

Clinical Communications

Clinical characteristics of severe asthma exacerbations among inner-city women in pregnancy

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Clinical Implications

- There is little known about the characteristics of severe asthma exacerbations among inner-city pregnant women. In this retrospective study, we identify characteristics that may be targeted for improving prenatal asthma control in an underserved, understudied population.

TO THE EDITOR:

Asthma has been reported to affect 3.7% to 8.4% of pregnancies in the United States,¹ and is a significant cause of maternal morbidity. As many as 20% to 45% of pregnant women with asthma suffer an exacerbation requiring medical intervention.^{2,3} The few studies that have systematically assessed risk factors for asthma exacerbations in pregnancy have identified underlying asthma severity,³ undertreatment with controller medications,⁴ and respiratory viral illnesses⁵ as potential contributors in heterogeneous populations. However, the specific characteristics of asthma exacerbations among inner-city pregnant women remain underreported in the literature.

The city of Philadelphia, and the zip codes adjacent to our institution in particular, have been previously noted to be “epi-centers” of US asthma morbidity and mortality, in part due to issues of poverty and race.⁶ Carroll et al⁷ examined racial differences in the incidence of asthma exacerbations in a low-income population of pregnant women and noted that the proportion of emergency room (ER) presentations and hospital admissions was significantly higher among blacks than among whites. Adverse maternal outcomes for patients with asthma have also been observed to be higher in minorities.⁸ Therefore, the objectives of our study are to characterize a cohort of inner-city pregnant women who experienced severe prenatal asthma exacerbation and identify potential risk factors associated with poor asthma control.

We defined severe exacerbations as those requiring ER visit and/or subsequent hospitalization at Hahnemann Hospital, an urban university hospital in Philadelphia, Pa. We included pregnant women aged 15 to 45 years who presented with exacerbation during an 8-year study period from January 1, 2007, to December 31, 2014. Using *International Classification of Diseases, Ninth Revision* code 493.xx to screen for potential cases, we reviewed 1811 electronic health record charts and identified a total of 72 occurrences of pregnant women with visits for asthma exacerbations during the study period.

Of the 72 occurrences of exacerbations, 8 women had multiple pregnancies and/or multiple exacerbations during the study

period. Only the first chronologically occurring record of pregnancy or exacerbation was selected for inclusion, resulting in 62 unique cases. Comparative controls (n = 1655) were identified from the hospital billing records as women who delivered between January 1, 2007, and December 31, 2014, and had an existing diagnosis of asthma, but did not have a documented exacerbation during pregnancy, as confirmed from review of their electronic health record. Excluding multiple pregnancies, matching 4 controls to each case by delivery date (± 2 weeks), and excluding those with missing data resulted in 227 unique controls.

We chart-abstracted information on demographic characteristics, medical and obstetric history, and relevant respiratory parameters on presentation. We assessed the statistical significance of differences between cases and controls with the *t* test and chi-square test, as appropriate. Descriptive analyses were performed using SAS software, version 9.4 (SAS Institute, Cary, NC). The study was approved by the Institutional Review Board at Drexel University (#1405002863).

Demographic and reproductive characteristics are presented in Table I. Given that 35.5% of the cases had missing infant sex data (mainly due to delivery elsewhere), the statistically significant difference in infant sex between cases and controls is an artifact of the high proportion of missing data among cases. Maternal history of invasive mechanical ventilation for asthma and prescription of both long-acting beta-agonist with inhaled corticosteroid (LABA/ICS) and leukotriene modifiers were more common among cases than among controls. Maternal comorbid health conditions were mostly similar in frequency between the groups, with the exceptions of being unvaccinated against influenza and allergic rhinitis, both of which were higher among cases. Although there was no significant difference in active tobacco use, the proportion of smokers in both groups was high relative to the national estimate of 7.2% for cigarette smoking during pregnancy.⁹

Table II lists asthma-related clinical characteristics of the cases at the time of exacerbation. Most of the cases (66.2%) delivered at the study hospital. Most exacerbations (71.0%) were inpatient hospitalizations. Preceding upper respiratory tract symptoms were common. Nearly half the cases (45.2%) presented with peak expiratory flow rate (PEFR) of less than or equal to 200 L/min at the time of exacerbation. In addition, nearly all women who had PEFR of less than or equal to 200 L/min were admitted to the hospital (Table III).

In this urban, largely minority sample of pregnant asthmatic patients, we observed a higher prevalence of recorded LABA/ICS and leukotriene modifier prescriptions among exacerbators. We hypothesize this to be a marker of asthma severity rather than a risk factor for poor control, because preexisting asthma severity has been shown to be related to asthma severity during pregnancy.³ Unfortunately, in this retrospective study, we were unable to collect data on adherence to prescribed maintenance medications, which may have a role in both the risk and severity of exacerbations. However, screening for LABA/ICS and/or leukotriene modifier prescription during pregnancy may enable early identification and referral of at-risk individuals for more intensive antenatal asthma care.

TABLE I. Characteristics of women presenting with severe asthma exacerbation (ER visit or hospitalization) during pregnancy (cases), and women with asthma diagnosis without exacerbation during pregnancy (controls), 2007-2014

Variable	Statistic	Cases (N = 62)	Controls (N = 227)	P value
Maternal age at delivery (y)	n	62	227	.4235
	Mean $\pm$ SD	26.5 $\pm$ 6.3	25.7 $\pm$ 6.0	
	Range	15-41	15-42	
Race				
Black (non-Hispanic)	n (%)	45 (72.6)	170 (74.9)	.5802
White (non-Hispanic)		8 (12.9)	22 (9.7)	
Other		5 (8.1)	26 (11.5)	
Missing		4 (6.5)	9 (4.0)	
Insurance status				
Insured	n (%)	60 (96.8)	223 (98.2)	.2392
Uninsured		2 (3.2)	2 (0.9)	
Missing		0	2 (0.9)	
Insurance type				
Public	n (%)	38 (61.3)	159 (70.0)	.2950
Private		22 (35.5)	64 (28.2)	
Missing		2 (3.2)	4 (1.8)	
Parity	n	60	227	.6640
	Mean $\pm$ SD	1.5 $\pm$ 1.3	1.4 $\pm$ 1.6	
	Range	0-5	0-10	
Gravidity	n	60	227	.8614
	Mean $\pm$ SD	3.3 $\pm$ 1.9	3.2 $\pm$ 2.2	
	Range	1-9	1-10	
Gestational age at birth (wk)	n	40	222	.3135
	Mean $\pm$ SD	37.7 $\pm$ 2.7	38.2 $\pm$ 2.7	
	Range	26-41	23-43	
Infant birthweight (g)	n	31	212	.3218
	Mean $\pm$ SD	3252.5 $\pm$ 782.7	3104.8 $\pm$ 628.9	
	Range	2442-6165	572-5100	
Infant sex				
Male	n (%)	23 (37.1)	122 (53.7)	<.0001
Female		15 (24.2)	100 (44.1)	
Twins		2 (3.2)	0	
Missing		22 (35.5)	5 (2.2)	
Maternal history of mechanical ventilation				
Yes	n (%)	5 (8.1)	5 (2.2)	.0091
No		52 (83.9)	216 (95.2)	
Missing		5 (8.1)	6 (2.6)	
Maternal use of controller medications (check all that apply)				
LABA/ICS	n (%)	23 (37.1)	30 (13.2)	<.0001
ICS		6 (9.7)	13 (5.7)	.2575
Leukotriene modifier		9 (14.5)	7 (3.1)	.0018
Maternal comorbid diagnoses (check all that apply)				
Obesity	n (%)	19 (30.6)	68 (30.0)	1.0000
Current tobacco use		15 (24.2)	33 (14.5)	.0832
Depression		7 (11.3)	27 (11.9)	1.0000
Unvaccinated against flu		9 (14.5)	1 (0.4)	<.0001
GERD		4 (6.5)	18 (7.9)	1.0000
Allergic rhinitis		5 (8.1)	3 (1.3)	.0129
None of the above		23 (37.1)	113 (49.8)	.0858

GERD, Gastroesophageal reflux disease.

TABLE II. Clinical characteristics of women presenting with severe asthma exacerbation (ER visit or hospitalization) during pregnancy, 2007-2014

Variable	n (%)
Type of hospital visit for exacerbation	
ER	18 (29.0)
Inpatient hospitalization	44 (71.0)
Exacerbation in last 6 mo	
Yes	24 (38.7)
No	36 (58.1)
Missing	2 (3.2)
Symptoms of upper respiratory tract infection at presentation	
Yes	30 (48.4)
No	32 (51.6)
Missing	0
Stage of pregnancy at time of presentation	
First trimester	17 (27.4)
Second trimester	25 (40.3)
Third trimester	20 (32.3)
Initial PEFR on admission for exacerbation (L/min)	
≤200	28 (45.2)
201-300	16 (25.8)
301-400	5 (8.1)
Missing	13 (21.0)

TABLE III. Initial PEFR on admission for women presenting with severe asthma exacerbation during pregnancy, by type of hospital visit, 2007-2014

Initial PEFR on admission for exacerbation (L/min)	Type of hospital visit for exacerbation		Total (n = 49)
	ER	Inpatient hospitalization	
≤200	1 (3.6)	27 (96.4)	28
201-300	5 (31.3)	11 (68.8)	16
301-400	2 (40.0)	3 (60.0)	5

Fisher exact test *P* value = .0112.

We also observed high rates of cigarette smoking among pregnant asthmatic patients in general, and frequent viral respiratory syndromes preceding asthma exacerbations, which is consistent with other published findings.^{2,5} Despite small patient counts, it is also possible that underrecognition or undertreatment of AR and lack of influenza vaccination contribute to the risk of poor asthma control during pregnancy. Finally, the low PEFRs recorded at the time of initial ER or hospital evaluation may be indicative of relatively late presentations for medical care during exacerbations. More granular data on the progression from symptom onset and recognition to hospital presentation should be collected in future studies to better understand the circumstances leading to severe exacerbations. Efforts to develop women's knowledge in asthma self-management skills during pregnancy may improve asthma outcomes in this population.

Our study provides complementary insight into a patient group in whom the complex interplay of race, socioeconomic status, health literacy, and environment has clinical implications for asthma control. There is a paucity of literature on asthma exacerbations among inner-city women during pregnancy. Consistent with previous literature, our cohort presented with exacerbations in the second and third trimesters.¹⁰ Notably, they presented with low PEFR levels and had frequent inpatient hospitalizations, which may be indicative of more severe underlying asthma or delays in seeking medical care. The cohort also had a high prevalence of upper respiratory tract infections and maternal smoking. These characteristics need to be further investigated in larger epidemiologic studies to identify which risk factors are modifiable to reduce maternal morbidity from severe asthma exacerbation.

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