Adverse Maternal Outcomes in Nevada: Does Asthma Matter?

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Abstract

Objective. Asthma is a common clinical complication of pregnancy and women with asthma are at greater risk of having complications. This study compared adverse maternal outcomes between women with asthma and women without asthma in Nevada.

Methods. A total of 64,664 hospital discharges of delivery were abstracted from the Nevada 2003-2004 hospital discharges and thirteen adverse maternal outcomes were examined. Logistic regression was applied to compare the maternal outcomes between women with and without asthma.

Results. Women with asthma were more likely to have pre-eclampsia (OR [CI] 1.73 [1.13, 2.65]), transient hypertension of pregnancy (OR [CI] 1.76 [1.11, 2.78]), pregnancy-induced hypertension (OR [CI] 1.89 [1.42, 2.53]), gestational diabetes (OR [CI] 1.89 [1.32, 2.72]), infection of the amniotic cavity (OR [CI] 2.15 [1.29, 3.58]), and cesarean section (OR [CI] 1.87 [1.56, 2.23]).

Conclusion. Women with asthma experienced a greater risk of having adverse maternal outcomes. Community-based education programs, as well as, services offered in traditional healthcare settings should be supported to educate pregnant women about the potential risk factors and the relationship between asthma and maternal outcomes.

Key Words: asthma, adverse maternal outcome, pregnant women, Nevada

Introduction

Asthma, a common chronic disease, has become more prevalent in recent years (Bhatnagar & Givelber 1999). The self-reported prevalence rate increased from 3.1% (6.8 million) to 5.6% (14.9 million) in the general population from the early 2000's to the mid-2000's (Moorman, et al 2007). The National Health Interview Survey Data for lifetime and current asthma (NHIS Data 2006) report that asthma prevalence percent is 7.8% (22.9 million) in 2006 in the United States (Center for Disease Control 2009). According to findings of a large prospective cohort study conducted in the northeastern United States, the prevalence rate of asthma was 8.4% among the pregnant population making it one of the most common clinical complications of pregnancy (Kwon, Triche, Belanger, & Bracken 2006). Uncontrolled asthma events during pregnancy is related to a high risk of certain adverse outcomes, such as intrauterine growth restriction (Mabie, Barton,Wasserstrum, & Sabai 1992), preeclampsia (Triche, Saftlas, Belanger, Leader, & Bracken 2004), hypertensive disorder of pregnancy, membrane-related disorders, preterm labor, antepartum hemorrhage, and cesarean delivery (Enriquez, et al 2007), as well as, adverse infant outcomes (Karimi, Davar, Mirzaei, & Mirzaei 2008).

Whereas most of these referenced studies are relatively limited in sample size, studies based on large sample size also have indicated associations between asthma and adverse maternal

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; Wen, DeMissie, & Liu 2001). These associations persist even when coexisting clinical conditions are taken into account (Sheiner, Mazor, Levy, Wiznitzer, & Bashiri 2005). Finally, a meta-analysis concludes that uncontrolled asthma increases the risk of low birth weight, preterm delivery, and complications in pregnancies (Murphy, Gibson, Smith, & Clifton 2005).

Given the limited number of comparison studies focusing on asthma and adverse maternal outcomes in other parts of the nation, along with the lack of literature that compares adverse maternal outcomes of pregnant versus non-pregnant women in Nevada, our literature review suggests that this study would contribute to a body of evidence which focuses on risk reduction for pregnant women with asthma in the state.

The purpose of this study was to examine whether adverse maternal outcomes between women with asthma and women without asthma were different in Nevada, and to determine whether these findings were consistent with results at the national level. Since asthma is a respiratory disease with symptoms of airway obstruction, airway inflammation and increased airway responsiveness to a variety of stimuli, and smoking is a trigger of an asthma attack (NAEPP 2007), from a health policy standpoint, implementation of the Nevada Clean Indoor Air Act (NCIAA) may have potential benefits of reducing the risk of smoke-triggered asthma, and in turn, improve maternal outcomes in the state.

Methods

Data were abstracted from the Nevada 2003 and 2004 State Inpatient Data (SID), available through the Health Care Cost and Utilization Project (HCUP), which is sponsored by the Agency for Healthcare Research and Quality (AHRQ). A total of 64,664 pregnant women aged 13 or older who delivered in 2003 and 2004 were selected based on International Classification of Diseases, Ninth Edition, Clinical Modification (ICD-9-CM) Diagnostic Codes. Among the entire delivery cases, 661 discharges with asthma were identified by ICD-9-CM diagnostic code of 463. The 2004 American Hospital Association (AHA) annual survey data was merged with the SID data by the use of the AHA identification number to provide hospital variables.

Based on the literature (Liu, et al 2001; MacMullen, Tymkow, & Shen 2006; Shen, Tymkow, & MacMullun 2005), a total of thirteen adverse maternal outcome measures, being used as dependent variables, were investigated in this study. They included preterm labor, hypertensive disorders of pregnancy (consisting of three measures:, pre-eclampsia, transient hypertension of pregnancy, and pregnancy-induced hypertension), gestational diabetes, antepartum hemorrhage (including two measures:, placenta previa and abruptio placenta), membrane disorders (including two measures:, premature rupture of membranes and infection of the amniotic cavity), cesarean section, prolonged labor, postpartum hemorrhage, and fetal death. Each dependant variable was coded as a dummy variable with the value “1” indicating an adverse outcome event, and the value “0” as a nonevent.

The primary independent variable was asthma, with the value “1” representing the pregnant woman with asthma as a comorbidity, and the value “0” representing the pregnant woman without asthma.

Multiple logistic regression was used to examine the relationship between the asthma comorbidity during pregnancy, and each of the thirteen adverse maternal outcome measures, respectively. The odds ratio (OR) was derived to approximate the risk ratio that indicated the risk of the adverse outcome anticipated among women with asthma over women without asthma. -Covariates such as patient demographics, health insurance status, comorbidities, and hospital characteristics were controlled in the multivariable

analysis. To make the age variable more meaningful, we defined seven dummy variables to represent seven age groups (younger than 15 years old, 15-19, 20-24, 25-29, 30-34, 35-39, and equal or older than 40 years), and the age group 25-29 was utilized as the reference group. The patient's residence was categorized as: large metropolitan areas with at least one million residents, small metropolitan areas with less than one million residents, micropolitan areas, and non-urban areas. Hospital characteristics, such as size (i.e., large, medium, and small with small hospitals being the reference) and teaching hospital status were controlled. In addition, patient's insurance status was categorized as Medicare, Medicaid, private insurance, uninsured and other insurance with private insurance being the reference group. The goodness-of-fit for the multivariable model for all of the thirteen dependent variables, except for infection of the amniotic cavity and prolonged labor, was greater than 0.05, which indicated good model fit for most of the variables (Hosmer&Lemeshow 2000).

Results

About 1.03% of pregnant women, who delivered in a hospital environment, had asthma in Nevada in 2003 and 2004. Table 1 shows the unadjusted descriptive results for the thirteen adverse maternal outcomes and patients' socio-demographics. The average ages at delivery for women with and without asthma were similar. The asthma group had a higher percentage of women who resided in large urban areas, however, it had lower rate for women who delivered in teaching hospitals. The average length of stay for women with asthma was 3.0 days and for women without asthma, it was 2.2 days ($p < 0.01$). Total hospital charges for women with asthma were on average $4,000 higher than the charges for women without asthma ($p < 0.01$). Women with asthma experienced higher risk for all the thirteen adverse outcomes except prolonged labor and fetal death. Results of the bivariate analysis indicated that asthma was a statistically significant risk factor related to six of the thirteen adverse outcome measures.

Table 2 shows the adjusted adverse maternal outcomes for women with asthma as compared with women without asthma. Women with asthma were more likely to have pre-eclampsia (OR [CI] 1.73 [1.13, 2.65]), transient hypertension of pregnancy (OR [CI] 1.76 [1.11, 2.78]), pregnancy-induced hypertension (OR [CI] 1.89 [1.42, 2.53]), gestational diabetes (OR [CI] 1.89 [1.32, 2.72]), infection of the amniotic cavity (OR [CI] 2.15 [1.29, 3.58]), cesarean section (OR [CI] 1.87 [1.56, 2.23]), and uterine tumor (OR [CI] 2.75 [1.42, 5.30]).

Discussion

In Nevada, women with asthma experienced a greater risk of having adverse pregnancy outcomes than did women without asthma, after controlling for insurance status, maternal age, comorbidities, rural residence, and hospital characteristics. Pregnant women with asthma experienced more pre-eclampsia, transient hypertension of pregnancy, pregnancy-induced hypertension, gestational diabetes, infection of the amniotic cavity, cesarean section, and uterine tumor. These findings were consistent with findings of prior studies in other parts of the country (Mabie, et al 1992; Sheiner, et al 2005; Triche, et al 2004), including a study based on a national representative sample (MacMullen, et al 2006), and the national guidelines of asthma diagnosis and treatment (NAEPP 2007).

More care is needed for women with asthma during the delivery process due to related complications. Asthma is associated with longer hospital stay and consequently hospital charges for the delivery process for women with asthma are higher than women without asthma.

Limitations inherent in the use of administrative data existed in this study. It was unknown whether the circumstances of women with asthma were under control or not. Infant outcomes were not available in the SID dataset, either. In addition, the data we used in were almost

six years old, trends of asthma and related complications can change during this period. Finally, information about patient severity of asthma, regular outpatient care, medication use, and emergency room visits was unavailable. Nevertheless, the availability of diagnostic information was one of the strengths of this study as compared to those based on self-reported asthma. Further, our findings provide a basic understanding of the relationship between asthma and adverse maternal outcomes in Nevada. Future research may compare the effects of controlled versus non-controlled asthma on maternal outcomes, examine the relationship between hospitals' quality of care and maternal outcomes for women with asthma, or study the effects of patients' factors on maternal outcomes for women with asthma among Nevada residents.

Policy implications: Both public and private sectors should support asthma related education programs available within community and healthcare settings. Such programs will educate pregnant women and their families about the association between asthma and maternal outcomes, and the methods to assess the potential risk factors such as smoking, respiratory infections, and other asthma triggers that may lead to a severe attack. Patient education should include the avoidance of risk factors and asthma self-management skills. Finally, hospitals and other healthcare providers should follow existing guidelines (NAEPP, 2007) to manage the potential risk for pre-eclampsia, transient hypertension of pregnancy, pregnancy-induced hypertension, gestational diabetes, infection of the amniotic cavity, and the possibility of cesarean birth for women with asthma during their pregnancy.

Table 1. Patients' Sociodemographic, Clinical, and Hospitalization Characteristics*

	Women w/o Asthma (n = 64003)	Women with Asthma (n=661)	Total (n = 64664)	p-value
Social demographics				
Average age, year (St.d)	27.0 (6.1)	27.1 (6.4)	27.0 (6.1)	
Age group				
< 15	128(0.2)	1(0.2)	129(0.2)	
15 - 19	7075(11.0)	82(12.4)	7157(11.1)	
20 - 24	17042(26.6)	179(27.1)	17221(26.6)	
25 - 29	17707(27.7)	152(23.0)	17859(27.6)	
30 - 34	13955(21.8)	155(23.5)	14110(21.8)	
35 - 39	6647(10.4)	74(11.2)	6721(10.4)	
>= 40	1449(2.3)	18(2.7)	1467(2.3)	
Area of residence				
Large metropolitan >= 1 million residents	46952(73.4)	532(80.5)	47484(73.4)	
Small metropolitan < 1 million residents	11900(18.6)	53(8.0)	11953(18.5)	
Micropolitan areas	2973(4.7)	50(7.6)	3023(4.7)	
Non-urban	2017(3.2)	26(3.9)	2043(3.2)	
Comorbidities				
Obesity	410(0.6)	30(4.5)	440(0.7)	
Depression	224(0.4)	15(2.3)	239(0.4)	

Maternal outcomes (Table 1, con't)				
Pre-term labor	1906(3.0)	24(3.6)	1930(3.0)	0.33
Hypertensive disorders of pregnancy				
Pre-eclampsia	1517(2.4)	26(3.9)	1543(2.4)	<0.01
Transient hypertension of pregnancy	1245(2.0)	26(3.9)	1271(2.0)	<0.01
Pregnancy-induced hypertension	3141(4.9)	67(10.1)	3208(5.0)	<0.01
Gestational diabetes	1976(3.1)	40(6.1)	2016(3.1)	<0.01
Antepartum hemorrhage				
Placenta previa	295(0.5)	6(0.9)	301(0.5)	0.09
Abruptio placenta	819(1.3)	11(1.7)	830(1.3)	0.38
Membrane disorders				
Premature rupture of membrane	2066(3.2)	22(3.3)	2088(3.2)	0.88
Infection of the amniotic cavity	1005(1.6)	20(3.0)	1025(1.6)	<0.01
Mode of Delivery				
Cesarean section	18571(29.0)	310(46.9)	18881(29.2)	<0.01
Others				
Prolonged labor	5344(8.4)	48(7.3)	5392(8.3)	0.31
Postpartum hemorrhage	1358(2.1)	17(2.6)	1375(2.1)	0.42
Uterine Tumor	404(0.6)	13(2.0)	417(0.6)	<0.01
Fetal death	257(0.4)	2(0.3)	259(0.4)	0.69
Hospitalization				
Average length of stay, day (St.d.)	2.2(2.0)	3.0(3.5)	2.2(2.0)	<0.01
Average total charges, $ (St.d)	8487(7296)	12115(13254)	8524(7390)	<0.01
Median total charges, $	6938	9502	6959	
Insurance				
Medicare	778(1.2)	8(1.2)	786(1.2)	
Medicaid	19417(30.4)	198(30.1)	19615(30.4)	
Private	36094(56.5)	414(62.9)	36508(56.6)	
Uninsured	4665(7.3)	26(4.0)	4691(7.3)	
Others	2893(4.5)	12(1.8)	2905(4.5)	
Hospital Characteristics				
Teaching hospital	28560(44.7)	194(29.4)	28754(44.6)	
Ownership				
Public	12231(19.2)	89(13.5)	12320(19.1)	
Non for profit	21466(33.6)	196(29.7)	21662(33.6)	
Profit	30180(47.3)	376(56.9)	30556(47.4)	
Size				
Small hospital	19289(30.2)	246(37.2)	19535(30.3)	
Medium hospital	5655(8.9)	76(11.5)	5731(8.9)	
Large hospital	38933(61.0)	339(51.3)	39272(60.9)	

St.d. - standard deviation

* Data are expressed as number and percentage unless otherwise indicated.

Table 2. Relationships between Asthma and Adverse Maternal Outcomes of Women (N = 64664)

Dependent Variable	Women w/o Asthma	Women with Asthma	Goodness-Of-Fit p-Value	c-Score
Pre-term labor†	1.00	1.29(0.80, 2.12)	0.30	0.59
Hypertensive disorders of pregnancy				
Pre-eclampsia‡	1.00	1.73(1.13, 2.65)	0.73	0.61
Transient hypertension of pregnancy‡	1.00	1.76(1.11, 2.78)	0.59	0.63
Pregnancy-induced hypertension‡	1.00	1.89(1.42, 2.53)	0.62	0.59
Gestational diabetes§	1.00	1.89(1.32, 2.72)	0.74	0.70
Antepartum hemorrhage				
Placenta previa	1.00	1.79(0.83, 3.84)	0.84	0.67
Abruptio placenta‡	1.00	1.22(0.63, 2.35)	0.64	0.59
Membrane disorders				
Premature rupture of membrane‡	1.00	1.04(0.64, 1.69)	0.20	0.58
Infection of the amniotic cavity‡	1.00	2.15(1.29, 3.58)	0.00	0.65
Mode of Delivery				
Cesarean section¶	1.00	1.87(1.56, 2.23)	0.55	0.66
Others				
Prolong labor	1.00	0.99(0.71, 1.38)	0.01	0.63
Postpartum hemorrhage‖	1.00	1.34(0.81, 2.21)	0.23	0.61
Uterine Tumor	1.00	2.75(1.42, 5.30)	0.64	0.81
Fetal death	1.00	0.69(0.17, 2.80)	0.21	0.64

† adjusted for maternal age.

‡ adjusted for maternal age, gestational diabetes, pre-existing diabetes, and pre-existing hypertension.

§ adjusted for maternal age, gestational diabetes, and pre-existing hypertension.

¶ Risk Ratio, adjusted for ‡, plus pregnancy-induced hypertension, preterm labor, placenta previa, abrupture placenta, premature, rupture of membrane, and infection of the amniotic cavity.

‖ adjusted for maternal age, coagulation disorders, uterine tumor, and cesarean section.

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