

Adverse maternal outcomes in women with asthma versus women without asthma

Nancy J. MacMullen, PhD, APN/CNS^{a,*}, Jay J. Shen, PhD^b,
Catherine Tymkow, ND/APRN, WHNP^c

^aNursing Department, Governors State University, Oak Forest, IL 60466, USA

^bUniversity of Nevada, Las Vegas, School of Public Health, Las Vegas, NV 89154, USA

^cNursing Department, Governors State University, Flossmoor, IL 60422, USA

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Abstract

The purpose of this retrospective cohort study was to examine differences in adverse maternal outcomes between pregnant women with asthma and pregnant women without asthma. A total of 7,777 pregnant patients with asthma were abstracted from a national database. The comparison group was 31,108 women, randomly selected from 541,719 pregnant women without asthma. Logistic regression was used to examine the relationship of asthma to 12 maternal outcome measures. Odds ratios were used to approximate the association of how much more likely pregnant women with asthma were to have adverse maternal outcomes. Pregnant women with asthma were more likely to have adverse maternal outcomes than did the pregnant women without asthma.

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1. Introduction

Asthma is a “common, chronic disorder of the airways that is complex and characterized by variable and recurring airflow obstruction, bronchial hyperresponsiveness, and an underlying inflammation” (National Heart, Lung, and Blood Institute [NHLBI], 2007, p. 12). The Centers for Disease Control reported that, during the 3-year period from 2001 to 2003, the estimated number of persons in the United States with self-reported asthma during the preceding 12 months increased from approximately 6.8 million (3.1%) to 14.9 million (5.6%; Moorman et al., 2007). For the pregnant population, up to 8.4% of pregnancies may be affected by asthma, making it one of the most common medical complications of pregnancy (Kwon, Triche, Belanger, & Bracken, 2006). Although well-controlled asthma poses little to no risk to the fetus or mother, uncontrolled asthma during pregnancy may result in maternal hypoxemia and has been

associated with adverse outcomes, such as premature delivery, low birth weight, fetal death, pregnancy-induced hypertension, hyperbilirubinemia, and an increased rate of operative delivery (MacMullen, Tymkow, & Shen, 2006).

2. Background literature

2.1. Comparison studies

There are few studies that compare adverse maternal outcomes of pregnant women with asthma with nonpregnant women with asthma. Mabie, Barton, Wasserstrum, and Sabai (1992) reviewed the medical records of pregnant women with asthma and compared them with pregnant women without asthma in the general population and found that there was no increased rate of preterm delivery or low birth weight among the women with asthma versus the comparison group. However, the authors found that intrauterine growth restriction was significantly more likely in women with moderate or severe asthma who were hospitalized as compared with those with mild asthma who did not require hospitalization. Triche, Saftlas, Belanger, Leader, and Bracken (2004), in their comparison study, determined that

* Corresponding author. Tel.: +1 708 534 4043 (w), +1 708 535 3410 (h); fax: +1 708 235 2197.

E-mail addresses: n-macmullen@govst.edu (N.J. MacMullen), jay.shen@unlv.edu (J.J. Shen), c-tymkow@govst.edu (C. Tymkow).

women with moderate to severe asthma symptoms are at increased risk of preeclampsia compared with women who had no asthmatic symptoms. In an exhaustive review of 30 studies on pregnancy and asthma, [Murphy, Gibson, Smith, and Clifton \(2005\)](#) concluded that, despite conflicting data and conclusions, methodological flaws, and lack of standard classification of asthma in the studies reviewed, pregnancy and asthma increase the risk of low birth weight, preterm delivery, and complications in pregnancies that are not actively managed for asthma. These studies included prospective and historical cohort studies with and without controls for the patients with asthma. [Sheiner, Mazor, Levy, Wiznitzer, and Bashiri \(2005\)](#) determined that adverse maternal outcomes associated with pregnant women with asthma persist even when controlling for coexisting variables. Results of a study done by [Enriquez et al. \(2007\)](#) showed that there were moderate dose-dependent relationships between asthma alone and exacerbated asthma with several adverse maternal outcomes: hypertensive disorder of pregnancy, membrane-related disorders, preterm labor, antepartum hemorrhage, and cesarean delivery. Seventy-six pregnant women with asthma and 152 pregnant women without asthma were studied by [Karimi, Davar, Mirzaei, and Mirzaei \(2008\)](#). Maternal asthma was found to be significantly associated with adverse infant outcomes.

The risks of asthma in pregnancy which result in adverse maternal outcomes are an ongoing concern of patients, researchers, and practitioners. Given the limited number of comparison studies focusing on asthma and adverse maternal outcomes (particularly by nurse researchers), there remains a need to continue to investigate the problem from a nursing perspective. Results of this research would lead to a body of evidence with a focus on risk reduction that will become the basis for best nursing practice in the care of pregnant women with asthma.

3. Purpose

The purpose of this study was to examine the relationship of asthma and adverse maternal outcomes among women with asthma and women who did not have asthma during their pregnancies.

4. Research question

Is there a relationship between asthma and adverse maternal outcomes in pregnant women with asthma compared with pregnant women without asthma?

5. Methods

5.1. Design

A retrospective cohort design was used. The design examined a potential association between the independent

variable and the dependent variable but did not establish a causal relationship between the variables. Data were abstracted from the National Inpatient Sample (NIS) data set available through the Healthcare Cost and Utilization Project (HCUP), maintained and disseminated by the Agency for Healthcare Research and Quality (AHRQ). The unit of the NIS data was the inpatient care episode that started from admission and ended at discharge. Individual hospitals submitted all of their discharge data to the state and the HCUP. The 33 states participating in the HCUP annually sent all hospital discharge data sets in their own states to AHRQ. The number of participating states varies year by year. The NIS data represent about 20% of community hospitals' discharges in the United States.

5.2. Sample

The International Classification of Diseases, Ninth Edition, Clinical Modification code of 493 was used to identify asthma patients. All patients with asthma were identified from 563,621 women aged 13 to 55 years who had a delivery in 2001 and abstracted from the NIS. On the basis of the empirical rule of thumb to select the comparison group as 3 to 4 times as large as the disease group, we randomly selected 31,108 (4 times of 7,777) patients from 541,719 pregnant patients without asthma to form our comparison group.

5.3. Outcome measures

Given the data availability of the NIS data, complications of pregnancy were identified as adverse maternal outcomes. Twelve adverse maternal outcome measures were selected based on those identified in a study by [Liu, Wen, DeMissie, Marcoux, and Kramer \(2001\)](#). They were preterm labor (22–37 weeks of gestation), hypertensive disorders of pregnancy (including preeclampsia, transient hypertension of pregnancy, and pregnancy-induced hypertension), gestational diabetes, antepartum hemorrhage (including placenta previa and abruptio placenta), membrane disorders (including premature rupture of membranes and infection of the amniotic cavity), cesarean section, postpartum hemorrhage, and pregnancy longer than 42 weeks.

The independent variable was the existence of asthma, a dichotomous variable. A dummy variable was created to indicate the asthma presentation, with a value of 1 indicating the patient with asthma and a value of 0 indicating the patient without asthma. The group without asthma was used as the reference group.

5.4. Data analysis

Logistic regression was used to examine the relationship of asthma for each of the 12 maternal outcome measures. The odds ratio (OR) was used to approximate the association about how much more likely (or unlikely) it is for the outcome to be present among those with exposure (i.e., being asthmatic) than among those without exposure (i.e., being

nonasthmatic; Hosmer & Lemeshow, 2000). Using the measure of gestational diabetes as an example to compare pregnant women with asthma with pregnant women without asthma, women without asthma are used as the reference group. Therefore, an estimated OR = 2 indicates that gestational diabetes is twice as likely to occur among women with asthma as among women without asthma. Moreover, when the frequency of the outcome is more than 10% (e.g., percentages of cesarean section in this study), the OR tends to be higher than the risk ratio. Therefore, we converted the OR to risk ratio when comparing cesarean section between the group with asthma and the group without asthma (Zhang & Yu, 1998).

During the multiple logistic regression, some covariates, available in the NIS data set, were controlled, such as maternal age, ethnicity, health insurance status, the income level, and comorbidities. For expanding the age to a meaningful interval (Hosmer & Lemeshow, 2000), six dummy variables were created to reflect six age groups: younger than 15, 15–19, 20–24, 30–34, 35–39, and equal to or greater than 40 years. The age group of 25–29 years was used as the reference group because it had the largest volume of patients. Race/Ethnicity was categorized as White (the reference group), African American, Hispanic, and Asian/Pacific Islander. Insurance status was categorized as Medicaid, uninsured, private insurance including HMO/prepaid health plans (the reference group), and Medicare. The median income by zip code of patient's residence was divided into four levels: <\$25,000, \$25,000–\$34,999, \$35,000–\$44,999, and ≥\$45,000. As for the comorbidities and complicating conditions, they varied across the 12 adverse maternal outcome measures according to Liu et al. (2001). Different comorbidities were used for different outcome measures. Detailed conditions are listed at the bottom of Table 2.

6. Results

Of the women who delivered in 2001, 1.4% had asthma. As shown in Table 1, the average ages at delivery were as follows: Women with asthma were 27 years old, and women without asthma were 27.4 years old. The women with asthma were predominately White (61.8%) and had private insurance (55.9%), whereas the percentage of women without asthma was 55.6%. The number of women who had comorbidities was small for both the group with asthma and group without asthma. The average length of stay for women with asthma was 3.0 days and for women without asthma was 2.5 days (Table 1).

For all of the 12 outcome measures, the unadjusted descriptive results show that patients with asthma had higher percentage than those of patients without asthma. For example, 3.5% of patients with asthma had preterm labor, and only 2.7% of patients without asthma had preterm labor. Of patients with asthma, 4.4% had gestational diabetes,

Table 1
Descriptive statistics

	Women with asthma (<i>n</i> = 7,777)	Women without asthma (<i>n</i> = 31,108)
Sociodemographics		
Average age (years)	27.0 (6.4)	27.4 (6.3)
Race/Ethnicity		
White	4,807 (61.8)	17,290 (55.6)
African American	1,568 (20.2)	4,026 (12.9)
Hispanic	1,231 (15.8)	8,021 (25.8)
Asian/Pacific Islander	139 (1.8)	1,566 (5.0)
Native American	32 (0.4)	205 (0.7)
Health insurance		
Medicare	66 (0.9)	122 (0.4)
Medicaid	3,133 (40.3)	12,225 (39.3)
Private insurance	4,341 (55.9)	17,565 (56.6)
Uninsured	233 (3.0)	1,149 (3.7)
Comorbidities		
Deficiency anemia	402 (5.6)	1,025 (3.3)
Obesity	271 (3.5)	174 (0.6)
Depression	191 (2.5)	134 (0.4)
Hypothyroidism	182 (2.3)	268 (0.9)
Maternal complications		
Preterm labor	269 (3.5)	826 (2.7)
Hypertensive disorders of pregnancy		
Preeclampsia	152 (2.0)	355 (1.1)
Transient hypertension of pregnancy	168 (2.2)	436 (1.4)
Pregnancy-induced hypertension	383 (4.9)	904 (2.9)
Gestational diabetes	341 (4.4)	825 (2.7)
Antepartum hemorrhage		
Placenta previa	21 (0.3)	58 (0.2)
Abruptio placenta	67 (0.9)	153 (0.5)
Membrane disorders		
Premature rupture of membrane	196 (2.5)	541 (1.7)
Infection of the amniotic cavity	162 (2.1)	430 (1.4)
Mode of delivery		
Cesarean section	2,551 (32.8)	7,483 (25.2)
Others		
Postpartum hemorrhage	200 (2.6)	624 (2.0)
Pregnancy >42 weeks	335 (4.3)	1,194 (3.8)
Hospitalization		
Average length of stay (day)	3.0 (2.9)	2.5 (2.3)
Average total charges (\$)	8,050 (7,949)	6,824 (6,747)
Median total charges (\$)	6,235	5,449

Note. Data are expressed as *n* (%), unless otherwise indicated.

compared with 2.7% for patients without asthma. Also, 2.5% of patients with asthma had premature rupture of membrane versus 1.7% for patients without asthma, and 32.8% of patients with asthma received cesarean section delivery compared with 25.2% for patients without asthma (Table 1).

The adjusted results from the multivariable analysis, as shown in Table 2, confirmed the unadjusted observation. Compared with patients without asthma, patients with asthma had a higher risk of having preterm labor (OR = 1.22, 95% confidence interval [CI] = 1.06–1.41). It indicates that the patients with asthma on average had about 22% higher risk of experiencing preterm labor than did the patients without asthma. Similarly, compared with the patients without asthma, preeclampsia (OR = 1.50,

Table 2

Adverse maternal outcomes of women with and without asthma ($n = 38,885$)

Dependent variable	Women without asthma ($n = 31,108$)	Women with asthma ($n = 7,777$)
	Reference	OR (95% CI)
Preterm labor ^a	1.00	1.22 (1.06–1.41)
Hypertensive disorders of pregnancy		
Preeclampsia ^b	1.00	1.50 (1.25–1.81)
Transient hypertension of pregnancy ^b	1.00	1.34 (1.10–1.63)
Pregnancy-induced hypertension ^b	1.00	1.45 (1.27–1.66)
Gestational diabetes ^c	1.00	1.45 (1.27–1.66)
Antepartum hemorrhage		
Placenta previa	1.00	1.52 (1.05–2.21)
Abruptio placenta ^b	1.00	1.69 (1.24–2.31)
Membrane disorders		
Premature rupture of membrane ^b	1.00	1.43 (1.22–1.67)
Infection of the amniotic cavity ^b	1.00	1.53 (1.27–1.84)
Mode of delivery		
Cesarean section ^d	1.00	1.21 (1.16–1.25)
Others		
Postpartum hemorrhage ^c	1.00	1.32 (1.11–1.58)
Pregnancy >42 weeks	1.00	1.15 (1.02–1.30)

^a Adjusted for maternal age.^b Adjusted for maternal age, gestational diabetes, preexisting diabetes, hypertension, and preexisting.^c Adjusted for maternal age and preexisting hypertension.^d Risk ratio, adjusted for footnote b, plus pregnancy-induced hypertension, preterm labor, placenta previa, abruptio placenta, premature, rupture of membrane, and infection of the amniotic cavity.^e Adjusted for maternal age, coagulation disorders, uterine tumor, and cesarean section.

CI = 1.25–1.81), transient hypertension of pregnancy (OR = 1.34, CI = 1.10–1.63), pregnancy-induced hypertension (OR = 1.45, CI = 1.27–1.66), gestational diabetes (OR = 1.68, CI = 1.47–1.92), placenta previa (OR = 1.52, CI = 1.05–2.21), abruptio placenta (OR = 1.69, CI = 1.24–2.31), premature rupture of membrane (OR = 1.43, CI = 1.22–1.67), infection of the amniotic cavity (OR = 1.53, CI = 1.27–1.84), cesarean section (risk ratio = 1.21, CI = 1.16–1.25), postpartum hemorrhage (OR = 1.32, CI = 1.11–1.58), and pregnancy term longer than 42 weeks (OR = 1.15, CI = 1.02–1.30).

7. Discussion

The results showed that women with asthma experienced greater adverse pregnancy outcomes than did women without asthma, despite controlling for insurance status, maternal age, ethnicity, income level, and comorbidities. Pregnant women with asthma experienced more preterm labor, preeclampsia, gestational diabetes, premature rupture of membranes, hypertensive conditions (transient hypertension of pregnancy and pregnancy-induced hypertension), hemorrhages (placenta previa, abruptio placenta, and postpartum hemorrhage), amnionitis, postdates, and cesarean sections. These results confirm what other researchers have

found: Asthma is related to adverse maternal and fetal outcomes such as preterm births, low birth weight, and preeclampsia (Mabie et al., 1992; MacMullen et al., 2006; Sheiner, et al., 2005; Triche et al., 2004).

8. Limitations

One limitation with the research is that the design is retrospective; therefore, the data obtained may be subject to error due to faulty recall of the respondents and potential errors in documentation of information. The data on severity of asthma, medication use, hospitalizations, emergency room visits, and asthma exacerbations were unavailable from the data set. Similar concerns were detailed in a study by Enriquez et al. (2007). Therefore, the results of the study were limited to indicating broad trends. However, the results provide the foundation for further research about the link between asthma and adverse maternal outcomes.

9. Future studies

Future studies should continue to focus on comparing pregnant women with asthma, but the type of asthma should be included in the comparison, which would enable the researchers to determine if this affects outcome, a factor which this study did not address. Ideally, future studies should be prospective.

To facilitate prospective studies, researchers, who are interested in studying asthma in pregnancy, should establish trusting relationships with health care providers and form partnerships in a variety of health care settings to do research. Sharing funding or authorship may be a key to accessing participants.

10. Application to practice

Because the study results cited conclude that the severity of asthma is implicated in adverse maternal outcomes, the first step for nurses who work with pregnant patients is to be aware of the relationship between asthma to adverse maternal outcomes and to be vigilant in assessing the patient for potential risk factors such as smoking, respiratory infections, and other asthma triggers that lead to hypoxic episodes from a severe attack. The nurse should do a thorough patient and family history and physical examination to determine if the patient has asthma and what severity level. Then, a prenatal management plan should be implemented accordingly. Patient education on the avoidance of risk factors and asthma self-management should be included in the plan.

10.1. Prenatal management

Monitoring of the patient and her fetus for any potential adverse outcome is an ongoing part of prenatal care. This

is true whether or not the problems stem from asthma or another cause. Specific guidelines regarding the potential risk for preterm delivery, pregnancy-induced hypertension, and the possibility of cesarean birth should be evaluated and implemented early in the pregnancy in a way that appropriately identifies and prepares the pregnant patient with asthma for concern without causing undue and unwarranted alarm.

10.2. Patient education

Patient education is an integral part of the management plan in working with pregnant women with asthma. It aids in preventing complications and maintaining wellness for both mother and fetus.

An important aspect of patient education is teaching self-assessment of asthma, with an emphasis on evaluation of environmental factors that may constitute asthma triggers. Asthma self-management skills (self-monitoring and correct use of inhalers and medications) and an asthma action plan are also essential elements of any planned patient education (The American College of Obstetricians and Gynecologists (ACOG), 2008). An asthma action plan is available online from NHLBI (2007). The asthma action plan contains information about the health care provider and the zones of severity of asthma. Each zone, green (doing well), yellow (getting worse), and red (medical alert), contains symptoms to look for and directions for what medications and what actions to take in each zone. The information in the asthma action plan is an important tool for avoiding asthma risk factors leading to an exacerbation and complications resulting in adverse maternal outcomes.

The nurse will continue to play a key role and is accountable for clinical competence and the ability to evaluate and use scientific evidence as the basis for practice. Benefits to the patient and the health care system include fewer hospital admissions, reduced waiting lists for office visits, and the potential for reduced costs (Niziol, 2004).

11. Conclusion

Asthma during pregnancy may have adverse outcomes for the mother or fetus. The nurse plays a crucial role in preventing these outcomes by utilizing research and applying it when working with patients and family in concert with physicians, respiratory therapists, and other members of the health care team. This provides guidance, education, and support that will help pregnant women with asthma achieve the goal of a healthy pregnancy, delivery, and postpartum trajectory. Future studies by nurse researchers will provide evidence as to best practice for nurses providing care for pregnant women with asthma.

12. Callouts

1. Asthma is potentially a serious complication of the perinatal period.
2. A sample of 7,777 pregnant patients with asthma was abstracted from a national database.
3. Research comparing pregnant patients with asthma with pregnant patients without asthma has been sparse.
4. Pregnant women with asthma experienced greater adverse maternal outcomes than did nonpregnant women with asthma.

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