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Prevalence of selected birth defects by maternal nativity status, United States, 1999–2007

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Abstract

Objectives: We investigated differences in prevalence of major birth defects by maternal nativity within racial/ethnic groups for 27 major birth defects.

Methods: Data from 11 population-based birth defects surveillance systems in the United States including almost 13 million live births (approximately a third of U.S. births) during 1999–2007 were pooled. We calculated prevalence estimates for each birth defect for five racial/ethnic groups. Using Poisson regression, crude and adjusted prevalence ratios (aPRs) were also calculated using births to US-born mothers as the referent group in each racial/ethnic group.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

Results: Approximately 20% of case mothers and 26% of all mothers were foreign-born. Elevated aPRs for infants with foreign-born mothers were found for spina bifida and trisomy 13, 18, and 21, while lower prevalence patterns were found for pyloric stenosis, gastroschisis, and hypospadias.

Conclusions: This study demonstrates that birth defects prevalence varies by nativity within race/ethnic groups, with elevated prevalence ratios for some specific conditions and lower prevalence for others. More detailed analyses focusing on a broader range of maternal behaviors and characteristics are required to fully understand the implications of our findings.

Keywords

birth defects; epidemiology; nativity; population health; race/ethnicity

1| INTRODUCTION

Birth outcomes have been shown to vary by maternal nativity status (Collins et al., 2013; Elo et al., 2014; Gagnon et al., 2009; Wingate and Alexander, 2006). Specifically, rates of adverse

pregnancy outcomes such as infant mortality, low birth weight, and preterm birth are generally higher among US-born mothers compared to foreign-born counterparts. Research has also demonstrated that the relative health advantage of migrants for birth outcomes is moderated by race/ethnicity. The differences in pregnancy outcomes by nativity among non-Hispanic whites and Asians are not as striking as the differences among blacks or Hispanics (Acevedo-Garcia et al., 2005; Cabral et al., 1990; Fuentes-Afflick et al., 1998: Howard et al., 2006; Janevic et al.,2011; Kramer et al., 2006; Lim et al., 2010; Madan et al., 2006; Rosenberg et al., 2005). However, information regarding the contribution of nativity and race/ethnicity to infant morbidities, specifically birth defects, is limited. Birth defects collectively are common pregnancy outcomes, and are a leading cause of infant mortality, accounting for one in five infant deaths in the United States and contributing to disability and health care costs (Parker et al., 2010; Petrini et al., 2002). Thus, birth defects are an important outcome and understudied in relation to our understanding of migration and infant morbidity.

The mechanisms by which differences in birth outcomes by nativity occur are not well understood; however, several explanations have been proposed. The healthy migrant theory posits that due to selection processes that enable healthier persons to migrate, migrants arrive in the United States with a health advantage (Palloni and Ewbank, 2004; Wingate and Alexander, 2006).

A contrasting theory proposes a potentially adverse role of acculturation and the incorporation of unhealthy norms and behaviors adopted after immigration. As time in the United States lengthens, the changes and deterioration of health status in immigrants and in subsequent generations is related to the adaptation of the populations to the behaviors and attitudes that are not in line with those of the country of origin (Collins et al., 2013; Elo et al., 2014). Identifying and understanding variations of birth defects by nativity and race/

ethnicity may provide new insights into cultural, environmental, and other mechanisms influencing child health.

Previous population-based analyses, conducted through the National Birth Defects Prevention Network (NBDPN), have examined the relationship between race/ethnicity and major birth defects (Canfield et al., 2014), as well as mortality and survival with major birth defects and a detailed examination of trisomy 13 and 18 (Meyer et al., 2016; Wang et al., 2015). Smaller studies have examined the additional role of maternal nativity for specific birth defects (Canfield et al., 2014; Hoyt et al., 2014; Khodr et al., 2013; Ramadhani et al., 2009; Salemi et al., 2009), but no study has examined comprehensive NBDPN data for maternal nativity, race/ethnicity, and country of birth. Using pooled data from 11 U.S. population-based birth defects surveillance programs, this study examines the prevalence of selected major birth defects overall, and by race/ethnicity within maternal nativity status categories. We hypothesize that the prevalence for those infants born to foreign-born mothers will vary from US-born mothers within the same racial categories, but that variability will also be present across racial/ethnic classifications.

2| METHODS

The NBDPN Data Committee issued a call to population-based birth defects surveillance programs in the United States for a multi-state collaborative project to examine major birth defects, maternal race/ethnicity, and nativity status. A previous article using this dataset focused on the prevalence of major birth defects by maternal race/ethnicity (Canfield et al., 2014). This article extends that work by examining maternal nativity status for 27 birth defects (anencephalus; spina bifida without anencephalus; encephalocele; anotia/microtia; common truncus; transposition of great arteries; tetralogy of Fallot; atrioventricular septal defect with and without Down syndrome; aortic valve stenosis; hypoplastic left heart syndrome; coarctation of the aorta; cleft palate without cleft lip; cleft lip alone; esophageal atresia; congenital hypertrophic pyloric stenosis; rectal and large intestinal atresia; hypospadias; upper, lower, and any limb deficiency; diaphragmatic hernia; gastroschisis; omphalocele; Down syndrome; trisomy 13; and trisomy 18) for years 1999–2007.

Eleven population-based surveillance programs participated: Arizona, Colorado, Florida, Illinois, Massachusetts, Michigan, North Carolina, Nebraska, New Jersey, New York, and Texas. The Texas Program served as the deferring IRB, and CDC was the central repository for the anonymized datasets. Programs were provided a data dictionary outlining the format for the selected birth defects and requested data elements. Infants with multiple defects were counted for each applicable condition except for anencephaly and spina bifida, which were mutually exclusive. All participating programs conduct population-based birth defects surveillance. Four states employed active case-finding (Arizona, Massachusetts, North Carolina, and Texas), where cases are identified by review of medical charts. The remaining states (Colorado, Florida, Illinois, Michigan, Nebraska, New Jersey, and New York) used passive case-finding methodologies, relying on administrative datasets or hospital reporting for case identification. Because some states were unable to provide data on all conditions for all study years, this is noted as relevant in the tables accompanying this study (Canfield et al., 2014). Each program provided data on cases among live births, and where available, fetal

deaths or pregnancy terminations, as well as provided files with all resident state births for use in analyses. Sociodemographic data were taken from birth certificates.

Nativity was categorized as US-born if the maternal country of birth as reported on the birth certificate indicated United States; otherwise, if the maternal country of birth was not missing, the nativity status was categorized as foreign-born. Because categorization by nation of origin varied by state, we were unable to further classify nativity status. We excluded cases with multiple or missing maternal race/ethnicity and/or missing nativity, as well as those who were native American/Alaskan natives. We could not compare American Indians or Alaska natives by nativity status, as a substantial number of all women within this racial/ethnic group were born in the United States, and the very small numbers of women in this sub-population born outside the United States were insufficient for valid statistical comparisons. Puerto Ricans were grouped in the US-born category if they self-identified their country of origin as United States; otherwise, they were classified as foreign-born.

Data cleaning and analysis were performed using SAS 9.3 (Cary, NC). Crude prevalence rates were calculated per 10,000 live births, with 95% confidence intervals (CIs) calculated using the exact method. Poisson regression was used to create crude prevalence ratios (PR) with the reference category of US-born for each racial/ethnic group (non-Hispanic white, all Hispanic ethnicities, Mexican, non-Hispanic black, and non-Hispanic Asian/Pacific Islander). Multivariable analyses were performed to adjust the PR by maternal state of residence at delivery and maternal age category (<20, 20–34, and ≥35 years). Adjusted prevalence ratios were calculated as the ratio of the prevalence of the child's defect among infants born to foreign-born mothers over the prevalence among infants born to US-born mothers, adjusted for maternal age and state of residence. The 95% CIs were calculated using the Wald method.

3| RESULTS

Table 1 presents the percentage of foreign-born mothers by race/ethnicity and state, both for cases and total live births. Specific demographic information is included in Supporting Information Table SS1. This study examined 172,235 cases of birth defects among 12,954,369 live births. Births to foreign-born women constituted 26% of all births, and 20% of birth defects cases. While child sex did not differ by maternal nativity, foreign-born mothers were less likely to be younger than 20 years of age, or of non-Hispanic White race/ethnicity. While the relative contribution of foreign-born mothers to all births varied by state of residence, each state contributed a sizeable number of births and cases to the study population. It is notable that for most states, approximately 90% of Asian mothers were foreign-born. Over one-half of Hispanic and specifically Mexican mothers (a subset of Hispanic mothers) were also foreign-born. The percentage of foreign-born non-Hispanic black mothers was lower, but varied greatly across states. Non-Hispanic white mothers were <10% foreign-born, with several exceptions (Massachusetts, New Jersey).

Prevalence rates and 95% CIs for each of the 27 birth defects, by race/ethnicity and nativity, are shown in Table 2. For many conditions the greatest differences in the US-born versus foreign-born prevalence were observed within the non-Hispanic white category. Crude

prevalence ratios comparing prevalence of infants born to foreign-born mothers to the prevalence among infants born to US-born mothers within each racial/ethnic category and for each defect are shown in Supplemental Table 2.

Table 3 presents adjusted prevalence ratios (aPRs) with 95% CIs for each condition. (Among non-Hispanic white mothers, about one-half of the birth defects showed significantly lower prevalence among foreign-born relative to US-born mothers, as evidenced by down arrows (aPRs <1.0 and 95% CI not including the null.) We observed aPRs with magnitudes as small as 0.5 for pyloric stenosis comparing foreign-born to USborn mothers in each racial/ethnic group. There were very few significantly elevated aPRs for other racial/ethnic categories, as evidence by up arrows (aPRs >1.0 and 95% CI not including the null). Among non-Hispanic black mothers, elevated aPRs for foreign-born versus US-born were seen for trisomy 13 and 18, while elevated aPRs were observed for spina bifida, anotia/microtia, and Down syndrome among Hispanic foreign-born versus US-born. Among Asian mothers, no elevated aPRs by nativity were observed; however, significantly lower prevalence was observed for six birth defects (encephalocele, anotia/microtia, tetralogy of Fallot, pyloric stenosis, gastroschisis, and omphalocele) for foreign-born mothers. We observed aPRs below 1 and statistically significant for at least three of the five foreign-born groups for the following birth defects: pyloric stenosis, hypospadias, and gastroschisis.

4| DISCUSSION

This large population-based study in the United States examined the prevalence of selected birth defects by race/ethnicity and maternal nativity. Our study provides estimates of birth defect prevalence for US-born and foreign-born non-Hispanic white, non-Hispanic black, non-Hispanic Asian women, as well as for all Hispanic and a subset limited to Mexican women. The covered live birth population (almost 13 million) represents approximately a third of all births in the United States during 1999–2007. The large size of the study population enabled comparisons of birth defects prevalence by nativity status for 27 specific conditions, providing a first look at the potential role of nativity as a factor influencing prevalence.

In general, within the four major racial/ethnic groups, prevalence of the specific birth defects was similar between US-born and foreign-born women. Infants born to foreign-born non-Hispanic white women were significantly less likely to be affected by 11 of the 27 conditions analyzed (Table 3). However, the prevalence ratios tended to be in the range of 0.7–0.8 for most conditions, suggesting a relatively small diminution in prevalence for infants born to foreign-born non-Hispanic white women. The high number of modest but statistically significant differences in prevalence identified for this group is probably associated with the much higher number of total births among non-Hispanic whites in the dataset. Three conditions with a reduced prevalence were identified in the foreign-born Hispanic group, all of which had also been identified as conditions for which foreign-born non-Hispanic white mothers were at a reduced risk.

Prevalence was significantly elevated for spina bifida, anotia/microtia, and trisomy 21 among infants born to foreign-born Hispanic mothers. Similar patterns were found in the

separate analysis of Mexican births to foreign-born and US-born mothers for these conditions except for anotia/microtia (although elevated but not statistically significant). These findings are generally concordant with those reported by Shumate et al. (2018), Padula et al. (2017), and Hoyt et al. (2014). Among infants born to non-Hispanic black women, prevalence was significantly lower for only one condition, pyloric stenosis, while higher prevalence was found for trisomy 13 and 18 among those with foreign-born mothers. The analysis for births among non-Hispanic Asian/Pacific Islander women revealed six conditions for which prevalence varied between foreign-born and US-born.

Gastroschisis and pyloric stenosis showed a persistent pattern of reduced prevalence by foreign nativity across all racial/ethnic groups (excepting only for non-Hispanic foreign-born black women for gastroschisis), generally confirming a Florida-specific analysis by Salemi et al. (2009). Similar to the present analysis, Salemi et al. were unable to explore the role of maternal pre-pregnancy body mass index. Risk factors for gastroschisis pose an explanatory conundrum yet to be unraveled—the highest prevalence as well as the greatest increase in recent prevalence is found among women of young maternal age (Jones et al., 2016; Kirby et al., 2013), while women with lean body mass tend to have the highest risk (Siega-Riz et al., 2009); however, the complex inter-relationships between maternal age, nativity, race/ethnicity, and maternal body mass and pregnancy weight gain have not been fully explored.

A large body of literature considers nativity and the migrant paradox of healthy birth outcomes (Juarez and Revuelta-Eugercios, 2016). However, because individual birth defects are rare and the data required for examination of these outcomes is beyond the scope of the typical administrative databases utilized to analyze other birth outcomes, for many of the 27 birth defects in this study there are few or no studies of the role of maternal nativity. Explanations for the paradox include US-born women's disadvantage in regard to biomedical, nutritional, and psychosocial risk factors (de la Rosa, 2002). These mechanisms may also explain the protective effect of foreign-born status we found for many conditions. A growing body of literature, however, has recognized that immigrant women may be at greater risk of certain maternal health outcomes during pregnancy, such as gestational diabetes (Savitz et al., 2008) and severe maternal morbidity (Howell et al., 2017). It is plausible that the conditions for which we found foreign-born women to be at an increased risk share factors with these maternal conditions, such as poor access to health care. Other conditions in our study for which foreign-born women have an increased prevalence, such as spina bifida and Trisomy 21, are those for which prenatal diagnostic testing are available given optimal prenatal care. We were unable to assess access to or quality of care before or during pregnancy or explore other potential mechanisms for the observed differences in these conditions. Given there is no clear pattern between US-born and foreign-born women, it is possible that multiple protective and deleterious factors are simultaneously at play. Overall, our findings fit into the complex story that is emerging in research on immigration and maternal and infant health.

4.1| Strengths

This large population-based study provides sufficient statistical power to make meaningful comparisons across several minority groups of broad public health interest. The study

sample is generally representative of the U.S. population, and includes several states with large immigrant populations and minority groups. Adjusted prevalence ratios were adjusted both for state of residence and maternal age. The database utilized represents the best available pooled source for birth defects from population-based birth defects surveillance programs.

4.2| Limitations

While our study population was large, we were unable to examine the role of nativity within some subgroups. While we were unable to examine differences in birth defects prevalence by nativity status for American Indians or Alaska natives, a recent study based on the same dataset explores the prevalence of selected birth defects in this population (Marengo et al., 2018). Although we are aware of the heterogeneity within Asian and Hispanic subgroups (e.g., China, India, Japan, Philippines, Puerto Rico, Mexico, Cuba, and South America), we plan to explore patterns of birth defects prevalence by nation of origin within these subgroups in separate reports. We do not have information on age at immigration to the United States so we were not able to test hypotheses regarding the influence of duration of residence in the United States on prevalence of birth defects.

Our assessment of nativity status was limited to information reported for a single birth certificate item, identifying whether the mother was born in or outside the United States. We were unable to examine foreign-born mothers by country of birth because, although birth certificates routinely collect maternal country of birth, the information was not available in a consistent code structure across the states participating in this study.

Our study spans the years of initial implementation of the 2003 revision of the national standard certificate of live birth; however, few of the participating states had adopted the new certificate during our study period. Therefore, we were unable to explore the role of pre-pregnancy body mass index, maternal smoking by trimester, and other clinical and behavioral factors reported on the new certificate (Kirby and Salihu, 2006). While we had access to data on maternal education from the birth certificate data, missing data was more common for records pertaining to infants born to foreign-born mothers, and preliminary analyses adjusting for maternal education yielded similar results to those reported in Table 3. Broader measures of socioeconomic status for families or small areas would enhance our understanding of the contribution of maternal nativity to birth defects prevalence. At least one study suggests a protective effect of breastfeeding for pyloric stenosis (Krogh et al., 2012). While infant feeding intention is not universally reported in US vital statistics, and birth defects registries typically do not document infant feeding practices, this association warrants further exploration by maternal nativity status. Our study was also limited in that, while case ascertainment included all liveborn infants, data on prenatal terminations were included for only three, and for stillbirths for only seven of the states included in this study.

Our study pooled data from 11 U.S. states, all of whichutilize surveillance methods based on national guidelines (NBDPN, 2014). These programs utilize different case-ascertainment strategies that could potentially influence our findings; while many programs include confirmation of diagnoses in their surveillance protocols, some cannot due to staffing and funding constraints. These issues are unlikely to influence our findings substantially, as there

is no reason to expect information bias by nativity status; however, prevalence of some conditions with typical onset after the initial hospital stay, such as congenital hypertrophic pyloric stenosis, may be affected by differences in surveillance methods.

5| CONCLUSION

This study examined differences in birth defects prevalence by nativity status across the United States, showing elevated prevalence ratios for some specific conditions and lower prevalence for others. We hope the findings spur interest in more detailed analyses using a broader range of maternal behaviors and characteristics, including pre-pregnancy body mass index, diet and nutrition in the preconception period and during pregnancy, and use or exposure to tobacco products (Ramadhani et al., 2011). Maternally linked pregnancy outcome files would enable examination of risk for birth defects in subsequent pregnancies. Assimilation and acculturation cannot be directly measured with available vital statistics data, yet these socio-cultural factors may influence the prevalence of birth defects among immigrant women, leading potentially to significantly lower or in some cases higher prevalence of specific birth defects. Previous studies have also illustrated the disparities in access to care, among foreign-born or non-US citizens compared to US-born women (Derose et al., 2007; El-Sayed and Galea, 2012; Goldfarb et al., 2017; Korinek and Smith, 2011; Massey et al., 2017). Evidence suggests that these factors should also be explored in the context of birth defects outcomes. The limited access to services including preconception and prenatal care services could influence the overall prevalence by nativity.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

REFERENCES

Acevedo-Garcia D, Soobader MJ, & Berkman LF (2005). The differential effect of foreign-born status on low birth weight by race/ethnicity and education. Pediatrics, 115(1), e20–e30. [PubMed: 15629963]

Cabral H, Fried LE, Levenson S, Amaro H, & Zuckerman B. (1990). Foreign-born and US-born black women: Differences in health behaviors and birth outcomes. American Journal of Public Health, 80(1), 70–72. [PubMed: 2293806]

Canfield MA, Mai CT, Wang Y, O'Halloran A, Marengo LK, Olney RS, … National Birth Defects Prevention Network. (2014). The association between race/ethnicity and major birth defects in the United States, 1999–2007. American Journal of Public Health, 104(9), e14–e23.

Collins JW, Soskolne GR, Rankin KM, & Bennett AC (2013). Differing first year mortality rates of term births to White, African-American, and Mexican-American US-born and foreign-born mothers. Maternal and Child Health Journal, 17(10), 1776–1783. [PubMed: 23196412]

de la Rosa IA (2002). Perinatal outcomes among Mexican Americans: A review of an epidemiological paradox. Ethnicity & Disease, 12(4), 480–487. [PubMed: 12477133]

Derose KP, Escarce JJ, & Lurie N. (2007). Immigrants and health care: Sources of vulnerability. Health Affairs (Millwood), 6(5), 1258–1268.

Elo IT, Vang Z, & Culhane JF (2014). Variation in birth outcomes by mother's country of birth among non-Hispanic black women in the United States. Maternal and Child Health Journal, 18(10), 2371–2381. [PubMed: 24756226]

El-Sayed AM, & Galea S. (2012). Prenatal care and risk of preterm birth among foreign and US-born mothers in Michigan. Journal of Immigrant and Minority Health, 14(2), 230–235. [PubMed: 21380854]

Fuentes-Afflick E, Hessol NA, & Perez-Stable EJ (1998). Maternal birthplace, ethnicity, and low birth weight in California. Archives of Pediatrics & Adolescent Medicine, 152(11), 1105–1112. [PubMed: 9811289]

Gagnon AJ, Zimbeck M, & Zeitlin J. (2009). Migration to western industrialised countries and perinatal health: A systematic review. Social Science and Medicine, 69(6), 934–946. [PubMed: 19664869]

Goldfarb SS, Smith W, Epstein AE, Burrows S, & Wingate M. (2017). Disparities in prenatal care utilization among U.S. versus foreign-born women with chronic conditions. Journal of Immigrant and Minority Health, 19(6), 1263–1270. [PubMed: 27221086]

Howard DL, Marshall SS, Kaufman JS, & Savitz DA (2006). Variations in low birth weight and preterm delivery among blacks in relation to ancestry and nativity: New York City, 1998–2002. Pediatrics, 118(5), e1399–e1405. [PubMed: 17079541]

Howell EA, Egorova NN, Janevic T, Balbierz A, Zeitlin J, & Hebert PL (2017). Severe maternal morbidity among Hispanic women in New York City: Investigation of health disparities. Obstetrics and Gynecology, 129(2), 285–294. [PubMed: 28079772]

Hoyt AT, Canfield MA, Shaw GM, Waller DK, Polen KN, Ramadhani T, … National Birth Defects Prevention Study. (2014). Sociodemographic and hispanic acculturation factors and isolated anotia/microtia. Birth Defects Research. Part A, Clinical and Molecular Teratology, 100(11), 852–862. [PubMed: 25074828]

Janevic T, Savitz DA, & Janevic M. (2011). Maternal education and adverse birth outcomes among immigrant women to the United States from Eastern Europe: A test of the healthy migrant hypothesis. Social Science and Medicine, 73(3), 429–435. [PubMed: 21724312]

Jones AM, Isenburg J, Salemi JL, Arnold KE, Mai CT, Aggarwal D, … Honein MA (2016). Increasing prevalence of Gastroschisis—14 states, 1995–2012. Morbidity and Mortality Weekly Report, 65, 23–26. [PubMed: 26796490]

Juarez SP, & Revuelta-Eugercios BA (2016). Exploring the 'Healthy migrant Paradox' in Sweden. A cross sectional study focused on perinatal outcomes. Journal of Immigrant and Minority Health, 18(1), 42–50. [PubMed: 25618026]

Khodr ZG, Lupo PG, Canfield MA, Chan W, Cai Y, & Mitchell LE (2013). Hispanic ethnicity and acculturation, maternal age and the risk of gastroschisis in the national birth defects prevention study. Birth Defects Research. Part A, Clinical and Molecular Teratology, 97(8), 538–545.

Kirby RS, & Salihu HM (2006). Back to the future? A critical commentary on the 2003 U.S. National standard certificate of live birth. Birth Issues in Prenatal Care, 33(3), 238–244.

Kirby RS, Marshall J, Tanner JP, Salemi JL, Feldkamp ML, Marengo L, … National Birth Defects Prevention Network. (2013). Prevalence and correlates of gastroschisis in 15 states, 1995–2005. Obstetrics and Gynecology, 122(2,Part 1), 275–281.

Korinek K, & Smith KR (2011). Prenatal care among immigrant and racialethnic minority women in a new immigrant destination: Exploring the impact of immigrant legal status. Social Science and Medicine, 72(10), 1695–1703. [PubMed: 21530038]

Kramer MS, Ananth CV, Platt RW, & Joseph KS (2006). US Black vs White disparities in foetal growth: Physiological or pathological? International Journal of Epidemiology, 35(5), 1187–1195. [PubMed: 16847026]

Krogh C, Biggar RJ, Fischer TK, Lindholm M, Wohlfahrt J, & Melbye M. (2012). Bottle-feeding and the risk of pyloric stenosis. Pediatrics, 130(4), e943–e949. [PubMed: 22945411]

Lim JW, Lee JJ, Park CG, Sriram S, & Lee KS (2010). Birth outcomes of Koreans by birthplace of infants and their mothers, the United States versus Korea, 1995–2004. Journal of Korean Medical Science, 25(9), 1343–1351. [PubMed: 20808679]

Madan A, Palaniappan L, Urizar G, Wang Y, Fortmann SP, & Gould JB (2006). Sociocultural factors that affect pregnancy outcomes in two dissimilar immigrant groups in the United States. The Journal of Pediatrics, 148(3), 341–346. [PubMed: 16615964]

Marengo LK, Flood TJ, Ethen MK, Kirby RS, Fisher S, Copeland G, Meyer RE, Dunn J, Canfield MA, Anderson T, Yazzie D, Mai CT; National Birth Defects Prevention Network. Study of selected birth defects among American Indian/Alaska Native population: A multi-state population-based retrospective study, 1999–2007. Birth Defects Research 2018;15;110(19):1412–1418. [PubMed: 30403007]

Massey PM, Langellier BA, Sentell T, & Manganello J. (2017). Nativity and language preference as drivers of health information seeking: Examining differences and trends from a U.S. population-based survey. Ethnicity & Health, 22(6), 596–609.

Meyer RE, Liu G, Gilboa SM, Ethen MK, Aylsworth AS, Powell CM, … National Birth Defects Prevention Network. (2016). Survival of children with trisomy 13 and trisomy 18: A multi-state population-based study. American Journal of Medical Genetics. Parta, 170A(4), 825–837. [PubMed: 26663415]

National Birth Defects Prevention Network (NBDPN). Guidelines for Conducting Birth Defects Surveillance. 2014 Retrieved from https://www.nbdpn.org/birth_defects_surveillance_gui.php#BD Surveillanceguidelines.

Padula AM, Yang W, Carmichael SL, Lurmann F, Balmes J, Hammond SK, & Shaw GM (2017). Air pollution, neighborhood acculturation factors, and neural tube defects among Hispanic women in California. Birth Defects Research, 109(6), 403–422. [PubMed: 28398703]

Palloni A, Ewbank DC. Selection processes in the study of racial and ethnic differentials in adult health and mortality 2004 In Anderson NB; Bulatao RA, Cohen B; (Ed.), Critical perspectives on racial and ethnic differences in health in later life (pp. 171–226). Washington, D.C.: The National Academies Press.

Parker SE, Mai CT, Canfield MA, Rickard R, Wang Y, Meyer RE, … National Birth Defects Prevention Network. (2010). Updated national birth prevalence estimates for selected birth defects in the United States, 2004–2006. Birth Defects Research. Part A, Clinical and Molecular Teratology, 88(12), 1008–1016. [PubMed: 20878909]

Petrini J, Damus K, Russell R, Poschman K, Davidoff MJ, & Mattison D. (2002). Contribution of birth defects to infant mortality in the United States. Teratology, 66(Suppl 1), S3–S6. [PubMed: 12239736]

Ramadhani T, Short V, Canfield MA, Waller DK, Correa A, Royle M, & Scheuerle A.. (2009). Are birth defects among Hispanics related to maternal nativity or number of years lived in the United States? Birth Defects Research. Part A, Clinical and Molecular Teratology, 85(9), 755–763.National Birth Defects Prevention Study (NBDPS)

Ramadhani TA, Canfield MA, Farag NH, Royle M, Correa A, Waller DK, … National Birth Defects Prevention Study. (2011). Do foreign-and U.S.-born mothers across racial/ethnic groups have a similar risk profile for selected sociodemographic and periconceptional factors? Birth Defects Research. Part a, Clinical and Molecular Teratology, 91(9), 823–830.

Rosenberg TJ, Raggio TP, & Chiasson MA (2005). A further examination of the “epidemiologic paradox”: Birth outcomes among Latinas. Journal of the National Medical Association, 97(4), 550–556. [PubMed: 15868775]

Salemi JL, Pierre M, Tanner JP, Kornosky JL, Hauser KW, Kirby RS, & Carver JD (2009). Maternal nativity as a risk factor for gastroschisis: A population-based study. Birth Defects Research. Part a, Clinical and Molecular Teratology, 85(11), 890–896.

Savitz DA, Janevic TM, Engel SM, Kaufman JS, & Herring AH (2008). Ethnicity and gestational diabetes in New York City, 1995–2003. BJOG: An International Journal of Obstetrics and Gynaecology, 115(8), 969–978. [PubMed: 18651880]

Shumate C, Hoyt A, Liu C, Kleinert A, & Canfield M. (2018). Understanding how the concentration of neighborhood advantage and disadvantage affects spina bifida risk among births to non-Hispanic white and Hispanic women, Texas, 1999–2014. Birth Defects Research. 10.1002/bdr2.1374

Siega-Riz AM, Herring AH, Olshan AF, Smith J, Moore C, & National Birth Defects Prevention Study. (2009). The joint effects of maternal pre-pregnancy body mass index and age on the risk of gastroschisis. Paediatric and Perinatal Epidemiology, 23(1), 51–57.

Wang Y, Liu G, Canfield MA, Mai CT, Gilboa SM, Meyer RE, … National Birth Defects Prevention Network. (2015). Racial/ethnic differences in survival of United States children with birth defects: A population-based study. The Journal of Pediatrics, 166(4), 819–826 e811–812. [PubMed: 25641238]

Wingate MS, & Alexander GR (2006). The healthy migrant theory: Variations in pregnancy outcomes among US-born migrants. Social Science and Medicine, 62(2), 491–498. [PubMed: 16039025]

TABLE 1

Count and percent of cases and live births to foreign-born mothers by race/ethnicity, 1999–2007

			Non-Hispanic white			Hispanic (Total)			Hispanic (Mexican)[a]			Non-Hispanic black			Non-Hispanic Asian/Pacific islander			Total[b]		
State	Years		FB	FB + US	(% FB)	FB	FB + US	(% FB)	FB	FB + US	(% FB)	FB	FB + US	(% FB)	FB	FB + US	(% FB)	FB	FB + US	(% FB)
Arizona	1999–2007	Cases	172	3,866	(4.4)	2,270	3,854	(58.9)	2,170	3,677	(59.0)	21	233	(9.0)	150	178	(84.3)	2,613	8,131	(32.1)
Arizona	1999–2007	Live births	17,811	351,285	(5.1)	209,877	352,507	(59.5)	200,099	333,613	(60.0)	3,155	25,192	(12.5)	16,572	20,696	(80.1)	247,415	749,680	(33.0)
Colorado	1999–2007	Cases	266	5,765	(4.6)	1,098	2,306	(47.6)	1,001	1,763	(56.8)	78	346	(22.5)	168	205	(82.0)	1,610	8,622	(18.7)
Colorado	1999–2007	Live births	22,177	374,165	(5–9)	97,179	185,111	(52.5)	88,419	142,532	(62.0)	4,645	25,653	(18.1)	16,169	19,620	(82.4)	140,170	604,549	(23.2)
Florida	1999–2007	Cases	731	13,855	(5.3)	3,519	5,368	(65.6)	746	1,181	(63.2)	1,035	4,392	(23.6)	339	393	(86.3)	5,624	24,008	(23.4)
Florida	1999–2007	Live births	68,877	936,812	(7.4)	356,266	505,528	(70.5)	95,709	126,774	(75.5)	106,651	418,839	(25.5)	43,623	49,072	(88.9)	575,417	1,910,251	(30.1)
Illinois	1999–2007	Cases	513	7,202	(7.1)	1,661	2,380	(69.8)	1,468	2,028	(72.4)	86	1,860	(4.6)	432	490	(88.2)	2,692	11,932	(22.6)
Illinois	1999–2007	Live births	71,484	899,223	(7–9)	260,583	375,690	(69.4)	233,752	317,632	(73.6)	11,760	288,419	(4.1)	69,459	78,224	(88.8)	413,286	1,641,556	(25.2)
Massachusetts	2000–2007	Cases	300	3,040	(9.9)	300	450	(66.7)	1	5	(20.0)	140	299	(46.8)	191	216	(88.4)	931	4,005	(23.2)
Massachusetts	2000–2007	Live births	48,215	440,238	(11.0)	41,779	64,988	(64.3)	2,855	3,777	(75.6)	23,035	48,269	(47.7)	37,366	41,707	(89.6)	150,395	595,202	(25.3)
Michigan	1999–2007	Cases	1,626	24,784	(6.6)	1,082	1,949	(55.5)	913	1,558	(58.6)	198	7,234	(2.7)	875	979	(89.4)	3,781	34,946	(10.8)
Michigan	1999–2007	Live births	50,823	849,213	(6.0)	35,807	68,817	(52.0)	30,536	55,233	(55.3)	5,406	204,965	(2.6)	30,017	34,443	(87.1)	122,053	1,157,438	(10.5)
North Carolina	2003–2007	Cases	142	4,385	(3.2)	862	978	(88.1)	688	745	(92.3)	62	1,360	(4.6)	11	12	(91.7)	1,077	6,735	(16.0)
North Carolina	2003–2007	Live births	14,222	353,978	(4.0)	84,403	96,166	(87.8)	64,908	71,167	(91.2)	7,335	142,558	(5.1)	1,570	1,869	(84.0)	107,530	594,571	(18.1)
Nebraska	1999–2007	Cases	71	8,924	(0.8)	713	1,117	(63.8)	303	451	(67.2)	37	680	(5.4)	81	106	(76.4)	902	10,827	(8.3)
Nebraska	1999–2007	Live births	1,612	169,006	(1.0)	18,304	27,401	(66.8)	16,103	22,958	(70.1)	959	11,943	(8.0)	1,551	2,089	(74.2)	22,426	210,439	(10.7)
New Jersey	1999–2007	Cases	634	5,945	(10.7)	1,690	2,363	(71.5)	439	468	(93.8)	332	1,441	(23.0)	629	676	(93.0)	3,285	10,425	(31.5)
New Jersey	1999–2007	Live births	59,351	508,928	(11.7)	163,968	228,671	(71.7)	44,327	46,660	(95.0)	34,343	155,841	(22.0)	80,603	86,552	(93.1)	338,265	979,992	(34.5)
New York	1999–2007	Cases	465	10,860	(4.3)	995	1,502	(66.2)	169	203	(83.3)	233	1,237	(18.8)	289	328	(88.1)	1,982	13,927	(14.2)
New York	1999–2007	Live births	60,820	842,992	(7–2)	99,636	142,658	(69.8)	17,924	20,344	(88.1)	27,184	121,176	(22.4)	37,479	41,239	(90.9)	225,119	1,148,065	(19.6)

			Non-Hispanic white			Hispanic (Total)			Hispanic (Mexican)[a]			Non-Hispanic black			Non-Hispanic Asian/Pacific islander			Total[b]		
State	**Years**		**FB**	**FB + US**	**(% FB)**	**FB**	**FB + US**	**(% FB)**	**FB**	**FB + US**	**(% FB)**	**FB**	**FB + US**	**(% FB)**	**FB**	**FB + US**	**(% FB)**	**FB**	**FB + US**	**(% FB)**
Texas	1999–2007	Cases	681	16,101	(4.2)	8,567	18,092	(47.4)	7,616	15,510	(49.1)	302	3,496	(8.6)	893	988	(90.4)	10,443	38,677	(27.0)
Texas	1999–2007	Live births	63,647	1,238,866	(5.1)	824,224	1,637,620	(50.3)	722,932	1,408,118	(51.3)	29,579	372,797	(7.9)	103,102	113,343	(91.0)	1,020,552	3,362,626	(30.3)
All states		Cases	5,601	104,727	(5.3)	22,757	40,359	(56.4)	15,514	27,589	(56.2)	2,524	22,578	(11.2)	4,058	4,571	(88.8)	34,940	172,235	(20.3)
All states		Live births	479,039	6,964,706	(6.9)	2,192,026	3,685,157	(59.5)	1,517,564	2,548,808	(59.5)	254,052	1,815,652	(14.0)	437,511	488,854	(89.5)	3,362,628	12,954,369	(26.0)

Note. Definitions: FB = Foreign-born mothers; FB + US = Foreign and US born mothers.

Percent Foreign-born is calculated for each racial/ethnic group as: (FB/[FB + US])*100.

Cases are counted without repetition (i.e., a single infant having multiple defect codes is counted only once for the purposes of this table).

[a]The category Hispanics (Mexican) is a subset of the category Hispanics (Total).

[b]Total excludes Native American/Alaskan Natives, Unknown race/ethnicity and nativity. Observations in the Hispanic (Mexican) category are counted in the total as part of the Hispanic (Total) category.

TABLE 2

The prevalence of selected birth defects, by maternal race/ethnicity and nativity, 1999–2007

Defect	Non-Hispanic white US born		Non-Hispanic white foreign-born		Hispanic (total) US born		Hispanic (total) foreign-born		Hispanic (Mexican) US born		Hispanic (Mexican) foreign-born	
	Cases	Prev[a] (95% CI)	Cases	Prev[a] (95% CI)	Cases	Prev[a] (95% CI)	Cases	Prev[a] (95% CI)	Cases	Prev[a] (95% CI)	Cases	Prev[a] (95% CI)
Central nervous system												
Anencephalus	558	0.9 (0.8–0.9)	32	0.7 (0.5–0.9)	212	1.4 (1.2–1.6)	345	1.6 (1.4–1.7)	168	1.6 (1.4–1.9)	283	1.9 (1.7–2.1)
Spina bifida without anencephalus	2,015	3.1 (3.0–3.2)	111	2.3 (1.9–2.8)	491	3.3 (3.0–3.6)	867	4.0 (3.7–4.2)	343	3.3 (3.0–3.7)	660	4.3 (4.0–4.7)
Encephalocele	394	0.6 (0.5–0.7)	25	0.5 (0.3–0.8)	120	0.8 (0.7–1.0)	199	0.9 (0.8–1.0)	79	0.8 (0.6–1.0)	146	1.0 (0.8–1.1)
Ear												
Anotia/microtia	752	1.2 (1.1–1.2)	63	1.3 (1.0–1.7)	430	2.9 (2.6–3.2)	712	3.2 (3.0–3.5)	321	3.1 (2.8–3.5)	555	3.7 (3.4–4.0)
Cardiovascular												
Aortic valve stenosis	1,575	2.4 (2.3–2.6)	87	1.8 (1.5–2.2)	308	2.1 (1.8–2.3)	373	1.7 (1.5–1.9)	229	2.2 (1.9–2.5)	286	1.9 (1.7–2.1)
Atrioventricular septal defect (Endocardial cushion defect)[b]	2,501	3.9 (3.8–4.1)	145	3.1 (2.6–3.6)	462	3.2 (2.9–3.5)	674	3.2 (3.0–3.4)	322	3.3 (2.9–3.7)	457	3.2 (2.9–3.5)
Atrioventricular septal defect (Endocardial cushion defect), without Down syndrome[b]	1,086	1.7 (1.6–1.8)	67	1.4 (1.1–1.8)	280	1.9 (1.7–2.2)	369	1.7 (1.6–1.9)	203	2.1 (1.8–2.4)	258	1.8 (1.6–2.0)
Coarctation of aorta	3,514	5.4 (5.2–5.6)	221	4.6 (4.0–5.3)	731	4.9 (4.5–5.3)	955	4.4 (4.1–4.6)	500	4.8 (4.4–5.3)	647	4.3 (3.9–4.6)
Common truncus	501	0.8 (0.7–0.8)	25	0.5 (0.3–0.8)	116	0.8 (0.6–0.9)	135	0.6 (0.5–0.7)	83	0.8 (0.6–1.0)	92	0.6 (0.5–0.7)
Hypoplastic left heart syndrome	1,681	2.6 (2.5–2.7)	105	2.2 (1.8–2.7)	297	2.0 (1.8–2.2)	430	2.0 (1.8–2.2)	195	1.9 (1.6–2.2)	300	2.0 (1.8–2.2)
Tetralogy of Fallot	2,687	4.1 (4.0–4.3)	150	3.1 (2.7–3.7)	529	3.5 (3.2–3.9)	736	3.4 (3.1–3.6)	356	3.5 (3.1–3.8)	457	3.0 (2.7–3.3)
Transposition of great arteries	2,398	3.7 (3.6–3.8)	144	3.0 (2.5–3.5)	473	3.2 (2.9–3.5)	695	3.2 (2.9–3.4)	331	3.2 (2.9–3.6)	471	3.1 (2.8–3.4)
Orofacial												

Defect	Non-Hispanic white US born		Non-Hispanic white foreign-born		Hispanic (total) US born		Hispanic (total) foreign-born		Hispanic (Mexican) US born		Hispanic (Mexican) foreign-born	
	Cases	Prev[a] (95% CI)	Cases	Prev[a] (95% CI)	Cases	Prev[a] (95% CI)	Cases	Prev[a] (95% CI)	Cases	Prev[a] (95% CI)	Cases	Prev[a] (95% CI)
Cleft lip alone	6,394	9.9 (9.6–10.1)	337	7.0 (6.3–7.8)	1,569	10.5 (10.0–11.0)	2,127	9.7 (9.3–10.1)	1,177	11.4 (10.8–12.1)	1,532	10.1 (9.6–10.6)
Cleft palate alone	4,192	6.5 (6.3–6.7)	222	4.6 (4.0–5.3)	800	5.4 (5.0–5.7)	1,070	4.9 (4.6–5.2)	565	5.5 (5.0–5.9)	762	5.0 (4.7–5.4)
Gastrointestinal												
Congenital hypertrophic pyloric stenosis[b]	12,122	19.0 (18.7–19.4)	433	9.2 (8.3–10.1)	3,224	22.4 (21.6–23.2)	3,317	15.7 (15.2–16.2)	2,218	22.6 (21.7–23.6)	2,188	15.2 (14.5–15.8)
Esophageal atresia	1,779	2.7 (2.6–2.9)	117	2.4 (2.0–2.9)	326	2.2 (2.0–2.4)	449	2.0 (1.9–2.2)	207	2.0 (1.7–2.3)	277	1.8 (1.6–2.1)
Rectal and large intestinal atresia[b]	2,767	4.3 (4.2–4.5)	145	3.1 (2.6–3.6)	691	4.8 (4.5–5.2)	954	4.5 (4.2–4.8)	486	5.0 (4.5–5.4)	656	4.5 (4.2–4.9)
Genitourinary												
Hypospadias[b,a]	23,927	73.3 (72.4–74.2)	1,537	63.1 (60.0–66.3)	3,230	44.0 (42.5–45.5)	3,154	29.2 (28.2–30.3)	2,017	40.3 (38.6–42.1)	1,725	23.4 (22.3–24.6)
Musculoskeletal												
Upper limb deficiency	1,827	2.8 (2.7–2.9)	84	1.8 (1.4–2.2)	501	3.4 (3.1–3.7)	609	2.8 (2.6–3.0)	354	3.4 (3.1–3.8)	456	3.0 (2.7–3.3)
Lower limb deficiency	986	1.5 (1.4–1.6)	55	1.1 (0.9–1.5)	237	1.6 (1.4–1.8)	302	1.4 (1.2–1.5)	160	1.6 (1.3–1.8)	206	1.4 (1.2–1.6)
Any limb deficiency	2,654	4.1 (3.9–4.3)	139	2.9 (2.4–3.4)	684	4.6 (4.2–4.9)	831	3.8 (3.5–4.1)	469	4.5 (4.1–5.0)	601	4.0 (3.6–4.3)
Gastroschisis[a]	1,828	3.2 (3.1–3.4)	64	1.5 (1.2–1.9)	900	6.2 (5.8–6.6)	636	2.9 (2.7–3.2)	653	6.5 (6.0–7.0)	464	3.1 (2.8–3.4)
Omphalocele[d,e]	700	1.5 (1.3–1.6)	32	0.9 (0.6–1.3)	215	1.6 (1.4–1.9)	236	1.3 (1.1–1.5)	154	1.6 (1.3–1.8)	182	1.3 (1.1–1.5)
Diaphragmatic hernia	1,634	2.5 (2.4–2.6)	88	1.8 (1.5–2.3)	393	2.6 (2.4–2.9)	597	2.7 (2.5–3.0)	251	2.4 (2.1–2.8)	422	2.8 (2.5–3.1)
Chromosomal												
Trisomy 13	552	0.9 (0.8–0.9)	35	0.7 (0.5–1.0)	117	0.8 (0.6–0.9)	197	0.9 (0.8–1.0)	90	0.9 (0.7–1.1)	130	0.9 (0.7–1.0)
Trisomy 21 (Down syndrome)	8,111	12.5 (12.2–12.8)	528	11.0 (10.1–12.0)	1,643	11.0 (10.5–11.5)	3,362	15.3 (14.8–15.9)	1,133	11.0 (10.4–11.6)	2,364	15.6 (15.0–16.2)

Defect	Non-Hispanic white US born		Non-Hispanic white foreign-born		Hispanic (total) US born		Hispanic (total) foreign-born		Hispanic (Mexican) US born		Hispanic (Mexican) foreign-born	
	Cases	Prev[a] (95% CI)	Cases	Prev[a] (95% CI)	Cases	Prev[a] (95% CI)	Cases	Prev[a] (95% CI)	Cases	Prev[a] (95% CI)	Cases	Prev[a] (95% CI)
Trisomy 18	962	1.5 (1.4–1.6)	76	1.6 (1.2–2.0)	226	1.5 (1.3–1.7)	360	1.6 (1.5–1.8)	154	1.5 (1.3–1.7)	272	1.8 (1.6–2.0)
Central nervous system												
Anencephalus	153	1.0 (0.8–1.1)	12	0.5 (0.2–0.8)	5	1.0 (0.3–2.3)	36	0.8 (0.6–1.1)	1,353	1.0 (1.0–1.1)		
Spina bifida without anencephalus	434	2.8 (2.5–3.1)	59	2.3 (1.8–3.0)	5	1.0 (0.3–2.3)	55	1.3 (0.9–1.6)	4,037	3.1 (3.0–3.2)		
Encephalocele	181	1.2 (1.0–1.3)	16	0.6 (0.4–1.0)	2	0.4 (0.0–1.4)	17	0.4 (0.2–0.6)	954	0.7 (0.7–0.8)		
Ear												
Anotia/microtia	106	0.7 (0.6–0.8)	18	0.7 (0.4–1.1)	13	2.5 (1.3–4.3)	69	1.6 (1.2–2.0)	2,163	1.7 (1.6–1.7)		
Cardiovascular												
Aortic valve stenosis	163	1.0 (0.9–1.2)	29	1.1 (0.8–1.6)	4	0.8 (0.2–2.0)	56	1.3 (1.0–1.7)	2,595	2.0 (1.9–2.1)		
Atrioventricular septal defect (Endocardial cushion defect)[b]	639	4.1 (3.8–4.4)	136	5.4 (4.5–6.4)	16	3.2 (1.8–5.2)	97	2.3 (1.8–2.7)	4,670	3.7 (3.6–3.8)		
Atrioventricular septal defect (Endocardial cushion defect), without Down syndrome[b]	349	2.2 (2.0–2.5)	53	2.1 (1.6–2.7)	8	1.6 (0.7–3.2)	50	1.2 (0.9–1.5)	2,262	1.8 (1.7–1.9)		
Coarctation of aorta	595	3.8 (3.5–4.1)	117	4.6 (3.8–5.5)	9	1.8 (0.8–3.3)	129	2.9 (2.5–3.5)	6,271	4.8 (4.7–5.0)		
Common truncus	125	0.8 (0.7–1.0)	21	0.8 (0.5–1.3)	1	0.2 (0.0–1.1)	10	0.2 (0.1–0.4)	934	0.7 (0.7–0.8)		
Hypoplastic left heart syndrome	416	2.7 (2.4–2.9)	63	2.5 (1.9–3.2)	7	1.4 (0.5–2.8)	52	1.2 (0.9–1.6)	3,051	2.4 (2.3–2.4)		
Tetralogy of Fallot	738	4.7 (4.4–5.1)	116	4.6 (3.8–5.5)	26	5.1 (3.3–7.4)	177	4.0 (3.5–4.7)	5,159	4.0 (3.9–4.1)		
Transposition of great arteries	467	3.0 (2.7–3.3)	83	3.3 (2.6–4.0)	25	4.9 (3.2–12)	133	3.0 (2.5–3.6)	4,418	3.4 (3.3–3.5)		
Orofacial												
Cleft lip with and without cleft palate	946	6.1 (5.7–6.5)	118	4.6 (3.8–5.6)	53	10.3 (7.7–13.5)	346	7.9 (7.1–8.8)	11,890	9.2 (9.0–9.3)		
Cleft palate alone	666	4.3 (3.9–4.6)	83	3.3 (2.6–4.0)	18	3.5 (2.1–5.5)	252	5.8 (5.1–6.5)	7,303	5.6 (5.5–5.8)		
Gastrointestinal												
Congenital hypertrophic pyloric stenosis[b]	1,424	9.2 (8.7–9.7)	169	6.7 (5.7–7.8)	28	5.6 (3.8–8.2)	173	4.0 (3.4–4.7)	20,890	16.5 (16.3–16.7)		
Esophageal atresia	303	1.9 (1.7–2.2)	56	2.2 (1.7–2.9)	8	1.6 (0.7–3.1)	62	1.4 (1.1–1.8)	3,100	2.4 (2.3–2.5)		

Defect	Non-Hispanic white US born		Non-Hispanic white foreign-born		Hispanic (total) US born		Hispanic (total) foreign-born		Hispanic (Mexican) US born		Hispanic (Mexican) foreign-born	
	Cases	Prev[a] (95% CI)	Cases	Prev[a] (95% CI)	Cases	Prev[a] (95% CI)	Cases	Prev[a] (95% CI)	Cases	Prev[a] (95% CI)	Cases	Prev[a] (95% CI)
Rectal and large intestinal atresia[b]	590	3.8 (3.5–4.1)	79	3.1 (2.5–3.9)	21	4.2 (2.6–6.5)	176	4.1 (3.5–4.7)	5,423	4.3 (4.2–4.4)		
Genitourinary												
Hypospadias[b,c]	4,430	56.1 (54.4–57.8)	745	58.1 (54.0–62.4)	129	50.6 (42.2–60.1)	996	44.9 (42.1–47.8)	38,148	58.8 (58.2–59.4)		
Musculoskeletal												
Upper limb deficiency	446	2.9 (2.6–3.1)	55	2.2 (1.6–2.8)	9	1.8 (0.8–3.3)	85	1.9 (1.6–2.4)	3,616	2.8 (2.7–2.9)		
Lower limb deficiency	298	1.9 (1.7–2.1)	37	1.5 (1.0–2.0)	3	0.6 (0.1–1.7)	48	1.1 (0.8–1.5)	1,966	1.5 (1.5–1.6)		
Any limb deficiency	687	4.4 (4.1–4.7)	89	3.5 (2.8–4.3)	11	2.1 (1.1–3.8)	124	2.8 (2.4–3.4)	5,219	4.0 (3.9–4.1)		
Gastroschisis[d]	322	2.4 (2.1–2.6)	26	1.0 (0.7–1.5)	22	4.7 (2.9–7.1)	45	1.1 (0.8–1.5)	3,843	3.3 (3.2–3.4)		
Omphalocele[d,e]	179	1.7 (1.5–2.0)	29	2.0 (1.4–2.9)	6	1.4 (0.5–3.1)	25	0.7 (0.4–1.0)	1,422	1.4 (1.4–1.5)		
Diaphragmatic hernia	377	2.4 (2.2–2.7)	59	2.3 (1.8–3.0)	13	2.5 (1.3–4.3)	94	2.1 (1.7–2.6)	3,255	2.5 (2.4–2.6)		
Chromosomal												
Trisomy 13	157	1.0 (0.9–1.2)	40	1.6 (1.1–2.1)	3	0.6 (0.1–1.7)	31	0.7 (0.5–1.0)	1,132	0.9 (0.8–0.9)		
Trisomy 21 (Down syndrome)	1,493	9.6 (9.1–10.1)	430	16.9 (15.4–18.6)	56	10.9 (8.2–14.2)	452	10.3 (9.4–11.3)	16,075	12.4 (12.2–12.6)		
Trisomy 18	294	1.9 (1.7–2.1)	95	3.7 (3.0–4.6)	7	1.4 (0.5–2.8)	61	1.4 (1.1–1.8)	2,081	1.6 (1.5–1.7)		

Note. CI = confidence interval, calculated using the exact method.

[a]Prevalence per 10,000 live births unless otherwise noted;

[b]Arizona data excludes years 2005–2007;

[c]Prevalence per 10,000 male live births;

[d]Excludes Michigan;

[e]Excludes Florida.

TABLE 3

Adjusted prevalence ratios of selected birth defects for maternal nativity by maternal race/ethnicity, 1999–2007

Defect	Non-Hispanic white foreign-born aPR (95% CI)	Hispanic (total) foreign-born aPR (95% CI)	Hispanic (Mexican) foreign-born aPR (95% CI)	Non-Hispanic black foreign-born aPR (95% CI)	Non-Hispanic Asian/ Pacific islander foreign-born aPR (95% CI)
Central nervous system					
Anencephalus	1.1 (0.8–1.6)	1.2 (1.0–1.4)	1.2 (1.0–1.4)	1.0 (0.5–2.0)	0.6 (0.2–1.8)
Spina bifida without anencephalus	0.8 (0.7–1.0)	**1.2 (1.1–1.4)** ↑	**1.3 (1.1–1.5)** ↑	0.9 (0.7–1.3)	0.6 (0.2–1.9)
Encephalocele	1.2 (0.8–1.8)	1.1 (0.8–1.3)	1.1 (0.9–1.5)	0.6 (0.4–1.1)	**0.2 (0.0–0.9)** ↓
Ear					
Anotia/microtia	1.3 (1.0–1.6)	**1.2 (1.1–1.3)** ↑	1.2 (1.0–1.4)	1.5 (0.8–2.7)	**0.3 (0.2–0.5)** ↓
Cardiovascular					
Aortic valve stenosis	0.9 (0.7–1.1)	0.9 (0.7–1.0)	0.9 (0.7–1.0)	1.1 (0.7–1.7)	0.5 (0.2–1.5)
Atrioventricular septal defect (Endocardial cushion defect)[a]	**0.8 (0.6–0.9)** ↓	1.0 (0.9–1.1)	0.9 (0.8–1.1)	1.0 (0.8–1.3)	0.5 (0.3–1.0)
Atrioventricular septal defect (Endocardial cushion defect), without Down syndrome[a]	1.0 (0.8–1.2)	0.9 (0.8–1.1)	0.9 (0.7–1.1)	0.9 (0.7–1.3)	0.5 (0.2–1.1)
Coarctation of aorta	0.9 (0.8–1.0)	0.9 (0.8–1.0)	0.9 (0.8–1.0)	1.0 (0.8–1.3)	1.0 (0.5–2.0)
Common truncus	0.9 (0.6–1.3)	0.8 (0.6–1.0)	0.7 (0.5–1.0)	1.3 (0.8–2.2)	0.1 (0.0–2.2)
Hypoplastic left heart syndrome	1.0 (0.8–1.2)	1.0 (0.8–1.1)	1.0 (0.8–1.2)	0.8 (0.6–1.1)	0.6 (0.2–1.5)
Tetralogy of Fallot	**0.8 (0.7–0.9)** ↓	0.9 (0.8–1.0)	0.9 (0.7–1.0)	0.9 (0.7–1.1)	**0.6 (0.4–0.9)** ↓
Transposition of great arteries	0.8 (0.7–1.0)	0 (0.9–1.1)	1.0 (0.8–1.1)	1.0 (0.7–1.2)	0.6 (0.4–1.0)
Orofacial					
Cleft lip with and without cleft palate	**0.8 (0.7–0.9)** ↓	1.0 (0.9–1.0)	0.9 (0.8–1.0)	0.8 (0.7–1.0)	0.8 (0.6–1.1)
Cleft palate alone	**0.7 (0.7–0.9)** ↓	0.9 (0.8–1.0)	0.9 (0.8–1.0)	0.8 (0.6–1.0)	1.0 (0.6–1.6)
Gastrointestinal					
Congenital hypertrophic pyloric stenosis[a]	**0.5 (0.5–0.6)** ↓	**0.7 (0.7–0.8)** ↓	**0.7 (0.7–0.8)** ↓	**0.6 (0.5–0.7)** ↓	**0.6 (0.4–0.8)** ↓
Esophageal atresia	0.9 (0.8–1.1)	0.9 (0.8–1.0)	0.9 (0.7–1.1)	1.3 (0.9–1.8)	0.6 (0.3–1.3)

Defect	Non-Hispanic white foreign-born	Hispanic (total) foreign-born	Hispanic (Mexican) foreign-born	Non-Hispanic black foreign-born	Non-Hispanic Asian/ Pacific islander foreign-born
	aPR (95% CI)	**aPR (95% CI)**	**aPR (95% CI)**	**aPR (95% CI)**	**aPR (95% CI)**
Rectal and large intestinal atresia[a]	**0.7 (0.6–0.9)** ↓	1.0 (0.9–1.1)	0.9 (0.8–1.1)	0.8 (0.7–1.1)	0.7 (0.4–1.1)
Genitourinary					
Hypospadias[a,b]	**0.9 (0.8–0.9)**	**0.6 (0.6–0.7)**	**0.6 (0.6–0.7)**	**1.0 (0.9–1.1)**	**0.9 (0.7–1.1)**
Musculoskeletal					
Upper limb deficiency	**0.7 (0.6–0.9)** ↓	0.9 (0.8–1.0)	0.9 (0.8–1.1)	1.0 (0.7–1.3)	0.6 (0.3–1.4)
Lower limb deficiency	0.9 (0.7–1.2)	0.9 (0.8–1.1)	1.0 (0.8–1.2)	1.0 (0.7–1.4)	0.3 (0.1–1.1)
Any limb deficiency	**0.8 (0.7–0.9)** ↓	0.9 (0.8–1.0)	0.9 (0.8–1.1)	1.0 (0.8–1.2)	0.7 (0.3–1.4)
Gastroschisis[c]	**0.7 (0.5–0.9)** ↓	**0.7 (0.6–0.7)** ↓	**0.6 (0.6–0.7)** ↓	0.9 (0.6–1.4)	**0.4 (0.2–0.7)** ↓
Omphalocele[c,d]	0.8 (0.5–1.1)	0.9 (0.7–1.0)	0.9 (0.7–1.1)	1.2 (0.8–1.8)	**0.1 (0.0–0.4)** ↓
Diaphragmatic hernia	0.8 (0.7–1.0)	1.0 (0.9–1.2)	1.1 (1.0–1.3)	1.2 (0.9–1.6)	0.8 (0.4–1.5)
Chromosomal					
Trisomy 13	0.9 (0.7–1.3)	0.9 (0.7–1.2)	0.9 (0.6–1.1)	**1.6 (1.1–2.4)** ↑	0.3 (0.1–1.1)
Trisomy 21 (Down syndrome)	**0.8 (0.7–0.9)** ↓	**1.2 (1.1–1.3)** ↑	**1.2 (1.1–1.3)** ↑	1.1 (1.0–1.3)	0.9 (0.6–1.1)
Trisomy 18	1.1 (0.8–1.3)	0.9 (0.8–1.1)	1.0 (0.8–1.3)	**1.4 (1.1–1.8)** ↑	0.4 (0.2–1.1)

Note. aPR = adjusted Prevalence Ratio. Adjusted for Maternal Age (<20, 20–34, 35+) and State. Reference group is US-born in each race/ethnic group. 95% CI = confidence interval for prevalence ratio calculated by SAS GENMOD (Wald 95% CI).

[a] Arizona data excludes years 2005–2007.

[b] Among male live births.

[c] Excludes Michigan.

[d] Excludes Florida.