Pregnancy Outcomes in Women with Pregestational Diabetes

Linpeiyu Ji[1], Zhaoyu Li[1,3], Mary Lucas[1,4], Irena Vodenska[2], Lou Chitkushev[1], and Guang Lan Zhang[1(✉)]

[1] Department of Computer Science, Metropolitan College, Boston University, Boston, MA 02215, USA
guanglan@bu.edu
[2] Administrative Sciences Department, Metropolitan College, Boston University, Boston, MA 02215, USA
[3] Krieger School of Arts and Science, Johns Hopkins University, Baltimore, MD 21218, USA
[4] College of Computing and Informatics, Drexel University, Philadelphia, PA 19104, USA

Abstract. Using data from the Truven Health Analytics MarketScan Databases, we study the characteristics of pregnant patients with pregestational diabetes and their pregnancy outcomes. We investigate whether there is a significant difference in pregnancy outcomes between women who have pregestational diabetes and those who don't. We find that patients with pregestational diabetes stay hospitalized longer and that pregestational diabetes is associated with a higher risk of delivering high birth weight babies and preeclampsia.

Keywords: Pregestational diabetes · Preeclampsia · Preterm delivery · High birth weight · Cesarean delivery

1 Introduction

The ACOG (the American College of Obstetricians and Gynecologists) December 2018 practice bulletin pointed out that pregestational diabetes is one of the most challenging complications of pregnancy. It not only requires frequent monitoring and medication adjustments for the mother but also increases the risk of maternal and fetal complications [1]. From 3.1% to 6.8% of women of reproductive age have diabetes, with pregestational diabetes observed in 1–2% of all pregnancies [1]. Pregestational diabetes is associated with multiple adverse pregnancy outcomes such as preeclampsia, macrosomia, cesarean delivery, preterm delivery, congenital malformation, and glucose tolerance [2].

We retrospectively studied pregnant patients with pregestational diabetes and their pregnancy outcomes. We compared them with those of pregnant patients without pregestational diabetes in 2008 using the Truven Health MarketScan Commercial Claims and Encounters Database. The questions underlying our study are: 1) Is there a significant difference in pregnancy outcomes between women who have pregestational diabetes compared to those who don't? 2) Do patients with pregestational diabetes stay hospitalized longer than those without diabetes?

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2 Material and Methods

The dataset used for this study was the Truven Health MarketScan Commercial Claims and Encounters Database, which records health insurance plan enrollment and captures person-specific, clinical utilization expenditure across inpatient, outpatient, and prescription drug services on millions of individuals (active employees and dependents, early (non-Medicare) retirees and dependents, and COBRA continues annually, covered by over 100 health plans and self-insured employers. Each inpatient admission record includes the principal diagnosis and up to fourteen secondary diagnosis codes, and each outpatient record includes the principal diagnosis and up to two secondary diagnosis codes. The diagnoses were coded in ICD-9-CM codes (International Classification of Diseases, 9th revision, Clinical Modification) before 2015.

We focused on pregnancy resulting in live births in 2008. Women 12 to 55 years old with continuous health insurance coverage for at least 12 months before and two months after the live birth were included in the study. The year 2008 inpatient visits of admission type 3 (maternity and newborn) and outpatient service data from January 1st, 2007 to February 28th, 2009 were used in the study. As shown in Fig. 1, after applying the specified study eligibility criteria, we ended up with 5437 patients in Group 1 (no pregestational diabetes) and 731 patients in Group 2 (with pregestational diabetes). The ICD-9-CM codes used in the study are listed in Table 1. All data analysis was carried out using the Python programming language.

We first compared the characteristics of the two groups of patients, including their age distribution and length of stay. We then assessed four adverse outcomes: preeclampsia, preterm delivery, high birth weight, and cesarean delivery. We used risk ratio (RR) to describe the relative risks of the four adverse outcomes between the two groups. The risk ratio, also called relative risk, is defined as the ratio of the probability of an outcome in an exposed group to the probability of the outcome in an control group [5]. We calculated it by dividing the risk (cumulative incidence) in Group 2 by the risk in Group 1,

$$\text{Risk Ratio} = \frac{\text{CIe}}{\text{CIc}} \tag{1}$$

where CIe is the cumulative incidence in the exposed group (Group 2) and CIc is the cumulative incidence in the control group (Group 1).

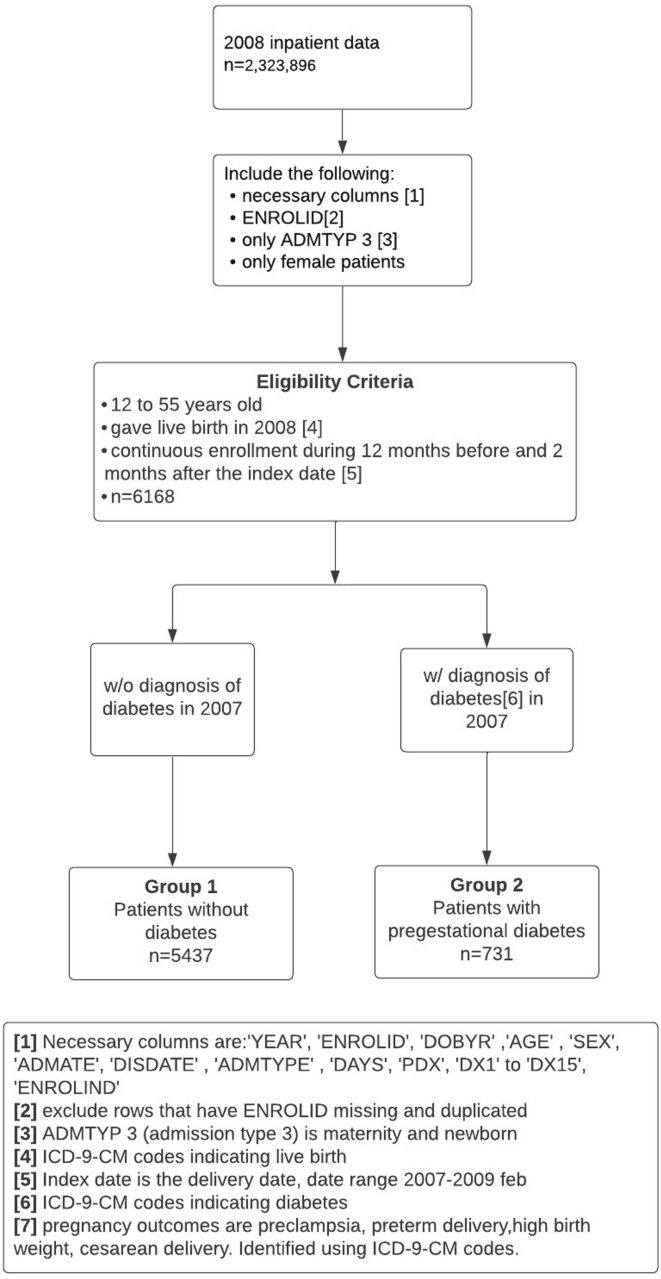

Fig. 1. Flowchart for the patient selection process.

Table 1. The ICD-9-CM codes used to identify various conditions and outcomes [4].

Category	Description	ICD-9-CM codes
Pregnancy type	Live birth, term delivery	645, 650, 766.2, 649.8, 765.29
	Live birth, preterm delivery	765.0, 765.1, 644.21, 765.20, 765.21, 765.22, 765.23, 765.24, 765.25, 765.26, 765.27, 765.28
	Live birth, unknown timing of delivery	V39, 650, V30, V279, V270
	Preeclampsia	642.4, 642.5, 642.6, 642.7
	High birth weight	766.0, 766.1, 775.0, 656.6, 653.5
	Cesarean delivery	V39.01, V37.01, V30.01, V31.01, 669.70, 669.71
Diabetes	Diabetes	250, 357.2, 362.0, 648.0, 366.41

3 Results

The study populations included 6168 pregnant women, with 5437 (88.15%) in Group 1 (without pregestational diabetes) and 731 (11.85%) in Group 2 (with pregestational diabetes). As shown in Table 2, the minimal length of stay was one day, and the median was two days for both groups. Most patients, 80% in Group 1 and 78% in Group 2, stayed 1–3 days in the hospital. No significant difference in the distribution of length of stay was observed between the two groups. The median patient age of both groups was 30, with most patients aged 21 to 40. No significant difference in the age distribution was observed either.

We performed summary statistics on the principal diagnosis and listed the top 20 reasons for hospitalization in Table 3. The top eight reasons were the same for the two groups. More than half of Group 2 patients experienced early onset of delivery (ICD-9-CM code 644.21), compared to over one-third of Group 1 patients. It indicates that patients with pregestational diabetes were more likely (12.75% higher frequency) to have early onset of delivery. Patients with pregestational diabetes were also more likely to have premature rupture of membranes (3.65% higher frequency for ICD-9-CM code 658.11) and abnormality in fetal heart rate or rhythm (2.86% higher frequency for ICD-9-CM code 659.71).

As shown in Table 4, pregestational diabetes was associated with a higher risk of delivering high birth weight babies (RR = 1.49). Pregestational diabetes did not affect the risk of preterm delivery and cesarean delivery. As shown in Table 5, pregestational diabetes was associated with a higher risk of preeclampsia (RR = 1.29) and did not affect the risk of preterm delivery. The numbers of high birth weight babies and cesarean delivery were too small to interpret meaningfully.

Table 2. Comparative analysis of the patient age and length of stay between the two groups.

		Group 1		Group 2	
		Counts	Percentages	Counts	Percentages
Length of stay	1–3 days	4372	80.41%	572	78.25%
	4–7 days	716	13.17%	107	14.64%
	8–20 days	237	4.36%	41	5.61%
	21–50 days	78	1.44%	8	1.09%
	51–170 days	33	0.62%	3	0.41%
	Mean	3.82		3.71	
	Median	2		2	
	Min	1		1	
	Max	169		122	
Age distribution	Age 12–20	407	7.49%	43	5.88%
	Age 21–30	2539	46.70%	355	48.56%
	Age 31–40	2354	43.30%	312	42.68%
	Age 41–50	134	2.46%	20	2.74%
	Age 51–55	3	0.06%	1	0.14%
	Mean	29.98		29.98	
	Median	30		30	
	Min	12		15	
	Max	54		54	

We studied the length of stay for pregnancies associated with high birth weight and preeclampsia. Among those suffering from preeclampsia, a higher proportion of women with pregestational diabetes had extended stays – around 22% in Group 2 stayed 1–3 weeks compared to 10% in Group 1. Among those who delivered high birth weight babies, a higher proportion of women with pregestational diabetes had extended stays-around 20% in Group 2 stayed 1–7 weeks compared to 6% in Group 1 (Fig. 2).

Table 3. The top 20 principal reasons for hospitalization sorted by their frequencies in Group 1.

	ICD-9-CM Codes	Description	Group1 freq.	Group2 freq.	Group 1%	Group 2%
1	64421	Early onset of delivery delivered with or without antepartum condition	2066	370	37.87%	50.62%
2	65811	Premature rupture of membranes delivered	450	87	8.25%	11.90%
3	66411	Second-degree perineal laceration with delivery	329	53	6.03%	7.25%
4	66401	First-degree perineal laceration with delivery	261	52	4.78%	7.11%
5	65101	Twin pregnancy delivered	216	25	3.96%	3.42%
6	65971	Abnormality in fetal heart rate or rhythm delivered with or without antepartum condition	157	42	2.88%	5.74%
7	650	Normal delivery	142	26	2.60%	3.56%
8	65821	Delayed delivery after spontaneous or unspecified rupture of membranes delivered	125	22	2.29%	3.01%
9	64251	Severe pre-eclampsia with delivery	121	18	2.22%	2.46%
10	64241	Mild or unspecified pre-eclampsia with deliver	98	27	1.80%	3.69%

(*continued*)

Table 3. (*continued*)

	ICD-9-CM Codes	Description	Group1 freq.	Group2 freq.	Group 1%	Group 2%
11	65961	Other advanced maternal age delivered with or without antepartum condition	91	15	1.67%	2.05%
12	66331	Other and unspecified cord entanglement without compression complicating labor and delivery delivered	77	8	1.41%	1.09%
13	65421	Previous cesarean delivery with delivery with or without antepartum condition	75	13	1.37%	1.78%
14	64891	Other current conditions classifiable elsewhere of mother with delivery	68	12	1.25	1.64%
15	64231	Transient hypertension of pregnancy with delivery	67	12	1.23	1.64%
16	65801	Oligohydramnios delivered	58	12	1.06%	1.64%
17	65261	Multiple gestation with malpresentation of one fetus or more delivered	53	0	0.97%	0%
18	65651	Poor fetal growth affecting management of mother delivered	52	10	0.95%	1.37%
19	65451	Cervical incompetence with delivery	44	9	0.81%	1.23%

(*continued*)

Table 3. (*continued*)

	ICD-9-CM Codes	Description	Group1 freq.	Group2 freq.	Group 1%	Group 2%
20	64421	Early onset of delivery delivered with or without antepartum condition	2066	370	37.87%	50.62%

Table 4. The relative risk of adverse outcomes of pregnancies complicated by pregestational diabetes compared to normal pregnancy. The numbers were counted by checking the outcomes in all diagnosis codes.

	Group 1		Group 2		Risk ratio(RR)
	Counts	Percentages	Counts	Percentages	
Preeclampsia	498	9.15%	73	9.99%	1.091
Cesarean delivery	296	5.44%	37	5.06%	0.949
High birth weight	50	0.92%	10	1.37%	1.49
Preterm delivery	5050	92.88%	703	96.16%	1.03

Table 5. The relative risk of adverse outcomes of pregnancies complicated by pregestational diabetes compared to normal pregnancy. The numbers were counted by checking the outcomes in the principal diagnosis code.

	Group 1		Group 2		Risk ratio(RR)
	Counts	Percentages	Counts	Percentages	
Preeclampsia	265	4.87%	46	6.29%	1.29
Cesarean delivery	7	0.13%	2	0.27%	2.07
High birth weight	13	0.24%	1	0.14%	0.58
Preterm delivery	2100	38.62%	275	37.62%	0.97

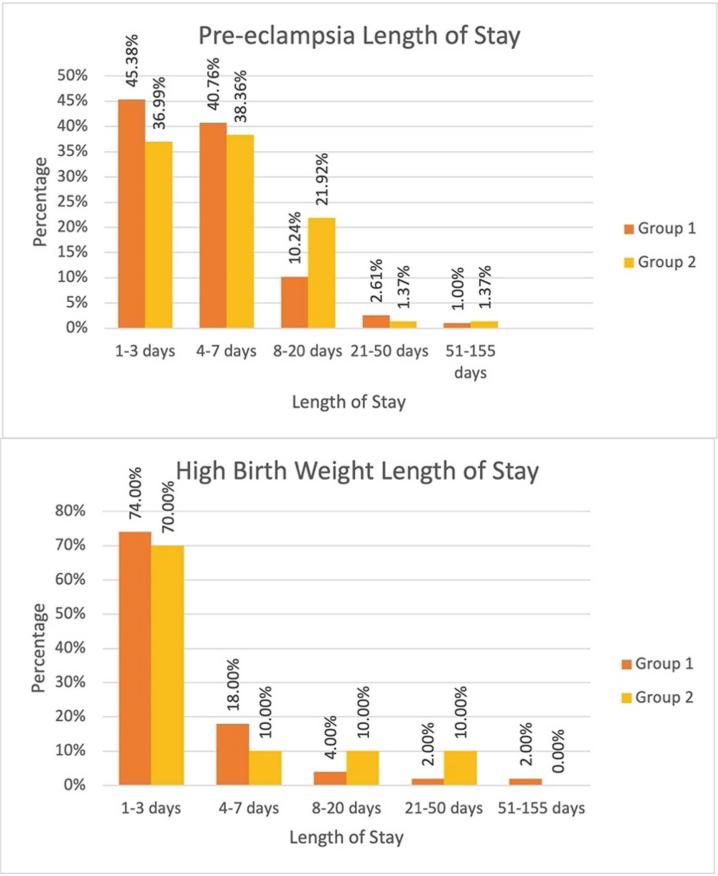

Fig. 2. The length of stay for pregnancies associated with preeclampsia and high birth weight by checking the outcomes in all diagnosis codes.

4 Conclusion

Based on the analysis of more than 6,000 pregnancies that resulted in a live birth in 2008, we concluded that pregestational diabetes is associated with a higher risk of delivering high birth weight babies and preeclampsia. High birth weight is associated with a higher risk of long-term health, including higher death rates from prostate cancer and possibly breast cancer [6]. Preeclampsia is among the top six causes of maternal mortality in the United States (US) and is associated with perinatal morbidity and mortality. The incidence of preeclampsia in the US has increased dramatically over the past twenty to thirty years [7]. We did not find significant differences between the risks of preterm delivery and cesarean delivery in the two groups. Higher proportions of women with pregestational diabetes had extended stays in hospital compared to those without pregestational diabetes.

Our result differed from a previous study of pregnancy outcomes in adolescent patients [4]. Kohn and coauthors reported that pregestational diabetes was associated with an increased risk for high birth weight babies, preeclampsia, preterm delivery, and cesarean delivery [4]. In the future study, we plan to expand the study population by including pregnancy data from multiple years and extend the scope by studying healthcare expenditure data and other pregnancy-related complications.

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