ORIGINAL RESEARCH

Population Changes, Racial/Ethnic Disparities, and Birth Outcomes in Louisiana After Hurricane Katrina

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ABSTRACT

Objective: To examine how the demographic and other population changes affected birth and obstetric outcomes in Louisiana, and the effect of the hurricane on racial disparities in these outcomes.

Methods: Vital statistics data were used to compare the incidence of low birth weight (LBW) (<2500 g), preterm birth (PTB) (37 weeks' gestation), cesarean section, and inadequate prenatal care (as measured by the Kotelchuck index), in the 2 years after Katrina compared to the 2 years before, for the state as a whole, region 1 (the area around New Orleans), and Orleans Parish (New Orleans). Logistic models were used to adjust for covariates.

Results: After adjustment, rates of LBW rose for the state, but preterm birth did not. In region 1 and Orleans Parish, rates of LBW and PTB remained constant or fell. These patterns were all strongest in African American women. Rates of cesarean section and inadequate prenatal care rose. Racial disparities in birth outcomes remained constant or were reduced.

Conclusions: Although risk of LBW/PTB remained higher in African Americans, the storm does not appear to have exacerbated health disparities, nor did population shifts explain the changes in birth and obstetric outcomes.

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Key Words: birth weight, preterm birth, cesarean section, prenatal care, race/ethnicity

The effects of Hurricane Katrina, in general, fell hardest on the most vulnerable populations, particularly African Americans.[1] In Orleans Parish, Louisiana, African Americans were between 1.7 and 4 times as likely to die due to the hurricane as whites.[2] Disparities in mental health,[3] diabetes,[4] and access to mental health services[5] after the disaster have been documented; however, the effects of disaster on disparities in maternal and child health have not been examined to our knowledge. Perinatal health risk in Louisiana was already relatively high when Katrina struck,[6] with the hard-hit New Orleans area having particularly high rates of birth complications and larger racial disparities in maternal and child health as compared to the national average.[7]

The hurricane may have exacerbated these problems. To begin with, several studies have indicated that stress is a risk factor for poor pregnancy outcome,[8-10] and the hurricane, evacuation, and subsequent disruption was stressful for everyone in the area. Natural disasters often lead to psychological disorders (eg, posttraumatic stress disorder and depression),[11-13] which have been associated with adverse birth outcomes.[14,15] Depression and stress may also increase poor health behaviors,[16,17] such as smoking and drinking alcohol during pregnancy, and may interfere with nutrition.[18] Disasters also affect health care provision and practices. Katrina caused the shutdown of nearly all of the hospitals and a near-total disruption of the public health and medical infrastructure in the greater New Orleans area. Charity Hospital, the major safety net for people without health insurance, remains closed.[19]

Recently, Hamilton et al reported that preterm birth (PTB) and low birth weight (LBW) did not rise in the year after Hurricane Katrina, either on the entire Gulf Coast or in the hardest-hit counties across the region.[20] Rates of the earliest PTB seemed to fall in the hardest-hit area. They also reported that rates of cesarean section and inadequate prenatal care rose; however, they did not examine the extent to which the demographic changes explain the differences in birth outcomes, nor did they examine the effects of the storm by race or ethnicity. In this article, we focus on the state of Louisiana, comparing the 2 years following Katrina to the years before the storm and the more- and less-affected regions of the state. We examine how the demographic and other changes affect the incidence of LBW and PTB, as well as cesarean section and prenatal care. We also look at the effect of the hurricane by race and its influence on racial disparities in these outcomes.

METHODS

We analyzed Louisiana 2003–2007 birth records–Medicaid-linked data. LBW was defined as birth weight <2500 g and PTB as birth at <37 weeks' gestation. The clinical estimate for gestation was used; if it was missing, gestational age was imputed by sex and weight.[21,22]

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Adequacy of prenatal care was calculated using the Kotelchuck index, based on reported initiation and number of prenatal care visits,[23] and categorized into inadequate, intermediate, adequate, and adequate-plus levels. Cesarean section (either primary or repeat) was separated from vaginal deliveries.

Region of residence was classified according to where mothers reported residing at birth, not where the birth took place. Louisiana is divided into 9 health regions. Region 1 consists of Orleans, Jefferson, Plaquemines, and St Bernard parishes; this is the area that was the most strongly hit by the hurricane and subsequent flooding. We examined birth outcomes (LBW and PTB) among residents of the state and this region for the 2 years before and after the hurricane, and compared birth outcomes for women who delivered inside their region of residence to those who delivered outside. We also examined Orleans Parish alone (city of New Orleans).

Frequency and rate (percentage) of birth outcomes and odds ratios (ORs) and 95% confidence intervals (CIs) were calculated comparing the year before and after and 2 years before and after Hurricane Katrina. Multivariable logistic models were created to compare birth outcomes before and after the hurricane, adjusting for demographic (race, education, Hispanic ethnicity, marital status) and health behaviors and biological risk factors (multiple gestation, parity, time since last birth or termination [interpregnancy interval], tobacco). There were 4343 (1.7%) records with missing data on at least 1 of the covariates, most commonly interpregnancy interval. These observations were omitted from multivariable regressions.

Next, we examined the effects of the storm by racial/ethnic group. All of the analyses were also performed separately for African American, white, and Hispanic women (the major racial/ethnic groups in Louisiana) by stratification and modeling using interaction terms. We compared the racial disparity (non-Hispanic black to non-Hispanic white; Hispanics were omitted from this calculation) in the outcomes before and after the storm, determining whether it differed across the 2 time periods.

We also wanted to put boundaries on the possible effects of misreporting of state of residence. Women who did not report residing in Louisiana at the time of the birth were eliminated from the analysis, but those who gave birth outside the state but reported residing in Louisiana were included (n = 2774) . A total of 4199 fewer births were recorded in Louisiana in the year after Katrina compared to the year before. It is likely that many women who gave birth outside the state did not report themselves as Louisiana residents; therefore, we wanted to estimate the maximum possible effect of Katrina on birth outcomes. For instance, if every birth out of state was PTB or LBW, this would cause us to underestimate the effect of the storm. (The other possibilities for the decline in births are reduced fertility and fecundability, and we do not have data to address those, nor would changes in these affect the rates of the outcomes in the births that did occur.)

To determine the amount of underestimation, we needed to estimate the total number of births that occurred. We chose to assume that the number of births to Louisiana women in the year after Katrina was the same as the year before Katrina. Louisiana population growth had been small in the year before (<0.2%[24]), and because our goal was to provide an upper bound for the effects, a decrease in births would lead to estimates lower than our upper bound. Finally, we needed to estimate the risk status of the 4199 births that we hypothesized were not reported as attributed to Louisiana residents. Because we had no way of knowing this, we tested the effect of different assumptions, assuming these births had a similar risk of PTB/LBW to women in the state overall and assuming they had greater risk. Before Katrina, the overall risk of PTB in the state was 14% and LBW was 11%. We hypothesized different risks in the 4199 births ranging from 2% to 25%, then added that "population" to the known data, determining what the overall rates of PTB/LBW would have been in the year after Katrina under those assumptions. This assumption allowed us to put boundaries on the maximum effect of the storm. This analysis of deidentified data was approved by the Tulane institutional review board.

RESULTS

There were 128 624 births to Louisiana women in the 2 years before Hurricane Katrina and 126 041 in the 2 years after Katrina. In region 1, the corresponding numbers were 28 287 and 17 955, and in New Orleans, 13 313 and 5698. The year-by-year data are presented in Tables 1 and 2. The demographic profile of mothers in Louisiana changed across the years studied (Table 1). When comparing the year pre-Katrina to the year post-Katrina, proportions of non-Hispanic white women giving birth were greater during the post period (state: pre- 54.1%, post- 56.5%; region 1: pre- 36.0%, post- 48.8%; New Orleans: pre- 17.2%, post- 31.7%). In addition, there were fewer teen births (state: pre- 14.9%, post- 14.1%; region 1: pre- 13.9%, post- 11.9%; New Orleans: pre- 16.0%, post- 13.2%), greater proportions were married (state: pre- 51.2%, post- 51.5%; region 1: pre- 43.9%, post- 51.6%; New Orleans: pre- 32.8%, post- 45.5%), and fewer had less than a high school education (state: pre- 22.1%, post- 20.7%; region 1: pre- 22.5%, post- 18.5%; New Orleans: pre- 23.7%, post- 17.1%). The proportion of Hispanic women rose substantially in region 1 (from 5.9% to 8.6%) and New Orleans (from 2.4% to 5.3%). Medicaid-funded births did not show a consistent trend; they rose in the state as a whole, but declined in the year after Katrina in region 1 and New Orleans.

For the state as a whole, rates of LBW rose in the 2 years after Katrina compared with the 2 years before, but preterm birth did not ($P = .65$; Table 1). Adjustments for covariates did not eliminate the LBW association; however, even before Katrina, LBW had been rising (data not shown). In region 1, rates of LBW declined and PTB declined. In New Orleans, both LBW and preterm birth fell. Rates of cesarean section and inadequate prenatal care rose after Katrina for the state, the region, and Orleans Parish. There was a particularly sharp rise in inadequate prenatal care in the year after Katrina. Results were similar when data were limited to singleton births only (data not shown).

The rise in LBW in the state was strongest for non-Hispanic black women, as was the fall in PTB in region 1 and New Orleans (Table 3). The rise in inadequate prenatal care was seen in all of the racial/ethnic groups, but it was strongest in non-Hispanic whites and Hispanics. The racial disparities in LBW did not change after Katrina. The racial disparity was lower in the years after Katrina in New Orleans for PTB only. The racial disparity in inadequate prenatal care was reduced at all levels after Katrina. These

TABLE 1

Demographic and Social Changes in Women Giving Birth in Louisiana Before and After Hurricane Katrina

	13-24 mo Pre-Katrina, % (N=64 758)	12 mo Pre-Katrina, % (N=63 866)	12 mo Post-Katrina, % (N=59 667)	13-24 mo Post-Katrina, % (N=66 374)	χ^2 *P*
Race/ethnicity					
Non-Hispanic white	54.2	54.1	56.5	54.7	<.01
Non-Hispanic black	40.7	40.4	38.0	38.5	
Non-Hispanic other	2.2	2.3	2.2	2.3	
Hispanic	2.8	3.2	3.2	4.5	
Marital status					
Yes	51.4	51.2	51.5	49.4	<.01
No	48.6	48.8	48.5	50.6	
Mother's age, y					
<20	14.9	14.1	13.6	13.7	<.01
20-34	76.0	76.8	77.3	77.4	
≥35	9.1	9.0	9.0	8.9	
Mother's education, grades completed					
<12	22.2	22.1	20.7	21.3	<.01
12	36.2	35.4	35.3	35.1	
13-15	21.1	21.2	21.7	22.0	
≥16	20.5	21.3	22.3	21.5	
Medicaid-paid delivery					
No	38.3	36.3	33.3	31.9	<.01
Yes	61.7	63.7	66.7	68.1	
Smoking					
Yes	10.0	10.1	10.4	10.1	.07
No	90.0	89.9	89.6	89.9	
Pregnancy interval, mo, among those with prior birth/termination					
<12	8.4	8.7	8.8	9.3	<.01
12-<24	27.9	28.4	28.1	28.3	
≥24	63.7	62.8	63.1	62.4	
Previous live birth					
First	39.4	39.5	39.9	40.0	<.01
≥1	60.6	60.5	60.1	60.0	
Region 1	**13-24 mo Pre-Katrina, % (N = 14 494)**	**12 mo Pre-Katrina, % (N = 13 793)**	**12 mo Post-Katrina, % (N = 7325)**	**13-24 mo Post-Katrina, % (N = 10 630)**	χ^2 *P*
Race/ethnicity					
Non-Hispanic white	37.2	36.0	48.8	40.1	<.01
Non-Hispanic black	53.8	54.6	38.6	44.4	
Non-Hispanic other	3.5	3.5	4.0	3.9	
Hispanic	5.4	5.9	8.6	11.6	
Marital status					
Yes	44.1	43.9	51.6	44.4	<.01
No	55.9	56.1	48.4	55.6	
Mother's age, y					
<20	14.7	13.9	11.9	12.1	<.01
20-34	74.2	74.6	75.0	75.3	
≥35	11.1	11.5	13.2	12.6	
Mother's education, grades completed					
<12	22.4	22.5	18.5	22.6	<.01
12	33.1	32.7	29.6	31.2	
13-15	22.3	21.9	22.5	22.2	
≥16	22.1	22.8	29.5	24.1	
Medicaid-paid delivery					
No	37.9	35.2	37.8	31.4	<.01
Yes	62.1	64.8	62.2	68.6	
Smoking					
Yes	4.9	4.1	4.7	4.7	.01
No	95.1	95.9	95.3	95.3	
Pregnancy interval, mo, among those with prior birth/termination					
<12	8.1	8.6	8.0	8.7	<.01
12-<24	27.8	27.6	25.2	26.5	
≥24	64.1	63.9	66.9	64.8	
Previous live birth					
First	40.4	40.5	42.5	41.6	<.01
≥1	59.6	59.5	57.5	58.4	

(continued)

TABLE 1

Demographic and Social Changes in Women Giving Birth in Louisiana Before and After Hurricane Katrina (continued)

New Orleans	13-24 mo Pre-Katrina, % (N=6826)	12 mo Pre-Katrina, % (N=6487)	12 mo Post-Katrina, % (N=1975)	13-24 mo Post-Katrina, % (N=3723)	χ^2 *P*
Race/ethnicity					
Non-Hispanic white	17.4	17.2	31.7	22.4	<.01
Non-Hispanic black	77.4	77.8	60.2	67.7	
Non-Hispanic other	2.7	2.6	2.9	3.2	
Hispanic	2.5	2.4	5.3	6.7	
Marital status					
Yes	33.0	32.8	45.5	34.5	<.01
No	67.0	67.2	54.5	65.5	
Mother's age, y					
<20	17.1	16.0	13.2	14.2	<.01
20-34	71.9	72.4	70.0	72.8	
≥35	11.0	11.6	16.8	13.1	
Mother's education, grades completed					
<12	24.1	23.7	17.1	23.4	<.01
12	32.3	32.3	27.8	31.0	
13-15	22.7	22.9	20.5	21.0	
≥16	20.8	21.1	34.6	24.5	
Medicaid-paid delivery					
No	29.5	27.3	35.6	27.1	<.01
Yes	70.5	72.7	64.4	72.9	
Smoking					
Yes	2.6	2.2	2.3	2.8	.19
No	97.4	97.8	97.7	97.2	
Pregnancy interval, mo, among those with prior birth/termination					
<12	8.2	8.7	7.4	9.5	.01
12-<24	28.2	27.8	26.4	28.7	
≥24	63.6	63.5	66.1	61.9	
Previous live birth					
First	39.5	39.8	43.3	41.4	<.01
≥1	60.5	60.2	56.7	58.6	

TABLE 2

Perinatal Outcomes Before and After Hurricane Katrina, State of Louisiana

	13-24 mo Pre-Katrina		12 mo Pre-Katrina		12 mo Post-Katrina		13-24 mo Post-Katrina		2 y Post-Katrina Compared to 2 y Pre-Katrina						
										Unadjusted			Adjusted		
	n	%	n	%	n	%	n	%	*P*	OR	95% CI	*P*	OR	95% CI	*P*
Low birth weight															
Louisiana	7064	10.9	7127	11.2	6764	11.5	7406	11.2	.01	1.03	(1.00-1.05)	.03	1.03	(1.00-1.06)	.04
Region 1	1656	11.4	1625	11.8	741	10.8	1128	10.6	.02	0.91	(0.86-0.97)	<.01	0.95	(0.89-1.01)	.11
Orleans Parish	934	13.7	889	13.7	220	12.5	468	12.6	.23	0.91	(0.82-0.99)	.04	1.01	(0.90-1.12)	.93
Preterm birth															
Louisiana	8585	13.3	8650	13.6	8156	13.9	8789	13.3	<.01	1.01	(0.99-1.03)	.42	1.01	(0.98-1.03)	.65
Region 1	2051	14.2	1953	14.2	857	12.5	1262	11.9	<.01	0.84	(0.79-0.89)	<.01	0.85	(0.80-0.90)	<.01
Orleans Parish	1137	16.7	1046	16.1	253	14.4	513	13.8	<.01	0.83	(0.76-0.90)	<.01	0.92	(0.83-1.02)	.10
Cesarean section															
Louisiana	20 658	32.0	20 747	35.8	21 178	35.7	23 617	35.7	<.01	1.09	(1.07-1.11)	<.01	1.09	(1.08-1.11)	<.01
Region 1	5174	35.8	4739	37.8	2961	40.7	4146	39.1	<.01	1.14	(1.09-1.18)	<.01	1.13	(1.09-1.18)	<.01
Orleans Parish	2236	32.8	2048	34.8	715	36.5	1305	35.1	<.01	1.09	(1.02-1.16)	.01	1.06	(0.99-1.13)	<.01
Inadequate prenatal care															
Louisiana	10 407	16.1	9033	15.5	9778	16.4	10 643	16.0	.29	1.03	(1.01-1.05)	.01	1.06	(0.99-1.13)	.11
Region 1	1938	13.4	1676	13.3	1371	18.7	2145	20.2	<.01	1.58	(1.50-1.66)	<.01	1.10	(1.07-1.12)	<.01
Orleans Parish	1107	16.2	968	16.4	466	23.6	843	22.6	<.01	1.53	(1.42-1.65)	<.01	2.10	(1.96-2.24)	<.01

CI, confidence interval; OR, odds ratio.

patterns were also seen when disparities were examined on an absolute instead of a relative scale (data not shown).

Louisiana residents who gave birth outside their home region in the year after Katrina were at greater risk of LBW (adjusted OR [aOR] 1.11, 95% CI 1.02–1.21) and PTB (aOR 1.10, 95% CI 1.03–1.18) compared with those who gave birth in their home region. A similar pattern had been seen in the year before the storm (aOR for LBW 1.28, 95% CI 1.17–1.40; for PTB 1.17, 95% CI 1.07–1.27). Region 1 residents who gave birth outside

TABLE 3

Perinatal Outcomes Before and After Katrina, by Racial/Ethnic Group, State of Louisiana

	13-24 mo Pre-Katrina		12 mo Pre-Katrina		12 mo Post-Katrina		13-24 mo Post-Katrina			OR 2 y After Katrina vs 2 y Before		
										Adjusted		
	n	%	n	%	n	%	n	%	*P* across years	OR	95% CI	*P*
Low birth weight												
Louisiana												
Non-Hispanic black	4029	15.3	3939	15.4	3683	16.6	4035	15.8	<.01	1.04	(1.01-1.08)	.03
Non-Hispanic white	2755	7.9	2910	8.5	2791	8.4	2999	8.3	.01	1.02	(0.98-1.07)	.32
Hispanic	138	7.6	150	7.3	138	7.3	196	6.6	.54	0.92	(0.77-1.10)	.38
Adjusted OR, black–white	2.28	(2.15-2.41)	2.12	(2.00-2.25)	2.20	(2.08-2.33)	2.24	(2.12-2.37)	.34			
Region 1												
Non-Hispanic black	1153	14.8	1126	15.0	390	14.9	681	14.4	.89	0.95	(0.87-1.03)	.21
Non-Hispanic white	385	7.1	396	8.0	275	8.3	334	7.9	.21	1.01	(0.90-1.15)	.82
Hispanic	71	9.0	63	7.7	35	6.0	71	5.8	.02	0.71	(0.53-0.96)	.02
Adjusted OR, black–white	2.36	(2.07-2.70)	2.04	(1.78-2.35)	1.98	(1.66-2.36)	2.28	(1.96-2.65)	.25			
Orleans Parish*												
Non-Hispanic black	819	15.5	794	15.7	166	15.8	375	14.9	.81	0.98	(0.87-1.11)	.76
Non-Hispanic white	84	7.1	74	6.6	44	7.9	71	8.5	.40	1.21	(0.92-1.60)	.18
Adjusted OR, black–white	2.44	(1.88-3.15)	2.36	(1.79-3.12)	2.17	(1.49-3.17)	1.97	(1.57-2.66)	.70			
Preterm birth												
Louisiana												
Non-Hispanic black	4365	16.6	4419	17.3	3922	17.7	4232	16.6	<.01	1.00	(0.96-1.03)	.90
Non-Hispanic white	3846	11.0	3846	11.2	3807	11.5	4047	11.2	.18	1.02	(0.99-1.06)	.23
Hispanic	187	10.3	222	10.8	186	9.8	268	9.0	.17	0.88	(0.75-1.02)	.09
Adjusted OR, black–white	1.65	(1.57-1.74)	1.69	(1.60-1.79)	1.62	(1.53-1.70)	1.61	(1.53-1.70)	.54			
Region 1												
Non-Hispanic black	1330	17.1	1306	17.4	394	15.0	699	14.8	<.01	0.82	(0.75-0.88)	<.01
Non-Hispanic white	565	10.5	507	10.2	366	11.0	418	9.8	.39	0.96	(0.86-1.06)	.42
Hispanic	94	12.0	93	11.4	44	7.5	105	8.6	.01	0.72	(0.57-0.92)	.01
Adjusted OR, black–white	1.79	(1.59-2.01)	1.83	(1.62-2.07)	1.45	(1.24-1.70)	1.74	(1.52-2.00)	.10			
Orleans Parish												
Non-Hispanic black	963	18.3	929	18.4	174	16.5	394	15.7	.01	0.89	(0.79-1.00)	.05
Non-Hispanic white	131	11.1	93	8.3	64	11.6	87	10.5	.09	1.09	(0.86-1.39)	.48
Adjusted OR, black–white	1.68	(1.36-2.09)	2.21	(1.71-2.84)	1.37	(0.99-1.90)	1.53	(1.17-2.01)	.07			
Cesarean section												
Louisiana												
Non-Hispanic black	7954	30.2	8137	34.8	7877	34.8	8779	34.4	<.01	1.10	(1.07-1.13)	<.01
Non-Hispanic white	11 655	33.3	11 565	36.9	12 189	36.4	13 381	37.0	<.01	1.09	(1.07-1.12)	<.01
Hispanic	618	34.1	664	35.7	672	34.9	983	33.0	.23	0.98	(0.89-1.08)	<.01
Adjusted OR, black–white	1.03	(0.99-1.07)	1.09	(1.05-1.13)	1.09	(1.05-1.13)	1.05	(1.01-1.09)	.06			
Region 1												
Non-Hispanic black	2499	32.1	2450	35.9	1107	38.8	1750	37.1	<.01	1.17	(1.10-1.24)	<.01
Non-Hispanic white	2224	41.3	1874	41.3	1522	53.5	1840	43.3	.01	1.09	(1.02-1.16)	.01
Hispanic	296	37.8	276	37.9	218	36.2	424	34.5	.09	0.97	(0.84-1.13)	.69
Adjusted OR, black–white	0.90	(0.83-0.97)	1.05	(0.97-1.14)	1.07	(0.96-1.19)	1.04	(0.95-1.14)	<.01			
Orleans Parish												
Non-Hispanic black	1628	30.9	1579	34.6	426	35.6	866	34.4	<.01	0.93	(0.81-1.07)	.32
Non-Hispanic white	483	40.9	382	37.1	233	38.3	319	38.4	.31	1.10	(1.01-1.20)	<.01
Adjusted OR, black–white	1.09	(0.95-1.26)	1.51	(1.29-1.76)	1.50	(1.21-1.86)	1.53	(1.28-1.82)	<.01			
Inadequate prenatal care												
Louisiana												
Non-Hispanic black	6011	22.8	5189	22.1	5203	22.9	5427	21.2	<.01	0.98	(0.95-1.01)	.28
Non-Hispanic white	3872	11.0	3341	10.6	3887	11.5	4153	11.4	.01	1.05	(1.01-1.08)	.01
Hispanic	309	17.0	338	18.1	437	22.7	837	28.1	<.01	1.55	(1.39-1.73)	<.01
Adjusted OR, black–white	1.74	(1.66-1.82)	1.74	(1.66-1.83)	1.69	(1.61-1.78)	1.50	(1.44-1.58)	<.01			
Region 1												
Non-Hispanic black	1406	18.1	1234	18.1	726	25.3	1086	23.0	<.01	1.51	(1.41-1.62)	<.01
Non-Hispanic white	390	7.2	332	7.3	455	12.8	614	14.4	<.01	2.03	(1.83-2.26)	<.01
Hispanic	86	11.0	71	9.7	126	20.9	370	30.1	<.01	2.83	(2.32-3.47)	<.01
Adjusted OR, black–white	1.79	(1.59-2.03)	1.80	(1.58-2.05)	1.57	(1.37-1.81)	1.04	(0.93-1.16)	<.01			
Orleans Parish												
Non-Hispanic black	987	18.9	862	18.9	349	29.0	599	16.6	<.01	1.56	(1.42-1.71)	<.01
Non-Hispanic white	80	6.7	74	7.2	77	12.5	122	14.6	<.01	2.20	(1.74-2.79)	<.01
Adjusted OR, black–white	1.29	(1.01-1.65)	1.17	(0.90-1.52)	1.23	(0.91-1.65)	0.60	(0.48-0.75)	<.01			

OR, odds ratio.
*There were too few Hispanic women to calculate reliable estimates for Orleans Parish.

their home region were not at increased risk and New Orleans residents were at reduced risk both before (aOR for LBW 0.75, 95% CI 0.59–0.94; aOR for PTB 0.64, 95% CI 0.51–0.80) and after Katrina (aOR for LBW 0.73, 95% CI 0.53–1.00; aOR for PTB 0.66, 95% CI 0.50–0.88). There were no significant differences in these associations by race/ethnicity.

Finally, we examined the possible effects of the population reduction on LBW and PTB. We examined the effects of the "missing" births—the number of births declined in the year after Katrina. For the state as a whole, to have a true OR of ≥1.10 comparing the 2 years after to the 2 years before Katrina, the risk in this "missing" population would be required to be at high risk (LBW and PTB>25%), substantially higher than the 2004 risks of 11% and 13.4%. For region 1, the number of "missing" births is large (n = 10 332) relative to the total number of births (n = 17 955) and could have a significant influence on the results. To hypothesize a truly increased risk of ≥10%, however, >15% of the women would had to have given birth to LBW babies and >20% preterm (see Supplementary Table S1, http://www.dmphp.org/misc/harville.pdf).

COMMENT

Hurricane Katrina was not associated with an increased risk of LBW and PTB in those areas most affected, and in fact, some areas had reduced risks of some poor birth outcomes.[20] Our analysis indicates that this was somewhat, although not completely, due to changes in the risk profile of the population. After Katrina, the population giving birth was more likely to have characteristics associated with lower risk: more educated, less likely to be teenaged, more likely to be married, and more likely to be non-Hispanic white or Hispanic.[25,26] Medicaid-funded births increased in the state as a whole but initially decreased in region 1 and New Orleans. Medicaid coverage was extended to cover many victims of Katrina,[27] which makes interpreting the patterns difficult. Population changes partially accounted for the reduction in LBW in region 1 and fully for the reduction in LBW in New Orleans. For PTB, population changes only partially accounted for the reduction in New Orleans and did not account for the reduction in region 1. Rates of cesarean section rose across the state, region, and parish and were not substantially affected by adjustment for population changes. Population shifts partially accounted for the increased proportion of inadequate prenatal care in region 1, but they caused an underestimation of the likelihood of inadequate prenatal care in New Orleans.

On balance, one would expect that women displaced from the New Orleans area would have had the most severe experiences of the hurricane, but there was no evidence for increased risk in displaced women within Louisiana. Our data are similar to those of Rich-Edwards et al and Endara et al, which addressed the terrorist attacks of September 11, 2001, in not finding a large effect due to disaster.[28,29] If the women whose births were not recorded were at high risk, then an overall small increased risk in LBW/PTB due to the storm is plausible but far from proven. Studies of stress and pregnancy often report odds ratios of 1.5 to 3.0 with increased stress,[30,31] and our data are not compatible with that effect size. Another possibility for the lack of major increases in risk would be an increase in miscarriage or reduction in fertility. We do not have data to address this question.

The effects of the hurricane on birth outcomes did not vary substantially by race and, if anything, African American women, the group hardest hit in New Orleans,[1] had the greatest reduction in PTB after the hurricane. Racial disparities were not exacerbated. Although these results largely indicate minimal differential effects on maternal and child health, 2 aspects of the context need to be remembered. One, rates of LBW, PTB, and inadequate prenatal care remained unacceptably high in African Americans and were close to double that of non-Hispanic whites. Two, people with the fewest resources (and likely the highest health risk) were also those with the least say in where they evacuated and whether they could return.[1] It is likely that the highest-risk group of African Americans was not able to return to New Orleans, indicated by the large reduction in PTB in the area. It is possible that this is reflected in the increase in LBW among non-Hispanic black women in the state as a whole, but not in region 1 or New Orleans. There is substantial heterogeneity of resources within racial/ethnic groups.

The quality of vital statistics data are variable. Some birth outcomes (eg, birth weight) were recorded accurately, whereas other complications tended to be underreported.[32,33] Birth certificate recording may have been less accurate after the storm than before it. Women who were separated from their usual health care providers may have been more likely to have improperly dated pregnancies; however, this usually produces higher rather than lower rates of PTB,[34] and it is difficult to understand how these issues would have affected birth weight data. Cesarean section should be accurately reported because it occurs close in time and normally in the same place as the completion of the birth certificate. Prenatal care is the outcome that is most vulnerable to problems in reporting; however, many women probably missed a prenatal visit or 2 or postponed initiation of prenatal care. In general, women who move residences during pregnancy are more likely to initiate prenatal care late (or be recorded as having initiated prenatal care late).[35] Nonetheless, vital statistics data are reliable for many outcomes, collected systematically, and allow for examination of large populations and the detection of small effects.

CONCLUSIONS

We found that Hurricane Katrina had significant effects on the population giving birth and on obstetric health care, even after adjusting for demographic and risk profile changes. We did not, however, find that Hurricane Katrina had major effects on birth outcomes such as LBW or PTB. In addition, we did not find that it exacerbated racial disparities, largely due to similar effects across population groups. The interpretation of research on the effect of disaster on pregnancy needs to be tempered by a clear understanding of population shifts. Future research should focus on identifying particularly high-risk women, as well as trying to determine the effects of disaster on fertility and spontaneous abortion. The population data suggest that the largest concerns for clinicians and disaster planners should be

ensuring normal care for most women and focusing care for the smaller group of high-risk women, rather than preparing for an enormous increase in adverse birth outcomes.

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