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Abstract

In 2010 in the US, there were 4.7 million childbearing age (15-44 years) women with disabilities (WWD) defined as, *being limited in any way in any activities because of physical, mental, or emotional problems.* Although their proportion and pregnancy rates are growing, there is little empirical evidence about their health, healthcare needs, pregnancy experiences and outcomes. We examined differences and predictors of pregnancy outcomes for women with and without disabilities. We used 2009 Pregnancy Risk Assessment Monitoring System (PRAMS) data from 15,585 Massachusetts and Rhode Island women. We conducted χ^2- and t –tests of pregnancy outcome differences for WWD and those without. Applying an economics' health production framework, we conducted multivariate and partial correlation analysis to determine disability significance in predicting pregnancy outcomes. We found no significant differences in delivery types, the mother's hospital stay or the likelihood of birth defects. However, relative to infants born to women without disabilities, those born to WWD had higher likelihoods of preterm birth, mortality, need for intensive care, low gestational age, and low birth weights. Health behavior, health capital stock and access to prenatal care were strong pregnancy outcome predictors, but disability was not. Therefore, having a disability is not a guarantee against positive pregnancy outcomes. Improved health behavior, health capital stock and access to prenatal care can improve pregnancy outcomes for WWD. A better understanding of interactions between disability and pregnancy, and between disability and other pregnancy outcome predictors could aid the identification of effective methods for improving outcomes for WWD.

Keywords

pregnancy outcomes; women with disabilities; disability disparities

Cover Page Footnote

I would like to thank the Centers for Disease Control and Prevention (CDC) for providing me with the PRAMS data

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A Comparative Analysis of Pregnancy Outcomes for Women With and Without Disabilities

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ABSTRACT

In 2010 in the US, there were 4.7 million childbearing age (15-44 years) women with disabilities (WWD) defined as, *being limited in any way in any activities because of physical, mental, or emotional problems.* Although their proportion and pregnancy rates are growing, there is little empirical evidence about their health, healthcare needs, pregnancy experiences and outcomes. We examined differences and predictors of pregnancy outcomes for women with and without disabilities. We used 2009 Pregnancy Risk Assessment Monitoring System (PRAMS) data from 15,585 Massachusetts and Rhode Island women. We conducted χ^2- and t –tests of pregnancy outcome differences for WWD and those without. Applying an economics' health production framework, we conducted multivariate and partial correlation analysis to determine disability significance in predicting pregnancy outcomes. We found no significant differences in delivery types, the mother's hospital stay or the likelihood of birth defects. However, relative to infants born to women without disabilities, those born to WWD had higher likelihoods of preterm birth, mortality, need for intensive care, low gestational age, and low birth weights. Health behavior, health capital stock and access to prenatal care were strong pregnancy outcome predictors, but disability was not. Therefore, having a disability is **not** a guarantee against positive pregnancy outcomes. Improved health behavior, health capital stock and access to prenatal care can improve pregnancy outcomes for WWD. A better understanding of interactions between disability and pregnancy, and between disability and other pregnancy outcome predictors could aid the identification of effective methods for improving outcomes for WWD.

Keywords: pregnancy outcomes, women with disabilities, disability disparities

INTRODUCTION

In 2010 in the US, 59.3 million people had disabilities, and 4.7 million were women of childbearing age, defined as 15-44 years (Brault, 2012; Census, 2012). Because of changes in population characteristics (e.g., higher obesity rates) and improvements in medical care, the proportion of childbearing age women with disabilities (WWD) is growing (Lakdawalla, Bhattacharya, & Goldman, 2004; Sturm Ringel & Andreyeva, 2004). Consequent to improvements in medical care, more women with cerebral palsy and spina bifida now reach their

reproductive years. Furthermore, there is a rise in the incidence of spinal cord injuries among women (Signore, 2012). Researchers project a rise in WWD's pregnancy rates because of changes in the law and in societal attitudes (Iezzoni, Yu, Wint, Smeltzer & Ecker, 2013). Despite the projected growth in the number of pregnant WWD, there is documented paucity of research about their health status, needs, pregnancy experiences and outcomes and little empirical evidence to guide policy and practice (Malouf, Redshaw, Kurinczuk & Gray, 2014; Rogers, 2010).

Pregnant WWD are a vulnerable population because of their disability, gender and socioeconomic status (SES). Compared to people without disabilities, those with disabilities have lower SES, evidenced by their lower educational attainment, higher unemployment and poverty rates (Bureau of Labor Statistics, 2013 & 2013b). In 2010 in the US, median family income for people with disabilities was $32,879, which is much lower than the $55,134 for people without disabilities (Census, 2012). These numbers indicate a wide income gap, but the real income gap is wider because people with disabilities incur the extra costs of assistive devices and services that facilitate their activities of daily living. Relative to people with high SES, those with low SES experience poorer health and have greater healthcare need (Cohen, Janicki-Deverts, Chen & Mathews, 2010).

WWD experience physical, environmental, architectural, attitudinal, policy and communication barriers to health care access (Iezzoni, Wint, Smeltzer, & Ecker, 2015). Physical and architectural barriers include inaccessible buildings, spaces and equipment such as inaccessible scales or examination tables, and mammogram machines that require standing. Attitudinal barriers come from stereotypes of people with disabilities and their abilities. Policy barriers (such as policies that favor institutionalization over home care) might compromise quality access for individuals with disabilities. Communication barriers affect access to quality care for those who are deaf or hard of hearing. These barriers compromise the quality of their care which could affect their pregnancy outcomes (WHO, 2013; Piotrowski & Snell, 2007; Iezzoni, Wint, Smeltzer, & Ecker, 2015b; Lagu, Delk, & Morris, 2015).

There are many disability types including, physical, intellectual, learning, psychological and invisible disabilities, therefore WWD is a diverse group of people with diverse experiences, needs and expectations. Disabilities interact with pregnancy in complex ways, requiring diverse and complex approaches to care (Smeltzer, 2007). Some interactions manifest in adverse effects, while others might be positive. Physical impairment-related pregnancy complications include, falls, urinary tract and bladder problems, wheelchair fit and stability, reduced mobility safety, significant shortness of breath that can require respiratory support, increased spasticity, bowel management difficulties, and skin integrity problems (Iezzoni, Wint, Smeltzer & Ecker, 2015b). Multiple sclerosis symptoms can exacerbate first trimester fatigue (Damek & Shuster, 1997) and women with spinal cord injuries tend to have more urinary tract infections during pregnancy (Jackson, 1996). Pregnancy-related edema is worse for women with movement limitations than for those without. Pregnancy-related back-pain is worse for women with physical disabilities particularly in the third trimester (Burns & Jackson, 2001; Amaragiri & Lee, 2000). However, women with multiple sclerosis and rheumatoid arthritis can experience remission in their symptoms during pregnancy, and pregnancy might reduce pressure sores and other skin conditions (Ostensen, 1991; Confavreux, 1998). Other disabilities and conditions complicate care and require specialized skills (Kuczkowski, 2006; Costello & Balki, 2008; Ko, & Leffert, 2009). Given disability diversity and complexity, there is a need for better understanding of the pregnancy experiences of WWD.

Despite the complexity of the interactions between pregnancy and disability, the American College of Obstetricians and Gynecologists states that physicians do not get comprehensive training about care for individuals with disabilities (ACOG, 2005). Moreover, there is a long history of eugenics programs sterilizing WWD (Kaelber, 2012). Based on evolution theories, eugenics targeted individuals with intellectual disabilities as a legitimate method for humans to improve their stock. As indicated by the 1927 ruling in *Buck v Bell*, in the US, sterilization of individuals with intellectual disabilities was considered the best way to protect society, leading to sterilization of thousands (Roy, Roy & Roy 2012). There is current evidence of lingering eugenics attitudes and egregious medical overreach and abuse (Stern, 2005). Some of the documented abuse resulted from well-intentioned programs. For instance, under increased Medicaid-funding and the Family Planning Services and Population Research Act of 1970, doctors offered sterilization as birth control to low-income Americans, particularly women of color. Often, sterilizations were without informed consent because the doctors deemed the sterilizations "involuntary as a matter of practice". Consequently, they sterilized 3,406 Native American women without their consent. From 2006 to 2010 in California, they sterilized incarcerated women without their consent (Johnson, 2013). This history and the documented paucity of research about pregnant WWD suggest a need for evidence about pregnancy experiences, needs and outcomes for WWD. The long eugenics history implies that the medical profession has a shorter history and experience caring for pregnant WWD than for those without. Therefore, there are questions about the current quality of care provided to WWD and the need for training care providers to ensure WWD get the same quality care provided to women without disabilities (Iezzoni, Wint, Smeltzer &, Ecker, 2015b; Lagu, Delk, & Morris, 2015).

METHODS

Study Objectives

We aimed to contribute evidence about pregnancy outcomes for WWD by examining differences in pregnancy outcomes for women with and without disabilities, and their outcome predictors. To gather the necessary evidence, we addressed the following questions: *What are the differences in pregnancy outcomes for women with and without disabilities? Is disability a significant pregnancy outcome predictor? Is disability the most important pregnancy outcome predictor?*

Study Methods

Data Source. We used data from the 2009 Pregnancy Risk Assessment Monitoring System (PRAMS) from Massachusetts and Rhode Island, the only state surveys that included a question about disability status. PRAMS is survey run by the Centers for Disease Control and Prevention (CDC) in collaboration with state health departments. It collects data about maternal pregnancy experiences, health, socioeconomic status and demographics before, during, and shortly after pregnancy (CDC, 2013). Data from birth certificates augment survey data. PRAMS' survey did not include questions about different disability types, so all disabilities are lumped together as one group.

Analytic Methods. To answer the first study question, we conducted χ^2 - and t-tests of differences in pregnancy outcomes for women with and without disabilities. We addressed the second question through multivariate analysis using the health production framework from health economics. For the third question, we used partial correlation and beta weights analysis to measure the relative importance of contributions of individual explanatory variables to variations in pregnancy outcomes (Nathans, Oswald, & Nimon, 2012).

Health production theory that guided multivariate and partial correlation analysis posits that households produce health using individual and environmental inputs (Grossman, 1972; Grossman & Joyce, 1990; Behrman & Rosenzweig, 2004). The economics health production function is:

$$H_i = f(\, I_i, E,) \qquad (1)$$

Where: the subscript i denotes the individual as the unit of analysis; H is a vector depicting health output; I is a set of individual and household variables (inputs) and E represents environmental inputs. Researchers applied this framework to examine effects of prenatal care on birth weights (Wehby et al., 2009) and household production and demand for health inputs and their effects on birth weights (Rosenzweig & Schultz, 1983). Other researchers used this framework to study the effects of childhood and education on health, the impact of maternal smoking on early child neurodevelopment, and the relationship between household production, fertility and child mortality (Wehby et al., 2011; Conti, Heckman & Urzua, 2011).

Based on this production function, we developed an econometrics model that we applied in multivariate analysis to answer study questions two and three:

$$PO_i = f(\, D_i, S_i\, B_i,\, H_i\, E_i) \qquad (2)$$

Where: PO represents pregnancy outcome (health output); D represents demographic factors (including disability status); S is socioeconomic status (SES); B is health behaviors; H is health capital stock; and E are environmental factors/inputs. Health capital stock is an individual's health state (Grossman, 1972), which we measure by presence of chronic health conditions.

*Dependent Variables***:** In the economics' health production framework (see equations 1 & 2 above), pregnancy outcomes are the production output or health output. We measured these as preterm birth (less than 37 weeks gestation), infant mortality, the infant's need for intensive care (ICU), birth weights, birth defects, plural birth (i.e., birth of two or more infants), gestational age, birth delays, delivery types and length of hospital stay.

Independent Variables: In the economics' health production framework, these are the health production inputs. They include demographics, socioeconomic status (SES), individual health behavior, health capital stock, and environmental factors.

Demographic variables include disability and marital status, age, and ethnicity. Disability is the variable of interest. In 2009, Massachusetts and Rhode Island PRAMS survey questionnaires included the question: "*Are you limited in any way in any activities because of physical, mental, or emotional problems?"* Positive responses to this question identified WWD. Therefore, the disability definition is "*being limited in any way in any activities because of physical, mental or emotional problems"*. Although broad, this definition is similar to the one used by the Americans with Disabilities Act (ADA, 1990). This definition lumps all disability types into one group of WWD. Conceptual frameworks indicate that because they experience less protective factors, minority women might have poorer outcomes than white women (Lu & Halfrom, 2003). However, there is evidence of Latina paradox –i.e., Latina women having favorable outcomes due to social, cultural factors and community networks (Flores, Simonsen, Manuck, Dyer, & Turok, 2012). We include being Latina as one of the demographic variables in our analysis.

Socioeconomic status (SES) has a significant role in health production (Marmot & Wilkinson, 2006; Merete et al., 2009) and in determining an individual's health behaviors and their environment (Pampel, Krueger, & Denney, 2010). Income is an important SES indicator,

and it significantly affects health outcomes such as, infant mortality and birth weights (Conley & Bennett, 200; Rowlingson, 2011; Thompson, 2012). However, greater than half of the study sample did not have income data. Our analysis using the subsample with income data indicated that participation in Women, Infants and Children (WIC) program was an adequate income surrogate. WIC is an income-based federal special supplemental nutrition program. Individuals eligible for WIC are at, or below 185% of the federal poverty line, or, they receive Medicaid or cash assistance under Temporary Assistance for Needy Families (TANF) program, or they get support from the Supplemental Nutrition Assistance Program (food stamps). These eligibility requirements imply that in 2009, a family of five with an income of $45,880 was eligible for WIC (USDA, 2010). Therefore, in this analysis we use participation in WIC as an income surrogate and SES indictor.

Individual health behaviors play a significant role in determining health outcomes. The proxies for health behavior are, the woman's smoking, weight, and the intention to get pregnant. There is evidence that smoking affects health (of the mother and infant) and social relations (Marmot, 2006; Jha et al., 2006; Cutler & Lleras-Muney, 2010). The same is true about an individual's weight. We used both pre-pregnancy weight and pregnancy weight gain. We measured smoking habits over the mother's lifetime (i.e. including during and before pregnancy).

Health production theory and empirical evidence include *health capital stock* (a measure of an individual's health state) as a critical health production input (Grossman, 1972; Galama & van Kippersluis, 2013). Indicators of health capital stock include, hypertension (HBP), bleeding during pregnancy, diabetes during pregnancy, having medical risks to pregnancy, experiencing fever during pregnancy, number of previous live births, plural birth (twins or more) and previous delivery by C-section. Although gestational age and preterm birth are pregnancy outcomes (dependent variables), they indicate the infant's health capital stock. Therefore, we used them as explanatory variables (production inputs) in analyses of birth weights, the likelihood of infant mortality and the need for intensive care (ICU).

Environmental factors are also inputs in health production (Collins, David, Rankin & Desireddi, 2009; Strully, Rehkopf & Xuan, 2010). In this study, we used household climate and access to prenatal healthcare as proxies for the environment. Household climate indicators were stressful events such as, violence by an intimate partner (IPV) before or during pregnancy, and death of a loved one. The total number of prenatal care visits was also included as an indicator of the environment.

RESULTS

Table 1 shows a summary and definitions of characteristics of the study sample, which totaled 15,585 women. About seven percent (6.8%) of these women had disabilities, the majority were white (68.8%), and 18.1% were Latina. College graduates comprised 37% of the sample while 15.3% of these women did not graduate from high school. Fifty three percent (53.3%) used WIC during pregnancy and 60.2% were married women.

Table 1: Study sample summary statistics and variable definitions

Demographics	**Definition**	**% of total**	**N**
Has a Disability	=1 if has a disability otherwise =0	6.8	1027

White	=1 if white otherwise =0	68.8	10729
Teenager	=1 if teenager otherwise =0	9.0	1399
Latina	=1 if Latina otherwise =0	18.1	2815
Married	=1 if married otherwise =0	60.2	9376
Socioeconomic status (SES)			
WIC	=1 if on WIC otherwise =0	53.3	8313
Health Behavior			
Smoker	=1 if mother smokes otherwise =0	9.5	1479
Trying to get pregnant	=1 if was trying to get pregnant otherwise =0	52.9	8176
Health capital			
Medical risk factors	=1 if had medical risk factors otherwise =0	35.0	5459
HBP (High blood pressure)	=1 if had high blood pressure during pregnancy otherwise =0	8.0	1251
bleeding	=1 if had bleeding during pregnancy otherwise =0	3.0	465
fever	=1 if had fever during pregnancy otherwise =0	2.2	345
Diabetic	=1 if diabetic during pregnancy otherwise =0	4.3	668
Preterm labor	=1 if had preterm birth otherwise =0	26.2	4078
Previous live birth	=1 if had previous live birth otherwise =0	51.4	8013
Delivery Types			
C-sect, 1st	=1 if delivered by C-section otherwise =0	23.2	3613

C-sect, repeat	=1 if delivered by repeat C-section otherwise =0		11.2	1750
Forceps delivery	=1 if delivered by forceps otherwise =0		0.8	125
Vacuum delivery	=1 if delivered by vacuum otherwise =0		4.0	616
Vaginal delivery	=1 if vaginal delivery otherwise =0		62.6	9749
Vaginal after c-sect	=1 if vaginal delivered after C-section otherwise =0		1.4	214
Infant Outcomes				
Infant died	=1 if infant not alive at questionnaire completion otherwise=0		1.7	258
Has birth defect	=1 if infant has a birth defect, otherwise=0		7.8	1221
Infant in Intensive Care Unit (ICU)	=1 if infant was in intensive care otherwise =0		22.5	3503
Male	=1 if male infant otherwise =0		50.2	7816
Preterm birth	=1 if gestational age is less than 37 weeks; otherwise =0		25.6	3994
Plural birth	=1 if more than one infants born otherwise =0		6.2	957
Environmental variables				
Pre-pregnancy IPV	=1 if the mother experience IPV pre-pregnancy otherwise =0		3.1	399
In-Pregnancy IPV	=1 if the mother experience IPV in-pregnancy otherwise =0		2.9	370
Loss of loved one	=1 if the mother experience death of a loved one otherwise =0		17.4	2651
Maternal pre- pregnancy weight	Mother's weight before pregnancy in pounds	147.23	37.88	14861

Maternal pregnancy weight gain	Weight gain during pregnancy in pounds	30.15	13.67	13372
Prenatal Care Visits	Total number of prenatal visits to care provider	2.36	0.77	14214
Previous live births	Total number of previous live births	0.96	1.03	14855
Gestational age [G]	Clinical estimate of gestational age grouped	3.53	0.83	15077
Birth weight	Infant birth weight in grams	2840.97	864.68	15086

[G] Clinical estimate of gestational age in weeks grouped as: ≤27weeks =1; 28-33 weeks=2; 34-36 weeks=3; 37-42 weeks= 4; 43≤ weeks=5

In this study sample, some notable differences between WWD and those without include, 54% of women without disabilities were trying to get pregnant while only 43% of WWD were trying. WWD had proportionately more teen mothers (12%) compared to women without disabilities (8%). There were also differences in their access to WIC, 41% of WWD were on this program a smaller proportion that the 56% of those without disabilities. A greater proportion of women without disabilities did not have health insurance (12%) compared to WWD (10%). This difference might be attributable to public support because 29% of WWD were on Medicaid but the proportion of women without disabilities was only 20%. Fifty seven percent of women without disabilities had employment-based health insurance compared to only 44% for WWD.

<u>Differences in Pregnancy Outcomes</u>

Table 2: Results of χ^2 and t-tests of differences in pregnancy outcomes for women with and without disabilities

Statistical Differences	**Proportion (%) with the outcome**		**Proportion difference**	**χ^2 Statistic**
	Women without disabilities	**Women with disabilities**		
Forceps delivery	0.9	0.4	0.5	2.09
Vacuum	4.2	4.1	0.1	0.033
Vaginal	62.7	61.7	1.1	0.401
Vaginal after C-Section	1.4	1.3	0.1	0.049

First C-section	23.4	23.5	-0.1	0.01
Repeat C-section	11.3	12.2	-0.9	0.692
Birth defects	8.3	9.4	1.1	1.223
Preterm Birth	24.4	32.2	-7.9***	28.611
Infant Mortality	1.5	3.9	-2.4***	33.467
Infant in ICU after birth	22.2	29	-6.9***	22.917
T-tests	**Mean**	**Mean**	**Difference**	**t-statistic**
Birth delays (days from due-date to birth)	14.90	20.76	-5.858***	-5.430
Birth weight (grams)	2969.30	2759.93	209.368***	7.323
Gestational age (grouped) [G]	3.62	3.47	.150***	5.816
Infant's Hospital Stay (days)	1.99	1.98	.014**	2.251
Mother's hospital stay (days)	4.93	4.95	-.025	.054
Multiple births	1.07	1.08	-0.01	-1.45

** $p \leq 0.01$; *** for $p \leq 0.001$ [G] Clinical estimate of gestational age in weeks grouped as: ≤27weeks =1; 28-33 weeks=2; 34-36 weeks=3; 37-42 weeks= 4; 43≤ weeks=5

Table 2 displays results of χ^2 and t-tests of differences in pregnancy outcomes for women with and without disabilities. On the average for the whole sample, 64% of the deliveries were vaginal, 33.4% C-section, and 6.2% of the births were plural (twins or more). A quarter (25.6%) of the infants were born preterm, 1.7% died, 22.5% needed intensive care (ICU), and 7.8% had birth defects. Differences in delivery types, the likelihood of birth defects or plural births, and the mother's length of hospital stay were statistically insignificant. However, infants born to WWD had a significantly ($p<0.001$) greater likelihood of being born preterm, requiring ICU, and higher mortality. They also had lower birth weights and lower gestational ages ($p<0.001$). Relative to women without disabilities, WWD had significantly longer birth delays ($p \leq 0.01$).

<u>Multivariate Analysis Results</u>

Table 3: Logistic Regression Results: the likelihood of infants being in intensive care (ICU) and of infant mortality

Variable	**Infant in ICU**				**Infant Mortality**		
Demographic	B	Wald Stat.	Exp(B)		B	Wald Stat.	Exp(B)
Disability	.152	1.25	1.164		.981*	4.27	2.668
Latina	-.224*	4.11	.800		.092	.047	1.096
SES							
WIC	-.153*	3.94	.858		.181	.303	1.198
Health Behavior							
Smoker	-.191	2.54	.826		-1.02	2.69	.362
Pre- weight	.003**	7.97	1.003		-.008	3.45	.992
Weight gain	.007**	6.63	1.007		-.008	.294	.992
Health Capital							
Bleed	.632***	11.4	1.88		-.913	2.23	.401
Fever	1.05***	24.8	2.85		-.838	.948	.432
Med. Risk	.221**	8.458	1.25		.300	.879	1.350
Birth Defect	1.23***	107.9	3.43		.594	3.17	1.812
Preterm	.379*	5.19	1.46		-3.0**	9.87	.050
Gestation Age	-1.4***	121.8	.24		-1.11**	6.81	.329
Birth weight	-.001***	71.1	.999		-.002***	29.9	.998
Diabetic	.207	1.45	1.23		-.399	.129	.671
Previous C-section	.22*	4.37	1.25		.637	1.58	1.89
Environment							
Prenatal	-.036	.543	.97		-.409	3.61	.664

Pre- IPV	.53**	8.10	1.7		-.099	.009	.906
Model fit Stats	89.4% accurate prediction; R^2=0.48; χ^2=3170.7*** N=9063				99.4% accurate prediction; R^2=.53; χ^2=391.14*** N=9116		

**** p≤ 0.05; ** p ≤ 0.01; *** for p ≤ 0.001***

<u>The Likelihood of the Infant Being in Intensive Care</u> (table 3)

Although disability related positively to the likelihood of an infant being in intensive care, it was **not** a significant predictor of this outcome. Significant predictors were *demographics* (Latina), *SES* (WIC), health behavior (measured as pre-pregnancy weight and pregnancy weight gain) and health capital stock. Infants born to Latina women were significantly ($p \leq 0.05$) less likely to require intensive care than those born to non-Latina women. Accessing WIC during pregnancy reduced the likelihood of infants requiring intensive care ($p<0.05$). Smoking appeared to have no significant effects on the likelihood of this outcome. However, the mother's weight related positively and significantly ($p<0.01$) to the likelihood of the infant being in ICU.

Health capital stock variables including bleeding during pregnancy, fever, having medical risks, birth defects, preterm birth, and previous delivery by C-section significantly affected the likelihood of the infant being in ICU. Being a diabetic was a statistically insignificant predictor of this outcome. As expected, birth weights and gestational age related negatively to the likelihood of the infant being in ICU, implying that the higher the infant's weight or gestational age the less likely they were to be in ICU.

Household climate measured as pre-pregnancy intimate partner violence (IPV) significantly increased the likelihood of the infant needing intensive care ($p<0.01$). The number of prenatal care visits was a statistically insignificant predictor of ICU likelihood.

To rank the contributions of the individual explanatory variables to the likelihood of the infant being in intensive care, we examined the size of standardized coefficients, the Wald statistic and the p-values. They indicate that the most important contributors to the likelihood of the infant being in ICU are health capital stock factors including gestational age, birth defect, and birth weight. Disability is a smaller and statistically insignificant contributor to this outcome.

<u>The Likelihood of Infant Mortality (</u>table 3)

Infants born to WWD had a significantly ($p<0.05$) higher likelihood of mortality than those born to women without disabilities. Gestational age and birth weights related negatively to the likelihood of infant mortality while birth defects had a positive effect. These results imply that the higher the birth weight or gestational age the less likely the infant mortality. The effects of two environmental factors included were statistically insignificant. Wald statistics showed birth weight, preterm birth and gestational age to be the most important predictors of infant mortality. Disability was a less significant contributor to this outcome.

Table 4: Multivariate analysis of the likelihood of preterm birth and factors affecting birth weights

Explanatory Variable	**Likelihood of preterm birth**				**Factors affecting birth weights**			
	B	Wald	Exp(B)		Beta	t	Zero-order	Partial

Demographics								
Disability	.318**	7.29	1.37		-.020**	-3.139	-.06***	-.033
Latina	-.55***	31.57	.58		.028***	4.075	.04***	.043
White	.656***	73.13	1.93					
Male baby					.082***	12.87	.08***	.134
SES								
WIC	-.058	.644	.94		.055***	7.800	.05***	.082
Health Behavior								
Smoker	.26**	6.79	1.3		-.08***	-12.06	-.11***	-.126
Pre- weight	- .003***	14.29	.997		.132***	20.08	.10***	.207
Weight gain	-.03***	123.3	.97		.129***	19.3	.19***	.199
Trying to be pregnant	.161*	5.937	1.18					
Health Capital								
Plural birth	2.94***	582.7	18.94		-.13***	-18.63	-.29***	-.193
Bleed	1.93***	147.6	6.86					
Diabetic	-.398*	6.007	.67		.017**	2.545	.03*	.027
Medical Risk	.52***	53.72	1.68		-.021**	-2.890	-.17***	-.030
HBP	1.3***	137.1	3.63		-.09***	-12.33		
Birth Defect	1.1***	113.3	3.00		-.03***	-4.111	-.18***	-.043
Previous C-section	-.180	3.257	.835		.013	1.920	.07***	.020
Previous live births	-.11***	10.87	.892		.08***	11.73	.05***	.123
Gestational age					.44***	42.11	.73***	.406
Birth delay-					-.26***	-26.14	-.68***	-.266

days								
Environmental Inputs								
Prenatal Care	-.86***	456.0	.424		.026***	3.756	.25***	.040
In-Preg. IPV	.262	2.39	1.300		-.02***	-3.578	-.05***	-.038
Loss of beloved	.159*	3.98	1.172					
Model fit Stats	83.6% accurate prediction; R^2=0.332; N=8936					R^2=.633; F=862.9***; N=9019		

**** p ≤ 0.05; ** p ≤ 0.01; *** p ≤ 0.001***

Likelihood of Preterm Birth (Table 4)

Having a disability significantly (p<0.001) increased the likelihood of preterm birth. Individual health behavior measured as weight gain and smoking significantly affected the likelihood of preterm birth. The implication was that the mother's weight had a protective effect (reduced the likelihood of preterm birth) while smoking increased this likelihood.

Health capital stock variables including plural birth, birth defects, bleeding during pregnancy, hypertension, and medical risks significantly increased the likelihood of preterm births. Being a diabetic, the number of previous live births and previous birth by C-section appeared to reduce the likelihood of preterm birth.

Environmental factors were also significant predictors of preterm birth. Prenatal care visits significantly reduced the likelihood of preterm birth (p<0.0001) while stress from the loss of a loved one significantly increased the likelihood of preterm birth (p<0.05). However, pre-pregnancy IPV had no significant effect on the likelihood of preterm birth.

The Wald statistic and p-values indicate that the most important contributors to this outcome were health capital stock factors including plural birth, bleeding during pregnancy, the mother's medical risks, the mother's hypertension, and birth defects. The mother's weight and pregnancy weight gain and the number of prenatal care visits were greater contributors to the likelihood of preterm birth than disability was.

Factors Affecting Birth Weights (linear regression - table 4)

Babies born to WWD were significantly (p<.01) more likely to have lower birth weights than those born to women without disabilities. Other significant predictors of birth weights were ethnicity (Latina), and the infant's sex (p<0.001). SES measured as participation in WIC showed a significant and positive effects on birth weights (p<0.001). That is, infants born to women who accessed WIC had higher birth weights than infants whose mothers did not access WIC. All behavioral variables (smoking, and the mothers weight) were significant birth weight predictors (p<0.0001). While the effect of smoking was negative, pre-pregnancy weight and pregnancy weight gain affected birth weights positively. These results implied that women who smoked had infants with lower weights than women who did not smoke, and that the higher the pre-pregnancy and pregnancy weight gain the higher the infants' birth weights.

Health capital stock was also a significant birth weight predictor. Gestational age, number of previous live births, and being a diabetic, were positive birth weight covariates while hypertension, birth defects, medical risk factors, plural birth and birth delays were negative covariates. The implication was that the higher the mother's pre-pregnancy weight or pregnancy

weight gain, or number of previous live births, the higher the infant's birth weight. The two environmental variables were also significant birth weight predictors. The total number of prenatal care visits significantly increased birth weights ($p<0.001$) while in-pregnancy intimate partner violence (IPV) had a negative impact on birth weights ($p \leq 0.001$).

Beta weights and partial correlations showed that health capital and health behavior were stronger contributors than disability in determining this outcome. The contribution of disability to the determination of birth weights (.033) was relatively small. The more important contributors were gestational age (.406) birth delays (.266), pre-pregnancy weight (.207), pregnancy weight gain (.199), plural birth (.193), male baby (.134), HPB (.129), and number of previous live births (.123). The disability zero-order correlation (.06) was almost twice as large as the partial (.033) which suggested that about half of what appeared to be the effects of disability on birth weights were effects of interactions between disability and other variables.

<u>Gestational Age and Birth Delays</u> (linear regression table 5)

Table 5: Factors affecting gestational age and birth delays (linear regression)

Explanatory Variables	Gestational age in weeks				Days from due- to birth date			
Demographics	Beta	t	Zero order	Partial	Beta	t	Zero order	Partial
Disability	-.03***	-3.269	-.05***	-.045	.029**	3.086	.04***	.03
Latina	.049***	5.022	.04***	.05	-.053***	-5.217	-.04***	-.06
White	-.08***	-8.304	-.06***	-.09	.072***	7.341	.05***	.08
Married	.017	1.444	.015	.02	-.016	-1.321	-.003	-.01
SES								
WIC	-.009	-.778	-.012	-.01	.013	1.089	.02*	.01
Behavior								
Smoker	-.020*	-2.130	-.04***	-.02	.023*	2.314	.04***	.03
Pre- weight	.018	1.893	-.02	.02	-.028**	-2.868	.014	-.03
Weight gain	.146**	15.547	.13***	.16	-.148***	-15.21	.14***	-.16
Trying to get pregnant	-.032**	-3.234	-.04***	-.03	.042***	4.004	.05***	.04
Health Capital								
Bleed	-.155***	-17.1	-.2***	-.178	.141***	15.03	.18***	.16
Medical Risk	-.073***	-6.984	-.16***	-.07	.070***	6.475	.15***	.07

Birth Defect	-.151***	-16.751	-.2***	-.174	.134**	14.24	.18***	.15
Diabetic	.034***	3.580	-02	.04	-.008	-.857	.01	-.01
Previous C-section	.022*	2.388	.04***	.03	.001	.094	.01	.001
Plural birth	-.285***	-30.914	-.29**	-.31	.237**	24.63	.24***	.25
HBP	-.115***	-11.614	-.16***	-.12	.102***	9.884	.15***	.104
Previous live births	.044***	4.503	-.01	.05	-.019	-1.851	.03**	-.02
Environment								
Prenatal Care visits	.262***	28.293	-29***	.29	-.236***	-24.47	.26***	-.25
Pre-preg. IPV	-.011	-1.202	-.02*	-.01	.000	.019	.01	.000
Model Fit Stats	**R^2=.279; F=182.66***; N=8985**				**R^2=.223; F=134.592***; N=8929**			

**** p ≤ 0.05; ** p ≤ 0.01; *** for p ≤ 0.001***

Disability significantly (p≤0.001) reduced gestational age but increased birth delays (p≤0.002). Similarly, being born to a white mother reduced gestational age and increased birth delays but the opposite was true for those born to Latina mothers. The effects of SES (measured as participation in WIC) on gestational age appeared to be statistically insignificant.

All behavioral variables, except pre-pregnancy weight, had statistically significant effects on gestational age. Smoking significantly reduced gestational age but increased birth delays (p<0.05). Pregnancy weight gain seemed protective, it had a significant and positive effect on gestational age (p<0.01) and significantly reduced birth delays (p<0.001). Infants born to women who reported deliberate efforts to get pregnant had significantly shorter gestational ages than those born to mothers who did not.

Health capital stock had significant effects on gestational age and birth delays. The number of previous live births, being diabetic, and having had a previous C-section related positively to gestational age but negatively to birth delays. Infants born women with hypertension (HBP), bleeding during pregnancy, and having medical risks, had significantly lower gestational ages (p<0.001) than infants of mothers without these conditions. The same was true for plural birth and birth defects. The greater the number of prenatal care visits, the longer the gestational age and the shorter the birth delays (p<0.001). Pre-pregnancy IPV was a statistically insignificant contributor to gestational age and birth delays.

The relatively small disability partial correlation (.045) indicated that disability was not a strong contributor in determining gestational age. The strongest two contributors were plural birth (.31) and the number of prenatal care visits (.29). Other relatively strong contributors were

bleeding during pregnancy (.178), birth defects (.174), pregnancy weight-gain (.162), and hypertension (.122). The disability zero-order correlation was larger (.05) than its partial correlation (.045), which is indicative of the contributions of interactions of disability with other variables to gestational age.

Partial correlations also indicated that disability (.03) was not a strong contributor to the determination of birth delays. Stronger contributors to birth delays were plural birth (.252), number of prenatal care visits (.251) pregnancy weight gain (.159), bleeding in pregnancy (.157) and birth defects (.149).

DISCUSSION

Our aim was to determine if there were differences in the pregnancy outcomes of women with and without disabilities and if disability was the most important contributor to the outcomes. Results from the χ^2- and t-tests of differences in outcomes showed no significant differences in delivery types, the mother's hospital stay or likelihood of birth defects. However, relative to infants born to women without disabilities, those born to WWD had significantly higher likelihoods of preterm birth, mortality, and the need for intensive care. They also had lower gestational ages, and lower birth weights.

Multivariate analysis, cast in the economics' health production framework, controlled for demographics, SES, health behavior, health capital stock, and environmental factors. Disability was a statistically significant contributor to the determination of gestational age, birth weights, and of the likelihood of preterm birth and mortality. However, disability was not a statistically significant predictor of the likelihood of the infant being in ICU. Partial correlations from multivariate analysis indicated that disability was **not** a strong contributor to the likelihood of infant needing intensive care, infant mortality, or preterm birth. The strong contributors were health capital stock and environmental factors measured as number of prenatal care visits. These findings suggest that improvements in health capital stock and in access to prenatal care could reduce the likelihood of infant mortality, ICU, and preterm birth of infants born to WWD.

Furthermore, disability was not a strong contributor to birth weights, or gestational age. The stronger contributors were health behavior, health capital stock, and the number of prenatal care visits. Partial correlation analysis showed that the number of prenatal care visits, health capital stock and the pre-pregnancy weight and pregnancy weight gain were strong contributors to these outcomes.

These findings imply that having a disability is **not** necessarily a guarantee against positive pregnancy outcomes. Improvements in health behavior, health capital and access to prenatal care services could improve pregnancy outcomes for WWD. These results indicated that being white significantly increased the likelihood of preterm birth ($p<0.0001$) but being Latina lowered this likelihood ($p<0.0001$). This finding supports the *Latina paradox* (McGlase, Saha, & Dahlstom, 2004; Flores, Sionsen, Manuck, Dyer, & Turok, 2012). Some conceptual models indicate that minority mothers have less protective factors, which can lead to a higher likelihood of preterm births than for white mothers (Lu & Halfon, 2003). However, the etiology of preterm birth, its environmental and genetic factors, and the underlying molecular and cellular pathogenic mechanisms are complex and poorly understood (Wise, Palmer, Heffner & Rosenberg, 2010; Bezold, Karjalainen, Hallman, Teramo & Muglia, 2013; Chaudhari, Plunkett, Ratajczak, Shen, DeFranco, & Muglia, 2008). Therefore, there is a need for more research to gather empirical evidence for a clearer understanding of pregnancy experiences and outcomes of WWD. There is also a need for more research to gather evidence about the interaction of

disability with other variables and the effect of that interaction on pregnancy outcomes for WWD.

Study Limitations

Causal interpretations were neither possible nor intended because of cross-sectional data. The data were from two small states in northeastern US. Therefore, the narrow geographic focus limits generalization of the results to other states. WWD is a diverse group of people encompassing women with Cerebral Palsy and SCI as well as women with depression, hearing or visual impairments, Downs Syndrome, and many other non-physical disabilities. This study could not capture that diversity because PRAMS survey lumps all disabilities into one group. The study could not capture and analyze interactions of diverse disabilities with pregnancy. This analysis shows average effects over the whole array of disability types. Therefore, the size of effects indicated might overestimate the impact of disabilities that have little effect on pregnancy while underestimating the effects of disabilities with larger effects on pregnancy.

Implications for Policy, Practice and Research

Despite its limitation, this study provided some preliminary implications for policy and practice. These results indicated that the total number of prenatal care visits significantly improved gestational age, and birth weights, which significantly affect the likelihood of infant mortality and the need for ICU services. Furthermore, relative to contributions of health capital stock, health behavior and prenatal care, disability's contribution to negative pregnancy outcomes was small. Therefore, instead of a focus on disability as the source of negative outcomes, the focus should be on improving health behavior, health capital stock and access to prenatal care as a way of improving pregnancy outcomes for WWD.

Moreover, the findings suggested that disability interacts with other variables to result in significant negative outcomes. Prenatal care visits might identify such interactions and provide the necessary services to reduce the negative impact on pregnancy outcomes for WWD. Studies of pregnancy experiences, needs and obstacles to accessing prenatal care and of other interactive factors would provide the necessary evidence to guide health and social care for pregnant WWD. Therefore, studies should also focus on gaining a better understanding of the interaction between disability and other pregnancy outcome predictors.

Health behavior has a significant impact on pregnancy outcomes. Smoking is a significant predictor of low birth weights. Pregnancy weight gain has positive effects on birth weights and gestational age. It lowers infant mortality, and the likelihood that the infant will need intensive care. Therefore, care providers need to be attentive to mothers' health behaviors and to offer appropriate advice.

Latina motherhood related positively and significantly to gestational age and birth weights ($p \leq 0.001$) and it was associated with a lower likelihood of preterm birth and of the infant's need for intensive care. This finding contradicts the finding that minority status has negative effects on pregnancy outcomes but it supports the Latina paradox. However, most studies treat minority populations as one group, which could potentially confound the differential ethnicity, cultural and social effects. There is a need for studies of the different population groups to gather information useful for more specifically targeted care that is cognizant of social cultural economic differences across the population groups.

These findings also suggested the need for a more holistic approach to implementing programs aimed at improving pregnancy outcomes for women with disabilities. Such programs should go beyond healthcare to include improving the mothers SES, behavior, and household climate by reducing stress, and intimate partner violence. The study findings point to the need for

improvements in incomes or access to food (WIC) as a means of improving pregnancy outcomes.

The complexity of disability and of its interactions with pregnancy form a significant barrier to closing the evidence and experience gap about care for pregnant WWD. Disability diversity and variations make evidence and experience accumulation by individual health care providers difficult. A central registry documenting care for pregnant WWD could alleviate this problem. Current use of electronic medical records can facilitate creation of such a registry and its accessibility to care providers as a reference source for evidence-based best practices of care for pregnant WWD. Furthermore, PRAMS provides a wealth of information about pregnancy experiences for all women. Information about WWD could be greatly enhanced if all states in the nation included a question such as the one used by Massachusetts and Rhode Island. That one question used to identify disability status could help reduce paucity of data about pregnancy experiences of WWD across the nation. PRAMS could also include a question identifying disability types. These questions enhance data about WWD and facilitate analysis of pregnancy experiences and outcomes for women with diverse disabilities. Such information is necessary for a better understanding of disability-pregnancy interactions across diverse disabilities and for formation of policy and practice that would improve pregnancy outcomes for WWD.

Other important issues for future studies include disability interactions with other variables and their effect on pregnancy outcomes, special needs of pregnant women with disabilities and effective methods of meeting them, and barriers to effective care for pregnant WWD and how healthcare can overcome them. Other important issues are the training needs of healthcare workers that would facilitate quality care for pregnant WWD, and approaches for gathering and recording disability type-specific evidence and making it accessible to all care providers. Such data would facilitate evidence-based care for pregnant WWD

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