

## BIRTH OUTCOMES AMONG ARAB AMERICANS IN MICHIGAN BEFORE AND AFTER THE TERRORIST ATTACKS OF SEPTEMBER 11, 2001

**Objective:** To assess whether the incidence of adverse birth outcomes among Arab Americans in Michigan changed after September 11, 2001.

**Design:** Birth data were collected on all births in Michigan from September 11, 2000, to March 11, 2001, and from September 11, 2001, to March 11, 2002. Self-reported ancestry and a name algorithm were used to determine Arab American ethnicity. Unadjusted and adjusted logistic regression analysis was used to assess the relationship between birth before/after September 11 and birth outcomes. Main outcome measures were low birth weight (LBW), very low birth weight (VLBW), and preterm birth (PTB).

**Results:** We observed no association between birth before/after September 11 and risk of adverse birth outcomes among Arab Americans in Michigan by using either the name algorithm or self-reported ancestry to determine Arab American ethnicity. Arab name was significantly associated with lower risk of VLBW and PTB in adjusted and unadjusted models. Arab ancestry was significantly associated with lower risk of VLBW and PTB in adjusted and unadjusted models and significantly associated with lower risk of LBW in an unadjusted model.

**Conclusions:** In contrast to previous findings in California, we observed no difference in adverse birth outcomes before and after the events of September 11, 2001, among Arab Americans in Michigan. Arab American ethnicity is associated with lower risk of adverse birth outcomes compared to other racial/ethnic groups. (*Ethn Dis.* 2008;18:348–356)

**Key Words:** Arab American, Birth Outcomes, September 11, 2001, Low Birth Weight, Preterm, Minority, Mass Trauma, Disaster

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### INTRODUCTION

An emerging literature describes the relationship between mass traumas and preterm birth (PTB) and birth weight. The earlier in a pregnancy that a disaster occurs, the greater its deleterious effect on gestational age at birth.<sup>1</sup> Losing a spouse in a disaster is associated with increased risk of delivering a low birth weight (LBW) infant.<sup>2</sup> Among 187 pregnant women who lived or worked around the World Trade Center during the time of the September 11, 2001, terrorist attacks, those with posttraumatic stress (PTS) in the aftermath of the attacks were more likely to have infants with smaller head circumference at birth than were mothers without PTS. This study also showed that both PTS and moderate depressive symptoms were associated with gestational age; the infants of women with PTS and moderate depression had higher average gestational ages than did infants born to other women in the study.<sup>3</sup>

Little work has considered the relationship between exposure to mass trauma and birth outcomes among specific demographic groups. One study considered birth outcomes among Arab Americans after the terrorist attacks of September 11, 2001, and reported that Arab American women were at increased risk for adverse birth outcomes

after the attacks.<sup>4</sup> Lauderdale reported that Arab-named women in California were 34% more likely to have LBW (<2500 g) singleton infants after the attacks. The author contended that because of the increase in discrimination against Arab Americans after September 11, 2001, stress levels among pregnant Arab American women also increased, which resulted in higher risk for adverse birth outcomes. Nationally, the September 11, 2001, terrorist attacks precipitated a surge in discrimination against Arab Americans.<sup>5–6</sup> Also, discrimination and stress increase risk for adverse birth outcomes.<sup>8–11</sup> Studies among other demographic groups have repeatedly shown that stress resulting from discrimination significantly increases risk for adverse birth outcomes in minority populations.<sup>12–16</sup>

Aiming to build on the literature assessing birth outcomes after mass trauma, we undertook a study of birth outcomes in Michigan to assess whether the risk for adverse birth outcomes increased after September 11, 2001,

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**Table 1. Descriptive statistics and bivariate associations between each covariate and LBW, VLBW and PTB**

	Total	%	Low Birth Weight			Very Low Birth Weight			Preterm Birth		
			N	%	P	N	%	P	N	%	P
<b>Ethnoracial Classification</b>											
White	97837	75.62	6480	6.62	<.01	1264	1.29	<.01	8813	9.01	<.01
Arab (Surname)	3133	2.42	184	5.87		20	0.64		223	7.12	
Black	23421	18.1	3317	14.16		782	3.34		3606	15.4	
Asian	3501	2.71	247	7.06		32	0.91		263	7.51	
Native American	614	0.47	44	7.17		9	1.47		67	10.91	
Other	878	0.68	90	10.25		33	3.76		89	10.41	
<b>Ethnoracial Classification</b>											
White	97268	75.32	6448	6.63	<.01	1255	1.29	<.01	8748	8.99	<.01
Arab (Ancestry)	3501	2.71	199	5.68		30	0.86		267	7.63	
Black	23476	18.18	3321	14.15		781	3.33		3612	15.39	
Asian	3375	2.61	243	7.2		31	0.92		257	7.61	
Native American	616	0.48	44	7.14		9	1.46		67	10.88	
Other	910	0.7	93	10.22		34	3.74		93	10.22	
<b>Mother/Infant Descriptives</b>											
Gender					<.01			0.46			<.01
Male	66515	51.41	4957	7.45		1117	1.68		7027	10.56	
Female	62869	48.59	5405	8.6		1023	1.63		6034	9.6	
Parity					<.01			<.01			<.01
0 previous	50238	38.83	4151	8.26		873	1.74		4971	9.89	
1 previous	41323	31.94	2791	6.75		564	1.36		3719	9	
2 previous	22500	17.39	1759	7.82		335	1.49		2295	10.2	
3+ previous	14924	11.53	1605	10.75		339	2.27		2023	13.56	
unknown	399	0.31	56	14.04		29	7.27		53	13.29	
Married					<.01			<.01			<.01
Married	84054	64.96	5420	6.45		1138	1.35		7581	9.02	
Unmarried	45330	35.04	4942	10.9		1002	2.21		5480	12.09	
Mother's age					<.01			<.01			<.01
<20	13446	10.39	1380	10.26		264	1.96		1506	11.2	
20-25	32211	24.9	2615	8.12		506	1.57		3136	9.74	
26-30	35848	27.71	2552	7.12		514	1.43		3258	9.09	
31-35	31359	24.24	2300	7.33		496	1.58		3197	10.19	
36-40	13736	10.62	1216	8.85		292	2.13		1593	11.6	
41+	2770	2.14	292	10.54		62	2.24		369	13.32	
Education					<.01			<.01			<.01
< 11 years	22725	17.56	2357	10.37		411	1.81		2577	11.34	
GED or Equivalent	42834	33.11	3659	8.54		750	1.75		4443	10.37	
College	48902	37.8	3263	6.67		705	1.44		4571	9.35	
Masters or above	11978	9.26	782	6.53		161	1.34		1103	9.21	
unknown	2945	2.28	301	10.22		113	3.84		367	12.46	
County					<.01			<.01			<.01
Macomb	9776	7.56	737	7.54		134	1.37		929	9.5	
Oakland	15270	11.8	1078	7.06		206	1.35		1494	9.78	
Wayne	29901	23.11	3119	10.43		712	2.38		3743	12.52	
All Others	74437	57.53	5428	7.39		1088	1.46		6895	9.26	
Pre/post September 11, 2001					0.69			0.28			0.5
Pre	65693	50.77	5242	7.98		1062	1.62		6595	10.04	
Post	63691	49.23	5120	8.04		1078	1.69		6466	10.15	

when compared to a comparable period during the previous year and, in particular, whether birth outcomes among Arab Americans were different before and after September 11, 2001. We chose to conduct our study with data from Michigan because, while

California has the largest absolute number of Arab Americans in the United States, Michigan's Arab American population is the largest per capita in the United States, with almost twice as many Arab Americans per capita as California.<sup>17</sup>

## METHODS

### Data

Data for this analysis were birth records on all births in Michigan during the six-month period after the attacks (9/11/2001-3/11/2002) and during the

**Table 2. Adjusted and unadjusted logistic regression models using Arab name to specify Arab-American cases**

	Low Birth Weight						
	Model 1			Model 2		Model 3	
	OR	CI	% LBW	OR	CI	Beta	P
<b>Ethnoracial Classification</b>							
White	Ref	Ref	6.62	Ref	Ref	Ref	Ref
Arab (Surname)	0.88	0.76–1.02	5.87	0.91	0.78–1.06	0.04	0.74
Black	2.33	2.23–2.43	14.16	1.97	1.87–2.07	0.68	<0.01
Asian	1.07	.94–1.22	7.06	1.14	1.00–1.31	0.13	0.05
Native American	1.10	0.80–1.48	7.71	1.00	0.73–1.36	0.01	0.99
Other	1.61	1.29–2.01	10.25	1.26	0.99–1.60	0.23	0.06
<b>Mother/Infant Descriptives</b>							
Married				0.72	0.68–0.76	–0.33	<0.01
Parity							
0 previous				Ref	Ref	Ref	Ref
1 previous				0.81	0.77–0.86	–0.21	<0.01
2 previous				0.89	0.83–0.95	–0.12	<0.01
3+ previous				1.05	0.98–1.13	0.05	0.14
unknown				1.36	1.00–1.85	0.31	0.04
Mother's age							
<20				0.99	0.92–1.06	–0.01	0.75
20–25				Ref	Ref	Ref	Ref
26–30				1.08	1.02–1.15	0.08	0.01
31–35				1.24	1.16–1.32	0.21	<0.01
36–40				1.49	1.38–1.62	0.40	<0.01
41+				1.73	1.51–1.98	0.55	<0.01
Education							
< 11 years				1.29	1.17–1.46	0.26	<0.01
GED or Equivalent				1.16	1.06–1.27	0.15	<0.01
College				0.97	0.90–1.06	–0.03	0.52
Masters or above				Ref	Ref	Ref	Ref
unknown				1.25	1.08–1.46	0.22	<0.01
Pre/post September 11, 2001						0.02	0.34
Pre/Post September 11*Arab Race						–0.26	0.09
<b>Very Low Birth Weight</b>							
	Model 1			Model 2		Model 3	
	OR	CI	% VLBW	OR	CI	Beta	P
<b>Ethnoracial Classification</b>							
White	Ref	Ref	1.29	Ref	Ref	Ref	Ref
Arab (Surname)	0.49	0.32–0.77	0.64	0.49	0.31–0.76	–0.46	0.12
Black	2.64	2.41–1.89	3.34	2.44	2.20–2.71	0.89	<0.01
Asian	0.71	0.50–1.00	0.91	0.70	0.49–1.00	–0.36	0.05
Native American	1.14	0.59–2.20	1.47	1.14	0.59–2.21	0.13	0.69
Other	2.98	2.10–4.24	3.76	1.36	0.89–2.08	0.32	0.14
<b>Mother/Infant Descriptives</b>							
Married				0.80	0.72–0.90	–0.22	<0.01
Parity							
0 previous				Ref	Ref	Ref	Ref
1 previous				0.76	0.68–0.84	–0.28	<0.01
2 previous				0.76	0.66–0.86	–0.28	<0.01
3+ previous				0.95	0.82–1.09	–0.06	0.44
unknown				2.27	1.46–3.55	0.83	<0.01
Mother's age							
<20				0.99	0.84–1.17	0.01	0.92
20–25				Ref	Ref	Ref	Ref
26–30				1.11	0.98–1.27	0.11	0.11
31–35				1.36	1.18–1.57	0.31	<0.01
36–40				1.82	1.55–2.14	0.60	<0.01

Table 2. Continued

	Very Low Birth Weight						
	Model 1			Model 2		Model 3	
	OR	CI	% VLBW	OR	CI	Beta	P
41+				1.83	1.38–2.41	0.60	<0.01
Education							
< 11 years				1.10	0.89–1.35	0.09	0.39
GED or Equivalent				1.16	0.97–1.40	0.15	0.11
College				1.02	0.85–1.21	0.02	0.83
Masters or above				Ref	Ref	Ref	Ref
unknown				2.05	1.57–2.68	0.72	<0.01
Pre/post September 11, 2001						0.07	0.12
Pre/Post September 11*Arab Race						-0.56	0.22
	Preterm Birth						
	Model 1			Model 2		Model 3	
	OR	CI	% PTB	OR	CI	Beta	P
<b>Ethnoracial Classification</b>							
White	Ref	Ref	9.01	Ref	Ref	Ref	Ref
Arab(Surname)	0.77	0.67–0.89	7.12	0.78	0.98–0.90	-0.24	0.02
Black	1.84	1.76–1.92	15.40	1.69	1.61–1.77	0.52	<0.01
Asian	0.82	0.72–0.93	7.51	0.84	0.74–0.96	-0.17	<0.01
Native American	1.24	0.96–1.60	10.91	1.20	0.93–1.55	0.19	0.16
Other	1.14	0.91–1.42	10.14	0.97	0.77–1.22	-0.03	0.80
<b>Mother/Infant Descriptives</b>							
Married				0.84	0.80–0.88	-0.18	<0.01
Parity							
0 previous				Ref	Ref	Ref	Ref
1 previous				0.89	0.85–0.93	-0.11	<0.01
2 previous				0.97	0.92–1.67	-0.03	0.35
3+ previous				1.19	1.12–1.27	0.17	<0.01
unknown				1.24	0.92–1.67	0.22	0.15
Mother's Age							
<20				1.02	0.95–1.09	0.02	0.63
20–25				Ref	Ref	Ref	Ref
26–30				1.04	0.99–1.10	0.04	0.15
31–35				1.24	1.17–1.32	0.22	<0.01
36–40				1.40	1.31–1.51	0.34	<0.01
41+				1.58	1.40–1.78	0.46	<0.01
Education							
< 11 years				1.08	0.99–1.18	0.08	0.07
GED or Equivalent				1.05	0.97–1.13	0.05	0.23
College				0.98	0.91–1.05	-0.02	0.60
Masters or above				Ref	Ref	Ref	Ref
unknown				1.24	1.08–1.42	0.21	<0.01
Pre/post September 11, 2001						0.76	0.38
Pre/Post September 11*Arab Race						-0.01	0.93

Models 1 show unadjusted odds ratios (OR) and confidence intervals (CI) for associations between each ethnoracial class and the particular outcome of interest. Models 2 show adjusted ORs and CIs for associations between each ethnoracial class and particular outcome. Models 3 show beta coefficients and P value for each covariate when the interaction term between birth pre/post September 11 and Arab ethnicity is included in the regression model. The table also shows the prevalence of the particular outcome of interest among each ethnoracial class.

corresponding six-month period that preceded the attacks (9/11/2000–3/11/2001). Data were compiled from the birth records of the state of Michigan by the Michigan Department of Community Health (MDCH).

Covariates collected were gestational length, birth weight, infant's sex, number of children previously born to the mother, mother's age (in years), education, and marital status. Time of gestation was used to categorize infants

born before 37 weeks as preterm birth (PTB). Infants with a birth weight <2500 g were considered LBW, and infants weighing <1500 g at birth were considered very low birth weight (VLBW).

**Table 3. Adjusted and unadjusted logistic regression models using Arab ancestry to specify Arab American cases**

	Low Birth Weight						
	Model 1			Model 2		Model 3	
	OR	CI	% LBW	OR	CI	Beta	P
<b>Ethnoracial Classification</b>							
White	Ref	Ref	6.63	Ref	Ref	Ref	Ref
Arab(Ancestry)	0.85	0.73–0.98	5.68	0.87	0.75–1.10	–0.07	0.39
Black	2.32	2.22–2.43	14.15	1.97	1.87–2.07	0.68	<0.01
Asian	1.08	0.95–1.23	7.20	1.16	1.02–1.32	0.15	0.02
Native American	1.08	0.80–1.47	7.14	0.99	0.73–1.35	0.01	0.97
Other	1.60	1.29–1.99	10.22	1.26	1.00–1.60	0.24	0.05
<b>Mother/Infant Descriptives</b>							
Married				0.72	0.69–0/76	–0.32	<0.01
Parity							
0 previous				Ref	Ref	Ref	Ref
1 previous				0.81	0.77–0.86	–0.21	<0.01
2 previous				0.89	0.84–0.95	–0.12	<0.01
3+ previous				1.06	0.98–1.13	0.05	0.13
unknown				1.37	1.01–1.85	0.32	0.04
Mother's Age							
<20				0.99	0.92–1.07	–0.01	0.76
20–25				Ref	Ref	Ref	Ref
26–30				1.08	1.02–1.15	0.08	0.01
31–35				1.24	1.16–1.32	0.21	<0.01
36–40				1.49	1.38–1.62	0.40	<0.01
41+				1.73	1.51–1.98	0.55	<0.01
Education							
< 11 years				1.30	1.18–1.43	0.26	<0.01
GED or Equivalent				1.16	1.07–1.27	0.15	<0.01
College				0.97	0.90–1.06	–0.03	0.54
Masters or above				Ref	Ref	Ref	Ref
unknown				1.25	1.07–1.45	0.22	<0.01
Pre/post September 11, 2001						0.02	0.36
Pre/post September 11*Arab Race						–0.21	0.09
<b>Very Low Birth Weight</b>							
	Model 1			Model 2		Model 3	
	OR	CI	% VLBW	OR	CI	Beta	P
<b>Ethnoracial Classification</b>							
White	Ref	Ref	1.29	Ref	Ref	Ref	Ref
Arab(Ancestry)	0.66	0.46–0.95	0.86	0.66	0.45–0.95	–0.19	0.33
Black	2.63	2.41–2.88	3.33	2.43	2/19–2.70	0.89	<0.01
Asian	0.66	0.46–0.95	0.92	0.66	0.46–0.94	–0.40	0.03
Native American	1.13	0.59–2.20	1.46	1.13	0.59–2.20	0.13	0.70
Other	2.97	2.10–4.20	3.74	1.37	0.90–2.08	0.33	0.12
<b>Mother/Infant Descriptives</b>							
Married				0.80	0.71–0.89	–0.22	<0.01
Parity							
0 previous				Ref	Ref	Ref	Ref
1 previous				0.76	0.68–0.84	–0.28	<0.01
2 previous				0.76	0.66–0.86	–0.28	<0.01
3+ previous				0.95	0.82–1.09	–0.06	0.45
unknown				2.27	1.45–3.54	0.83	<0.01
Mother's Age							
<20				0.99	0.84–1.17	–0.01	0.93
20–25				Ref	Ref	Ref	Ref
26–30				1.11	0.98–1.27	0.11	0.11
31–35				1.36	1.18–1.57	0.31	<0.01
36–40				1.82	1.55–2.14	0.60	<0.01

Table 3. Continued

	Very Low Birth Weight							
	Model 1			Model 2		Model 3		P
	OR	CI	% VLBW	OR	CI	Beta		
41+				1.83	1.38–2.41	0.60	<0.01	
Education								
< 11 years				1.09	0.88–1.35	0.09	0.40	
GED or Equivalent				1.16	0.96–1.39	0.15	0.11	
College				1.02	0.85–1.21	0.02	0.84	
Masters or above				Ref	Ref	Ref	Ref	
unknown				2.03	1.55–2.66	0.71	<0.01	
Pre/post September 11, 2001						0.07	0.09	
Pre/post September 11*Arab Race						-0.90	0.02	
	Preterm Birth							
	Model 1			Model 2		Model 3		P
	OR	CI	% PTB	OR	CI	Beta		
<b>Ethnoracial Classification</b>								
White	Ref	Ref	8.99	Ref	Ref	Ref	Ref	
Arab(Ancestry)	0.84	0.74–0.95	7.63	0.84	0.73–0.95	-0.12	0.09	
Black	1.84	1.77–1.92	15.39	1.69	1.61–1.77	0.52	<0.01	
Asian	0.83	0.73–0.94	7.61	0.85	0.75–0.97	-0.15	0.02	
Native American	1.24	0.96–1.59	10.88	1.20	0.93–1.55	0.18	0.16	
Other	1.15	0.93–1.43	10.22	0.98	0.78–1.24	-0.01	0.91	
<b>Mother/Infant Descriptives</b>								
Married				0.83	0.80–0.88	-0.18	<0.01	
Parity								
0 previous				Ref	Ref	Ref	Ref	
1 previous				0.89	0.85–0.94	-0.11	<0.01	
2 previous				0.97	0.92–1.03	-0.03	0.35	
3+ previous				1.19	1.12–1.27	0.17	<0.01	
unknown				1.24	0.92–1.67	0.22	0.15	
Mother's Age								
<20				1.02	0.95–1.09	0.02	0.62	
20–25				Ref	Ref	Ref	Ref	
26–30				1.04	0.99–1.10	0.04	0.16	
31–35				1.24	1.17–1.32	0.22	<0.01	
36–40				1.41	1.31–1.51	0.34	<0.01	
41+				1.58	1.40–1.78	0.46	<0.01	
Education								
< 11 years				1.08	0.99–1.18	0.08	0.07	
GED or Equivalent				1.05	0.97–1.13	0.05	0.22	
College				0.98	0.92–1.05	-0.02	0.62	
Masters or above				Ref	Ref	Ref	Ref	
unknown				1.23	1.08–1.41	0.21	<0.01	
Pre/post September 11, 2001						0.02	0.30	
Pre/post September 11*Arab Race						-0.17	0.12	

Models 1 show unadjusted odds ratios (OR) and confidence intervals (CI) for associations between each ethnoracial class and the particular outcome of interest. Models 2 show adjusted ORs and CIs for associations between each ethnoracial class and particular outcome. Models 3 show beta coefficients and P value for each covariate when the interaction term between birth pre/post September 11 and Arab ethnicity is included in the regression model. The table also shows the prevalence of the particular outcome of interest among each ethnoracial class.

Self-reported race was also collected. Races, or ethno-racial groups, recorded by the MDCH are White, Black, Native American, Asian, other, and unknown; the latter two were grouped in this analysis. Arab Americans are

racially classified as White, but for the purposes of our analysis, we reclassified Arab Americans as an independent ethno-racial classification.<sup>17</sup> Two systems were used to identify Arab and non-Arab individuals. First, the

MDCH keeps data on self-reported Arab and non-Arab ancestry, and these data were used to code births as Arab and non-Arab. Second, first and last names of mothers and infants were used to code each mother-child dyad as Arab

or non-Arab by using an empirically-based probabilistic name algorithm derived from the Social Security Administration's file of applications for Social Security cards.<sup>4</sup> The derivation of the Arab names list used country of birth as a proxy for Arab ethnicity. In this manner, names were considered "Arab" if  $\geq 20\%$  of those with the stated name in the Social Security Administration's file were born in 1 of the 22 countries in the League of Arab Countries (omitting the Comoros Islands and limiting Palestine/Israel to Gaza and the West Bank).<sup>19</sup> First and last names were coded individually; if a name matched one that could be found in the list, the name was coded as Arab. If the name did not match, the name was coded as non-Arab. For the purposes of our analyses, only mother's surname was used for this algorithm.

This study was reviewed by the health science institutional review board of the University of Michigan and the institutional review board of the MDCH.

### Analysis

All analyses were conducted by using three different birth outcomes of interest (LBW, VLBW, and PTB) as dependent variables. First, we used  $\chi^2$  tests to test for associations between each of the independent and dependent variables. Second we used logistic regression models to assess the bivariate relationships between ethno-racial classification and each of the three different dependent variables of interest and then multivariable logistic regression to account for potential sociodemographic confounders. Third, we tested for interactions between Arab American ethno-racial classification and birth before or after September 11, 2001 in each multivariate model. We used separate models for each of the classification methods for our main independent variable of Arab American ethnicity. SAS 9.1 (SAS Institute, Inc, Cary, NC) was used for all statistical analyses. This study was powered to

detect a minimum odds ratio of 1.22 between Arab Americans before and after September 11, 2001, and a minimum odds ratio of 1.004 in the general population before and after September 11, 2001, with 80% power and  $\alpha = .05$ . Statistical significance was set at the  $P = .05$  level.

### RESULTS

Each independent variable was significantly associated with each birth outcome, with two exceptions: before and after September 11, 2001, was not significantly associated with any of the outcomes, and sex was not significantly associated with VLBW (Table 1).

Arab name was significantly associated with lower levels of VLBW and PTB in both bivariate regression models and multivariate regression models that controlled for infant sex, parity, maternal age, education, and marital status (Table 2). Arab name was not significantly associated with LBW in either model. The interaction between Arab name and birth before or after September 11 was not significant in any model.

Table 3 shows bivariate and multivariate logistic regression analyses using all three birth outcome variables individually and Arab ancestry as the classification for Arab American ethnicity. Arab ancestry was significantly associated with lower levels of each of the three adverse birth outcomes in uncontrolled regression models. Arab ancestry was not significantly associated with LBW when infant sex, parity, maternal age, education, and marital status were introduced; however, in controlled models, Arab ancestry remained significantly associated with both VLBW and PTB. The interaction between Arab name and birth before/after September 11 was not significant for LBW or PTB. However, even while controlling for the effects of other sociodemographic variables; the interac-

tion was significant for VLBW, indicating that Arab ancestry mothers were significantly less likely to have VLBW infants after the September 11 attacks than before the attacks (before September 11, 2001, the incidence of VLBW for Arab Americans was .03%, while the incidence for all others was 1.59%. After September 11, 2001, the incidence of VLBW for Arab Americans decreased to 0.02%, while that for all others increased to 1.68%).

### DISCUSSION

In a study of 129,384 births in Michigan in the six-month period after September 11, 2001, and the comparable six-month period the previous year, we found no difference in birth outcomes among Arab American women who gave birth in Michigan before and after September 11, 2001. In addition, we found that Arab Americans had better birth outcomes than did other ethno-racial groups.

Our findings contrast with the only other published study that has assessed the relationship between mass trauma and birth outcomes of a specific group. That study reported a significant in-

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*In a study of 129,384 births in Michigan in the six-month period after September 11, 2001, and the comparable six-month period the previous year, we found no difference in birth outcomes among Arab American women who gave birth in Michigan before and after September 11, 2001.*

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crease in adverse birth outcomes among Arab Americans in California after the September 11, 2001, terrorist attacks.<sup>4</sup> Two reasons could explain why our findings differ from this previous observation. First, although our study was powered to detect differences at least as big as those detected by the other study, there may have been a difference that we did not detect in Michigan, or the difference in birth outcomes observed in California may have been due to chance alone. Second, differences in the dynamics of the Arab American populations in California and Michigan account for the differences observed.

According to the 2000 Census, California's Arab American population density was .48%, while that of Michigan was .82%.<sup>17</sup> Additionally, the concentration of Arab Americans varies within each state: 82% of the Arab American population in Michigan lives in three neighboring counties, while in California, the Arab American population is more diffuse, with only 56% of the population living in the three most populous counties.<sup>20</sup> Several studies show that social integration and social networking can influence health and that social support can benefit coping and perceptions of emotion, mood, and well-being.<sup>21-25</sup> Ethnic minority groups may preferentially interact with members of their own groups.<sup>26</sup> Larger, more concentrated ethnic enclaves should correspond to larger and more complex social networks.<sup>27</sup> Therefore, given the greater concentration of the Arab American population in Michigan when compared with California, differences in the effects of post-September 11 discrimination on either community's birth outcomes may lie fundamentally in the degree of social networking that members of Michigan's Arab American community might have over those in California. If Arab Americans in Michigan live in larger, more complex social networks, they may be more socially cohesive and more likely to benefit from

positive health effects that could mitigate any effects of September 11, 2001, on birth outcomes.

Studies have shown the positive effects of ethnic density on ethnic minority health.<sup>28-30</sup> We also found that birth outcomes among Arab Americans were better than among other ethno-racial groups. This finding is consistent with other studies that reported better birth outcomes among ethnic minorities<sup>31-36</sup> and, more specifically, among Arabs in Michigan and internationally.<sup>37,35</sup> Social integration and social networking among ethnic minorities have also been used to explain this second finding. In one study, Mexican American women residing in Mexican enclaves were at less risk of having LBW infants than were their counterparts in integrated localities.<sup>38</sup> Social integration and social cohesiveness have also been used to explain other ethnic health advantages.<sup>39,40</sup>

Our study has several limitations. We included a limited covariate set in our analyses. Other covariates not included here may have confounded the associations of interest. Of particular note, in order to make our results directly comparable to those of Lauderdale, we did not control for maternal smoking in our analysis. Another covariate that was not considered here that may be important in future work is immigration status of mothers. Finally, because our study period was limited to six months before and after September 11, 2001, we were unable to infer the long-term effect of September 11, 2001, on Arab American birth outcomes in Michigan.

Despite the limitations, our findings have implications for future research. First, our analysis is one of only two that considers the effects of mass trauma on the birth outcomes of specific groups; this topic is ripe for further analysis. The effects of September 11, 2001, on Arab American birth outcomes should be analyzed in other localities because the studies in Michi-

gan and California have not reached a consensus. Because post-September 11 discrimination against Arab Americans has been proposed as an explanation for observations of poorer birth outcomes, future studies should include empiric measurements of discrimination against Arab Americans to assess the viability of discrimination as an explanatory mechanism.

Second, differences in social integration and networking could account for the differences between results in California and Michigan, and therefore, studies measuring social networking and degrees of integration within the Arab American communities in different localities are needed. Third, while Arab Americans have better birth outcomes than other groups, the current literature has not attempted to explain this observation. Future research should focus on empirically explaining this phenomenon.

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