Maternal Nativity as a Risk Factor for Gastroschisis: A Population-Based Study

Jason L. Salemi,[1,2] Marie Pierre,[2] Jean Paul Tanner,[1,3] Jennifer L. Kornosky,[1,2] Kimberlea W. Hauser,[1,2] Russell S. Kirby,[1,2,3] and Jane D. Carver[2]*

[1]Birth Defects Surveillance Program, University of South Florida, Tampa, Florida
[2]Department of Pediatrics, University of South Florida College of Medicine, Tampa, Florida
[3]Department of Community and Family Health, University of South Florida College of Public Health, Tampa, Florida

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BACKGROUND: The prevalence of gastroschisis is increasing in many parts of the world, although the etiology is largely unexplained. Young maternal age has been the only consistently identified, strong risk factor. The objective of this study was to examine the role of maternal nativity in relation to other suspected risk factors for gastroschisis in Florida. **METHODS:** We conducted a retrospective cohort study of singleton infants born in Florida from 1998–2003. Gastroschisis cases were identified from the Florida Birth Defects Registry. Demographic and perinatal data were obtained from birth records. Multivariable Poisson regression was used to estimate adjusted prevalence ratios (PRs) and 95% confidence intervals (CIs) for each factor of interest. **RESULTS:** The 6-year birth prevalence of gastroschisis was 3.26 per 10,000 live births, and the annual rate increased 41% during the study period. In addition to maternal age and marital status, maternal race/ethnicity and nativity were significantly associated with the risk of delivering an infant with gastroschisis. Compared with non-Hispanic white women, non-Hispanic black women had the lowest risk of delivering an infant with gastroschisis (PR, 0.19; 95% CI, 0.13–0.26), followed by Hispanic women (PR, 0.60; 95% CI, 0.43–0.83). Women born outside the United States were significantly less likely than U.S.-born women to deliver an infant with gastroschisis (PR, 0.59; 95% CI, 0.41–0.86). **CONCLUSIONS:** Although young maternal age remains a strong significant risk factor for gastroschisis in Florida, other factors such as maternal race/ethnicity and nativity could be important in explaining the increasing prevalence of gastroschisis. *Birth Defects Research (Part A) 85:890–896, 2009.* © 2009 Wiley-Liss, Inc.

Key words: gastroschisis; nativity; race/ethnicity; Florida

INTRODUCTION

Gastroschisis is a paraumbilical defect of the abdominal wall resulting in herniation of abdominal contents into the amniotic cavity. Although survival rates are greater than 80%, gastrointestinal complications are common, hospital stays are often prolonged, and the associated medical costs are considerable (Hunter and Soothill, 2002). The global prevalence of gastroschisis ranges from approximately 0.5–4.5/10,000 live births (Saada et al., 2005; Loane et al., 2007), and the reported prevalence in the United States is 3.73/10,000 live births, with rates varying by state (Centers for Disease Control and Prevention, 2006). Much of the variation among states can be attributed to the method of case ascertainment and the case definition. States that use active case finding and that include cases from fetal deaths and live births, such as North Carolina (Laughon et al., 2003) and Hawaii (Forrester and Merz, 1999a), report relatively high prevalence rates (4.5 and 3.0/10,000 live births, respectively), while New York (Salihu et al., 2003), which uses passive case finding among live born infants, reports a relatively low rate (1.4/10,000).

During the past few decades, an increasing prevalence of gastroschisis has been reported by several countries, including Finland, England, Japan, Canada, Australia, Ireland, and Norway (Baerg et al., 2003; Reid et al., 2003; Kazaura et al., 2004; Chabra, 2007; Loane et al., 2007). The prevalence is also increasing in the United States,

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*Correspondence to: Jane Carver, USF College of Medicine, Department of Pediatrics, 2 Tampa General Circle, 5th Floor, Tampa, FL 33606.
E-mail: jcarver@health.usf.edu
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where the population-based rate of gastroschisis repairs was twofold higher in 2003 than 1996, with increases occurring in each census region (Alvarez and Burd, 2007). Utah (Hougland et al., 2005), Hawaii (Forrester and Merz, 1999a), New York (Salihu et al., 2003), Tennessee (Collins et al., 2007), California (Vu et al., 2008), and North Carolina (Laughon et al., 2003) reported increasing prevalence rates over the past decade.

Despite its increasing prevalence, the etiology of gastroschisis remains largely unexplained. Young maternal age is the most consistently reported risk factor (Baerg et al., 2003; Feldkamp et al., 2007; Hougland et al., 2005; Saada et al., 2005). Other maternal factors that have been suspected to increase gastroschisis risk include maternal smoking, maternal use of vasoactive substances, low socioeconomic status, low pregnancy body mass index, and Hispanic ethnicity (Haddow et al., 1993; Torfs et al., 1994; Lam et al., 1999; Werler et al., 2002; Salihu et al., 2003; Saada et al., 2005; Canfield et al., 2006; Feldkamp et al., 2007; Stothard et al., 2009). More recently, maternal birthplace (nativity) has been reported to affect the risk of congenital malformations, including gastroschisis; foreign-born women have a lower risk of delivering an infant with gastroschisis than U.S.-born women (Zhu et al., 2006; Vu et al., 2008). Many birth outcomes, including infant mortality, low birth weight, and preterm birth, differ according to maternal nativity. Foreign-born women, especially Hispanics, have more favorable birth outcomes than U.S.-born women, despite their having more demographic and socioeconomic risk factors (Crump et al., 1999; Carter-Pokras et al., 2008). Women born outside the United States tend to have more social support, engage in fewer risky behaviors during pregnancy such as tobacco and alcohol use, and have fewer medical risks (Leslie et al., 2006; Campos et al., 2008; McDonald et al., 2008; Ruiz et al., 2008). However, many of these advantageous factors and better pregnancy outcomes experienced by foreign-born women diminish with increasing acculturation in the U.S. and the adoption of new cultural beliefs and health behaviors (Abriado-Lanza et al., 2005; Carter-Pokras et al., 2008; Ruiz et al., 2008).

Given the potential protective factors associated with being foreign-born and the increasing proportion of foreign-born women—particularly Hispanics—giving birth in Florida, changes in nativity patterns could affect reported gastroschisis prevalence. The objective of this study was to examine the role of maternal nativity in relation to other suspected perinatal and demographic risk factors for gastroschisis in Florida. We hypothesized that foreign-born women would have a lower risk of delivering an infant with gastroschisis than U.S.-born women.

METHODS

We conducted a retrospective cohort study using data derived from the Florida Birth Defects Registry (FBDR), a statewide, population-based, passive surveillance system. Since 1999, the FBDR has monitored birth defects that are identified within the first year of life in live-born children of women who are Florida residents at the time of delivery. Cases are identified by collecting information from the (1) Florida Office of Vital Statistics birth records, (2) Agency for Health Care Administration hospital discharge data, (3) Children's Medical Services (CMS) Regional Perinatal Intensive Care Centers data, (4) CMS Early Steps Program data, and (5) CMS service-related data sets. Birth defect diagnoses are recorded using International Classification of Diseases, ninth edition, Clinical Modification (ICD-9-CM) codes. These data sets are merged to develop an unduplicated inventory of infants with birth defects in Florida.

Singleton infants born alive between January 1, 1998 and December 31, 2003, inclusive, were eligible for inclusion in this study. Potential cases of gastroschisis were identified from the FBDR using the ICD-9-CM diagnosis code 756.79 (''other congenital anomalies of abdominal wall''). Infants with gastroschisis were differentiated from infants with other abdominal wall defects, such as omphalocele, using the ICD-9-CM procedure code 54.71, which indicates surgical repair of gastroschisis. This approach to identification of gastroschisis cases has been described previously (Williams et al., 2005).

Demographic and perinatal data were obtained from the Florida Office of Vital Statistics birth record. Maternal race/ethnicity was determined based on maternal self-report and was first grouped by ethnicity (Hispanic or non-Hispanic), with the non-Hispanic (NH) group further subdivided by race (white, black, or other). Although the term *Hispanic* includes diverse groups, including immigrants from Cuba, Mexico, Puerto Rico, and South America, maternal nativity was dichotomized as U.S.-born or foreign-born (born outside the 50 U.S. states), because case counts were sparse for most non-U.S. countries. Maternal age in years was categorized as <20, 20 to 24, 25 to 29, 30 to 34, or 35 and over; maternal education was classified as <12 years, high school graduate (12 years), or college (≥ 13 years); and maternal marital status at the time of delivery was categorized as *married* or *unmarried*. Parity was grouped into *nulliparous* or *multiparous*, and maternal smoking during pregnancy was reported as *yes* or *no*. Maternal place of residence at the time of delivery was classified as *urban* or *rural*, with *urban* being defined as a housing unit located in a core census block or block group that has a population density of at least 1000 people per square mile, or a surrounding census block that has an overall density of at least 500 people per square mile.

Descriptive statistics including birth prevalence rates (number of infants with gastroschisis per 10,000 live births) were calculated for each category of maternal age, race/ethnicity, nativity, education, marital status, smoking status, parity, place of residence, and infant sex. Poisson regression was used to calculate the crude prevalence ratios (PRs) and 95% confidence intervals (CIs) for each covariate. A multivariable Poisson regression model was used to estimate adjusted PRs and 95% CIs; only covariates that were significantly associated with gastroschisis risk in univariate analyses were included in the adjusted model. To test for a linear trend in the gastroschisis rate over the study period, we included year of birth as a continuous covariate in the adjusted model. All statistical tests were two-sided and declared significant at $p < 0.05$. Statistical analyses were performed with SAS software, version 9.1.3 (SAS Institute, Inc., Cary, NC). Approval for the study was obtained from the Institutional Review Board at the University of South Florida, the Florida Department of Health, and the Florida Office of Vital Statistics.

Table 1
Maternal and Infant Demographic Characteristics of Singleton Live-Born Gastroschisis Cases and All Singleton Live Births (Florida Residents, 1998–2003)

Characteristic	Total births[a] (n = 1,179,418)	Gastroschisis cases (n = 395)	Birth prevalence of gastroschisis[b]
Maternal age (years)			
<20	144,739	167	11.54
20–24	299,118	143	4.78
25–29	308,229	62	2.01
30–34	262,762	19	0.72
≥35	164,410	4	0.24
Marital status			
Married	725,682	117	1.61
Unmarried	453,471	278	6.13
Maternal education			
Less than high school	244,427	159	6.51
High school only	402,534	153	3.80
College	525,541	82	1.56
Maternal race/ethnicity			
Non-Hispanic white	606,336	277	4.57
Non-Hispanic black	261,777	39	1.49
Hispanic	275,848	71	2.57
Other	33,616	7	2.08
Maternal country of birth			
United States	842,764	342	4.06
Foreign	333,342	49	1.47
Smoking during pregnancy			
Nonsmoker	1,067,150	326	3.05
Smoker	111,391	68	6.10
Parity			
Multiparous	680,996	139	2.04
Nulliparous	498,093	255	5.12
Residency			
Urban	1,047,237	335	3.20
Rural	120,491	56	4.65
Infant sex			
Male	604,178	216	3.58
Female	575,226	179	3.11

[a]Numbers may not reflect total because of missing data.
[b]Per 10,000 births.

RESULTS

During the study period, there were 1,216,142 live births to Florida residents, including 397 gastroschisis cases (birth prevalence rate: 3.26 per 10,000 live births). Multiple births were excluded, yielding 395 cases among 1,179,418 singleton live births for analysis. During the study period, the birth prevalence of gastroschisis increased from 2.95 per 10,000 in 1998 to 4.15 per 10,000 in 2003 ($P\text{-}_{trend}$ = 0.06). The distribution of the study population and the birth prevalence of gastroschisis by important maternal and perinatal factors are presented in Table 1. Women younger than 20 years, women who reported they were unmarried at the time of delivery, women with less than a high school education, nulliparous women, and those who reported smoking during their pregnancy had the highest singleton birth prevalence rates of gastroschisis. Non-Hispanic white women had the highest rate of gastroschisis-affected offspring (4.57), followed by Hispanics (2.57), whereas NH-black women had the lowest rate (1.49). Women born in the United States had a much higher rate of gastroschisis (4.06) than their foreign-born counterparts (1.47).

In multivariable analyses, young maternal age remained the single greatest risk factor for gastroschisis (Table 2). Compared with women 25 to 29 years of age, women younger than 20 years were 3.4 times more likely to deliver an infant born with gastroschisis (PR, 3.44; 95% CI, 2.40–4.94), and women 20 to 24 years of age were almost twice as likely to deliver an affected offspring (PR, 1.88; 95% CI, 1.37–2.57). The risk of delivering an infant with gastroschisis continued to decline with increasing age, with women 30 to 34 years old (PR, 0.39; 95% CI, 0.23–0.65) and those 35 years and older (PR, 0.13; 95% CI, 0.05–0.37) having the lowest risk. After adjusting for age, women who were unmarried at the time of delivery were 2.2 times more likely to deliver an infant with gastroschisis, compared with women who were married (95% CI, 1.71–2.82). Compared with infants of NH-white women, infants of NH-black women had the lowest gastroschisis risk (PR, 0.19; 95% CI, 0.13–0.26), followed by Hispanic infants (PR, 0.60; 95% CI, 0.43–0.83). Independent of their race/ethnicity, women born outside the U.S. were significantly less likely to deliver an infant with gastroschisis than U.S.-born women (PR, 0.59; 95% CI, 0.41–0.86).

There was considerable variation in the racial/ethnic–specific distribution of live births and gastroschisis prevalence rates according to maternal nativity (Table 3). Among all women giving birth to a live born infant, only

Table 2
Unadjusted and Adjusted[a] Prevalence Ratios for Gastroschisis, by Infant and Maternal Demographic Characteristics (Florida Residents, 1998–2003)

Characteristic	Crude PR	95% CI	Adjusted PR	95% CI
Maternal age (years)				
<20	5.74	4.29–7.68	3.44	2.40–4.94
20–24	2.38	1.76–3.20	1.88	1.37–2.57
25–29	Reference		Reference	
30–34	0.36	0.22–0.60	0.39	0.23–0.65
≥35	0.12	0.04–0.33	0.13	0.05–0.37
Marital status				
Married	Reference		Reference	
Unmarried	3.80	3.06–4.72	2.19	1.71–2.82
Maternal education				
Less than high school	1.71	1.37–2.14	1.07	0.84–1.36
High school only	Reference		Reference	
College	0.41	0.31–0.54	0.80	0.60–1.08
Maternal race/ethnicity				
Non-Hispanic white	Reference		Reference	
Non-Hispanic black	0.33	0.23–0.46	0.19	0.13–0.26
Hispanic	0.56	0.43–0.73	0.60	0.43–0.83
Other	0.46	0.22–0.97	0.82	0.38–1.77
Maternal country of birth				
United States	Reference		Reference	
Foreign	0.36	0.27–0.49	0.59	0.41–0.86
Smoking during pregnancy				
Non-smoker	Reference		Reference	
Smoker	2.00	1.54–2.60	0.97	0.73–1.28
Parity				
Multiparous	Reference		Reference	
Nulliparous	2.51	2.04–3.08	1.24	0.98–1.56
Residency				
Urban	Reference		Reference	
Rural	1.45	1.09–1.93	0.97	0.73–1.30
Infant sex				
Male	Reference		NA	
Female	0.87	0.71–1.06	NA	

[a]Adjusted for maternal age, marital status, education, race/ethnicity, smoking status, parity and place of residence.

PR, prevalence ratio; CI, confidence interval; NA, not applicable, not included in multivariate analysis.

7% of NH-white women and 26% of NH-black women identified themselves as foreign-born, compared with more than 70% of Hispanic women. In addition, the crude prevalence rates were twofold to threefold higher for U.S.-born versus foreign-born women in each major racial/ethnic group. Among Hispanic women, gastroschisis risk also differed by maternal nativity. U.S.–born Mexican, Puerto Rican, Cuban, and other Hispanic women had higher prevalence rates of gastroschisis in their offspring than their foreign-born counterparts, regardless of Hispanic subgroup (Table 3); however, low case counts result in imprecise stratum-specific PRs in multivariate analyses. To determine whether the association between maternal nativity and risk of gastroschisis in offspring differed by self-reported maternal race/ethnicity, we included an interaction term between maternal race/ethnicity and maternal nativity in our final multivariable main effects model. After adjusting for maternal age, marital status, education, smoking status, and parity, the interaction term was not statistically significant.

DISCUSSION

During the 6-year study period, the singleton birth prevalence of gastroschisis in Florida was 3.26 per 10,000 live births, increasing 41% over the study period. Young maternal age was the strongest risk factor, in agreement with findings from earlier studies (Goldbaum et al., 1990; Werler et al., 1992; Loane et al., 2007). We identified a number of additional risk factors.

In our study, maternal nativity was an important demographic factor contributing to gastroschisis risk. Specifically, we observed a 41% lower risk of having a gastroschisis-affected infant for foreign-born versus U.S.-born women, after adjusting for several other established or suspected risk factors. The protective effect associated with being foreign-born persisted in all racial/ethnic groups studied, with the birth prevalence of gastroschisis being several-fold lower for NH-white, NH-black, and Hispanic mothers born outside the U.S. compared with their U.S-born counterparts. Independent of nativity, we also observed an effect of maternal race/ethnicity. Compared with NH-white women, NH-black and Hispanic women had an 81% and 40% lower risk, respectively, of delivering a live born singleton infant with gastroschisis. Although our findings agree with several studies that found a lower risk of gastroschisis among NH-black women (Canfield et al., 2006; Williams et al., 2005), our observation that Hispanic ethnicity is protective was not consistently reported in previous studies. Using popula-

Table 3
Distribution of Singleton Live Born Gastroschisis Cases, and All Singleton Live Births by Maternal Race/Ethnicity and Nativity (Florida Residents, 1998–2003)

	U.S. Born			Foreign-Born		
Epidemiologic Factors	Total Births	Gastroschisis Cases	Birth Prevalence of Gastroschisis[a] 95% CI)	Total Births	Gastroschisis Cases	Birth Prevalence of Gastroschisis[a] 95% CI)
Maternal Race/Ethnicity						
Non-Hispanic white	561,856	266	4.73 (4.20–5.34)	43,933	10	2.28 (1.22–4.23)
Non-Hispanic black	194,569	34	1.75 (1.25–2.45)	66,621	4	0.60 (0.23–1.60)
Other	6,481	3	4.63 (1.49–14.35)	27,092	4	1.48 (0.55–3.93)
Hispanic	78,733	39	4.95 (3.62–6.78)	195,221	31	1.59 (1.12–2.26)
Mexican	17,170	13	7.57 (4.40–13.04)	48,289	2	0.41 (0.10–1.66)
Puerto Rican	26,315	14	5.32 (3.15–8.98)	22,428	8	3.57 (1.78–7.13)
Cuban	21,219	7	3.30 (1.57–6.92)	34,372	6	1.75 (0.78–3.89)
Other Hispanic	14,029	5	3.56 (1.48–8.56)	90,132	15	1.66 (1.00–2.76)

[a]Per 10,000 births.
CI, confidence interval.

tion-based data on nearly 1000 cases from 11 states with active case-finding, Canfield et al. (2006) reported that Hispanic women had a significantly higher unadjusted birth prevalence of gastroschisis compared with NH-white women (PR, 1.25; 95% CI, 1.09–1.43). Likewise, a study investigating 308 cases in New York reported that, after adjusting for maternal age, Hispanic women were 1.5 times more likely to have an offspring affected by gastroschisis (95% CI, 1.12–2.00; Salihu et al., 2003). However, in a population-based study in California on nearly 1000 cases over 17 years, Vu et al. (2008) reported that the effect of Hispanic ethnicity on gastroschisis risk was modified by maternal nativity. In that study, the risk of having an infant affected by gastroschisis for U.S.-born Hispanics was nearly identical to that of NH-whites (PR, 1.0; 95% CI, 0.8–1.2). However, foreign-born Hispanic women had an estimated 40% risk reduction (PR, 0.6; 95% CI, 0.4–0.9), even after adjusting for parity, parental age and education. We found a similar risk reduction for foreign-born women independent of race/ethnicity, and we did not find evidence of effect modification between nativity and race/ethnicity. The differences among studies could be explained, in part, by differences in maternal country of birth in the Hispanic population, as well as differences in the percent that were foreign- or U.S.-born. For example, although Vu et al. (2008) do not report the overall proportion of U.S.- and foreign-born mothers or the specific ethnic make-up of their Hispanic population, 46% of their study population was Hispanic, compared with 23% of our population. In addition, only 33% of Hispanic women in their study were foreign-born, compared with 71% in our study.

The significantly lower rates of gastroschisis among foreign-born women concord with many studies that have observed similarly paradoxical findings of better birth outcomes among foreign-born women, who are typically medically underserved and of lower socioeconomic status. Women born outside the U.S., particularly those of Hispanic ethnicity, have a lower risk of preterm delivery, low birth weight, and infant mortality, and they report less preterm labor and hypertension than U.S.-born women; this advantage tends to diminish with increasing acculturation (Cervantes et al., 1999; Crump et al., 1999; Buekens et al., 2000; Carter-Pokras et al., 2008; McDonald et al., 2008; Ruiz et al., 2008). The protective effect associated with being foreign born is not consistent for all birth outcomes. For example, foreign-born women and less acculturated women tend to be at greater risk of gestational diabetes and of delivering infants with serious neural tube defects than U.S.-born women (McDonald et al., 2008; Canfield et al., 2009).

Theories proposed to explain empirically observed advantages in birth outcomes in foreign-born women incorporate concepts of acculturation, differences in health behaviors, selective migration, and the ''weathering'' hypothesis. In terms of acculturation, maternal birth in a foreign country might represent preservation of cultural values, such as close family relationships, which are associated with lower stress and pregnancy anxiety and greater social support (Page, 2004; Campos et al., 2008). These benefits might play a significant role in promoting healthy pregnancies. The close social ties tend to diminish with increasing acculturation, resulting in ''acculturative stress.'' The physiologic response to acculturative stress might include changes in the levels of corticotrophin-releasing hormone (Ruiz et al., 2006), inflammatory response markers (Ruiz et al., 2007), and the progesterone/estriol ratio (Ruiz et al., 2008). Changes in the levels of these stress biomarkers might contribute to an increased risk of preterm birth and other negative birth outcomes. Foreign-born women tend to have more favorable behavioral risk factors than U.S.-born women. Compared with those born in the U.S., foreign-born women reportedly smoke less tobacco and drink less alcohol during their pregnancy (Rosenberg et al., 2005; Leslie et al., 2006; McDonald et al., 2008), use less marijuana and cocaine (Singh and Yu, 1996), and engage in healthier nutritional practices. Foreign-born women also have higher intakes of protein and vitamins, including folic acid (Abrams and Guendelman, 1995), and greater consumption of fruits and vegetables; consumption levels decline with longer residence in the U.S. (Gordon-Larsen et al., 2003; Lin et al., 2003; Dubowitz et al., 2008).

The ''healthy migrant'' theory proposes that (1) women capable of migrating are healthier and will likely have better birth outcomes than those who cannot, and (2) foreign-born women immigrating into the U.S. have better reproductive outcomes than U.S.-born women due to a

bias that ''selects'' women in better health before conception (Lechner and Mielck, 1998; Wingate and Alexander, 2006). Wingate and Alexander (2006) studied an internally migrant (movement only within the borders of a single nation) population of Mexican origin, and reported that women with active mobility histories had lower risks of delivering low birth weight or small-for-gestational age infants than less mobile women.

According to the weathering hypothesis, the health of certain populations deteriorates with increasing time spent living in the U.S. and accumulating socioeconomic disadvantages. It has been suggested that U.S-born Hispanics experience more weathering than foreign-born Hispanics, likely owing to greater relative deprivation for the former (Geronimus, 1992; Wildsmith, 2002). However, because younger women have the highest risk for gastroschisis, it is unlikely that the weathering hypothesis contributes to our findings. With the exception of the weathering hypothesis, each of these theories might contribute to the lower risk of gastroschisis in foreign-born women. How these theories contribute to our understanding of the underlying etiology of gastroschisis remains unclear. It is also unclear what commonalities exist between foreign nativity and advanced maternal age, both of which protect against the development of gastroschisis.

Interpretation of our study results should consider several limitations. First, the FBDR is a passive surveillance system without case confirmation. The FBDR links administrative data sets not initially created for constructing a birth defects registry, and it relies on ICD-9-CM diagnosis codes for case identification. A degree of inaccuracy and incompleteness is inherent in such a system. Furthermore, in the ICD-9-CM coding system, gastroschisis is identified by a nonspecific code that also includes other congenital anomalies of the abdominal wall. To minimize potential misclassification, we used a procedure code specific to gastroschisis repair to differentiate cases from other abdominal wall defects. Second, the FBDR does not include spontaneous and elective terminations; thus our data reflect gastroschisis live birth prevalence and not incidence. Prenatal diagnosis increases elective terminations, and certain demographic factors such as maternal age and race/ethnicity might influence the decision to terminate a pregnancy. However, we speculate that the incidence-prevalence bias has a negligible effect on our findings related to nativity, because early spontaneous loss and the proportion of women who decide to terminate a gastroschisis-affected pregnancy are relatively low, especially compared with other major birth defects (Forrester et al., 1998; Forrester and Merz, 1999b). Third, we rely on the Florida birth certificate as the source of infant and maternal demographic and perinatal data. There are well-recognized limitations to the accuracy and reliability of some birth certificate data, such as self-reported smoking during pregnancy; this and other behaviors are generally underreported on the birth certificate (Ventura, 1999; Roohan et al., 2003; Northam and Knapp, 2006). However, the association between gastroschisis and maternal smoking reported on the birth certificate is comparable with other studies that used more reliable means to assess maternal smoking and its relationship to birth defects (Honein et al., 2001). An additional limitation is that nativity was based on maternal self-report and is thus merely a proxy for the underlying culture and acculturation constructs it aims to represent. We had no information on length of residence in the United States, motivation for emigrating, or generation status, thus making it difficult to further clarify the relationship between maternal nativity and gastroschisis risk. Lastly, there is some evidence of under-identification of birth defects among non–native-born women, primarily owing to the FBDR's limited success in linking vital statistics birth records to hospital discharge records (birth and postbirth hospitalizations) in this population. Although this limitation is not large enough to affect our overall findings, we anticipate that it might result in a bias away from the null, thus producing a slight overestimation of the protective effects of being foreign born. Despite these limitations, our findings are based on a large, multiethnic, population-based study, thus making the results generalizable. In addition, Florida has a diverse population with a Hispanic subgroup distribution that differs from other large states with sizeable Hispanic populations, including California, Texas, and New York.

Our study confirms that young maternal age is a significant risk factor for gastroschisis in Florida, and it also demonstrates that maternal nativity is associated with differences in gastroschisis birth prevalence among mothers in several major racial/ethnic groups. Thus, nativity might be an index for underlying factors that modify gastroschisis risk. Foreign-born women were 41% less likely to deliver an infant with gastroschisis than U.S.-born women. Our results suggest that environmental and/or behavioral factors associated with residence in the United States might increase the risk for gastroschisis, and that future studies of gastroschisis should consider nativity as a contributor to risk. These findings provide valuable opportunities to further elucidate the roles of several risk factors in the etiology of gastroschisis.

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