



Sexual Orientation Disparities in Pregnancy and Infant Outcomes

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Abstract

Objectives Little is known about maternal and infant health among sexual minority women (SMW), despite the large body of research documenting their multiple preconception risk factors. This study used data from the 2006–2015 National Survey of Family Growth (NSFG) to investigate sexual orientation inequities in pregnancy and birth outcomes, including miscarriage, stillbirth, preterm birth, and birth weight. **Methods** Women reported 19,955 study eligible pregnancies and 15,996 singleton live births. Sexual orientation was measured using self-reported identity and histories of same-sex sexual experiences (heterosexual-WSM [women who only report sex with men]; heterosexual-WSW [women who report sex with women]; bisexual, and lesbian). Logistic regression models were used that adjusted for several maternal characteristics. **Results** Compared to heterosexual-WSM, heterosexual-WSW (OR 1.25, 95% CI 1.00–1.58) and bisexual and lesbian women (OR 1.77, 95% CI 1.34–2.35) were more likely to report miscarriage, and bisexual and lesbian women were more likely to report a pregnancy ending in stillbirth (OR 2.85, 95% CI 1.40–5.83). Lesbian women were more likely to report low birth weight infants (OR 2.64, 95% CI 1.38–5.07) and bisexual and lesbian women were more likely to report very preterm births (OR 1.84, 95% CI 1.11–3.04) compared to heterosexual-WSM. **Conclusions for Practice** This study documents significant sexual orientation inequities in pregnancy and birth outcomes. More research is needed to understand the mechanisms that underlie disparate outcomes and to develop interventions to improve sexual minority women’s maternal and infant health.

Keywords Maternal health · Health inequities · Sexual orientation · Sexual minority women

Significance

What is already known about this subject: Sexual minority women are exposed to multiple stressors and are more likely to report multiple pre-conception risk factors than heterosexual women, potentially placing them at risk for adverse maternal and infant health outcomes.

What this study adds: This study uses nationally representative data to document that bisexual and lesbian women have an increased risk of miscarriage, stillbirth, and very preterm births compared to heterosexual women.

Introduction

The U.S. lags significantly behind other developed nations in infant and maternal health outcomes (MacDorman 2014). Risk of stillbirth, preterm birth and low birth weight infants, however, are concentrated among marginalized groups who are also at elevated risk for a variety of adverse health conditions and who disproportionately face barriers to health care services (e.g. racial/ethnic minorities; Blumenshine et al. 2010; Smith et al. 2007; Willinger et al. 2009). Sexual minority women (SMW; women who do not identify as exclusively heterosexual and/or engage in same-sex sexual or romantic relationships) represent one such marginalized population. SMW’s maternal, infant, and child health outcomes, however, have yet to be systematically studied.

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The biopsychosocial framework emphasizes the role of maternal stress in shaping infant and childhood outcomes (Dunkel Schetter 2011; Entringer et al. 2015). This model builds upon studies using both human and animal models that have linked maternal stress to preterm birth, low birth weight, and infant mortality (Dole et al. 2003; Hoffman et al. 2016; Lilliecreutz et al. 2016). Elevated levels of stress are well documented among SMW who are exposed to a variety of stressors above and beyond those experienced by women in the general population (Meyer 1995). Minority stress theory suggests that these stressors occur via interpersonal experiences with discrimination and victimization, and institutional exclusion from important health-related social resources (Hatzenbuehler 2009). Studies have consistently shown that this excess exposure to discrimination, victimization and stress leads to depression (Almeida et al. 2009; Katz-Wise and Hyde 2012), obesity (Aaron and Hughes 2007; Bowen et al. 2012), and a variety of negative coping behaviors such as alcohol use and misuse (Hughes 2011; Marshal et al. 2009) and tobacco use (McCabe et al. 2017). Additionally, studies have shown that SMW are less likely to have insurance or a reliable source of care (Buchmueller and Carpenter 2010), and they are more likely to report unmet healthcare needs (Everett and Mollborn 2014; Jeong et al. 2016). Taken together, these factors highlight that SMW may be vulnerable to adverse maternal and infant health outcomes.

Current estimates show 59% of self-identified bisexual women and 31% of self-identified lesbians report having given birth (Goldberg et al. 2014). Little research, however, has examined SMW's maternal and infant health. Extant research shows that lesbian and bisexual women experience heterosexism in reproductive health care settings (Ross et al. 2012; Dahl et al. 2013) and a lack of social support from family members and friends during pregnancy (Yager et al. 2010). These studies, however, rely on qualitative data, use convenience samples, and/or focus only on pregnancies experienced within same-sex relationships.

The current study addresses this gap in research by using data from the 2006–2015 National Surveys of Family Growth (NSFG) to assess sexual orientation inequities in pregnancy and infant outcomes, including miscarriage, stillbirth, preterm birth, cesarean delivery, and birth weight. Based on minority stress theory and biopsychosocial theories of maternal stress, we hypothesize that SMW will be more likely to report adverse pregnancy and infant outcomes compared to heterosexual women.

Method

Data

The National Survey of Family Growth (NSFG) annually collects data from a nationally representative sample of reproductive-age U.S. men and women ages 16 to 45. For women, the NSFG collects detailed reproductive histories including information on all reported pregnancies, how they ended, and for those ending in live births, multiple birth outcome indicators. Beginning in 2006, NSFG has measured sexual orientation identity and same-sex behavior.

Our sample was restricted to pregnancies reported during the 2006–2015 NSFG. To reduce recall bias issues, we restricted our sample to pregnancies reported in the 10 years prior to the interview ($n = 24,282$). Further, following explicit NSFG guidelines, we excluded pregnancies ending in termination ($N = 2273$) (National Survey of Family Growth 2006), those in which the respondent was still currently pregnant ($n = 1003$), ectopic pregnancies ($n = 345$), and pregnancies reported before age 14 ($n = 36$). We additionally excluded pregnancies ending in multiple live births because of increased risks of preterm and low birth weight outcomes ($n = 282$). We excluded pregnancies reported by women who did not answer the sexual orientation questions ($n = 388$). Our final sample was 19,955 pregnancies among 7944 women over the ten-year period. We use a second sample when analyzing preterm delivery, cesarean delivery, and birth weight that was restricted to pregnancies that ended in a live birth. This sample included 15,996 live births among 6633 women. Because this study used secondary, publicly available data, it was exempt from IRB review.

Measures

Sexual Orientation

We incorporated two measures of sexual orientation: sexual identity and same-sex behavior. Respondents were asked, “Do you think of yourself as: heterosexual or straight; homosexual, gay or lesbian; or bisexual?” Female respondents were also asked: “Have you ever had any sexual experience of any kind with another female?” From these two survey items, four mutually exclusive categories were created: heterosexual-identified and only (ever) male sexual partners (heterosexual-WSM) [referent]; heterosexual-identified and has had (any) female sexual partners (heterosexual-WSW); bisexual; and lesbian. For analyses of rare outcomes (e.g. miscarriage, stillbirth, very low birth weight, very preterm

birth), lesbian and bisexual women were combined to increase statistical power.¹

Pregnancy Outcomes

We examined pregnancy and birth outcomes known to be impacted by preconception risk factors. *Stillbirth* measured whether a woman reported the pregnancy ending in stillbirth or after the 20th week (1) or a live birth (0, referent). *Miscarriage* captured whether a woman reported the pregnancy ended before the 20th week (1) or ended in a live birth (0 = referent).

Birth Outcomes

We restricted all birth outcomes measures to pregnancies that ended in live birth. *Preterm birth* indicated whether an infant was born at < 37 weeks gestation (1) or ≥ 37 weeks gestation (0 = referent). *Extremely preterm birth* captured whether an infant was born at < 28 weeks gestation (and > 23 weeks) (1) or ≥ 28 weeks gestation (0 = referent). *Cesarean delivery* was assessed based on whether a delivery was a cesarean (1) or vaginal (0 = referent).

Low birth weight was assessed based on whether an infant was born weighing < 2500 g (1) or ≥ 2500 (0 = referent). *Very low birth* was coded as 1500 g (1) or ≥ 1500 g (0 = referent).

Confounding Variables

Maternal age at pregnancy was derived from self-reported age at conception, ranging from 14 to 44. *Race/ethnicity* was a series of four dummy variables: non-Hispanic white (referent), non-Hispanic Black, Hispanic, and other. *Education* was measured at the time of interview and captured whether respondents reported having a high school degree or fewer years of education, some college, or a college degree (referent).

Individuals were coded as having received *public assistance* if they responded that they used any form of public assistance such as Temporary Assistance to Needy Families (TANF) at the time of interview. Income-to-needs ratio was measured as a categorical variable, adjusting for household size that measured whether incomes were < 100% of the federal poverty level (referent), ≥ 100% and < 200% federal poverty, ≥ 200% and < 300% federal poverty, ≥ 300% and < 400% federal poverty, or ≥ 400% federal poverty. *In vitro*

fertilization captured whether a respondent reported having ever used *in vitro fertilization* methods in an attempt to become pregnant. *Intrauterine insemination* was measured using a dichotomous variable that captured whether a respondent reported having ever used this method to become pregnant. *Gravidity* was measured using an ordered variable that captured the number of pregnancies a woman had experienced at the time of interview (range 1–10). We included a dichotomous measure of whether a participant reported receiving prenatal care in the first trimester. We also included a dichotomous measure of whether a participant reported smoking during their pregnancy. To control for period effects, we adjusted for *date of interview*, a continuous variable that measured the month and year of the interview in century months.

Statistical Analysis

We first present descriptive statistics for the total sample and stratified by sexual orientation. Paired *t* tests were used to assess difference in means between heterosexual-WSM compared individually to each sexual minority subgroup. We then present the results of a series of logistic regressions. All logistic regression models included appropriate survey sampling weights to reflect nationally representative estimates. Because some pregnancies are clustered within women, we adjusted for the autocorrelation of errors, similar to other multilevel modeling approaches in our analyses, using the “cluster” command in Stata 14.0. The first model presents results from bivariate logistic regressions. Model 2 controlled for all covariates.² To reduce the lag between time of interview and pregnancy, we also conducted supplementary analyses restricting the sample to pregnancies (n = 10,375) and live births (n = 8027) reported in the past 5 years. All results are presented in the form of odds ratios, the exponentiated form of the beta coefficients. For analyses of birth outcomes, we restricted the sample to live singleton births. For analyses examining miscarriages, we excluded pregnancies that ended in stillbirth, and for those examining stillbirth, we excluded pregnancies that ended in miscarriage. All analyses were conducted using Stata 14.0.

¹ Supplementary analyses were conducted to test differences between bisexual and lesbian women for analyses. Betas were in the same direction for all models, and no statistical differences were detected between the two groups; thus, they were combined for increased statistical power.

² Supplementary analyses included a covariate reflecting pregnancy intention. The inclusion of this variable did not have a significant impact on our results and was thus excluded. Intentions were also excluded because we include pregnancies reported in the past 10 years and measures of intention are generally restricted to the past 5 years in the literature due to recall bias. We also conducted sensitivity analyses that included body mass index (BMI) and alcohol use at time of interview, however, these variables did not impact our results. This, and our inability to correctly time-order these variables led to the decision to exclude them in the final models.

Table 1 Descriptive statistic for the total sample and paired t-tests comparing means for sexual minority populations to heterosexual-WSM
 Reproduced with permission from National Survey of Family Growth 2006–2015

	Total population (n = 19,955)	Hetero-WSM (n = 16,581)	Hetero-WSW (n = 2156)	Bisexual (n = 1074)	Lesbian (n = 120)
Maternal age (m)	26.89	27.28	25.21**	23.81**	25.23
Race/ethnicity (%)					
White	57.41	55.67	67.86*	64.97*	48.54
Black	15.04	14.28	18.72	18.87	19.14
Latina	20.43	23.27	10.40**	11.56**	6.00*
Other	7.12	7.68	3.02*	4.60	26.33
Education (%)					
High school	37.65	36.92	36.92	51.93**	46.79
Some college	26.28	24.18	38.05*	35.32*	30.96
College graduate	36.07	38.90	25.03**	12.75**	22.25*
Income-to-needs ratio (%)					
< 100	31.68	30.11	36.56	45.58*	55.59*
≥ 100 and < 200	22.81	22.59	25.22	21.51	18.62
≥ 200 and < 300	15.96	15.89	17.00	15.33	11.29
≥ 300 and < 400	13.06	13.98	9.23	6.74	3.38
≥ 400	16.49	17.43	12.00	10.84	11.12
Public assistance (%)	8.67	8.18	8.78	17.01*	12.78
Smoked during pregnancy (%)	6.83	5.52	12.93*	15.51***	11.97 [†]
Prenatal care, 1st trimester (%)	47.29	47.62	46.10	44.53	47.73
Intrauterine insemination (%)	2.50	2.58	1.95	1.88	10.79
In vitro fertilization (%)	0.89	0.92	0.95	0.05*	0.00***
Gravidity (m)	2.39	2.44	2.08*	2.15	2.29
Interview date (in century months) (m)	1344.43	1343.68	1348.04	1347.08	1359.75
Miscarriage (%)	19.89	18.65	24.56	30.08***	30.03
Stillbirth (%)	1.00	0.83	1.61	2.62	4.12
	Live births				
	(n = 15,975)	(n = 13,501)	(n = 1634)	(n = 754)	(n = 86)
Preterm birth (%)	11.98	11.75	11.30	16.28*	33.92 [†]
Very preterm birth (%)	2.00	1.84	2.40	3.81	4.80*
Low birth weight (%)	7.59	7.35	7.74	10.02	21.63*
Very low birth weight (%)	1.34	1.26	1.67	2.52**	1.21
Cesarean section (%)	29.09	28.81	32.89**	25.67	24.91

[†] $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$

Results

Descriptive Statistics

Descriptive statistics are provided in Table 1. Eighty-three percent of pregnancies were reported by heterosexual-WSM, 11% by heterosexual-WSW, 5% by bisexual women, and 1% by lesbian identified women. While lesbian-identified women had a much higher prevalence of having ever used intrauterine insemination (10.8%) compared to all other groups, no lesbian-identified women reported having used in vitro fertilization. Further, no differences across sexual

orientation groups in the use of prenatal care in the first trimester were found. However, smoking during pregnancy was at twice as high among sexual minority groups (11.9–15.5%) compared to heterosexual-WSM (5.5%).

Nineteen percent of pregnancies reported by heterosexual-WSM ended in miscarriage, compared to 30% of pregnancies reported by bisexual ($p < .001$) and lesbian women ($p \geq .05$, non-significant). Further, 0.8% of pregnancies reported by heterosexual-WSM ended in stillbirth, compared to 1.6% of heterosexual-WSW, 2.6% of bisexual women, and 4.1% of lesbian women ($p \geq .05$). Among live births, 12% of births reported by heterosexual-WSW were preterm, compared to

Table 2 Results from logistic regressions examining sexual orientation disparities in birth outcomes (n=19,995) Reproduced with permission from National Survey of Family Growth 2006–2015

	Panel A: miscarriage vs. live birth (n=19,765)						Panel B: still birth vs. live birth (n=16,141)					
	Model 1			Model 2			Model 1			Model 2		
	OR	95% CI	<i>p</i>	OR	95% CI	<i>p</i>	OR	95% CI	<i>p</i>	OR	95% CI	<i>p</i>
Sexual orientation												
Heterosexual-WSM	1.00			1.00			1.00			1.00		
Heterosexual-WSW	1.43	(1.08, 1.91)	*	1.25	(1.00, 1.58)	*	1.96	(0.80, 4.79)		1.71	(0.80, 3.66)	
Bisexual/lesbian	1.89	(1.38, 2.58)	***	1.77	(1.34, 2.35)	***	3.43	(1.64, 7.16)	***	2.85	(1.40, 5.83)	**

Model 2 adjusts for race/ethnicity, education, maternal age, public assistance, income-to-needs ratio, intrauterine insemination, in vitro fertilization, prenatal care in first trimester, smoked during pregnancy, gravidity, and month of interview

CI confidence interval, OR odds ratio, WSM women who have only had sex with men, WSW Women who have had sex with a woman

* $p < .05$; ** $p < .01$; *** $p < .001$

16% of those reported by bisexual women ($p < .05$) and 34% of those reported by lesbian women ($p < .10$). Similar trends were observed for extremely preterm births; lesbian women reported 2.5 times the proportion of very preterm births as heterosexual-WSM ($p < .05$). Only bisexual women reported a significantly higher prevalence of cesarean delivery than heterosexual-WSM (30.1 vs. 18.7%, $p < .001$). Results for low birth weight show that 22% of pregnancies reported by lesbian women were low birth weight compared to 8% of those reported by heterosexual-WSM ($p < .05$).

Pregnancy Outcome Results

Panel A (Table 2) shows the risk of reporting a miscarriage. Model 1 shows pregnancies reported by heterosexual-WSW (OR 1.43, 95% CI 1.08–1.91) and bisexual and lesbian women (OR 1.89, 95% CI 1.38–2.58) were more likely to end in miscarriage compared to those reported by heterosexual-WSM. These results persisted after adjusting for all other controls in Model 2.

Panel B presents the results for risk of a pregnancy ending in stillbirth compared to a live birth. Model 1 shows that pregnancies reported by bisexual and lesbian women had greater than three times the odds (OR 3.43, 95% CI 1.64–7.16) of ending in stillbirth compared to those reported by heterosexual-WSM. Adjusting for all other covariates reduced the odds; however, bisexual and lesbian women were still more than two and one-half times as likely as heterosexual-WSM to report a pregnancy ending in stillbirth (OR 2.85, 95% CI 1.40–5.83).

Live Birth Outcomes

Panel A, Table 3 presents results for low birth weight and shows that infants of lesbian women were more likely to be low birth weight (OR 3.44, 95% CI 1.71–6.95) compared to those of heterosexual-WSM. This finding held after

adjusting for additional covariates in Model 2 (OR 2.64, 95% CI 1.38–5.07). Results for very low birth weight (Panel B) were similar: infants of bisexual and lesbian women were more likely to be very low birth weight (OR 1.86, 95% CI 1.09–3.17). However, this difference was reduced in Model 2 with the inclusion of other control variables (OR 1.60, 95% CI 0.93–2.76).

Panel C, Model 1 shows that births reported by bisexual (OR 1.46, 95% CI 1.05–2.02) and lesbian (OR 3.85, 95% CI 1.17–12.67) women were more likely to be preterm than those of heterosexual-WSM. After adjusting for additional covariates in Model 2, outcomes for lesbian women continued to show elevated risk of preterm birth (OR 3.10, 95% CI 0.99–9.65). As shown in Panel D, pregnancies reported by bisexual or lesbian women were more likely to be extremely preterm (OR 2.13, 95% CI 1.31–3.45)—a disparity that persisted in Model 2 (OR 1.84, 95% CI 1.11–3.04). Panel E, which presents the results for cesarean deliveries, shows no differences in risk by sexual orientation.

Pregnancies and Live Births in the Past 5 Years

Table 4 presents the results for study outcomes restricted to pregnancies in the five years prior to the interview. All models controlled for all additional covariates. The results show patterns similar to those in Tables 2 and 3. Compared to heterosexual-WSM, pregnancies reported by lesbian and bisexual women were more likely to end in stillbirth (OR 3.01, 95% CI 1.01–8.96), and among live births, lesbian and bisexual women were more likely to report very low birth weight infants (OR 2.65, 95% CI 1.33–5.25), and very preterm births (OR 3.15, 95% CI 1.66–5.99). Heterosexual-WSW were more likely than heterosexual-WSM to report stillbirth (OR 2.55, 95% CI 1.10–5.92).³

³ Additional sensitivity analyses were conducted that restricted the sample to pregnancies in the past year. Results of these analyses were similar to those for pregnancies completed in the past 5 and 10 years.

Table 3 Results from logistic regressions examining sexual orientation disparities in birth outcomes among pregnancies that ended in live births (n=15,996) Reproduced with permission from National Survey of Family Growth 2006–2015

	Panel A: low birth weight						Panel B: very low birth weight					
	Model 1			Model 2			Model 1			Model 2		
	OR	95% CI	<i>p</i>	OR	95% CI	<i>p</i>	OR	95% CI	<i>p</i>	OR	95% CI	<i>p</i>
Sexual orientation												
Heterosexual-WSM	1.00			1.00								
Heterosexual-WSW	1.07	(0.79, 1.45)		1.02	(0.75, 1.37)							
Bisexual	1.39	(0.96, 2.01)	†	1.18	(0.81, 1.74)							
Lesbian	3.44	(1.71, 6.95)	***	2.64	(1.38, 5.07)	**						
Heterosexual-WSM							1.00			1.00		
Heterosexual-WSW							1.29	(0.63, 2.68)		1.21	(0.59, 2.46)	
Bisexual/Lesbian							1.86	(1.09, 3.17)	*	1.60	(0.93, 2.76)	†
Panel C: preterm birth												
Panel D: very preterm birth												
Sexual orientation												
Heterosexual-WSM	1.00			1.00								
Heterosexual-WSW	0.96	(0.75, 1.24)		0.88	(0.68, 1.15)							
Bisexual	1.46	(1.05, 2.02)	*	1.21	(0.86, 1.72)							
Lesbian	3.85	(1.17, 12.67)	*	3.10	(0.99, 9.65)	†						
Heterosexual-WSM							1.00			1.00		
Heterosexual-WSW							1.28	(0.73, 2.23)		1.27	(0.74, 2.17)	
Bisexual/lesbian							2.13	(1.31, 3.45)	**	1.84	(1.11, 3.04)	*
Panel E: C-section												
Sexual orientation												
Heterosexual-WSM	1.00						1.00					
Heterosexual-WSW	1.21			(0.95, 1.55)			1.23			(0.96, 1.59)		
Bisexual	0.85			(0.65, 1.13)			0.96			(0.72, 1.26)		
Lesbian	0.82			(0.33, 2.01)			0.75			(0.27, 2.06)		

Model 2 adjusts for race/ethnicity, education, maternal age, public assistance, income-to-needs ratio, intrauterine insemination, in vitro fertilization, prenatal care in first trimester, smoked during pregnancy, gravidity, and month of interview

CI confidence interval, OR odds ratio, WSM women who have only had sex with men, WSW women who have had sex with a woman

† *p* < .10; * *p* < .05; ** *p* < .01; *** *p* < .001

Discussion

This study is the first to use nationally representative data to document sexual orientation inequities in pregnancy and

birth outcomes, particularly among bisexual and lesbian women. Using a novel application of the minority stress framework (Meyer 1995) we found results in line with other research showing adverse maternal and infant health outcomes among marginalized populations (Blumenshine et al. 2010; Smith et al. 2007; Willinger et al. 2009). Although we were unable to assess discrimination, previous research has demonstrated the negative impact discriminatory policies (Krieger et al. 2013), interpersonal discrimination (Collins et al. 2004; Earnshaw et al. 2012), and threats of discrimination (Braveman et al. 2017) on maternal and infant health.

Footnote 3 (continued)

However, due to the small sample sizes for lesbian (n=3) and bisexual (n=62) women, the results produced large confidence intervals. Thus we did not include these estimates. They are, however, available upon request.

Table 4 Results from logistic regression restricted to pregnancies and births reported in the past 5 years Reproduced with permission from National Survey of Family Growth 2006–2015

	Miscarriage			Stillbirth		
	OR	95% CI	<i>p</i>	OR	95% CI	<i>p</i>
Heterosexual-WSM				1.00		
Heterosexual-WSW	1.14	(0.89, 1.47)		2.55	(1.10, 5.92)	*
Bisexual/lesbian	1.63	(1.16, 2.29)	**	3.01	(1.01, 8.96)	*
	Low birth weight			Very low birth weight		
	OR	95% CI	<i>p</i>	OR	95% CI	<i>p</i>
Sexual orientation						
Heterosexual-WSM	1.00					
Heterosexual-WSW	1.03	(0.69, 1.54)				
Bisexual	1.50	(0.93, 2.43)	†			
Lesbian	1.88	(0.64, 5.55)				
Heterosexual-WSM				1.00		
Heterosexual-WSW				1.73	(0.68, 4.40)	
Bisexual/lesbian				2.65	(1.33, 5.25)	**
	Preterm birth			Very preterm birth		
	OR	95% CI	<i>p</i>	OR	95% CI	<i>p</i>
Sexual orientation						
Heterosexual-WSM	1.00					
Heterosexual-WSW	0.99	(0.70, 1.40)				
Bisexual	1.65	(1.05, 2.59)	*			
Lesbian	2.05	(0.64, 6.54)				
Heterosexual-WSM				1.00		
Heterosexual-WSW				1.58	(0.69, 3.63)	
Bisexual/lesbian				3.15	(1.66, 5.99)	***
	C-section					
	OR	95% CI	<i>p</i>	OR	95% CI	<i>p</i>
Sexual orientation						
Heterosexual-WSM		1.00				
Heterosexual-WSW		1.27			(0.95, 1.68)	
Bisexual		0.94			(0.66, 1.32)	
Lesbian		1.06			(0.27, 4.17)	

Model 2 adjusts for race/ethnicity, education, maternal age, public assistance, income-to-needs ratio, intrauterine insemination, in vitro fertilization, prenatal care in first trimester, smoked during pregnancy, gravidity, and month of interview

CI confidence interval, OR odds ratio, WSM women who have only had sex with men, WSW women who have had sex with a woman

†*p* < .10; **p* < .05; ***p* < .01; ****p* < .001

Given the high rates of discrimination experienced by SMW, it is possible that similar processes contribute to the inequities in birth outcomes observed among bisexual and lesbian women. In addition, research with non-pregnant samples has shown that exposure to stress is associated with higher cortisol stress reactivity among bisexual and lesbian women than heterosexual women (Juster et al. 2015). Thus, it may be that pregnant SMW who experience levels of stress during pregnancy that are similar to their heterosexual peers are

more vulnerable to adverse birth outcomes due to differences in physical reactivity to stress.

In light of our findings of elevated risk of adverse birth outcomes among SMW, it is important to keep in mind research showing that children raised by same-sex parents demonstrate similar, or better, developmental outcomes compared to children raised by opposite-sex parents (Adams and Light 2015; Manning et al. 2014). SMW, however, become pregnant and raise children in a variety of contexts.

At the time of pregnancy, it is possible some of SMW did not identify as lesbian or were in heterosexual relationships and thus may have been exposed to lower levels of discrimination. However, research on sexual fluidity and identity change suggests that identity changes are associated with elevated levels of stress and depression, which may impact pregnancy outcomes (Diamond 2003; Everett et al. 2016).

Alternatively, research has shown that sex with men is not uncommon among bisexual and lesbian women (Xu et al. 2010) and that SMW are disproportionately more likely to experience an unintended pregnancy (Everett et al. 2017). Supplementary analyses using the current data show that none of the pregnancies reported by lesbian women in the past 2 years were the result of using intrauterine insemination. Thus, it is likely that many of the lesbian women who became pregnant in this study did so through penile-vaginal intercourse *while* identifying as lesbian at the time of pregnancy. Further, it may be that some women in same-sex relationships do not have the financial resources to use assisted reproductive technologies, and engage in sex with men in their social networks for the purposes of becoming pregnant (Reed et al. 2011). Women who are excluded from the use of reproductive technologies because of cost, however, may face additional challenges related to their socioeconomic status not captured by the variables measured at the time of interview in this study. Research is needed to understand how the results presented here may vary based on context of the pregnancy.

Interestingly, our results also showed that heterosexual-WSW were more likely to report a miscarriage than heterosexual-WSM. However, this was the only significant difference detected between these two groups of women. Several studies have shown that, similar to bisexual and lesbian women, heterosexual-WSW are more likely to report multiple preconception risk factors (Bell et al. 2006; Przedworski et al. 2014). The fact that heterosexual-WSW's risk profile, for the most part, did not translate into adverse infant outcomes is interesting and suggests that minority stressors associated with a bisexual or lesbian *identity* play an important role in shaping maternal and fetal health for bisexual and lesbian women, above and beyond the role of risk factors such as smoking, hazardous drinking and obesity.

Overall, our findings highlight the need for increased access to culturally sensitive maternal health services among SMW. The American Congress of Obstetricians and Gynecologists has officially endorsed equitable treatment for sexual minorities and same-sex families (ACOG 2012). Further, a recent statement by the American College of Physicians emphasizes the positive role that medical providers can play in improving the reproductive health outcomes of SMW (Daniel and Butkus 2015). In particular, this statement emphasizes that the definitions of family should be inclusive of all family formations and that health education

programs should incorporate LGBT health issues to create a safe and non-judgmental space for SMW in healthcare settings. Despite these endorsements, SMW continue to experience stigma and discrimination in clinical settings (Malmquist and Nelson 2013) and have unmet medical needs (Everett and Mollborn 2014).

This study has several limitations. Most notably, we were unable to assess some potentially important preconception and perinatal risk factors. The NSFG includes multiple survey items regarding drug, tobacco, and alcohol use, and BMI. Unfortunately, these measures are based on a past 12 month timeframe and therefore cannot be assumed to represent the health or health behaviors of a woman prior to pregnancy. We were unable to assess minority-stress-specific risk factors, such as discrimination, to determine if these factors contribute to the observed inequities. Many other health conditions that impact maternal and fetal outcomes, such as gestational diabetes or hypertension, were not assessed in the NSFG. Because the NSFG data are based on self-report, the results may be affected by recall bias, however, our results were largely robust to shortened time frames between the survey and pregnancy. Including indicators of sexual orientation in other maternal health datasets, such as the Pregnancy Risk Assessment Management System, could rectify some of the methodological limitations of the NSFG. The incorporation of sexual orientation measures into large datasets could provide opportunities to analyze data related to rare birth outcomes from bisexual and lesbian women separately, something we were unable to do in some analyses. Additionally, risks of preterm birth and other adverse pregnancy outcomes increase when pregnancies are conceived via assisted reproductive technologies as opposed to spontaneous conceptions. We adjusted for the use of such methods, and use of in vitro fertilization was overall < 1% in this study; therefore, we expect that these methods had a minimal, if any, influence on our findings.

Finally, the NSFG dataset did not include measures of gender identity for the respondent or their partners. Sex/gender of respondents was assessed via the household roster, where one respondent identified all members of the household and listed their "sex." Eligible respondents for the survey were then given the "male" or "female" survey and male and female samples were released in separate data files (National Survey of Family Growth 2015). As a result, transgender men identified as male in the household roster would be excluded from this study sample. Because the unit of analysis is pregnancy, transgender women are also excluded. Questions about sexual partners for pregnancies refer explicitly to "males" and would likely exclude partners who identify as women, but have the capacity to impregnate a partner. Future research would benefit from the inclusion of gender identity measures, in addition to measures of sexual orientation in large national health surveys.

Conclusion

Our findings provide compelling evidence of the need for research dedicated to understanding and improving the pregnancy experiences, and maternal, infant, and child health outcomes, of SMW. Furthermore, pregnancy provides a key opportunity to address health risk factors among SMW, who are less likely than heterosexual women to interact with health care providers. Reproductive health care visits can be used to assess and educate SMW about alcohol and tobacco use, obesity, depression, and sexually transmitted infections. Ensuring that SMW have positive experiences with health care providers during pregnancy also has the potential to improve fetal outcomes and health of the children of SMW, and to increase the likelihood that SMW will seek help for future health concerns in a timely manner.

Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflicts of interest.

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