Prenatal Care and Adverse Pregnancy Outcomes Among Women With Schizophrenia: A Nationwide Population-Based Study in Taiwan

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Objective: To compare the number of prenatal care visits for women with and without schizophrenia and to explore the relationship between the level of prenatal care and adverse pregnancy outcomes (low birth weight [LBW], preterm gestation, and small-for-gestational-age [SGA] babies).

Method: We identified a total of 607 women who gave birth from 2001 to 2003, who had been diagnosed with schizophrenia (*ICD-9-CM* criteria) in the 2 years preceding the index delivery, together with 1,821 matched women as a comparison cohort. Multivariate logistic regression and Poisson regression analyses were performed for estimation.

Results: Results show women with schizophrenia had a significantly lower mean number of prenatal care visits (7.92 vs 8.72, $P < .001$). Multivariate logistic regression shows that, after adjusting for characteristics of mother and infant, women with schizophrenia were 1.77 (95% CI, 1.46–2.15; $P < .001$) times more likely than women without schizophrenia to receive inadequate prenatal care. The results also show that after adjusting for other factors, schizophrenic women who received inadequate prenatal care were 2.47 (95% CI, 1.27–4.77; $P = .007$), 1.84 (95% CI, 1.02–3.37; $P = .036$), and 1.77 (95% CI, 1.15–2.73; $P = .010$) times more likely to have preterm births, LBW babies, and SGA babies, compared to schizophrenic women who received adequate care.

Conclusions: We conclude that women with schizophrenia were more likely to receive inadequate prenatal care than women without this disorder. Schizophrenic women who received inadequate prenatal care had a higher risk of adverse pregnancy outcomes than schizophrenic women who received adequate care.

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Numerous studies have provided observational evidence linking poor prenatal care and increased risk of premature birth, low birth weight (LBW), and perinatal deaths.[1–3] Therefore, to identify and treat women who are at greatest risk of receiving poor prenatal care may improve obstetrical and infant outcomes. Studies have identified that factors such as income, race, marital status, educational level, lack of social support, unwanted pregnancy, and psychiatric disturbances were associated with poor prenatal care compliance.[4–7] Among these factors, psychiatric disturbances have drawn much attention during the past decade. However, although much research has reported inadequate prenatal care among pregnant women with a recent history of depression,[8–10] almost no studies have examined prenatal care use by women with severe psychiatric disorders, especially schizophrenia. Lack of such information may prevent policy makers and psychiatrists from putting high priority on developing effective strategies to promote maternal and infant health among this group of women.

According to our knowledge, only one empirical study to date has documented the rate of prenatal care use among women with schizophrenia. A study by Goodman and Emory[11] compared 57 women with schizophrenia and 31 healthy women and found no difference in the number of prenatal care visits between these 2 groups (8.87 vs 8.96). However, the small sample size and potential selection bias may limit the generalizability of their findings to the population as a whole. In addition, their study did not take possible confounding factors into account, such as the characteristics of mother and infant.

To better understand the level of prenatal care received by women with schizophrenia, we undertook a cross-sectional analysis, linking 2 large nationwide population-based datasets. The objectives of this study were to compare the number of prenatal care visits between women with and without schizophrenia and to explore the relationship between inadequate prenatal care and adverse pregnancy outcomes among such women. We hypothesized that women with schizophrenia had significantly fewer prenatal care visits compared with others. We also hypothesized that those receiving inadequate care were more likely to have adverse pregnancy outcomes.

METHOD

Database

This study used 2 nationwide population-based datasets in Taiwan. The first was the National Health Insurance Research Dataset (NHIRD), published by the Taiwan National Health Research Institutes. Taiwan initiated the Bureau of National Health Insurance (NHI) program in 1995 to finance health care for all citizens of Taiwan. Taiwan's NHI has the following combination of characteristics: universal coverage, a single-payer payment system with the government as the sole insurer, comprehensive benefits, low copayments, and access to any medical institution of the patient's choice. The NHIRD includes all inpatient and ambulatory care medical claims data and registries (contracted medical facilities, board-certified specialists, and beneficiaries). The system provides care for over 22 million enrollees, representing about 99% of the Taiwanese population. Therefore, the NHIRD presents a unique opportunity to examine the level of prenatal care received by women with schizophrenia and unaffected mothers.

The second dataset used was sourced from the Taiwan birth certificate registry, published by the Ministry of Interior in Taiwan. Birth certificates include birth dates for both infants and their parents; gestational week at birth; infant birth weight, gender, parity, and place of birth; parental education level; and maternal marital status. In Taiwan, the government requires all births and deaths to be registered, so the birth certificate data are considered to be very accurate and comprehensive.

With assistance from the NHI in Taiwan, the mothers' and infants' unique personal identification numbers provided links between the NHIRD and birth certificate data. All personal identifiers were encrypted by the NHI before release to the researchers. Confidentiality assurances were addressed by abiding by the data regulations of the NHI. Because the NHIRD consists of unidentified secondary data released to the public for research purposes, this study was exempt from full review by the institutional review board.

Study Sample

From the birth certificate registry, we identified 473,529 women with singleton live births in Taiwan between January 1, 2001, and December 31, 2003. If a mother had more than 1 singleton birth during the study period, we selected only the first for the study sample. Among these women, we identified 958 women who had been hospitalized or visited ambulatory care centers for treatment of schizophrenia (any *International Classification of Diseases, Ninth Revision, Clinical Modification* [*ICD-9-CM*] 295 code other than 295.7, schizoaffective disorder) within 2 years prior to their index deliveries. Because administrative databases often have questionable coding validity, the study cohort included only patients hospitalized for schizophrenia treatment or with at least 3 consensus schizophrenia diagnoses in ambulatory care within the 2 years prior to index deliveries, in order to ensure the validity of the diagnoses. Ultimately, 607 women were selected as the study cohort.

In this study, the comparison cohort was selected from the remaining 472,571 mothers. We randomly extracted 1,821 mothers (3 for every mother with schizophrenia), matched with the study cohort in terms of age (< 20, 20–24, 25–29, 30–34, and ≥ 35 years) and the year of delivery for our comparison cohort.

Variables of Interest

The first part of this study compared the number of prenatal care visits received by pregnant women with and without schizophrenia. In Taiwan, the NHI recommends 10 prenatal visits for all pregnant Taiwanese women, provided free of charge, in order to remove the financial barriers and to reduce the risk of poor pregnancy outcomes. Therefore, for the purposes of this study, we define "adequate prenatal care" as "a woman receiving at least 10 prenatal care visits during pregnancy." The key dependent variables of interest were the number of prenatal care visits and whether these qualified as adequate prenatal care or not. The key independent variable of interest was whether a pregnant woman had ever been diagnosed with schizophrenia or not.

The second part of this study was to examine the relationship between the adequacy of prenatal care visits and adverse pregnancy outcomes among women with schizophrenia. The dependent variables were dichotomous outcome measures including LBW (< 2,500 g), preterm gestation (< 37 weeks), and small-for-gestational-age (SGA) (birth weight below the 10th percentile for gestational age) babies. The key independent variable was whether a woman had adequate prenatal care or not. In addition, further analyses were performed by categorizing the number of prenatal care visits into the following 3 groups: ≥ 10, 8–9, and ≤ 7, to examine the effect of inadequate prenatal care on pregnancy outcomes.

We have also adjusted for potential confounding factors in the regression modeling. These included the pregnant woman's age, monthly income, the urbanization level of her place of residence (using 5 standardized levels published by the Taiwan National Health Research Institutes), the geographic location (northern, central, eastern, and southern Taiwan), and the infant's gender and parity. We also took comorbid chronic medical conditions, obstetrical complications, and substance abuse into consideration in the analysis. Comorbid chronic medical conditions included arterial hypertension (*ICD-9-CM* codes 642.0, 642.1, 642.2, 642.3, 642.9, or 760.0), diabetes (648.0, 648.8, or 775.0), anemia (648.2), and coronary heart disease (410–414 or 429.2). Obstetrical complications consisted of malpresentation (652, 761.7, 763.0, or 763.1), insufficient or excessive fetal growth (656.5 or 656.6), and placenta or previa abruption (641, 762.0, or 762.1).

Statistical Analysis

The SAS statistical package (SAS System for Windows, Version 8.2, SAS Institute Inc., Cary, North Carolina) was used to perform the statistical analyses in this study. Differences between the study and comparison cohorts in terms of characteristics of infant and mother were evaluated with Pearson χ^2 tests. Poisson regression analysis was also performed, in which the number of prenatal care visits was regressed against the independent variable of whether or not a pregnant woman had been diagnosed with schizophrenia in the 2 years prior to the index delivery. Furthermore, multivariate logistic regression analysis was also carried out to compare mothers with schizophrenia by the number of prenatal care visits, in terms of the risk of LBW, preterm gestation, and SGA, after adjusting for potential confounding factors. A 2-sided *P* value of < .05 was considered statistically significant for this study.

RESULTS

Table 1 shows the distributions of demographic characteristics, chronic comorbid medical conditions, and obstetrical complications for the 2 study cohorts. There were statistically significant differences in monthly income ($P < .001$), urbanization level of residential area ($P = .048$), coronary heart disease ($P < .001$), and substance abuse ($P < .001$) between women with schizophrenia and unaffected women. On the other hand, no significant differences were observed between the 2 cohorts for age, geographic region in which the patient resided, hypertension, diabetes, malpresentation, placenta or previa abruption, and insufficient or excessive fetal growth.

The *t* test shows that women with schizophrenia had a significantly lower mean number of prenatal care visits ($P < .001$); the mean number of such visits for women with and without schizophrenia was 7.92 and 8.72 times, respectively. Furthermore, only 42.5% of women with schizophrenia and 56.6% of women without received adequate prenatal care (≥ 10 visits) ($P < .001$). Multivariate logistic regression shows that after adjusting for characteristics of mother and infant, women with schizophrenia were 1.77 (95% CI, 1.46–2.15; $P < .001$) times more likely than women without schizophrenia to receive inadequate prenatal care (not shown on tables).

Table 2 presents results of the Poisson regression analysis for the adjusted relationship between the number of prenatal care visits and whether a mother had been diagnosed with schizophrenia. After adjusting for potential confounders, mothers with schizophrenia had a 0.89-fold lower (95% CI,

Table 1. Demographic Characteristics and Comorbid Medical Disorders for Pregnant Women With Schizophrenia and Unaffected Women in Taiwan, 2001–2003 (N = 2,428)

	Women With Schizophrenia (n = 607)		Women in the Comparison Cohort (n = 1,821)		
Variable	n	%	n	%	*P* Value
Mother characteristics					
Age, y					1.000
< 20	21	3.5	63	3.5	
20–24	92	15.2	276	15.2	
25–29	189	31.1	567	31.1	
30–34	216	35.6	648	35.6	
> 34	89	14.7	267	14.7	
Monthly income, NT					< .001
$0	169	27.8	540	29.7	
$1–$15,840	216	35.6	511	28.1	
$15,841–$25,000	193	31.8	465	25.5	
≥ $25,001	29	4.8	305	16.8	
Urbanization level					.048
1	166	27.4	594	32.6	
2	169	27.8	508	27.9	
3	113	18.6	322	17.7	
4	79	13.0	219	12.0	
5	80	13.2	178	9.8	
Geographic region					.176
Northern	280	46.1	879	48.2	
Central	153	25.2	441	24.2	
Southern	149	24.6	457	25.1	
Eastern	25	4.1	45	2.5	
Hypertension					.559
Yes	14	2.3	50	2.8	
No	593	97.7	1,771	97.3	
Diabetes					.483
Yes	58	9.6	157	8.6	
No	549	90.4	1,664	91.4	
Anemia					.379
Yes	22	3.6	53	2.9	
No	585	96.4	1,768	97.1	
Coronary heart disease					< .001
Yes	18	3.0	12	0.7	
No	589	97.0	1,809	99.3	
Substance abuse					< .001
Yes	23	3.9	21	1.2	
No	597	98.3	1,818	99.8	
Insufficient or excessive fetal growth					.362
Yes	6	1.0	27	1.5	
No	601	99.0	1,794	98.5	
Malpresentation					.080
Yes	66	10.9	155	8.5	
No	541	89.1	1,666	91.5	
Placenta or previa abruption					.869
Yes	12	2.0	38	2.1	
No	595	98.0	1,783	97.9	
Infant characteristics					
Gender					.222
Male	335	55.2	953	52.3	
Female	272	44.8	868	47.7	
Parity					.561
1	300	49.4	860	47.2	
2	202	33.3	648	35.6	
3 or more	105	17.3	313	17.2	

Abbreviation: NT=New Taiwanese dollar.

Table 2. Poisson Regression Analysis for Adjusted Relationship Between the Number of Prenatal Care Visits and Whether a Pregnant Woman Was Diagnosed With Schizophrenia in Taiwan (N = 2,428)

	Rate of Prenatal Care Visits		
Variable	Relative Risk	95% CI	*P* Value
Women with schizophrenia	0.89	0.85–0.96	< .001
Age, y			
< 20	0.99	0.91–1.08	.923
20–24	0.99	0.95–1.04	.926
25–29 (reference group)	1.00	…	…
30–34	0.98	0.94–1.01	.192
> 34	0.96	0.91–1.01	.052
Monthly income, NT			
$0 (reference group)	1.00	…	…
$1–$15,840	1.03	0.99–1.07	.198
$15,841–$25,000	1.02	0.97–1.06	.472
≥ $25,001	1.02	0.97–1.07	.480
Urbanization level			
1 (reference group)	1.00	…	…
2	1.01	0.97–1.05	.665
3	1.01	0.96–1.05	.757
4	0.99	0.95–1.05	.925
5	1.01	0.95–1.06	.823
Geographic region			
Northern (reference group)	1.00	…	…
Central	0.99	0.96–1.04	.989
Southern	1.00	0.97–1.04	.986
Eastern	1.00	0.92–1.09	.977
Hypertension	0.94	0.86–1.02	.151
Diabetes	1.03	0.98–1.08	.300
Anemia	0.97	0.89–1.05	.393
Coronary heart disease	0.99	0.88–1.13	.985
Insufficient or excessive fetal growth	0.97	0.86–1.09	.596
Malpresentation	0.99	0.95–1.05	.925
Placenta or previa abruption	0.93	0.84–1.02	.136
Substance abuse	0.93	0.76–1.14	.484
Infant gender			
Male (reference group)	1.00	…	…
Female	0.98	0.96–1.01	.269
Infant parity			
1 (reference group)	1.00	…	…
2	1.03	0.99–1.06	.055
3 or more	0.97	0.93–1.01	.106

Abbreviation: NT = New Taiwanese dollar.

0.85–0.96; $P < .001$) chance of receiving prenatal care than the comparison subjects.

Among mothers with schizophrenia, those who received inadequate prenatal care had significantly higher percentages of LBW babies (12.0% vs 5.4%, $P < .001$), preterm births (12.3% vs 7.4%, $P < .001$), and SGA babies (24.6% vs 15.9%, $P = .008$) than those who received adequate prenatal care. Table 3 describes the distribution and crude odds ratios (ORs) of LBW, preterm birth, and SGA according to the number of prenatal care visits among the women with schizophrenia. The χ^2 tests showed that there were statistically significant differences in LBW (5.4% vs 6.3% vs 16.8%), preterm birth (7.4% vs 7.6% vs 16.3%), and SGA (15.9% vs 19.0% vs 29.3%) among schizophrenic mothers receiving ≥10, 8–9, and ≤7 prenatal care visits. Multivariate logistic regression analyses revealed that schizophrenic mothers who received prenatal care ≤7 times were 3.51 (95% CI, 1.82–6.78; $P < .001$), 2.44 (95% CI, 1.33–4.46; $P = .004$), and 2.20 (95% CI, 1.39–3.47; $P < .001$) times as likely to have LBW babies, preterm birth, and SGA babies, respectively, compared to schizophrenic mothers who received prenatal care 10 times.

Multivariate logistic regression shows that after adjusting for other factors, schizophrenic women who received inadequate prenatal care were 2.47 (95% CI, 1.27–4.77; $P = .007$), 1.84 (95% CI, 1.02–3.37; $P = .036$), and 1.77 (95% CI, 1.15–2.73; $P = .010$) times more likely to have LBW babies, preterm births, and SGA babies compared to schizophrenic women who received adequate prenatal care. Further analysis found that after adjusting for potential confounding factors, the odds of LBW, preterm, and SGA babies for schizophrenic mothers who received ≤7 prenatal care visits were 3.55 (95% CI, 1.77–7.12; $P < .001$), 2.63 (95% CI, 1.38–5.02; $P = .003$), and 2.10 (95% CI, 1.31–3.39; $P = .002$) times, respectively, that of schizophrenic mothers who received 10 prenatal care visits (Table 4). No significant difference in LBW, preterm, and SGA babies was observed between schizophrenic mothers who received 10 prenatal care visits and those who received 8–9 prenatal care visits. The variables of placenta or previa abruption and insufficient or excessive fetal growth were not used in the regression analysis because of the small sample sizes in those categories.

DISCUSSION

We believe that this comprehensive population-based study is the first of its kind to examine use of prenatal care among women with schizophrenia. Our study found that, after adjusting for potential confounders, women with schizophrenia had independently and significantly fewer prenatal care visits than other women and were 1.77 ($P < .001$) times more likely to receive inadequate prenatal care than women without the disorder. Our finding supported our hypothesis that women with schizophrenia had poorer prenatal care compliance than women without the disease. Our finding is also in agreement with prior studies that reported higher risk of inadequate prenatal care among women with psychiatric histories compared with the general population.[7–10] However, one similar study by Goodman and Emory[11] reported no significant difference in the number of prenatal care visits between women with schizophrenia and well women. Such inconsistent results may be due to differences in patient selection, the number of patients included in the series, the ability to control for confounding effects, and the availability of prenatal care.

Among the risk factors contributing to inadequate prenatal care, financial obstacles have been cited as the major barrier.[12] Under Taiwan's National Health Insurance program, all pregnant women are allowed to have 10 scheduled prenatal care visits for free, in order to reduce the risk of poor pregnancy outcomes and to decrease the need for pediatric care after birth. In addition, more than 90% of eligible health care institutions distributed well throughout

Table 3. Crude Odds Ratios for Low Birth Weight, Preterm Birth, and Babies Small for Gestational Age by Group Rate of Prenatal Care Visits Among Mothers With Schizophrenia, 2001–2003 (n = 607)

	Rate of Seeking Prenatal Care Visits						
	≥ 10 (n = 258)		8–9 (n = 158)		≤ 7 (n = 191)		
Variable	n	%	n	%	n	%	*P* Value
Low birth weight							< .001
Yes	14	5.4	10	6.3	32	16.8	
No	244	94.6	148	93.7	159	83.2	
Crude OR (95% CI)	1.00		1.18 (0.51–2.72)		3.51*** (1.82–6.78)		
Preterm birth							.004
Yes	19	7.4	12	7.6	31	16.3	
No	239	92.6	146	92.4	160	83.8	
Crude OR (95% CI)	1.00		1.03 (0.49–2.19)		2.44** (1.33–4.46)		
Small for gestational age							.002
Yes	41	15.9	30	19.0	56	29.3	
No	217	84.1	128	81.0	135	70.7	
Crude OR (95% CI)	1.00		1.24 (0.74–2.09)		2.20*** (1.39–3.47)		

**$P < .01$.
***$P < .001$.
Abbreviation: OR = odds ratio.

Table 4. Adjusted Odds Ratios for Low Birth Weight, Preterm Birth, and Babies Small for Gestational Age by Group Rate of Prenatal Care Visits Among Mothers With Schizophrenia, 2001–2003 (n = 607)

	Adverse Pregnancy Outcomes		
Variable	Low Birth Weight, OR (95% CI)	Preterm Birth, OR (95% CI)	Small for Gestational Age, OR (95% CI)
Rate of prenatal care visits			
≥ 10 (reference group)	1.00	1.00	1.00
8–9	1.26 (0.53–3.00)	1.10 (0.50–2.43)	1.35 (0.78–2.33)
≤ 7	3.55*** (1.77–7.12)	2.63** (1.38–5.02)	2.10** (1.31–3.39)
Age, y			
< 20	2.93 (0.61–14.04)	0.80 (0.13–4.99)	4.65** (1.57–13.82)
20–24	2.58 (0.92–7.25)	1.54 (0.55–4.30)	2.62* (1.26–5.48)
25–29 (reference group)	1.00	1.00	1.00
30–34	1.61 (0.71–3.67)	1.66 (0.79–3.51)	1.32 (0.76–2.28)
> 34	1.96 (0.73–5.26)	1.93 (0.79–4.73)	2.35* (1.22–4.54)
Monthly income, NT			
$0 (reference group)	1.00	1.00	1.00
$1–$15,840	1.21 (0.53–2.79)	0.92 (0.40–2.12)	1.58 (0.85–2.94)
$15,841–$25,000	0.70 (0.27–1.78)	0.84 (0.35–2.03)	1.13 (0.57–2.23)
≥ $25,001	0.86 (0.16–4.74)	0.63 (0.13–3.04)	0.93 (0.29–3.01)
Urbanization level			
1 (reference group)	1.00	1.00	1.00
2	1.83 (0.72–4.62)	0.64 (0.29–1.41)	1.16 (0.64–2.08)
3	2.22 (0.80–6.20)	0.79 (0.32–1.94)	1.14 (0.58–2.25)
4	2.78 (0.93–8.32)	0.35 (0.10–1.24)	1.63 (0.78–3.40)
5	2.72 (0.87–8.54)	1.29 (0.49–3.42)	1.36 (0.62–3.00)
Geographic region			
Northern (reference group)	1.00	1.00	1.00
Central	1.15 (0.52–2.54)	0.98 (0.43–2.23)	0.81 (0.46–1.45)
Southern	1.07 (0.49–2.33)	0.86 (0.40–1.87)	0.77 (0.44–1.34)
Eastern	0.33 (0.04–2.90)	1.14 (0.26–4.95)	0.51 (0.15–1.78)
Hypertension	1.21 (0.83–1.56)	2.87 (0.76–10.93)	0.46 (0.10–2.41)
Diabetes	0.96 (0.34–2.71)	1.53 (0.66–3.56)	0.69 (0.32–1.47)
Anemia	0.39 (0.05–3.36)	0.26 (0.03–2.21)	0.45 (0.12–1.67)
Coronary heart disease	1.18 (0.23–5.98)	3.50* (1.09–11.17)	2.78 (0.95–8.12)
Malpresentation	3.25* (1.42–7.44)	1.44 (0.63–3.26)	1.44 (0.76–2.74)
Substance abuse	2.01 (0.93–3.21)	1.83 (0.79–2.76)	1.20 (0.89–3.21)
Infant gender			
Male (reference group)	1.00	1.00	1.00
Female	0.74 (0.41–1.34)	1.82* (1.00–3.31)	0.79 (0.52–1.20)
Infant parity			
1 (reference group)	1.00	1.00	1.00
2	1.86 (0.91–3.81)	1.63 (0.87–3.06)	1.29 (0.80–2.09)
3 or more	2.90** (1.33–6.36)	0.76 (0.32–1.81)	1.43 (0.80–2.55)

*$P < .05$.
**$P < .01$.
***$P < .001$.
Abbreviations: NT = New Taiwanese dollar, OR = odds ratio.

the country were contracted with the Bureau of National Health Insurance by 2008 and could therefore provide such free services. In other words, the NHI has removed financial obstacles to access to prenatal care. However, even though prenatal care was universally and easily available, after adjusting for characteristics known to be risk factors for inadequate prenatal care, we still found that women with schizophrenia receive inadequate prenatal care more often than women without this disorder.

Many psychosocial factors, as well as characteristics of women and of health care delivery systems, have been proposed as explanations for inadequate prenatal care. These include lack of social support, attitudes toward health professionals, unintended or unplanned pregnancy, attitudes and beliefs toward prenatal care and pregnancy, and depression.[13–17] In addition, Goodman and Emory[11] found that a psychiatric history in pregnant women is related to less emotional support, more marital conflict or divorce, and more chronic stress. Similarly, Kim et al[4] found that women with psychiatric diagnoses were more likely to experience stressors such as partner problems, financial difficulties, social isolation, and health and weight issues. In turn, psychiatric disorders may influence women's motivation or beliefs about the benefits of receiving regular prenatal care visits. Consequently, women with schizophrenia may suffer greater psychosocial and biologic stress during pregnancy, resulting in a tendency toward inadequate prenatal care visits.

Additionally, substance abuse is of special consideration because it is strongly associated with lack of prenatal care[18] and adverse pregnancy outcomes, including fetal growth retardation and preterm births.[19,20] Consistent with our findings, schizophrenic patients had considerably higher rates of substance abuse compared with the general population.[21] Comorbid substance abuse in schizophrenic patients was thus associated extensively with inadequate prenatal care and poor neonate outcomes. Substance abuse is frequently underestimated,[22] especially in the medical claims dataset of our study. Nevertheless, we extended previous literature on establishing a link between having a schizophrenia diagnosis and possessing inadequate prenatal care visits, even when the effects of substance abuse disorder were considered.

As far as we know, this is the first study to report the association between inadequate prenatal care and adverse pregnancy outcomes among women with psychiatric disorders. This study found that schizophrenic women who received inadequate prenatal care were at greater risk of adverse pregnancy outcomes than schizophrenic women who received adequate prenatal care. Furthermore, we found that schizophrenic women who received ≤ 7 prenatal care visits were as much as 3.55, 2.63, and 2.10 times more likely to have LBW, preterm, and SGA babies, respectively, compared to schizophrenic women who received adequate prenatal care. Our findings are consistent with prior studies reporting the positive association between adequate prenatal care and decreased risk of preterm, LBW, and SGA babies in different regions and segments of populations.[23–25] Most likely, inadequate prenatal care means fewer maternal and fetal complications are detected or treated during the course of the pregnancy. Therefore, by identifying and treating medical conditions, adequate prenatal care has the potential to reduce adverse pregnancy outcomes. The present study augments prior research by evaluating the effects of adequate prenatal care on pregnancy outcomes, specifically among women with psychiatric disorders.

This study has several strengths. First, the very large sample size used provides sufficient statistical power to detect the true differences in risk of adverse birth outcomes between pregnant women with and without schizophrenia. Second, this is the most complete nationwide population-based study ever conducted to assess how prenatal care affects the risk of adverse pregnancy outcomes, leaving little room for selection and nonresponse bias, so its robust findings can be generalized to the population as a whole. Lastly, we have taken risk factors known to affect pregnancy outcomes, including characteristics of mother and infant, into consideration in the study design.

Some caveats also deserve mention. First, administrative claims data may be less accurate for schizophrenia or comorbid chronic medical conditions. However, in order to ensure the validity of the schizophrenia diagnoses in this study, we ensured that all of the study cohort patients were hospitalized for treatment of schizophrenia or had at least 3 consensus schizophrenia diagnoses in ambulatory care. Second, information on the mothers' smoking history, nutrition, and body mass index are not available through our datasets. In addition, potential confounders for prenatal care use, such as wanting and planning a pregnancy, were not available. Lastly, because the NHIRD does not include complete information regarding medications taken during pregnancy, it is not possible for us to assess the confounding role of medications in the relationship between schizophrenia and adverse birth outcomes.

Despite the above limitations, this study found that women with schizophrenia were more likely to receive inadequate prenatal care than women without the disorder. Therefore, clinicians should be aware that women with schizophrenia are at higher risk for inadequate prenatal care. Identifying and treating women with schizophrenia might improve continuity of prenatal care. Further, this study documented that schizophrenic women who received adequate prenatal care had a lower risk of adverse pregnancy outcomes than schizophrenic women who did not. Several prior studies have demonstrated that women with schizophrenia have an increased risk of adverse pregnancy outcomes compared with healthy pregnant women.[26,27] Therefore, our finding serves to reemphasize the indispensible role of prenatal care for favorable pregnancy outcomes and suggests that enabling women with schizophrenia to obtain better prenatal care may decrease the risk of adverse pregnancy outcomes as well.

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