

Obstetric Complications in Women with Diagnosed Mental Illness: The Relative Success of California's County Mental Health System

Dorothy Thornton, Sylvia Guendelman, and Nap Hosang

Objective. To examine disparities in serious obstetric complications and quality of obstetric care during labor and delivery for women with and without mental illness.

Data Source. Linked California hospital discharge (2000–2001), birth, fetal death, and county mental health system (CMHS) records.

Study Design. This population-based, cross-sectional study of 915,568 deliveries in California, calculated adjusted odds ratios (AORs) for obstetric complication rates for women with a mental illness diagnosis (treated and not treated in the CMHS) compared with women with no mental illness diagnosis, controlling for sociodemographic, delivery hospital type, and clinical factors.

Results. Compared with deliveries in the general non-mentally ill population, deliveries to women with mental illness stand a higher adjusted risk of obstetric complication: AOR = 1.32 (95 percent confidence interval [CI] = 1.25, 1.39) for women treated in the CMHS and AOR = 1.72 (95 percent CI = 1.66, 1.79) for women not treated in the CMHS. Mentally ill women treated in the CMHS are at lower risk than non-CMHS mentally ill women of experiencing conditions associated with suboptimal intrapartum care (postpartum hemorrhage, major puerperal infections) and inadequate prenatal care (acute pyelonephritis).

Conclusion. Since mental disorders during pregnancy adversely affect mothers and their infants, care of the mentally ill pregnant woman by mental health and primary care providers warrants special attention.

Key Words. Maternal and perinatal care and outcomes, maternal mental health, obstetric complications, population health, deliveries in California, mental illness burden

Mental disorders are widespread in the United States. Approximately 22 percent of the U.S. adult population has one or more diagnosed mental disorders in a given year (Kessler et al. 2005). As many as 50 percent of adults with a

diagnosed mental disorder have a coexisting substance abuse disorder, which makes their condition harder to treat and requires more services than those with either a mental or substance abuse disorder alone (Health and Human Services [HHS] 2002).

Among women, peak prevalence of psychiatric disorders occurs during the childbearing years (Burke et al. 1991). Evidence shows that pregnant women in the United States experience a high burden of serious obstetric complications during labor and delivery, many of which are preventable through optimal obstetric care (Danel et al. 2003; Guendelman et al. 2005, 2006a, b; Remy, Oliva, and Clay 2008). However, the extent to which women with mental illness experience more obstetric complications and suboptimal obstetric care during labor and delivery compared with women without a mental illness diagnosis is not well ascertained.

While some studies have shown that mental disorders can affect obstetric outcomes, others have found no effect. Three studies showed higher obstetric risk among women with depression and/or anxiety during pregnancy. One study of 1,495 women attending two obstetric clinics in Sweden found significant associations between depression and/or anxiety and increased nausea and vomiting, prolonged sick leave before 36 weeks gestation, and increased number of obstetric visits (Andersson et al. 2004). A longitudinal study conducted in Finland by Kurki et al. (2000) followed 623 pregnant women in a defined geographic area of Helsinki and found that depression and anxiety in early pregnancy were both associated with an increased risk of preeclampsia. Chung et al. (2001) followed 959 women at a university-associated hospital in China from early pregnancy to 3 years postpartum, and they found significant associations between depression in late pregnancy and increased risk of epidural analgesia, cesarean delivery, and instrumental vaginal deliveries.

In contrast, two hospital-based studies of women with depression and/or anxiety found no associations with poor obstetric outcomes. In a study of 1,515 pregnant women at an obstetric clinic in London, Perkin, Peacock, and

Address correspondence to Dorothy Thornton, Ph.D., Assistant Adjunct Professor, Division of Community Health and Human Development, Berkeley School of Public Health, University of California, University Hall, Berkeley 415-596-6569, CA 94720; email: dthornto@berkeley.edu. Sylvia Guendelman, Ph.D., Professor and Chair, is with the Maternal and Child Health Program, Division of Community Health and Human Development, Berkeley School of Public Health, University of California, Berkeley, CA. Nap Hosang, M.D., M.P.H., M.B.A., Lecturer, is with Department of Obstetrics and Gynecology, Kaiser Permanente, School of Public Health, Hayward Medical Center, University of California, Berkeley, CA.

Anderson (1993) found no relationship between depression and an increased risk for nonspontaneous onset of labor, major analgesia in the first or second stages of labor, assisted vaginal delivery, or preterm delivery. Only a weak but significant relationship was detected between anxiety and analgesia/anesthesia use during the second stage of labor. A similar study by Wu et al. (2002) of obstetric patients at Massachusetts General Hospital found depression in the early third trimester was unrelated to mode of delivery, and detected no significant difference in the rate of cesarean delivery or assisted vaginal delivery between depressed and nondepressed mothers. However, these hospital-based studies are often not representative of the general population of pregnant women because they may overrepresent high-risk obstetric patients who may get better than average care. In addition, these studies have generally examined only a limited array of obstetric complications.

Recently, several population-based studies have examined the relationship between mental illness and obstetric complications. Studies in Australia and Europe have focused on the effects of serious and persistent mental illness (schizophrenia, bipolar disorder, major depression) on obstetric outcomes. However, different psychiatric diagnoses and obstetric outcome indicators are used in each study, limiting their comparability. Jablensky et al. (2005) examined obstetric records for all women in Western Australia with schizophrenia or a major affective disorder diagnosis who gave birth during 1980–1992 ($n = 1,831$ women and 3,174 births) and 3,126 control births to women without such diagnoses. They found that women with a psychiatric diagnosis were at significantly higher risk of placental abnormalities and antepartum hemorrhage. In contrast, using similar methodology, Bennedsen et al. (2001) found no significant difference in obstetric complication level for Danish women with schizophrenia. Finally, Bánhidý et al. (2006) compared infants born to mothers with and without panic disorders ($n = 187$ and 37,964, respectively) in a large Hungarian population-based dataset. They found that anemia and polyhydramnion had a higher prevalence in women with panic disorders.

In one of the few U.S. population-based studies, Kelly et al. (1999) examined the relationship between mental disorders and prenatal care. They found that women with psychiatric diagnoses stood three times the risk of receiving inadequate prenatal care, and this risk factor was associated with negative obstetric outcomes. However, the direct relationship between mental illness diagnoses and obstetric outcomes was not ascertained due to under-reporting of mental disorders in their dataset.

Given the dearth of information on maternal mental health and obstetric outcomes in U.S. populations, we conducted a study comparing mentally ill

and nonmentally ill women in California to (i) examine the extent to which women with a diagnosed mental illness experience obstetric complications and specific complications indicating receipt of suboptimal obstetric and/or prenatal care; (ii) evaluate whether disparities in obstetric complications between women with and without mental illness persist after adjusting for demographic characteristics, clinical factors, and delivery hospital type; and (iii) explore the effects of the mental illness treatment setting on obstetric outcomes. An understanding of the relationship between mental disorders and obstetric complications, and the effects of mental health treatment setting, can help raise awareness of health disparities among pregnant mentally ill women in a state such as California, which has the largest number of births in the nation.

METHODS

This is a cross-sectional study that linked hospital discharge records for all 12–50-year-old women who delivered in California hospitals between January 2000 and December 2001 with county mental health service records and the infant's birth certificate records.

Linked birth certificate–hospital discharge records for each delivery to California residents ($N=952,447$) were examined for an ICD-9/DSM-IV code of a mental health diagnosis, or mental illness as a condition complicating pregnancy (ICD-648.4). Similarly, mental illness DSM-IV diagnoses were taken from the Client Services Information dataset of California's county mental health system (CMHS) and linked to the hospital discharge dataset. The CMHS is a specialty carve-out for poor (Medi-Cal eligible) women meeting "medical necessity" requirements (i.e., have at least one among a statutory list of DSM-IV diagnoses and a significant functional impairment for which an intervention is available from a qualified practitioner). Women with a mental illness diagnosis but no record of treatment in the CMHS could have received no mental health services or received mental health services in any of a large variety of mental health settings ranging from community clinics to private offices of mental health specialists.

Because the focus was on maternal outcomes, a delivery of multiple infants was counted as a single delivery. The data were age restricted (12–50 years) in order to exclude the ~ 300 obvious or possible data quality errors. Women for whom we had no race/ethnicity information ($n=5,527$) were excluded from the analysis.

We excluded women with a record of chronic conditions ($n = 31,136$, 3.3 percent) from the analysis because women with psychiatric diagnoses had higher rates of these medical conditions and they are large predictors of negative obstetric outcomes. The chronic conditions excluded were chronic hypertension, cardiac disease, diabetes mellitus, renal disease, thrombophilia, chronic liver disease, and thyroid disease. The final analytic sample consisted of 915,568 deliveries.

The sample was divided into three subgroups, namely deliveries to (1) the *general population* ($n = 886,268$), who had no record of any mental illness in hospital discharge or county mental health records; (2) *non-CMHS women* ($n = 18,911$), who had a record of a diagnosed mental illness in their delivery hospital discharge records but had not received any services in the CMHS; and (3) *CMHS women* ($n = 10,389$), who had a record of a diagnosed mental illness and had received mental health services in the CMHS at some point during the study period.

Non-CMHS women are further divided into those with a specific psychiatric diagnosis and those with only a nonspecific psychiatric diagnosis, assuming that the former group had sufficient mental health treatment to obtain a formal diagnosis, while the latter group would likely have never received mental health services.

The *obstetric services* received during labor and delivery occurred in diverse types of delivery hospital settings and do not correspond to the setting for mental illness treatment.

Outcome Variables: Characterizing Obstetric Complications

We used a modified method of Danel et al. (2003) to characterize serious maternal morbidities during labor and delivery using ICD-9 codes of obstetric complications (Guendelman et al. 2005). A maternal morbidity is a condition caused by the pregnancy itself or by its management, which adversely affects a woman's physical health beyond what would be expected in a normal delivery. Furthermore, in keeping with recent evidence, we interpret elevated risk of third- and fourth-degree lacerations, postpartum hemorrhage, and major puerperal infections as indicating suboptimal intrapartum obstetric care (Casey and Cox 1997; Agency for Healthcare Research and Quality [AHRQ] 2003; Lu et al. 2005), while acute pyelonephritis identifies women at risk of inadequate prenatal care (Korst et al. 2006). Conditions that affected the fetus, but not the woman's physical health, were not considered.

Key Exposures

Mental Illness. A woman is regarded as having a mental illness diagnosis if her hospital discharge records or county mental health records show a psychiatric diagnosis or report a psychiatric condition complicating the pregnancy. Alcohol and substance abuse diagnoses alone were considered comorbidities rather than psychiatric diagnoses. ICD9/DSM-IV codes used are shown in Table 2.

A woman is regarded as having a mental illness at the time of delivery, regardless of whether the diagnostic record occurred before, during, or after pregnancy. We make this assumption because mental illness diagnosis typically is provided long after initial symptoms of underlying mental illness. Recent evidence shows that the median delay in seeking treatment in the United States was 8 years for major depression and 6 years for bipolar disorder (Wang et al. 2005). Furthermore, it is recognized that the earlier in life the onset of symptoms, the longer the delay in obtaining treatment (Wang et al. 2005). Additionally, there are strong barriers to initial entry into California's CMHS such that care is far more likely if illness has reached serious levels.

Mental Health Treatment Setting. We postulate that maternal morbidities during labor and delivery are influenced by the setting in which mental health treatment is received (due to differences in the population served, and/or quality of the mental health treatment received) and by the obstetric treatment received. Hence, deliveries are further divided into those to mentally ill CMHS and non-CMHS women. Non-CMHS women are further divided into those with and without a specific psychiatric diagnosis.

Other independent variables included *demographic characteristics*, namely mother's age at delivery, race/ethnicity, education, and a proxy for socioeconomic status—prenatal care payment source dichotomized as public versus private; *clinical factors* included parity, trimester when prenatal care was initiated, and prevalent clinical factors that might mediate the obstetric outcome, namely, cesarean sections, labor inductions, and postdate pregnancies (Table 3). Induced labor includes medically induced, surgically induced, and "other induced" labors. Finally, we included *delivery hospital type* categorized by (a) ownership: private, public, nonprofit and (b) teaching hospital, in the models. Hospital type is a proxy for care practices and patient mix.

Data Analysis

In bivariate analyses, we compared the distributions on sociodemographic characteristics, clinical factors, and type of delivery hospital across the three study populations (general population—no mental illness diagnosis, mental illness diagnosis—treated in CMHS, mental illness diagnosis—not treated in CMHS). We compared the psychiatric diagnostic profiles of women in the latter two study populations. We calculated the frequency (and percent) of each obstetric morbidity for each study population.

To calculate adjusted odds ratios (AORs) and 95 percent confidence intervals (CI) obstetric outcomes for the CMHS and non-CMHS populations compared with the general population, we used logistic regression models controlling for age, race/ethnicity (white, black, Hispanic, Other), education level (categorized as 0–6, 7–11, 12, 13–16, 17+ years), economic status (private versus public pay), clinical factors (parity [primiparous versus multiparous], trimester of prenatal care initiation [first, second, third, or none], and where appropriate, induced labor, cesarean section, and postdate pregnancy), and delivery hospital type.

Obstetric Complication_{*i*} = $f(\text{CMHS, non-CMHS, Age, Black, Hispanic, Other/Asian, Education-Level, PublicPayPNC, Primiparous, Trimester Prenatal Care Initiated, C-section*}, \text{Induced Labor*}, \text{Postdate pregnancy*}, \text{Public Hospital, For-Profit Hospital, Teaching Hospital})$.

*The inclusion of these clinical factors varied by outcome; see Table 3 for details.

We also repeated the analysis above restricted to deliveries to only those women with a mental illness diagnosis and compared “any obstetric complication” rates for non-CMHS women with and without specific psychiatric diagnoses to CMHS women.

RESULTS

Describing the Study Populations

Sociodemographic, Clinical Factors, and Hospital-Type Profile. Compared with the general population, at delivery, CMHS women are younger, less educated, black or white non-Hispanic, and reliant on Medicaid (Medi-Cal in California) and other public funds to pay for their prenatal care. Furthermore, although equally as likely to be primiparous, CMHS women tend to initiate prenatal care later in their pregnancies or forego care (Table 1).

Table 1: Sociodemographic Characteristics, Clinical Factors, and Type of Delivery Hospital by Study Population, of Women Who Delivered in California in 2000–2001

	<i>Deliveries</i>		
	<i>General Population</i> <i>n = 886, 268 (%)</i>	<i>Non-CMHS</i> <i>n = 18, 911 (%)</i>	<i>CMHS</i> <i>n = 10, 389 (%)</i>
Sociodemographic characteristics			
Age (years)			
10–14	0.2	0.1	1.6
15–19	11.1	13.4	26.5
20–24	24.7	27.3	28.3
25–29	26.3	22.6	18.7
30–34	23.1	20.3	14.0
35–40	11.9	12.8	8.4
40+	2.8	3.5	2.6
Mother's education (in years)			
missing = 10,376			
0–6	10.4	2.4	3.0
7–11	21.8	28.8	44.9
12	29.1	39.4	36.4
13–16	30.0	25.7	14.9
17+	8.8	23.7	0.9
Mother's race			
White	29.3	50.9	34.4
Asian/Pacific Islander	10.3	4.6	5.5
Black	6.2	14.2	24.0
Hispanic	52.6	28.7	34.6
Other	1.7	1.6	1.6
Public payment for prenatal care*	47.6	52.0	80.7
missing = 2,902			
Clinical factors			
Primiparity (missing = 671)	38.9	34.9	38.8
Trimester prenatal care initiated			
missing = 15,695			
First	84.2	72.6	69.7
Second	12.6	18.3	22.1
Third	2.6	4.7	5.7
No care	0.6	4.5	2.5
Cesarean section	23.4	26.4	24.3
Induced labor	17.9	17.7	17.1
Postdate pregnancy	7.9	8.7	9.0
Delivery hospital			
Hospital ownership type			
missing = 73,161			
Public	11.7	10.6	15.6

continued

Table 1. *Continued*

	<i>Deliveries</i>		
	<i>General Population</i> <i>n = 886, 268 (%)</i>	<i>Non-CMHS</i> <i>n = 18, 911 (%)</i>	<i>CMHS</i> <i>n = 10, 389 (%)</i>
Nonprofit	68.8	74.6	59.1
Investor-owned	19.4	9.5	17.1
Teaching hospital	11.5	12.0	12.0

*Medicare, Medi-Cal, Medi-Cal+comprehensive perinatal services program, other government programs, medically indigent.
CMHS, county mental health system.

At delivery, non-CMHS women have a similar age, parity, and payment for prenatal care profile as those in the general population. However, non-CMHS women are more likely to have a college or vocational education, to be black, and to delay or lack prenatal care.

Women with a mental illness diagnosis have a higher prevalence of postdate pregnancy and cesarean sections but not of inductions compared with women in the general population. Cesarean sections were highest among non-CMHS women.

All women were most likely to deliver in a nonprofit-owned hospital; however, women in the CMHS were more likely than others to deliver in a publicly owned hospital, and non-CMHS women were less likely than all others to deliver in an investor-owned hospital.

Psychiatric Illness Profiles. Compared with non-CMHS women, CMHS women have higher rates of mental disorder and are more likely to have multiple mental illness diagnoses (Table 2). For non-CMHS women, the psychiatric profile is limited to those women for whom we had a specific psychiatric diagnosis (~ 6,000 women). For the remaining women, no specific diagnosis was available, and the only record of a mental illness was an ICD-9 diagnosis of 648.4—a nonspecific code for mental disorders complicating pregnancy, childbirth, or the puerperium.

Among common psychiatric diagnoses, CMHS women are much more likely than non-CMHS women to suffer major depression (32 versus 19 percent), PTSD (13 versus 2 percent), dysthymia (12 versus 4 percent), personality disorders (10 versus 5 percent), and oppositional defiant disorders (4 versus 0.2 percent). However, aggregate rates of anxiety, mood, and

psychotic disorders are not very different. Rates of bipolar disorder and schizophrenia are also very similar in the two populations.

Women with a psychiatric disorder are far more likely to have a record of alcohol or substance use problems than women without a mental illness diagnosis. Rates of recorded substance/alcohol use diagnoses are 1, 57, and

Table 2: Prevalence Rates of Specific Mental Illness Diagnoses* and Substance Abuse Comorbidities for Women in the County Mental Health System[†] (CMHS) and Non-CMHS Women

<i>Mental Illness Diagnosis</i>	<i>ICD9/DSM-IV Codes</i>	<i>Non-CMHS N = 5,803* (%)</i>	<i>CMHS[†] N = 10,389 (%)</i>
Any anxiety disorder	29,389, 300 (not including 3,004), 30,830, 30,921, 30,981	20.40	24.66
Panic disorder	30,001 30,021	4.03	3.47
Agoraphobia (without panic)	30,022	0.03	0.13
Specific phobia	30,029	0.16	0.07
Social phobia	30,023	0.03	0.52
Generalized-anxiety disorder	30,002	0.22	2.71
OCD	3,003	0.93	0.63
Separation anxiety	30,921	0.02	0.05
PTSD	30,981	2.09	12.68
Mood disorder	29,383, 296, 30,040, 30,113, 311	67.45	68.46
Major depression	2,962, 2,963	19.06	32.20
Dysthymia	300.4	4.17	12.40
Bipolar	2,961 2,964–2,968	12.44	11.03
Impulse control disorders	3,123	0.45	2.38
Oppositional defiant disorder	31,381	0.19	4.24
Conduct disorders	3,128	0.22	3.02
ADHD	314	0.50	1.64
Intermittent explosive disorder	31,234	0.12	1.13
Psychotic disorders	29,381, 29,382, 295, 2,971, 2,973, 2,988, 2,989	8.51	11.72
Schizophrenia	295	5.58	5.79
Personality disorder	301	4.96	10.37
Autistic	299	0.00	0.07
Other specific mental illness diagnosis	All codes 290, 293–302, 306–319 not included in a specific dx above	11.51	15.26

continued

Table 2. *Continued*

<i>Mental Illness Diagnosis</i>	<i>ICD9/DSM-IV Codes</i>	<i>Non-CMHS</i>	<i>CMHS[†]</i>
		<i>N = 5,803* (%)</i>	<i>N = 10,389 (%)</i>
Nonspecific mental illness diagnosis [‡]	648.4	47.63	14.52
Substance/alcohol use comorbidities	291, 292, 303, 304, 305, 648.3	57.34 [§]	31.61

Note. Women with multiple diagnoses are counted multiple times.

*No specific diagnoses were available for women whose only record of their psychiatric condition was an ICD-9 648.4 diagnosis ($n = 13,108 = 69\%$)—a nonspecific code indicating that a psychiatric condition complicated the pregnancy. This code can include alcohol/substance use diagnoses.

[†]To be eligible to receive *county* mental health services, a beneficiary must have one of the following disorders: disorders of infancy childhood or adolescence (except autism), pervasive developmental and other disruptive behaviors and attention deficit disorders, elimination disorders, schizophrenia and other psychotic disorders, mood disorders, anxiety disorders, somatoform disorders, factitious disorders, dissociative disorders, paraphilias, gender identity disorders, impulse control disorders not elsewhere classified, adjustment disorders, personality disorders (excluding antisocial personality disorder), medication-induced movement disorders related to other included diagnoses.

[‡]All these women also had a specific psychiatric diagnosis.

[§]This is the percent of women in the entire non-CMHS population (not only those with a specific psychiatric diagnosis) who have a substance/alcohol diagnosis. Among those with a specific psychiatric diagnosis, 75% had a substance use or alcohol comorbidity.

32 percent among general population, non-CMHS, and CMHS mothers, respectively, indicating for the first group that alcohol and substance problems are probably highly underreported. Rates of alcohol and drug diagnoses are also lower than expected for CMHS women where other work suggests that a figure closer to 50 percent would be more accurate (HHS 2002).

Obstetric Outcomes. Women with a record of a mental illness diagnosis are at significantly higher risk than the general population of experiencing “any obstetric complication” during labor and delivery (Table 3).

After controlling for demographic, clinical, and hospital covariates, deliveries to CMHS women have a 32 percent (95 percent CI = 1.25–1.39) increased risk of an obstetric complication during labor and delivery when compared with deliveries in the general population. In contrast, deliveries to non-CMHS women have a 72 percent (95 percent CI = 1.66–1.79) increased risk of an obstetric complication during labor and delivery when compared

Table 3: Prevalence of Obstetric Complications during Labor and Delivery in the General Population and Adjusted Odds Ratios (ORs) for Deliveries to Mentally Ill Women in Non-CMHS and CMHS Compared to Deliveries to the General Population

<i>Obstetric Complication</i>	<i>Prevalence in Deliveries to General Population Count (%)</i> <i>N = 886,268</i>	<i>Adjusted* OR Non-CMHS: (95% CI) N = 18,911</i>	<i>Adjusted* OR CMHS: (95% CI) N = 10,387</i>	<i>†</i>
Any obstetric complication shown below (excludes preterm labor)	163,107 (18.4%)	1.72 (1.66, 1.79)	1.32 (1.25, 1.39)	1, 2, 3
Hemorrhage				
Antepartum	15,097 (1.7%)	2.16 (2.00, 2.34)	1.79 (1.57, 2.03)	
Postpartum	21,948 (2.5%)	1.49 (1.37, 1.63)	1.16 (1.02, 1.33)	1, 2, 3
Eclampsia and preeclampsia	21,604 (2.4%)	1.61 (1.49, 1.75)	1.37 (1.22, 1.54)	
Obstetric trauma				
Major lacerations [†]	24,824 (4.2%)	0.76 (0.68, 0.85)	0.77 (0.66, 0.90)	2, 4
Obstetric trauma	16,778 (1.9%)	1.26 (1.14, 1.39)	1.01 (0.86, 1.17)	2, 3
Ruptured uterus	647 (0.1%)	1.39 (0.86, 2.23)	1.29 (0.64, 2.61)	2, 3
Infection				
Any infection shown below	61,766 (7.0%)	1.94 (1.84, 2.03)	1.40 (1.30, 1.50)	1, 2, 3
Genito-urinary infection	23,387 (2.6%)	2.45 (2.29, 2.62)	1.73 (1.57, 1.91)	1, 2, 3
Aminonitis	16,633 (1.9%)	1.50 (1.36, 1.66)	1.04 (0.89, 1.23)	1, 2, 3
Other infection	13,042 (1.5%)	2.73 (2.52, 2.96)	1.61 (1.41, 1.84)	1, 2, 3
Fever	11,309 (1.3%)	0.92 (0.79, 1.07)	0.85 (0.67, 1.07)	1, 2, 3
Major puerperal infection	6,612 (0.7%)	1.63 (1.41, 1.87)	1.16 (0.93, 1.44)	1, 2, 3
Puerperal pyrexia of unknown origin	4,206 (0.5%)	1.21 (0.99, 1.48)	0.70 (0.50, 0.98)	1, 2, 3
Sepsis	535 (0.1%)	1.33 (0.78, 2.27)	0.66 (0.21, 2.08)	1, 2, 3
Other complications				
Other major puerperal conditions	11,968 (1.4%)	3.02 (2.78, 3.28)	1.87 (1.64, 2.15)	1, 2, 3
Other major complications of L & D	2,414 (0.3%)	1.97 (1.60, 2.43)	1.55 (1.11, 2.17)	1, 2, 3

continued

Table 3. Continued

<i>Obstetric Complication</i>	<i>Prevalence in Deliveries to General Population Count (%)</i> <i>N = 886,268</i>	<i>Adjusted* OR Non-CMHS: (95% CI) N = 18,911</i>	<i>Adjusted* OR CMHS: (95% CI) N = 10,387</i>	†
Anesthetic complications	2,939 (0.3%)	2.12 (1.77, 2.55)	1.33 (0.95, 1.85)	1, 2, 3
Wound complications	3,087 (0.3%)	1.55 (1.26, 1.90)	1.81 (1.37, 2.38)	1, 2, 3
Deep venous thrombosis	487 (0.1%)	2.79 (1.86, 4.18)	1.51 (0.71, 3.22)	1, 2, 3
Gestational liver disease	536 (0.1%)	3.51 (2.58, 4.77)	3.90 (2.57, 5.92)	
Late vomiting	708 (0.1%)	5.20 (4.05, 6.66)	2.23 (1.40, 3.59)	
Pulmonary or amniotic embolism	184 (0.0%)	2.59 (1.35, 4.97)	2.83 (1.13, 7.07)	1, 2, 3
CVA	266 (0.0%)	1.43 (0.71, 2.93)	0.63 (0.16, 2.61)	
Acute pyelonephritis	3,702 (0.4%)	2.93 (2.54, 3.38)	1.86 (1.51, 2.29)	
Preterm labor	62,232 (7.0%)	2.05 (1.96, 2.14)	1.62 (1.52, 1.73)	1, 2

*Covariates: age, education, race/ethnicity, parity, trimester prenatal care initiated, socioeconomic status, additional clinical factors that varied by complication (see †), and delivery hospital type (teaching, ownership type).

†Additional clinical factors: 1 = cesarean section, 2 = induction, 3 = postdate pregnancy, 4 = birth weight.

‡Only full-term vaginal deliveries included in the analyses.

with the general population, controlling for the same covariates. Women with a record of a mental illness diagnosis stand greater risk for almost every obstetric outcome examined. In addition to their greater aggregate risk, non-CMHS deliveries show greater risk than CMHS deliveries for almost every category of obstetric complication. Deliveries to CMHS mothers have a 62 percent (95 percent CI = 1.52–1.73) adjusted increased risk—and deliveries to non-CMHS mothers a twofold (AOR = 2.05, 95 percent CI = 1.96–2.14) adjusted increased risk—of premature labor compared with the general population.

Conditions Associated with Suboptimal Intrapartum and Inadequate Prenatal Care. After adjusting for covariates, compared with the general population (no mental illness diagnosis), women with a mental illness are at higher risk of suffering from two of the three conditions associated with suboptimal intrapartum obstetric care (postpartum hemorrhage and major puerperal infection—not major lacerations) and at even higher risk of having acute pyelonephritis, a condition associated with inadequate prenatal care (Table 3). Non-CMHS women stand a higher risk for all these complications (except major lacerations) compared with CMHS women. Full-term, vaginal deliveries to women with a mental illness diagnosis are, however, at significantly less risk of major lacerations compared with the general population.

Non-CMHS women with and without specific psychiatric diagnoses had significantly higher risk of “any obstetric complication” than CMHS women and did not differ significantly from each other (OR = 1.39, 95 percent CI = 1.28–1.52 non-CMHS-specific psychiatric diagnosis, OR = 1.33, 95 percent CI = 1.24–1.42 non-CMHS nonspecific psychiatric diagnosis).

CONCLUSIONS

Our findings from this population-level study show that women with mental illness are at markedly greater risk than nonmentally ill women of experiencing an obstetric complication during labor and delivery and experiencing premature labor, and these disparities remain after controlling for age, socioeconomic status, race/ethnicity, parity, trimester in which prenatal care was initiated, type of delivery hospital, and other clinical factors (cesarean sections, inductions, postdate pregnancy).

While compared with the general population, the burden of maternal complications is 32 percent (95 percent CI = 1.25, 1.39) higher for CMHS women, and the burden is two times higher (72 percent) for non-CMHS women. Non-CMHS women with a formal psychiatric diagnosis and hence some level of mental health treatment are at 39 percent excess risk compared with CMHS women (OR = 1.39, 95 percent CI = 1.28–1.52).

The relatively strong performance of California's CMHS compared with the non-CMHS, despite the demographic vulnerability of the population it serves, and despite the higher rates of serious mental illness, requires further investigation. It could result from unmeasured differences in the two populations such as substance/alcohol use comorbidities, prescription drug use, or other unmeasured clinical factors. Alternatively, it could be due to differences in obstetric care received by the two populations, or to differences in the mental health care received.

With respect to differences in obstetric care between the two populations, we find suggestions of higher levels of suboptimal obstetric care among non-CMHS women (significantly higher rates of postpartum hemorrhage and puerperal infection) and suggestions of inadequate prenatal care (significantly higher rates of acute pyelonephritis), net of demographic, clinical factors, or hospital type. But the underlying mechanism explaining why women with a mental illness treated in the public CMHS might be more at risk of patient-specific factors for these conditions, or might have better intrapartum and prenatal care than their non-CMHS counterparts also needs to be understood and investigated.

With respect to differences in mental health treatment, our evidence is only suggestive, in large part because of the variety of mental health services (or lack thereof) that non-CMHS women experience. Yet the CMHS women had significantly better aggregate outcomes than non-CMHS women with and without a formal psychiatric diagnosis.

In contrast to the private mental health system, which generally offers limited mental health insurance coverage, the public mental health system in California ensures continuous mental health insurance coverage and may be providing more help and better coordination of care and follow through with referrals. Use of mental health services may help reduce stress and this could improve maternal physical health (AHRQ 2005). Further research is needed to evaluate what effect this organized treatment setting and other specific practices in the CMHS may be contributing to reduced risk of negative obstetric outcomes during labor and delivery.

Our findings must be interpreted cautiously given some limitations. OSHPD obstetric diagnostic codes are determined from hospital discharge

face sheets, and failure to note conditions will result in undercounts. As pointed out by Yasmeen et al. (2006), obstetric records may not be documented and abstracted as carefully as surgical records. Physicians completing face sheets are unlikely to apply consistent case definitions, and verification may not be consistent by coders. However, serious morbidities such as those we describe are determined by changes in vital signs, need for blood, specific drugs, and procedures that are less prone to reporting bias. A study by Handa, Danielsen, and Gilbert (2001) validating California OSHPD data against medical records found that coding for anal lacerations was accurate with a sensitivity and positive predictive value of 90.3 and 91.5 percent, respectively. However, another study estimating the validity of obstetric procedures and diagnoses coded in OSHPD by Yasmeen et al. (2006) found marked heterogeneity in coding. For instance, cesarean sections had a sensitivity and positive predictive value that exceeded 90 percent, while induction of labor was markedly underreported and for preeclampsia and premature labor the sensitivity of reporting was moderate (60–80 percent). Similar to a study in Washington state, Yasmeen et al. (2006) found that linked birth and hospital discharge data were better than either data source alone. Discharge data used for reimbursement purposes may be particularly accurate (Parish et al. 1989).

Psychiatric data in the OSHPD dataset are considerably more problematic. Kelly et al. (1999) found that psychiatric and substance use disorders were significantly underrecorded in California hospital discharge records. Further work by Kelly, Zatzick, and Anders (2001) found that substance abuse and psychiatric disturbances were also substantially underreported in chart notes by primary health care providers. Our study, linking hospital discharge records to the County Mental Health's Client Services Information data improved data capture of psychiatric disorders among pregnant women who deliver in California by 38 percent.

In addition, there may be significant underreporting of alcohol and other drug use disorders in the CMHS and the OSHPD data because interventions for these care components are unreimbursed or not treated, or because *pregnant* women are reluctant to disclose alcohol/drug use. For this reason, our models did not control for substance use. We were also unable to explore the role of psychiatric prescription drug use in our models due to lack of data.

The non-CMHS group is not well characterized in terms of its mental illness treatment setting or lack of treatment. Further work needs to be done to characterize this population more accurately.

Finally, we excluded women with chronic medical diseases from the analysis. Although these conditions are not always coded accurately, rates

of all chronic disease were higher among the mentally ill than the general population.

In summary, we found a strong and consistent relationship between mental illness and obstetric complications. We also observed that mentally ill women treated in the CMHS appear to have lower rates of obstetric complications and of morbidities that might reflect suboptimal care compared with women with mental illness treated in non-county mental illness treatment settings or not treated at all. Because the effect of mental illness on both the mothers' and infants' health is profound (Beardslee, Versage, and Gladstone 1998; Kurki et al. 2000; Federenko and Wadhwa 2004), it behooves us to further investigate the better performance of women in the CMHS so that we can improve services to all mentally ill pregnant women.

ACKNOWLEDGMENTS

Joint Acknowledgment/Disclosure Statement: Dr. Thorton's contributions were funded by the Robert Wood Johnson Foundation Health and Society Scholars Program at University of California, Berkeley.

Disclosures: None.

Disclaimers: None.

REFERENCES

- Agency for Healthcare Research and Quality (AHRQ). 2003. *AHRQ Quality Indicators—Guide to Patient Safety Indicators*. AHRQ Publication 03-R203. Rockville, MD: AHRQ.
- AHRQ. 2005. *Perinatal Depression: Prevalence, Screening Accuracy, and Screening Outcomes. Evidence Report/Technology Assessment, Number 119*. AHRQ Publication No. 05-E006-3. Rockville, MD: AHRQ.
- Andersson, L., I. Sundstrom-Poromaa, M. Wulff, M. Åstrom, and M. Bixo. 2004. "Implications of Antenatal Depression and Anxiety for Obstetric Outcome." *Obstetrics and Gynecology* 104 (3): 467–76.
- Bánhidý, F., A. Nandor, P. Erzsebet, and A. E. Czeizel. 2006. "Association between Maternal Panic Disorders and Pregnancy Complications and Delivery Outcomes." *European Journal of Obstetrics, Gynecology and Reproductive Biology* 124 (1): 47–52.
- Beardslee, W. R., Em. Versage, and T. R. Gladstone. 1998. "Children of Affectively Ill Parents: A Review of the Past 10 Years." *Journal of the American Academy of Child and Adolescent Psychiatry* 37 (11): 1134–41.

- Bennedsen, B. E., P. B. Mortensen, A. V. Olesen, and T. B. Henriksen. 2001. "Congenital Malformations, Stillbirths, and Infant Deaths among Children of Women with Schizophrenia." *Archives of General Psychiatry* 58 (7): 674–9.
- Burke, K. C., J. D. Burke, D. S. Rae, and D. A. Regier. 1991. "Comparing Age at Onset of Major Depression and Other Psychiatric Disorders by Birth Cohorts in Five US Community Populations." *Archives of General Psychiatry* 48 (9): 789–95.
- Casey, B. M., and S. M. Cox. 1997. "Chorioamnionitis and Endometritis." *Infectious Disease Clinics of North America* 11 (1): 203–22.
- Chung, T. K., T. K. Lau, A. S. Yip, H. F. Chiu, and D. T. Lee. 2001. "Antepartum Depressive Symptomatology Is Associated with Adverse Obstetric and Neonatal Outcomes." *Psychosomatic Medicine* 63 (5): 830–4.
- Danel, I., C. J. Berg, C. Johnson, and H. Atrash. 2003. "Magnitude of Maternal Morbidity during Labour and Delivery: United States, 1993–1997." *American Journal of Public Health* 93 (4): 631–4.
- Federenko, I., and P. Wadhwa. 2004. "Women's Maternal Health during Pregnancy Influences Fetal and Infant Development and Health Outcomes." *CNS Spectrums* 9 (3): 198–206.
- Guendelman, S., D. Thornton, J. Gould, and N. Hosang. 2005. "Social Disparities in Maternal Morbidity during Labor and Delivery between Mexican-Born and US-Born White Californians, 1996–1998." *American Journal of Public Health* 95 (12): 2218–24. Erratum in: *American Journal of Public Health* 96(2): 207.
- . 2006a. "Mexican Women in California: Differentials in Maternal Morbidity between Foreign and US-Born Populations." *Paediatric and Perinatal Epidemiology* 20 (6): 471–81.
- . 2006b. "Obstetric Complications during Labor and Delivery: Assessing Ethnic Differences in California." *Women's Health Issues* 16 (4): 189–97.
- Handa, V., B. Danielsen, and W. Gilbert. 2001. "Obstetric Anal Sphincter Lacerations." *Obstetrics and Gynecology* 98: 225–30.
- Health and Human Services (HHS). 2002. *Report to Congress on the Prevention and Treatment of Co-Occurring Substance Abuse Disorders*. Rockville, MD: HHS, SAMHSA.
- Jablensky, A. V., V. Morgan, S. R. Zubrick, C. Bower, and L. A. Yellachich. 2005. "Pregnancy, Delivery, and Neonatal Complications in a Population Cohort of Women with Schizophrenia and Major Affective Disorders." *American Journal of Psychiatry* 162 (1): 79–91.
- Kelly, R. H., B. H. Danielson, D. F. Zatzick, M. N. Haan, T. F. Anders, W. M. Gilbert, and V. K. Burt. 1999. "Chart-Recorded Psychiatric Diagnoses in Women Giving Birth in California in 1992." *American Journal of Psychiatry* 156 (6): 955–7.
- Kelly, R., D. Zatzick, and T. Anders. 2001. "The Detection and Treatment of Psychiatric Disorders and Substance Use among Pregnant Women Cared for in Obstetrics." *American Journal of Psychiatry* 158: 213–9.
- Kessler, R. C., W. T. Chiu, O. Demler, K. R. Merikangas, and E. E. Walters. 2005. "Prevalence, Severity, and Comorbidity of 12-Month DSM-IV Disorders in the National Comorbidity Survey Replication." *Archives of General Psychiatry* 62 (6): 617–27. Erratum in *Archives of General Psychiatry* 62(7): 709.

- Korst, L. M., C. Reyes, M. Fridman, M. C. Lu, C. J. Hobel, and K. D. Gregory. 2006. "Gestational Pyelonephritis as an Indicator of the Quality of Ambulatory Maternal Health Care Services." *Obstetrics and Gynecology* 107 (3): 632–40.
- Kurki, T., V. Hiilesmaa, R. Raitasalo, H. Mattila, and O. Ylikorkala. 2000. "Depression and Anxiety in Early Pregnancy and Risk for Preeclampsia." *Obstetrics and Gynecology* 95 (4): 487–90.
- Lu, M. C., M. Fridman, L. M. Korst, C. Reyes, C. J. Hobel, G. Chavez, and K. D. Gregory. 2005. "Variations in the Incidence of Postpartum Hemorrhage across Hospitals in California." *Maternal and Child Health Journal* 9 (3): 297–306.
- Parish, K. M., V. L. Holt, F. A. Connell, B. Williams, and J. P. LoGerfo. 1989. "Variations in the Accuracy of Obstetric Procedures and Diagnoses on Birth Records in Washington State." *American Journal of Epidemiology* 138 (2): 119–27.
- Perkin, M. R., J. L. Peacock, and H. R. Anderson. 1993. "The Effect of Anxiety and Depression during Pregnancy on Obstetric Complications." *British Journal of Obstetrics and Gynecology* 100 (7): 629–34.
- Remy, L., G. Oliva, and T. Clay. 2008. Maternal Morbidity and Outcomes Including Mortality, California 2001–2006. Family Health Outcomes Project. University of California, San Francisco.
- Wang, P. S., P. Berglund, M. Olsson, H. A. Pincus, K. B. Wells, and R. C. Kessler. 2005. "Failure and Delay in Initial Treatment Contact after First Onset of Mental Disorders in the National Comorbidity Survey Replication." *Archives of General Psychiatry* 62 (6): 603–13.
- Wu, J., A. Viguera, L. Riley, L. Cohen, and J. Ecker. 2002. "Mood Disturbances in Pregnancy and the Mode of Delivery." *American Journal of Obstetrics and Gynecology* 187 (4): 864–7.
- Yasmeen, S., P. Romano, M. Schembri, J. Keyzer, and W. Gilbert. 2006. "Accuracy of Obstetric Diagnoses and Procedures in Hospital Discharge Data." *American Journal of Obstetrics and Gynecology* 194: 992–1001.

SUPPORTING INFORMATION

Additional supporting information may be found in the online version of this article:

Appendix SA1: Author Matrix.

Please note: Wiley-Blackwell is not responsible for the content or functionality of any supporting materials supplied by the authors. Any queries (other than missing material) should be directed to the corresponding author for the article.