HHS Public Access

Author manuscript

Disabil Health J. Author manuscript; available in PMC 2018 July 01.

Published in final edited form as:

Disabil Health J. 2017 July ; 10(3): 406–412. doi:10.1016/j.dhjo.2017.02.010.

Birth Outcomes among US Women with Intellectual and Developmental Disabilities

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Abstract

Background—Women with intellectual and developmental disabilities (IDD) are bearing children at increasing rates. However, there is very little research about pregnancy experiences and birth outcomes among women with IDD. No studies to date have examined birth outcomes with a US population-based sample.

Objective—The main objective was to estimate the national occurrence of deliveries in women with IDD and to compare their birth outcomes to women without IDD.

Methods—We examined the 2007-2011 Nationwide Inpatient Sample of the Healthcare Cost and Utilization Project to compare birth outcomes in women with and without IDD. Birth outcomes included preterm birth, low birth weight, and stillbirth. Multivariable regression analyses compared birth outcomes between women with and without IDD controlling for race/ethnicity, maternal age, household income, health insurance status and type, comorbidity, region and hospital location, teaching status, ownership, and year.

Results—Of an estimated 20.6 million deliveries identified through the HCUP 2007-2011 data 10,275 occurred in women with IDD. In adjusted regression analyses, women with IDD compared to those without IDD were significantly more likely to have preterm birth (OR=1.46; 95%CI: 1.26-1.69, p<0.001), low birth weight (OR=1.61, 95%CI: 1.27 - 2.05, p<0.001), and stillbirth (OR=2.40, 95% CI: 1.70 – 3.40, p<0.001).

Conclusion—This study provides a first examination of the birth outcomes among women with IDD in the United States using a largest population-based sample. There are significant differences in birth outcomes between women with and without IDD. Understanding the causes of these

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No financial disclosures were reported by the authors of this paper.

The preliminary findings of this study were only presented orally at the 49th Annual Gatlinburg Conference in San Diego on March 2016 under the title “Fetal outcomes among women with intellectual and developmental disabilities. ” http://ucdmc.ucdavis.edu/mindinstitute/gatlinburg/pdf/gatlinburg-conference.pdf

differences and addressing these causes are critical to improving pregnancy outcomes among women with IDD.

Keywords

Women intellectual and developmental disabilities; Pregnancy; Birth outcomes; Low birth weight; Preterm birth; Stillbirth

Introduction

The federal government has encouraged researchers to address the lack of research about healthcare disparities for people with disabilities. The Surgeon General's *Closing the Gap* report[1] found, “Especially as adolescents and adults, people with [IDD] … face ever-growing challenges in finding and financing primary and specialty health care that responds both to the characteristics of [IDD] and to the distinctive health care needs of each stage of life.” Further, the CDC's *Healthy People 2020* initiative outlines various priorities related to improving the well-being of expectant mothers and their children and reducing health disparities of vulnerable populations, including people with disabilities[2]. Salient *Healthy People 2020* aims include reducing low birth weight and preterm births and increasing receipt of adequate prenatal care.[2]

Recent studies suggest women with IDD in the United States are at greater risk for pregnancy complications and adverse birth outcomes compared to women without IDD. Negative birth outcomes are likely for women with IDD, because of the “cascade” of health disparities that accrue to people with IDD and which are based on biological, social and environmental factors[3]. Parish and colleagues[4] analyzed Healthcare Cost and Utilization Project (HCUP) data to understand pregnancy outcomes for mothers with IDD in the United States. They found that women with IDD had longer hospital stays and were more likely to have caesarean deliveries in contrast to other women. Mitra and colleagues[5] analyzed Massachusetts Pregnancy to Early Life Longitudinal data and found that women with IDD who delivered were younger, less educated, more likely to be black and Hispanic, and less likely to be married than other women who delivered.

A handful of research from other countries has found that children born to mothers with IDD have increased risk of adverse fetal outcomes. Brown and her colleagues examined the pregnancy complications and birth outcomes among Canadian women with IDD[6-8]. Deliveries to Canadian women with IDD in their study were more vulnerable to medical complications during pregnancy and their babies were more likely to be born preterm and small for their gestational age. A Swedish study found that children born to mothers with IDD were more often stillborn or died perinatally than children born to mothers without IDD[9] . Similarly, an Australian cohort study found that 28% of children in their sample born to mothers with IDD were born prematurely, and 22% had low birth weights[10]. However, most of this research has been conducted with relatively small samples that are not representative of the general population.

Further research is clearly warranted to understand the pregnancy experiences and birth outcomes of US women with IDD. To address some of these research gaps, this study used a

nationally representative data set to (1) investigate the number of deliveries occurring in women with IDD in the United States, and (2) compare the percentage of deliveries complicated by adverse birth outcomes in US women with and without IDD. Given the increased risk of poor health among people with IDD and their reduced healthcare access[1,11-13], we hypothesized that the birth outcomes of infants born to women with IDD would be worse than infants born to the general obstetric population.

Methods

Data Source

Data for this study were derived from the Nationwide Inpatient Sample (NIS) of the Health Care and Cost Utilization Project (HCUP), the largest all-payer, publicly available US inpatient healthcare database. It contains data on approximately 8 million hospital stays each year from about 1,000 hospitals. This approach yields approximately a 20% stratified sample of US community hospitals. The sample of hospitals was drawn from 46 states and was divided into 60 strata based on geographic region, ownership, location, teaching status, and bed size. Detailed information on the design of the survey is available elsewhere.[14]

The HCUP NIS contains more than 100 clinical and nonclinical data elements for each hospital stay, including primary and up to 24 secondary diagnoses and up to 14 procedures coded using ICD-9 CM. Records also include admission and discharge status, patients' demographic characteristics (e.g., sex, age, race), hospital characteristics (e.g., size, teaching status), Elixhauser comorbidities[15], type of health insurance, total charges, and length of stay[16]. The HCUP NIS does not include unique patient identifiers, so the unit of analysis is the hospitalization and not the woman or the infant. However, each delivery is associated with only one pregnancy; any woman who delivered more than once in a single calendar year was counted twice. Nevertheless, this situation is uncommon because short inter-pregnancy intervals that result in US women giving birth twice within a twelve-month period are relatively rare[17].

Sample

All delivery-related hospitalizations were included in the analysis. Delivery hospitalizations were identified using the *International Classification of Disease*, *Ninth Revision, Clinical Modifications* (ICD-9-CM codes 640.0-676.9, where the fifth digit is 1 (delivered, with or without mention of antepartum condition) or 2 (delivered, with mention of postpartum complication) or ICD-9-CM 650 (normal delivery).

Women with IDD were identified from ICD-9-CM codes (see Table 1 for complete listing). The comparison group was identified as any delivery hospitalization among women without IDD. Due to the small number of cases of deliveries in women with IDD, we combined data from four years (2007-2011) to increase the sample size, hence the statistical power of the analyses.

Measures

Dependent variables—The main dependent variables included the following birth outcomes: (1) *preterm birth* [1] identified using ICD-9-CM code 644.2, 644.20, 644.21, 765.0 and 765.1; (2) *low birth weight*[2] (656.5, 656.50, 656.51, and 656.53) and *stillbirth* identified using ICD-9-CM code 656.4, 656.40, 656.41, 656.43, 768.0, 768.1, V27.1, V27.3, and V27.4.

Independent variables—The main independent variable was the IDD status of a woman with the delivery-related hospitalization.

Covariates—Model covariates included maternal age, racial and ethnic identity (non-Hispanic White, non-Hispanic Black, Hispanic, non-Hispanic other), Elixhauser comorbidities (having 1 or more of the comorbidities identified by Agency for Health Care Research and Quality using standard methods by Elixhauser[15]), type of health insurance (Medicare, Medicaid, private, uninsured), median household income for mother's zip code (1st quartile: $1-$38,999, 2nd quartile: $39,000-$47,999, 3rd quartile: $48,000-$62,999, 4th quartile:≥ $63,000), region of hospital (Northeast, Midwest, South, West), location (urban, rural), teaching status of the hospital (teaching, non-teaching), ownership of the hospital (public, private). Finally, owing to the use of combined 2007-2011 HCUP NIS dataset, year of the survey was also modeled to control for the effect of unobserved time-variant confounders.

Statistical analyses

National estimates of the sample's socio-demographic characteristics were compared between the two study groups: women with IDD and women without IDD. Unadjusted rates of hospitalizations with adverse birth outcomes (preterm birth, low birth weight, and stillbirth) were calculated for each group. Chi-square and student t-test was applied to test the difference in rates in each group. Logistic regression analyses were performed for each bivariate dependent variable. These models were similar to estimates in previous studies of pregnancy and delivery outcomes[5,18,19]. We used mothers' IDD status as the main independent variable, while covariates, as noted above, included maternal age, and race/ethnicity, type of health insurance, comorbidity, household income, region and hospital location, teaching status, ownership, and year.

The logistic regression coefficients and the 95% confidence interval (95% CI) were estimated as unadjusted and adjusted odds ratios. Hospital discharge weights were applied to the sample data for all bivariate and multivariate statistical analyses. All estimation procedures were corrected for the complex survey design of the HCUP NIS. All analyses were performed using STATA 14 MP (StataCorp LP, College Station, TX).

This study was approved by the authors' university Institutional Review Board.

[1]Birth of an infant before 37 weeks of pregnancy (Source: World Health Organization)
[2]Birth of an infant weighting less than 2500 g (Source: World Health Organization)

Results

There were 4,196,835 delivery-associated hospitalizations between 2007 and 2011. Of these, 1,897 delivery hospitalizations were among women with IDD and 4,194,938 delivery hospitalizations were among women without IDD. After application of the sample weights, there were an estimated 17,948,409 delivery-associated hospitalizations, including 10,275 among women with IDD and 20,539,123 among women without IDD during the 2007-11 period.

Women with IDD who delivered were more likely to be Black and less likely to be Latina or from other racial/ethnic groups than other women (Table 2). Women with IDD who delivered were more likely to be younger (aged <25 years) and were much less likely to be in the older cohorts of women compared to other women. Medicaid and Medicare were the most common payers for delivery hospitalizations among women with IDD, but private insurance was the most common payer for deliveries among women without IDD. Nearly one-sixth of women with IDD had their deliveries paid for by Medicare, which was significantly higher compared to the rates of Medicare coverage for women without IDD (16.4% vs. 0.7%). Women with IDD were almost three times more likely than other women to have one or more comorbidities (72.4% vs. 23.1%), more likely to live in zip code areas with lower median income, and were also more likely be admitted to rural or teaching hospitals. The rates of delivery hospitalization in women with IDD were highest in hospitals in the Northeast and Midwest regions, and lowest in the West region.

Table 3 reports the unadjusted, weighted comparison between deliveries to women with and without IDD in terms of adverse birth outcomes. Women with IDD had higher risk of having preterm births, low births, and stillbirths. Namely, women with IDD had more than two–fold higher odds of having preterm births (uOR=2.08, 95%CI: 1.83 -2.36, p<0.001), and low birth weights (uOR=2.41, 95%CI: 1.96 - 2.96, p<0.001), and nearly 4 times higher odds of having stillbirths (uOR=3.52, 95%CI: 2.61 - 4.74, p<0.001), compared to other women.

The weighted multivariate analyses comparing the risk of adverse birth outcomes for women with and without IDD are presented in Table 4. Even after controlling for all available model covariates which potentially influence birth outcomes (i.e., maternal age, race/ethnicity, type of health insurance, comorbidity, household income, region and hospital location, teaching status, ownership, and year), deliveries to women with IDD were significantly more likely than other deliveries to have worse birth outcomes, including having preterm births (aOR=1.46; 95%CI: 1.26-1.69, p<0.001), low birth weights (aOR=1.61, 95%CI: 1.27 - 2.05, p<0.001), and stillbirths (aOR=2.40, 95% CI: 1.70 – 3.40, p<0.001). Differences in birth outcomes were also observed by women's racial and ethnic identity, with deliveries to Black women having a higher likelihood of having preterm birth (aOR=1.32; 95%CI: 1.31-1.34, p<0.001), low birth weight (aOR=1.25, 95%CI: 1.22 – 1.28, p<0.001), and stillbirth (aOR=1.94, 95% CI: 1.88 – 2.01, p<0.001) when compared to deliveries of White women. Deliveries to Hispanic women on the other hand, had lower odds of a having preterm birth (aOR=0.91; 95% CI: 0.90-0.92, p<0.001), low birth weight (aOR=0.65, 95% CI: 0.64 – 0.67, p<0.001), and stillbirth (aOR=1.94, 95% CI: 1.88 – 2.01, p<0.001) compared to deliveries of White women. Women from other races had lower odds of having preterm birth

(aOR=0.96; 95%CI: 0.95-0.98, p<0.001), but higher odds of having low birth weight (aOR=1.09, 95% CI: 1.07 – 1.12, p<0.001), and stillbirth (aOR=1.07, 95% CI: 1.02 – 1.12, p<0.001) when compared to White women. Differences in birth outcomes by women's age were mixed. Deliveries to older women (i.e., aged >34 years) were more likely to be preterm birth (aOR=1.16; 95% CI: 1.14-1.17, p<0.001) and stillbirth (aOR=1.49, 95% CI: 1.43 – 1.55, p<0.001), but lower odds of lower birth weight (aOR=0.81, 95% CI: 0.79 – 0.83, p<0.001), when compared to women <25 years old. Women who were 25-34 years old had both lower odds of having preterm birth (aOR=0.96, 95% CI: 0.95 – 0.97, p<0.001) and lower birth weight (aOR=0.74, 95% CI: 0.73 – 0.76, p<0.001), compared to women <25 years old. Differences in birth outcomes were also observed by types of health insurance. Compared to private health insurance, public health insurance such as Medicare or Medicaid or having no health insurance, interestingly, provided protection from adverse birth outcomes. Specifically, women with Medicare and Medicaid or those who were uninsured had significantly lower odds of having preterm birth (Medicare: aOR=0.80; 95% CI: 0.76-0.83, p<0.001; Medicaid: aOR=0.72; 95% CI: 0.69-0.75, p<0.001; uninsured: aOR=0.84; 95% CI: 0.80-0.88, p<0.001), low birth weight (Medicare: aOR=0.77; 95% CI: 0.71-0.83, p<0.001; Medicaid: aOR=0.71; 95% CI: 0.66-0.77, p<0.001; uninsured: aOR=0.68; 95% CI: 0.62-0.74, p<0.001), and stillbirth (Medicare: aOR=0.73; 95% CI: 0.64-0.82, p<0.001; Medicaid: aOR=0.66; 95% CI: 0.58-0.75, p<0.001) compared to those with incomes of $63,000 or more. Deliveries of women with one or more of Elixhauser comorbidities were more likely to have adverse birth outcomes (preterm birth: aOR=1.59; 95% CI: 1.58-1.61, p<0.001; low birth weight: aOR=1.41, 95% CI: 1.39 – 1.43, p<0.001, and stillbirth: aOR=1.40, 95% CI: 1.36 – 1.44, p<0.001) as compared to deliveries of women without these comorbidities. Women who gave birth in urban hospitals were more likely to have preterm birth (aOR=1.26; 95% CI: 1.24-1.28, p<0.001) and low birth weight (aOR=1.11, 95%CI: 1.08 – 1.14, p<0.001), but less likely to have stillbirth (aOR=0.91, 95% CI: 0.86 – 0.95, p<0.001), compared to women who gave birth in rural hospitals. Similarly, women who gave birth in teaching hospitals were more likely to have preterm birth (aOR=1.38; 95% CI: 1.37 -1.40, p<0.001), low birth weight (aOR=1.19, 95%CI: 1.17 - 1.21, p<0.001), and stillbirth (aOR=1.17, 95% CI: 1.14 - 1.21, p<0.001), compared to women who gave birth in rural hospitals. Regional differences in adverse birth outcomes were also observed. Women in were more likely to have adverse birth outcomes if they gave birth in the Midwest (stillbirth: aOR=1.09, 95% CI: 1.04 – 1.15, p<0.001), the South (preterm birth: aOR=1.13; 95% CI: 1.11-1.14, p<0.001; low birth weight: aOR=1.09, 95% CI: 1.07 – 1.11, p<0.001, and stillbirth: aOR=1.17, 95% CI: 1.12 – 1.22, p<0.001), or West (preterm birth: aOR=1.18; 95% CI: 1.16-1.19, p<0.001; and stillbirth: aOR=1.11, 95% CI: 1.07 – 1.17, p<0.001), compared to women in the Northeast region. Finally, we found that over time the risk of preterm birth decreased (2009: aOR=0.95; 95% CI: 0.94 - 0.96, p<0.001; 2010: aOR=0.98, 95% CI: 0.96 -0.99, p<0.001; 2011: aOR=0.87, 95% CI: 0.86 - 0.89, p<0.001), while the risk of low birth weight (2008: aOR=1.09; 95% CI: 1.07 - 1.12, p<0.001; 2009: aOR=1.08; 95% CI: 1.06 - 1.11, p<0.001; 2010: aOR=1.37, 95% CI: 1.28 - 1.35, p<0.001, and 2011: aOR=1.37, 95% CI: 1.28 - 1.35, p<0.001) increased.

Discussion

Our study found that after controlling for all available covariates, there was a significant association between IDD and elevated risk of adverse birth outcomes. These findings were robust and persisted after controlling for socioeconomic and demographic characteristics, comorbidities and hospital-level characteristics. Mothers with IDD were significantly more likely than other mothers to have preterm deliveries, low birth weight infants, and stillbirths. In addition to the IDD status, mothers who were Black, from lower income households, had one or more of Elixhauser comorbidities, gave birth in urban or teaching hospitals, lived in the Midwest, South, or West regions and had private health insurance, were more likely to have adverse birth outcomes. Finally, we found that, over time (between 2007 and 2011), the risk of preterm birth has decreased while the risk of low birth weight has increased.

First, these findings call for an in-depth examination of the pregnancy experiences, complications, costs, quality of care, and outcomes of women with IDD in the United States. In addition, given the results of this study, further research is warranted in understanding these differences in birth outcomes between women with and without IDD. We are not able to draw conclusions about the types of perinatal care the women received, or the other possible causes for the differences observed in this study. Earlier studies by Mitra and collegues[20] examined the rates of antenatal hospital use among population-based samples of women with IDD in the US. They found a higher frequency of emergency department visits and observational stays and frequency and duration of hospital stays among women with IDD compared to women without IDD. Given the higher risk of inpatient hospital use, pregnancy complications, and adverse birth outcomes among women with IDD, future research needs to examine the longitudinal association between outpatient care, inpatient hospital use, and adverse birth outcomes among women with IDD. Additional research identifying the risk factors for adverse birth outcomes in this population of women are important next steps.

In addition to the need for further research, these findings highlight an urgent need for an integrated approach to the delivery of comprehensive perinatal services to high-risk and vulnerable populations such as women with IDD. Namely, there is a need to develop networks and partnerships across and within perinatal health and perinatal mental health services to address the needs of women with IDD beginning from preconception to extended postnatal period (12 months). Recent research has shown that person-centered and coordinated care is one of the most significant aspects of a positive birthing experience.[21] Healthcare professionals, including obstetricians and midwives who are treating women with IDD should be aware of their elevated potential for adverse infant outcomes and prepare accordingly to personalize the prenatal and perinatal care and counseling experiences for these women. Pregnant women with IDD may well need additional time during prenatal visits to understand guidance for good health during pregnancy, given the relatively common communication limitations of women with IDD. Clinicians may also consider verifying the adherence to medical advice of their patients with IDD before, during and after pregnancy. Further research is necessary to determine what specific clinical practice changes are warranted to improve the birth outcomes of women with IDD.

To the best of our knowledge, this is the largest study examining birth outcomes among women with IDD in the United States. As results of combining multiple years of cross-sectional survey data, we were able to improve on previous studies[4,5] by significantly increasing the sample size and improving the modeling strategy. Greater statistical power and use of a more parsimonious modeling strategy enabled us to calculate the least biased and most generalizable effect of IDD status in women on birth outcomes and examine sociodemographic and clinical characteristics of women with IDD who gave birth.

Limitations

The study limitations warrant consideration. First, there is the possibility of erroneous data in the HCUP NIS. The researchers could not verify the accuracy of the coded outcomes. Furthermore, ICD-9 codes are not flawless. It is possible that some women with IDD who gave birth were not coded by the ICD-9 as having intellectual or developmental disability, since labor and delivery were the focus of the hospitalization and not the women's IDD. As such, the weighted estimate of 10,275 deliveries for the 2007-2011 period most likely represents an undercount of deliveries by women with IDD. Second, the unit of analysis was hospitalization rather than the individual patient; therefore, any woman who delivered more than once in a single calendar year was counted twice. However, this situation is uncommon because short interpregnancy intervals that result in US women giving birth within one twelve-month period are rare[17] and thus very few women give birth twice in one calendar year. Third, the level of detail provided by the HCUP NIS was limited; future research could explore the relationships between early prenatal care and pregnancy and health outcomes. Fourth, the HCUP NIS does not permit linkage between the hospital records of the infant and the mother, so it was not possible to analyze infant outcomes other than those reported here (which are part of the maternal discharge summary). Additionally, owing to HCUP NIS data restrictions, the study was unable to account for marital status, a variable that has been associated with both low birth weight and preterm birth[21]. Another potential limitation is out-of-hospital deliveries. Although recent studies[22-24] have shown an increase in the trend of out-of-hospital deliveries, only 1.5% of all deliveries in the United States occurred out of the hospital. Notably, women who have lower birth risks and fewer or no comorbidities are among those who are most likely to give birth outside hospitals. While there are no exact statistics on out-of-hospital deliveries among women with IDD, higher comorbidity rates among women with IDD, likely reduces the rates of out-of-hospital deliveries among women with IDD compared to other women. Finally, about 17 percent of the race/ethnicity variable were missing. Missing values for race/ethnicity were considered missing at random and analyses were performed using observations which did not contain missing data for the race/ethnicity variable. Additionally, the study tested the regression results with the full sample by excluding the race variable from the model and did not find significant bias. Additionally, the analyses were replicated with a random 1% of the non-IDD women and no significant differences in results were observed.

Despite these limitations, this study has important strengths. The HCUP NIS provides high quality, nationally representative data and therefore permits this study to draw inferences about the entire US population of women with IDD who have given birth. Despite potential omitted variable bias, the sample is less constrained by selection bias or sampling bias

arising from convenience samples derived from a single hospital, service provider organization, or single geographic region.

Conclusions

We found significant differences in birth outcomes between women with and without IDD. Namely, women with IDD were significantly more likely than women without IDD to have preterm deliveries, low birth weight infants, and stillbirths. These findings highlight an urgent need for an integrated approach to the delivery of comprehensive perinatal services to the high-risk and vulnerable populations of women with IDD. Namely, there is a need to develop networks and partnerships across and within perinatal health and perinatal mental health services to address the needs of women with IDD beginning from preconception to extended postnatal period (12 months). In addition, these findings indicate that health care professionals, including obstetricians and midwives who are treat women with IDD, should be aware of their elevated potential for adverse pregnancy and infant outcomes. Additional research is needed to identify the specific risk factors for adverse birth outcomes in this population of women. Further research is also necessary to determine what specific clinical practice changes are warranted to improve the birth outcomes of women with IDD.

Acknowledgments

Funding support for this research was provided by Grant # 1R01HD082105-01 from the Eunice Kennedy Shriver National Institute for Child Health and Human Development.

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Table 1
Classification of intellectual and developmental disability

Intellectual and developmental disabilities	ICD-9 codes
Mild mental retardation	317
Moderate mental retardation	318.0
Severe mental retardation	318.1
Profound mental retardation	318.2
Unspecified mental Retardation	319
Fragile X syndrome	759.83
Prader-Willi syndrome	759.81
Down syndrome	758.0
Rett syndrome	330.8
Lesch Nyhan	277.2
Cri du chat	758.31
Autistic disorder	299.0, 299.00, 299.01
Childhood disintegrative disorder	299.1, 299.10, 299.11
Other Specified pervasive developmental disorder	299.8, 299.80, 299.81
Unspecified pervasive developmental disorder	299.9, 299.90, 299.91
Tuberous sclerosis	759.5
Fetal alcohol syndrome	760.71
Cerebral palsy athetoid	333.71
Cerebral palsy diplegic	343.0
Cerebral palsy hemiplegic	343.1
Cerebral palsy quadriplegic	343.2
Cerebral palsy monoplegic	343.3
Other cerebral palsy	343.4
Infantile cerebral palsy	343.8
Cerebral palsy Spastic	343.9
Cerebral palsy spastic non-congenital non-infantile	344.89

Acronyms: ICD-9- International Classification of Diseases

Disabil Health J. Author manuscript; available in PMC 2018 July 01.

Table 2

Description of the sample of women with and without intellectual and developmental disability

Characteristic	Women without IDD n=4,194,938		Women with IDD n=1,897		F test
	n	%	n	%	
Race and ethnic identity					212.6***
Non-Hispanic White	1,795,889	42.8%	896	47.2%	
Non-Hispanic Black	485,234	11.6%	371	19.6%	
Hispanic	812,815	19.4%	210	11.1%	
Non-Hispanic Other	380,195	9.1%	98	5.2%	
Unknown Race/Ethnicity	720,805	17.2%	322	17.0%	
Age in years at admission					138.8***
<25	1,415,245	33.8%	882	46.5%	
25-34	2,168,133	51.7%	810	42.7%	
>34	608,121	14.5%	205	10.8%	
Insurance payer type					7338.5***
Medicare	27,980	0.7%	311	16.4%	
Medicaid	1,801,506	43.0%	1,081	57.0%	
Private insurance	2,097,112	50.1%	438	23.1%	
Uninsured	261,319	6.2%	65	3.4%	
Comorbidity†					2593.4***
No comorbidity	3,226,627	76.9%	524	27.6%	
One or more comorbidities	968,311	23.1%	1,373	72.4%	
Median household income for patient's ZIP code					58.0***
1st quartile:$1-$38,999	1,111,933	27.0%	752	40.6%	
2nd quartile:$39,000-$47,999	1,044,490	25.4%	512	27.6%	
3rd quartile:$48,000-$62,999	1,015,860	24.7%	366	19.7%	
4th quartile:$63,000 +	941,864	22.9%	224	12.1%	
Region of hospital					75.8***

Characteristic	Women without IDD n=4,194,938		Women with IDD n=1,897		F test
	n	%	n	%	
Northeast	655,016	15.6%	364	19.2%	
Midwest	885,687	21.1%	471	24.8%	
South	1,602,552	38.2%	737	38.9%	
West	1,051,683	25.1%	325	17.1%	
Location of hospital					14.7***
Rural	469,588	11.3%	264	14.1%	
Urban	3,681,235	88.7%	1,606	85.9%	
Hospital teaching status					
Non-teaching hospital	2,187,554	52.7%	821	43.9%	
Teaching hospital	1,963,269	47.3%	1,049	56.1%	
Calendar year					12.6*
2007	929,895	22.2%	363	19.1%	
2008	868,657	20.7%	382	20.1%	
2009	821,627	19.6%	395	20.8%	
2010	778,012	18.5%	369	19.5%	
2011	796,747	19.0%	388	20.5%	
Age in years at admission	**Mean**	**SE**	**Mean**	**SE**	-11.5***
	27.6	0.002	25.9	0.14	

* $p<0.05$;

** $p<0.01$;

*** $p<0.001$.

Acronyms: IDD- Intellectual and developmental disability, AHRQ- Agency for Health Care Research and Quality.

† Comorbidity variable is generated using the AHRQ comorbidity software.[15,25] Patients are considered to have comorbidity if their discharge records show that they have one more of the 29 types of patient comorbidities identified by AHRQ using the standard method by Elixhauser.[15]

Data source: Nationwide Inpatient Sample, Healthcare Cost and Utilization Project, 2007-2011

Table 3

Unadjusted comparison of birth outcomes for women with and without intellectual and developmental disability, (n=4,196,835)

Disability status	Preterm birth		Low birth weight		Stillbirth	
	uOR	95% CI	uOR	95% CI	uOR	95% CI
Women without IDD (referent)	1	1	1	1	1	1
Women with IDD	2.08***	1.83 - 2.36	2.41***	1.96 - 2.96	3.52***	2.61 - 4.74

*$p<0.05$;

**$p<0.01$;

***$p<0.001$

Acronyms: IDD- Intellectual and developmental disability; uOR-unadjusted odds ratios; CI-confidence interval.

Data source: Nationwide Inpatient Sample, Healthcare Cost and Utilization Project, 2007-2011

Table 4

Logistic regression analysis for intellectual and developmental status and other relevant variables predicting birth outcomes, U.S., (n=3,345,474)

Variables	Preterm birth		Low birth weight		Stillbirth	
	aOR	95% CI	aOR	95% CI	aOR	95% CI
Disability status						
Women without IDD (referent)	1	1	1	1	1	1
Women with IDD	1.46***	1.26 - 1.69	1.61***	1.27 - 2.05	2.40***	1.70 - 3.40
Race and Ethnicity						
Non-Hispanic White (referent)	1	1	1	1	1	1
Non-Hispanic Black	1.32***	1.31 - 1.34	1.25***	1.22 - 1.28	1.94***	1.88 - 2.01
Hispanic	0.91***	0.90 - 0.92	0.65***	0.64 - 0.67	1.02	0.98 - 1.06
Non-Hispanic Other	0.96***	0.95 - 0.98	1.09***	1.07 - 1.12	1.07**	1.02 - 1.12
Age group						
<24 (referent)	1	1	1	1	1	1
25-34	0.96***	0.95 - 0.97	0.74***	0.73 - 0.76	1.01	0.98 - 1.05
>34	1.16***	1.14 - 1.17	0.81***	0.79 - 0.83	1.49***	1.43 - 1.55
Type of insurance coverage						
Private insurance (referent)	1	1	1	1	1	1
Medicare	0.80***	0.76 - 0.83	0.77***	0.71 - 0.83	0.73***	0.64 - 0.82
Medicaid	0.72***	0.69 - 0.75	0.71***	0.66 - 0.77	0.66***	0.58 - 0.75
Uninsured	0.84***	0.80 - 0.88	0.68***	0.62 - 0.74	1.02	0.89 - 1.17
Comorbidity †						
No comorbidity	1	1	1	1	1	1
1 or more comorbidities	1.59***	1.58 - 1.61	1.41***	1.39 - 1.43	1.40***	1.36 - 1.44
Median household income for patient's ZIP code						
4th quartile:$63,000 + (referent)	1	1	1	1	1	1
1st quartile:$1-$38,999	1.17***	1.15 - 1.18	1.00	0.98 - 1.02	1.32***	1.27 - 1.38
2nd quartile:$39,000-$47,999	1.08***	1.07 - 1.09	1.03*	1.00 - 1.05	1.20***	1.15 - 1.25

Variables	Preterm birth		Low birth weight		Stillbirth	
	aOR	95% CI	aOR	95% CI	aOR	95% CI
3rd quartile:$48,000-$62,999	1.03***	1.02 - 1.05	1.00	0.98 - 1.02	1.15***	1.10 - 1.20
Hospital location						
Rural (referent)	1	1	1	1	1	1
Urban	1.26***	1.24 - 1.28	1.11***	1.08 - 1.14	0.91***	0.86 - 0.95
Teaching status of hospital						
Non-teaching referent)	1	1	1	1	1	1
Teaching	1.38***	1.37 - 1.40	1.19***	1.17 - 1.21	1.17***	1.14 - 1.21
Ownership of hospital						
Private, investor-owned (referent)	1	1	1	1	1	1
Public, government, non-federal	1.01	0.99 - 1.02	0.97*	0.94 - 1.00	1.04	0.99 - 1.10
Private, not-for-profit	0.93***	0.92 - 0.95	1.00	0.97 - 1.02	0.96	0.93 - 1.00
Region of hospital						
Northeast (referent)	1	1	1	1	1	1
Midwest	1.01	0.99 - 1.02	1.00	0.97 - 1.02	1.09***	1.04 - 1.15
South	1.13***	1.11 - 1.14	1.09***	1.07 - 1.11	1.17***	1.12 - 1.22
West	1.18***	1.16 - 1.19	0.99	0.96 - 1.01	1.11***	1.07 - 1.17
Year						
Calendar Year = 2007 (referent)	1	1	1	1	1	1
Calendar Year = 2008	1.00	0.99 - 1.02	1.09***	1.07 - 1.12	1.03	0.98 - 1.07
Calendar Year = 2009	0.95***	0.94 - 0.96	1.08***	1.06 - 1.11	0.96	0.92 - 1.00
Calendar Year = 2010	0.98***	0.96 - 0.99	1.31***	1.28 - 1.35	1.02	0.98 - 1.06
Calendar Year = 2011	0.87***	0.86 - 0.89	1.31***	1.28 - 1.35	0.98	0.94 - 1.02

* $p<0.05$;

** $p<0.01$;

*** $p<0.001$.

Acronyms: IDD- Intellectual and developmental disability, aOR-Adjusted odd ratios, AHRQ- Agency for Health Care Research and Quality; CI-confidence interval.

†Comorbidity variable is generated using the AHRQ comorbidity software.[15,25] Patients are considered to have comorbidity if their discharge records show that they have one more of the 29 types of patient comorbidities identified by AHRQ using the standard method by Elixhauser.[15]

Data source: Nationwide Inpatient Sample, Healthcare Cost and Utilization Project, 2007-2011