25). The majority of available data on asthma prevalence during pregnancy are estimates and retrospective chart reviews from the US, Australia, and European countries (24,26–30). However, few questionnaire-based studies have examined the actual burden and treatment of asthma during pregnancy in developing countries (31,32). There is an information lacuna on the burden of asthma in pregnancy in sub-Saharan Africa.

The previous asthma study in the same general population observed a high asthma prevalence of 15.2% (5), and, by extrapolation, it was expected that the prevalence of asthma to be high among pregnant women (5). Therefore, it is hypothesized that the prevalence of asthma and respiratory symptoms during pregnancy is high in this study's population of pregnant women attending antenatal clinics in Ilorin, the Middle Belt of Nigeria. The purpose of this study was to determine the prevalence of asthma and respiratory symptoms amongst pregnant women attending the antenatal clinics in Ilorin, the Middle Belt of Nigeria.

Materials and methods

Study design and setting

This study involved a cross sectional hospital based survey of pregnant women from January to June 2017 at the antenatal clinics of three hospitals located in the city of Ilorin, Kwara State, Middle Belt of Nigeria. The three hospitals were the University of Ilorin Teaching Hospital, State Specialist Hospital, Sobi, and the General Hospital. Ilorin is the capital of the Kwara State, which is located in the Middle Belt region of Nigeria. These hospitals provide primary and tertiary healthcare services to the residents of the city. The city is a confluence of cultures and is populated by the Yoruba people, as well as other Nigerians and foreign nationals. As of the 2006 census, it had a population of 777, 667, making it the seventh largest city by population in Nigeria. However, it is less industrialized and urbanized when compared with other cities like Lagos, Port Harcourt, and Kano.

Sample size and method

The calculated sample size was obtained using online statistical software from Raosoft Incorporated (33). With a study population of 11,900 pregnant women, a confidence level of 95%, an acceptable margin of error set at 1%, and an expected (proportion) prevalence of 2.1% was obtained from a similar study in India (31), the minimum calculated sample size of 683 was obtained. This sample size was increased by 30% to 890 to account for non-response and poorly completed questionnaires. The final sample size of 890 was allotted to the three sites using proportional allocation, in which the number of participants selected from each site was determined by their number relative to the entire study population (Figure 1).Trained assistants used systematic random sampling to select the number of pregnant women from each hospital.

Participants recruitment

The inclusion criteria were as follows: participant must be confirmed to be pregnant, reside in Ilorin, and not be using any medication that may affect the respiratory system, such as beta blockers. Participants were excluded if they were unwilling to participate in the study and had either of the following conditions: maternal or fetal distress, tuberculosis, chronic obstructive pulmonary disease, high blood pressure, or heart failure.

Data collection

The European Community Respiratory Health Survey (ECRHS) screening questionnaire was used, which included questions on asthma (34–36). The English version of the questionnaire was translated into the Yoruba language using conventional procedures for translation, including forward and backward translation, as well as reconciliation to ensure that there were no discrepancies between the two versions. The Yoruba version of the questionnaire was pre-tested and piloted among 50 women for clarity; however, it has not been validated in the country. Participants

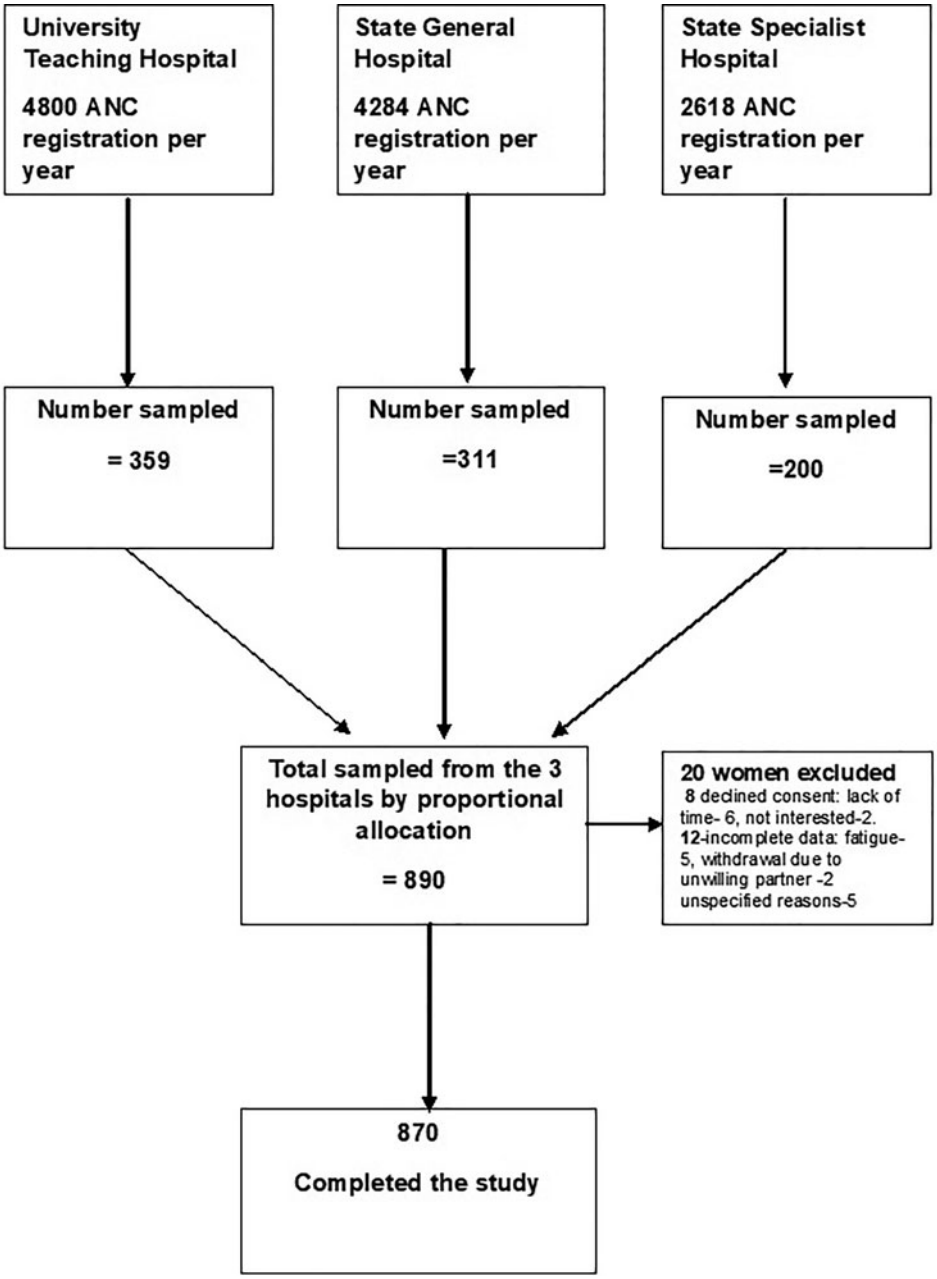

Figure 1. Flowchart of the proportional sampling of the pregnant women.

were interviewed using the English or Yoruba version depending on their language preference. The questionnaire was administered face-to-face by trained assistants and a certified data manager who were subjected to classroom and audiovisual training before the administration of the questionnaire to ensure credible collection of data. Furthermore, trained assistants were given various audio recordings of wheezing which were shown to the participants to correlate the recordings with reported wheezing and to remove the variability in intercultural responses to the descriptive terms for wheezing. The participants were shown common asthma medications (tablets and inhalers) available in the country to assist them in understanding questions about asthma medication. Socio-demographic profiles, parity, reported asthma symptoms, and attacks in the past 12 months, asthma medications, history of allergies, and family history of allergies were also obtained, along with a previous history of physician diagnosis of asthma and a history of active and secondhand cigarette smoking and the use of biomass fuel.

Operational definitions

The operational definitions of asthma and respiratory symptoms, as well as tobacco smoking, were adopted

from the ECRHS protocol previously described in detail (34–36). Asthma was defined using three definitions: possible asthma was defined as the presence of either an attack of shortness of breath, an attack of asthma in the last 12 months, or use of asthma medication. Current asthma was defined as reporting an attack of asthma in the previous 12 months or currently taking asthma medications. Physician-diagnosed asthma was defined as ever having had asthma that a doctor confirmed by diagnosis. Asthma-related symptoms include (1) wheezing or whistling in the chest, (2) having been awakened with a feeling of tightness in the chest, (3) having been awakened by an attack of shortness of breath in the last 12 months, or (4) a cough at night in the last 12 months. Respiratory symptoms include asthma-related symptoms with nasal allergies. We defined secondhand smoke (SHS) exposure as regular exposure to tobacco smoke in the last month in their homes (37,38). Exposure to biomass fuel was defined as households using biomass fuels (firewood, charcoal, and agricultural waste) with traditional stoves or indoor cooking with biomass fuel (39).

Data analysis

The collected data were entered into a computer by two trained data entry clerks. One operator entered the data, which was cross-checked by the second operator, and corrections were made when necessary. Quality assurance procedures were performed by a random verification of completed forms in the field and after data entry by the data manager. The data were cleaned and analyzed using statistical package for the social sciences (SPSS) version 21. The missing categorical variables were treated as a separate category, while the continuous variables were handled by a predictive model or multiple imputations. Frequency and mean with standard deviations were generated to examine the characteristics of the study population in relationship to demographic and other clinical variables. The prevalence rates were presented with a 95% confidence interval (95% CI). A Chi-square test, χ^2 was used to determine the level of significance between two or more variables, and Fisher's exact test was used if the expected frequency in a cell of a table was less than 5.

The worsening of asthma symptoms was adjusted for biomass fuel and secondhand tobacco smoke exposure by multiple logistic regressions. The regression model was used to estimate the association between possible asthma and worsening symptoms by calculating the probability of worsening symptoms. Based on this model, the number of worsening symptoms associated with possible asthma was estimated by applying the multivariate parameter estimate to the mean values of those women without asthma and then recalculating the probability of worsening symptoms in those with possible asthma. A p values less than 0.05 was considered statistically significant.

Ethics research approval

The study was approved by the ethics and research committees of the Kwara State Ministry of Health, Ilorin, and the University of Ilorin Teaching Hospital. We acquired informed consent to participate in the study from each of the enrolled participants.

Results

General characteristics of the study participants

During the enrollment period, 890 eligible participants were approached in the three hospitals, and 870 (97.8%) were enrolled. Of the 20 participants we did not enroll, eight declined to participate due to lack of time ($n = 6$) and interest in the study ($n = 2$). Twelve participants did not complete the questionnaire due to fatigue ($n = 5$), spousal advice ($n = 2$), and unspecified/personal reasons ($n = 5$) and were excluded from the study. The non-responders were equally distributed across the three sites and age groups. The mean age of the participants was 29 ± 5 years, and the mean gestational age was 26 ± 9 weeks. The median parity was 2(interquartile range of 1–3). Most participants had post-secondary education (>grade 12) and belonged to the Yoruba Tribe. Five (0.6%) of the pregnant women had a history of tobacco smoking, but none of them smoked tobacco during pregnancy. Moreover, 110 participants (12.9%) reported having had a skin allergy (Table 1).

Prevalence of asthma using ECRHS definitions

The prevalence of possible asthma was 2.1% (95% CI: 1.3–3.1%), of physician-diagnosed asthma, was 1.0% (95% CI: 0.5–1.7%), and of current asthma, was 0.7% (95% CI: 0.2–1.3%). There was no statistically significant difference in the prevalence of asthma by age group regardless of the definition used (Table 2).

Prevalence of respiratory and asthma symptoms in study participants

Table 3 shows that the prevalence of respiratory symptoms ranged from 0.6% (95% CI: 0.1–1.1%) for wheezing without cold to 12.9% (95% CI: 10.7–15.2%)

Table 1. General characteristics of the study participants ($n = 870$).

Characteristics	UTH ($n = 359$)	SGH ($n = 311$)	SSH ($n = 200$)	Total ($n = 870$)
Age (Mean ± SD)	30 ± 5yrs	28 ± 5yrs	28 ± 5yrs	29 ± 5yrs
Median Parity(IQR)	1(1–2)	1(1–2)	2(1–3)	1(1–2)
Gestational Age (Mean ± SD)	24 ± 10weeks	26 ± 9weeks	27 ± 9weeks	26 ± 9weeks
Education, *n* (%)				
None /	6(1.7)	11(3.5)	7(3.5)	24(2.8)
Primary(Elementary)	16(4.5)	26(8.4)	24(12.0)	66(7.6)
Secondary	66(18.4)	84(27.0)	80(40)	230(26.4)
Post Secondary	271(75.5)	190(61.1)	89(44.5)	550(63.2)
Income in Naira, *n*(%)				
<50,000	96(26.7)	167(53.7)	83(41.5)	346(39.8)
50–100,000	184(51.3)	104(33.4)	108(54.0)	396(45.5)
>100,000	78(21.7)	30(9.7)	8(4.0)	116(13.3)
No Disclosure	1(0.3)	10(3.2)	1(0.5)	12(1.4)
Tribe, *n*(%)				
Yoruba	327(91.7)	283(91.0)	194(97.0)	804(92.4)
Others	32(8.3)	28(9.0)	6(3.0)	66(7.6)
Religion, *n*(%)				
Christianity	240(66.9)	228(73.3)	190(95.0)	658(75.6)
Islam	119(33.1)	83(26.7)	10(5.0)	212(24.4)
Smoking, *n*(%)				
Never smokers	355(98.9)	309(99.4)	200(100)	864(99.3)
Ever smokers	4(1.1)	2(0.6)	–	6(0.7)
Current smokers	–	–	–	–
Indoor pollution, *n* (%)				
Household Exposure to ETS	25(7.0)	65(20.9)	17(8.5)	107(12.2)
Biomass fuel smoke exposure	93(25.9)	98(31.5)	97(48.5)	288(33.4)
Family history of asthma, *n* (%)				
Yes	19(5.3)	23(7.4)	18(9.0)	60(6.9)
No	340(97.4)	287(92.3)	173(86.5)	800(92)
Not aware/no disclosure	–	1(0.3)	9(4.5)	10(1.1)
Ever had a skin allergy, *n* (%)	53(14.8)	44(14.2)	13(6.5)	110(12.6)

Biomass smoke exposure–Use of biomass fuels with traditional stoves or indoor cooking with biomass fuel.
Education: Grade 1–6-Primary, Grade 7–12-Secondary, > grade 12-Post Secondary.
365 Naira (official currency of Nigeria) = 1 US Dollar.
UTH: University Teaching Hospital; SGH: State General Hospital; SSH: State Specialist Hospital.

Table 2. Prevalence of asthma using ECRHS definitions ($n = 870$).

Asthma definitions	Age range < 20yrs ($n = 9$)	Age range 20–29yrs ($n = 471$)	Age range 30–39yrs ($n = 366$)	Age range 40 + yrs ($n = 24$)	All ($n = 870$)	*P values
Possible Asthma-Q3 or Q5 or Q6	–	10(1.2;0.5–1.9)	7(0.8;0.2–.3.0)	1(0.1;0.1–0.35)	18(2.1,1.3–3.1)	0.858
Current Asthma- Q5 or Q6	–	4(0.5;0.1–1.0)	2(0.2;0.1–0.5)	–	6(0.7;0.2–1.3)	0.914
Physician-diagnosed Asthma	–	4(0.5;0.1–1.0)	50.6;0.1–1.1)	–	9(1.0 ;0.5–1.7)	0.830

The results are presented in number and % (95% Confidence. Interval),
*Chi-square and Fisher exact test.
Possible asthma–the presence of either an attack of shortness of breath, an attack of asthma in the last 12 months or current use of asthma medication.
Current asthma–presence of an attack of asthma in the last 12 months or current use of asthma medication.
Physician-diagnosed asthma–Previous asthma diagnosed by a doctor.

Table 3. Prevalence of respiratory and asthma symptoms in study participants ($n = 870$).

Respiratory symptoms in the past 12 months	Possible asthmatics ($n = 18$)	Non asthmatics ($n = 852$)	All ($n = 870$)	*p values
Q1. Wheezing	16.7(0–35.3)	1.6(0.4–2.5)	2.0(1.0–2.9)	0.004
Q1.1. Breathless with wheezing	11.2(0–27.3)	0.6(0.1–1.2)	0.8(0.1–1.5)	0.008
Q1.2. Wheezing without cold	16.7(0–35.3)	0.2(0.1–0.7)	0.6(0.1–1.0)	<0.001
Q2. Woken by chest tightness	44.4(21.4–70.6)	1.1(0.5–1.8)	2.0(1.0–2.9)	<0.001
Q3. Woken by breathlessness	77.8(57.7–96.0)	–	1.6(0.8–2.5)	<0.001
Q4. Nocturnal cough	27.8(8.3–50.0)	0.7(0.2–1.3)	1.3(0.6–2.1)	<0.001
Q5. Asthma attack	33.3(10.5–55.0)	–	0.7(0.2–1.3)	<0.001
Q6. Asthma medication	27.8(6.7–47.8)	–	0.6(0.1–1.1)	<0.001
Q7. Nasal allergy	22.2(5.6–43.7)	12.7(10.5–15.0)	12.9(10.7–15.2)	0.274

Result presented in % with (95% Confidence Interval).
*Chi-square and Fisher exact test $p < 0.05$.
Possible asthma: The presence of either an attack of shortness of breath, an attack of asthma in the last 12 months or use of asthma medication.

for nasal allergies. Wheezing in the last 12 months was 2.0% (95% CI: 1.0–2.9%), while 0.7% (95% CI: 0.2–1.3%) had an asthma attack in past 12 months, and 0.6% (95% CI: 0.1–1.1%) were currently taking asthma medications. Participants with possible asthma reported significantly more respiratory symptoms than

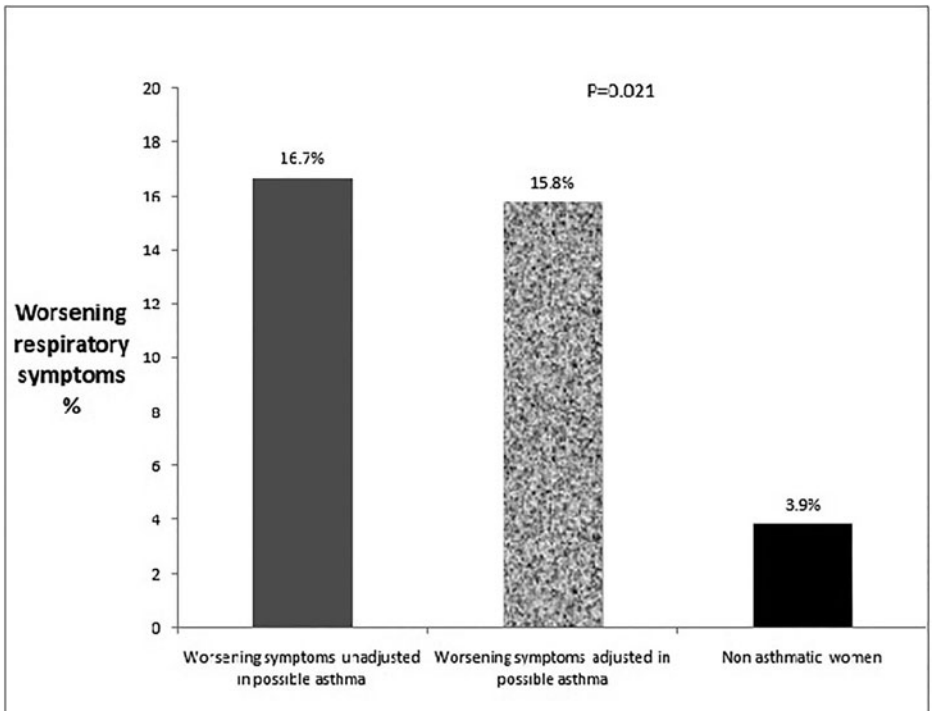

Figure 2. Reported worsening of asthma symptoms during pregnancy by definition.

those without asthma, and the most common symptom in those with possible asthma was being awakened by breathlessness.

Worsening asthma symptoms

The proportion of women with worsening asthma symptoms was significantly higher in participants with possible asthma than in those without (Figure 2). Overall, participants with possible asthma had a 4.3 times greater prevalence than non-asthmatic participants (16.7% vs. 3.9%; $P < 0.001$). However, after adjusting for biomass smoke and SHS exposure, the proportion of women with worsening asthma symptoms declined to 15.8%, and the risk ratio declined to 4.0.

Prevalence of asthma attack by diagnosis

One-third (33.3%) of participants with possible asthma in this study reported asthma attacks in the last 12 months, while five out of nine (55.6%) women with physician-diagnosed asthma reported an asthma attack during the current pregnancy (Figure 3). The median number of attacks was 2, with an interquartile range of 1–3 at the time of the study.

Discussion

The main findings of the study revealed that the prevalence of asthma among pregnant women was low. The lowest reported respiratory symptom was wheezing without cold while the highest was a nasal allergy. Participants with possible asthma diagnosis reported more symptoms in the past 12 months and more worsening symptoms during the current pregnancy than those without asthma. Less than 1% of all pregnant women had experienced an asthma attack in the previous year and currently used asthma medication. Most of the women previously diagnosed with asthma before the study had experienced an asthma attack during the current pregnancy.

The prevalence of possible asthma among the pregnant women in the present study was 2.1%, indicating that the prevalence of asthma during pregnancy in this setting is low compared to the general population (5). The outcome of this study nullified the proposed hypothesis that the prevalence of asthma and related symptoms in pregnancy is high. The rejection of the hypothesis is surprising considering the high prevalence of asthma in the general population. In this study, the hypothesis was based on a study conducted 15 years ago that defined asthma mostly by symptoms (5). However, unpublished data from Asthma Insight and Reality Study in Nigeria (AIRNIG) that has a similar asthma definition as this study, reported a low prevalence of asthma in the same general population. This observation further highlights the impact of operational definitions on asthma estimates (11).

In the present study, the prevalence of asthma in pregnancy is similar to the 2.1% obtained in Bikaner,

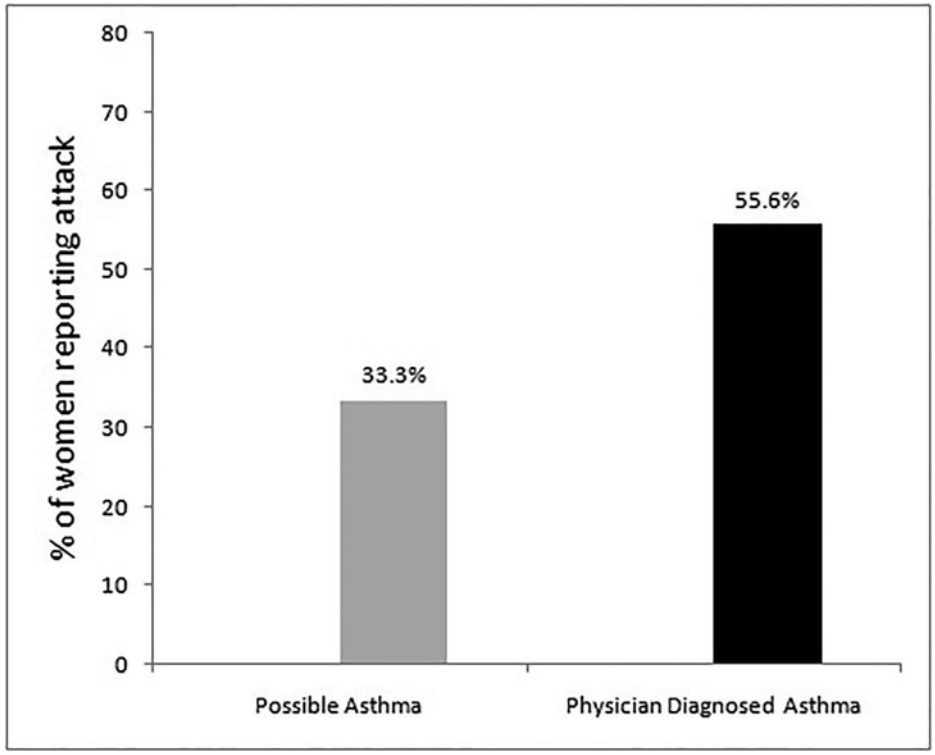

Figure 3. Reported asthma attacks in the past 12 months by diagnosis.

India (31), which also shares the same socio-demographic characteristics as Nigeria. The prevalence obtained in this study is lower than what was reported in western and developed countries like Japan (5.5%) (40), the US (6.7–8.8%) (24,27), Ireland (9.3%) (28), Sweden 9.4% (29), and Australia (12.7%) (30). The differences in the prevalence of asthma may be attributed to the high burden of asthma in these countries (34,36). Other reasons are the low levels of urbanization and industrialization, a low prevalence of some socio-environmental risk factors, like tobacco smoking, the research methodology, and the asthma definitions (3–11,24,27).

In this study, the prevalence of current asthma by ECRHS definition was 0.7%. Another study conducted in a neighboring state in southwestern Nigeria reported a prevalence of 1.4% (32), corroborating the low prevalence of asthma during pregnancy in this region of the country. The major strength of this study is that it adopted three different asthma definitions and a standardized questionnaire to enable international comparisons of the prevalence of asthma.

We also discovered that the lowest reported respiratory symptom was wheezing without cold, while the highest was nasal allergy. Participants with possible asthma reported more respiratory symptoms in the past 12 months and worsening of asthma-related symptoms in the current pregnancy than those without asthma. The worsening of symptoms during pregnancy may be due to cessation or reduction of medication due to participants' fear or their medical advisers' concern about the safety of the asthma medications (41). The most common respiratory symptom in participants with possible asthma was being awakened by shortness of breath. This result agrees with a study that reported that most pregnant women who reported shortness of breath to pulmonologists have asthma (25). The predominance of breathlessness among those with asthma is a result of changes in respiratory function during pregnancy (41).

In this sample of pregnant women, less than 1% currently used asthma medications and 0.7% had experienced an asthma attack. This asthma attack rate is similar to the 0.4% in a Korean study (42), however; it is lower than the 1.4% in the previous study in Nigeria (32) and 4.1% in the US (24). After stratification by asthma diagnosis, we observed that one in three (33.3%) of those with possible asthma has had an asthma attack in the past 12 months. The proportion having an attack was even higher (55.6%) when those with a previous doctor diagnosis of asthma were used as the denominator. This result aligns with the results of previous studies (15–17,43). One previous study has documented that up to 45% of pregnant women with asthma experience moderate to severe exacerbations requiring medical intervention during

pregnancy (44). This finding implies that there is poor asthma control in pregnancy, and hence, the priority during asthma management should be to achieve disease control and prevent asthma attacks during pregnancy.

The path of asthma in pregnancy in an individual is mainly unpredictable (45). The level of deterioration might be due to increased stress and gastro-esophageal reflux and poor medication compliance. The poor medication compliance is supported by the result from this study that showed that less than 1% of the pregnant women and 27.8% of those with asthma were currently on asthma medication. Previous studies (26,32) have also reported that only a small proportion of pregnant women used their asthma medication. The limitation of this survey is that it was a self-reported survey based on the ECRHS questionnaire. Thus, there is no way to assess the real accuracy of the entire self-reported data because none of the previous studies in Nigeria has demonstrated an acceptable correlation between in-person measurements of the clinical parameters. Due to the low prevalence of asthma, an in-depth assessment of the pattern of asthma and medication used during pregnancy was not feasible. Furthermore, the participants were recruited only from the antenatal clinics in public hospitals, so the results may not represent the population that receive prenatal care from other sources, such as private medical clinics or traditional birth attendant clinics, or those with no prenatal care.

Despite these limitations, this study was able to determine the prevalence of asthma and respiratory symptoms in pregnancy using a standardized questionnaire and three asthma definitions that enable international comparison of results. The description of asthma in pregnancy needs further clarification in future studies. Thus, a multicenter and national study would be needed in the future to study the impacts of asthma in pregnancy.

Conclusion

The prevalence of asthma and respiratory symptoms in our sample of pregnant women was low, but we observed an increase and worsening of respiratory symptoms during pregnancy in those with asthma. These findings imply that there is poor asthma control during pregnancy. Hence, the priority of clinicians should be disease control to prevent feto-maternal morbidity and mortality. This study may also serve as a template for future study of the impact of asthma in pregnancy on fetal and maternal outcomes in Nigeria.

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Declaration of interest

The authors report no conflicts of interest.

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