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## The Prevalence Of Birth Defects Among Non-Hispanic Asians And American Indians/Alaska Natives In Texas, 1999-2015

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THE PREVALENCE OF BIRTH DEFECTS AMONG NON-HISPANIC ASIANS AND  
AMERICAN INDIANS/ALASKA NATIVES IN TEXAS, 1999-2015

by

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2019

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AMERICAN INDIANS/ALASKA NATIVES IN TEXAS, 1999-2015

by

VAN LE  
BSA, The University of Texas at Austin, 2016

Presented to the Faculty of The University of Texas

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AMERICAN INDIANS/ALASKA NATIVES IN TEXAS, 1999-2015

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The University of Texas  
School of Public Health, 2019

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**Background:** Birth defects are disproportionately higher among certain race/ethnic groups.

We examined how birth defects prevalence differs among the less studied non-Hispanic (NH) Asian and any American Indian/Alaska Native (AI/AN) populations, relative to NH Whites.

**Methods:** Data were obtained from the Texas Birth Defect Registry from 1999 to 2015 for infants born to Texas-resident mothers who were NH White, NH Asian, or AI/AN. This covers a livebirth population of 2.6 million. Prevalence ratios were calculated for NH Asians and AI/ANs (relative to NH Whites) for 44 birth defects using Poisson regression and were adjusted for maternal age.

**Results:** After adjustment, there were 34 statistically significant prevalence ratios. Among NH Asians, 23 defects had a lower adjusted prevalence ratio (aPR) and 3 defects had a higher aPR. AI/ANs had 2 defects with a significantly lower aPR and 6 with a higher aPR.

**Conclusions:** NH Asians generally have a lower prevalence for birth defects while AI/ANs have a higher prevalence compared to NH Whites. These findings update the limited previous literature on this topic and also warrant additional research among larger populations in order to identify the true association of these understudied race/ethnic groups.

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## **BACKGROUND**

### **Literature Review**

In the United States (U.S.), birth defects affect 1 in every 33, or 3.0%, of all live births.<sup>1</sup> Birth defects are common and are the leading cause of infant mortality. In 2016, the Centers for Disease Control and Prevention (CDC) reported that birth defects accounted for 20.8% off all infant deaths.<sup>3</sup> Infant mortality can be used as a predictor of overall health in a given population. As birth defects are the number one cause of infant death in the U.S., it is important to better understand the underlying causes, risk factors for, and strategies for preventing them.

In Texas, the overall prevalence of birth defects is 4.7%, which is higher compared to the national percent prevalence.<sup>2</sup> The infant mortality rate in the U.S. as a whole is 5.9 per 1,000 live births.<sup>3</sup> Among the 50 states in the U.S., Texas has the 32nd highest infant mortality rate— with a rate of 5.7 per 1,000 live births.<sup>4</sup> These statistics provide evidence that Texas measures similarly to nationwide values. Consequently, studies of birth defects in Texas may be helpful in providing a framework for developing future studies incorporating data from other regions of the U.S.

Birth defects are disproportionally associated with specific racial/ethnic groups. One of the most commonly studied associations is the increased prevalence of neural tube defects (NTDs) among Hispanics.<sup>5</sup> Further, race/ethnicity groups often examined in birth defect analyses are typically limited to non-Hispanic (NH) Whites, NH Blacks, and Hispanics.<sup>6-9</sup> Minority groups such as Asians and American Indians/Alaska Natives (AI/ANs) generally make up a small proportion of the population in comparison to other race/ethnicity groups,

making it difficult to conduct meaningful subgroup analyses. Researchers, therefore, have frequently ignored these groups or lumped them into an “Other” category to increase sample size and power. When this is done, however, important differences with respect to culture, environment, and genetic makeup are missed. Cultural and environmental differences between race/ethnicity groups point to potential differences in socioeconomic status—a factor also associated with varying environmental exposures, access to care issues, low maternal educational attainment, and barriers to services.<sup>10</sup>

In addition to cultural and environmental factors, genetics also play a role in birth defect outcomes. Research on birth defects and genetics, however, is incomplete due to its complex nature.<sup>11</sup> Various studies have shown that individuals with similar biogeographical ancestry, which can be categorized broadly by race/ethnicity, have a similar genetic makeup.<sup>12</sup> Therefore, it is important to examine specific groupings rather than the more homogeneous “Other” category, to fully elucidate these differences.

According to data from the U.S. Census Bureau, Asians were the fastest growing racial/ethnic group in the U.S. during the period of 2000 to 2010, increasing 43% during this time.<sup>13</sup> Similarly, the AI/AN population also experienced a 39% growth.<sup>14</sup> Although these two populations are among the fastest growing in the U.S., little is known about the occurrence and etiology of birth defects with reference to these groups.

In a previous study using pooled data from 12 population-based state birth defects surveillance systems in the U.S., Canfield et al. (2014), provided prevalence data for selected birth defects among 5 racial/ethnic groups, including Asians and AI/AN.<sup>15</sup> Analyses were conducted for infants born from 1999 to 2007. Results of this study showed a higher

prevalence for selected birth defects for AI/ANs and a lower prevalence among Asians. Marengo et al. (2018) further studied birth defect prevalence in the AI/AN population incorporating additional covariates.<sup>16</sup> The results of this study showed that higher prevalence remained for two birth defects even after adjustment. To build on these findings, the present study included more recent data for analyses from 1999 through 2015 birth year in Texas, and considered an important covariate, maternal age. Currently, there are no studies on the prevalence of birth defects among Asian and AI/AN race/ethnicity groups for this extended period in Texas, including data from recent years.

### **Public Health Significance**

Infant mortality can be used as a proxy for a nation's health and is a commonly used proxy measure worldwide.<sup>17</sup> This measure is highly regarded because there are many contributing factors including those related to maternal health, access to care, socioeconomic factors, and environmental health. In a report conducted by MacDorman et al. (2010), the U.S. ranked 26th out of the 29 European countries in the Organisation for Economic Co-operation and Development (OECD) database.<sup>17</sup> Although a developed country, the U.S. ranks behind many developing nations. In order to reduce the nation's infant mortality rate, it is important to recognize that birth defects are the most common cause of infant mortality in the U.S.

While birth defects as a whole are somewhat common occurrences, individual birth defects can be quite rare. Moreover, each birth defect has its own unique etiology and mortality profile. Since there is high variation from one defect to another, the causes are

largely unknown. Feldkamp et al. (2017), conducted a five-year population-based study to assess the causes of birth defects that are monitored in Utah's birth defect surveillance system.<sup>18</sup> The results showed that only 20% of birth defects had a known etiology, underscoring the fact that there are large gaps in the literature regarding birth defects. In order to create effective interventions to reduce the largest contributor to infant mortality, it is important to first understand what causes birth defects and their associated risk factors. Thus the specific aims of this research are:

### **Specific Aims**

1. To describe the prevalence of 44 selected birth defects among non-Hispanic (NH) Whites, NH Asians, and American Indians/Alaskan Natives (AI/ANs) in Texas from 1999 to 2015.
2. To determine the unadjusted associations between NH Asian or AI/AN (regardless of Hispanic ethnicity) and selected birth defects, relative to NH Whites.
3. To describe the relationship between NH Asians or AI/ANs and selected birth defects, relative to NH Whites, with adjustment for maternal age.

## **METHODS**

### **Dataset**

In this study we used data from the Texas Birth Defects Registry (BDR). The Texas BDR is an active surveillance system that is population-based and maintained by Texas

Department of State Health Services (DSHS) Birth Defects Epidemiology and Surveillance (BDES) Branch. Statewide data became available in the Texas BDR in 1999 and includes complete data up to 2015. This study included complete data on infants born from 1999 to 2015 (regardless of pregnancy outcome) and whose mothers were residents of Texas at the time of delivery. Data used in this analysis were de-identified line-item data for both birth defects and birth records.

## **Outcome**

Infants included in the study were diagnosed with at least one or more of 44 selected birth defects within the first year of life. The birth defects considered for analyses in this study were based on defects that were reported and published for the National Birth Defects Prevention Network (NBDPN) Annual Report. The following broad organ systems or categories were included: central nervous system, ear/eye, cardiovascular, orofacial, gastrointestinal, genitourinary, musculoskeletal, and chromosomal defects (see Table 1 for specific defect breakdowns). Twenty of the 44 defects were not previously examined in the national studies on birth defects and race/ethnicity. If an infant was diagnosed with multiple birth defects, each occurrence of the defect was counted in each birth defect category.

The NBDPN was used as guidance for the selection of birth defects to be included in this study because it is widely referred to by public health officials, researchers, and families for its high standards in birth defect surveillance.<sup>19</sup> By combining data from several state and population-based surveillance systems, studies using the NBDPN data are able to have higher statistical power, which enables researchers to study rare birth defects and diverse

populations. Numerous publications on birth defects have been developed from the NBDPN data; therefore, using similar defects as those reported to the NBDPN allow for greater comparability with the results to existing work.

## **Data Analysis**

Birth record data were obtained from the Texas DSHS Center for Health Statistics (CHS). Birth records are routinely linked to birth defect cases in the Texas BDR in order to gain maternal sociodemographic data for cases, such as maternal race/ethnicity and maternal age. Maternal race/ethnicity was categorized into the following categories: NH White, NH Asian, and any American Indian/Alaska Native. NH Blacks and Hispanics were excluded from this study. Race/ethnicity classification were based on vital records. Individuals were grouped by Hispanic ethnicity then by race. Additionally, NH Asians and AI/ANs who were misclassified in the “Other” race/ethnic category were corrected based on the “Other” race description field from the vital records. Because NH Asians and AI/ANs were the populations of interest, the data for NH Whites were not similarly corrected. As an aside, NH Asians and AI/ANs were not further stratified into specific subgroups due to the small population size. Records of mothers who were of multiple race/ethnicities or had that variable missing were excluded from the study.

Birth defect prevalence were calculated by dividing cases of birth defects (of any pregnancy outcome) by the number of live births, in terms of cases per 10,000 live births. Live birth denominators are commonly used in birth defects epidemiology, even when non-live cases are included in the numerator. Additionally, 95% confidence intervals (CIs) also

were calculated for each birth defect prevalence estimate. Birth defect prevalence was calculated for NH Whites alone, NH Asians alone, and any AI/AN alone. Poisson regression was used to calculate crude and adjusted prevalence ratios (aPRs) for each race/ethnic group, adjusting for maternal age (<20, 20-34, 35+ years). NH Whites served as the referent group. Crude prevalence ratios were not shown in the final results because the measures were similar to that of the aPRs. The 95% CIs were also provided with the aPRs following a Poisson distribution. These calculations were performed using SAS statistical software, version 9.4.

Table 1: Birth Defects Examined, Texas BDR, 1999-2015

<b>Central Nervous System</b>
Anencephalus
Spina bifida without anencephalus
Encephalocele
Holoprosencephaly*
<b>Ear/Eye</b>
Anophthalmia/microphthalmia*
Congenital cataract
Anotia/microtia
<b>Cardiovascular</b>
Aortic valve stenosis
Common truncus (truncus arteriosus)
Transposition of great arteries (TGA)
Ventricular septal defect
Atrial septal defect*
Atrioventricular septal defect (endocardial cushion defect)
Pulmonary valve atresia and stenosis*
Tricuspid valve atresia and stenosis*
Ebstein's anomaly*
Hypoplastic left heart syndrome*
Coarctation of aorta
Total anomalous pulmonary venous connection*

Single ventricle*
Interrupted aortic arch*

Orofacial
Cleft palate alone
Cleft lip alone
Cleft lip with cleft palate
Choanal atresia*
Gastrointestinal
Esophageal atresia/ tracheoesophageal fistula
Rectal and large intestinal atresia/stenosis
Biliary atresia*
Small intestinal atresia/stenosis*
Genitourinary
Renal agenesis/hypoplasia*
Bladder exstrophy*
Hypospadias
Congenital posterior urethral valves*
Musculoskeletal
Gastroschisis
Omphalocele
Diaphragmatic hernia
Limb deficiencies (reduction defects)
Craniosynostosis*
Clubfoot*
Chromosomal
Trisomy 13
Trisomy 21 (Down syndrome)
Trisomy 18
Turner syndrome*
Deletion 22q11.2*

\*defect was not previously examined in national studies<sup>15,16</sup>

## RESULTS

This study included 75,960 cases of the selected birth defects that were either co-occurring or isolated defects among NH Whites, NH Asians, and any AI/AN. There were



2,586,306 in the livebirth population, which accounts for approximately 40% of all livebirths in Texas from 1999 to 2015. Table 2 shows the prevalence and the 95% CIs for the 44 birth defects. This table shows prevalences for the total study population and for the 3 mutually exclusive race/ethnic groups: NH White, NH Asian, and any AI/AN. The least prevalent birth defects among NH Asians were bladder exstrophy, deletion 22q11.2, and common truncus. For both NH Asians and AI/ANs, the most prevalent defects were hypospadias, atrial septal defect, and ventricular septal defect. Among only AI/ANs, the least prevalent birth defects were trisomy 13, choanal atresia, and common truncus. However there were 3 defects with 0 cases among the AI/AN population: Turner syndrome, interrupted aortic arch, and bladder exstrophy. Also note that approximately half of the prevalences among AI/ANs were based on 5 or less cases.

Table 3 displays the aPRs and 95% CIs for NH Asians and any AI/ANs, relative to NH Whites. Based on only statistically significant findings, NH Asians had a 50% or lower prevalence for spina bifida without anencephalus (aPR= 0.38; 95% CI= 0.25-0.54), craniosynostosis (aPR= 0.42; 95% CI= 0.39-0.46), and hypoplastic left heart syndrome (aPR= 0.46; 95% CI= 0.29-0.67), compared to NH Whites. Lower prevalence ratios were also noted for aortic valve stenosis (aPR= 0.54; 95% CI= 0.31-0.88), choanal atresia (aPR= 0.54; 95% CI= 0.35-0.79), and esophageal atresia/tracheoesophageal fistula (aPR= 0.55; 95% CI= 0.31-0.89). Furthermore, NH Asians were found to have significantly higher prevalence rates for 3 defects: biliary atresia (aPR= 2.50, 95% CI= 2.06-3.01), total anomalous pulmonary venous connection (aPR= 1.36, 95% CI= 1.07-1.71), and anotia/microtia (aPR= 1.19, 95% CI= 1.14-1.24).

Among AI/ANs, only two defects had a statistically significantly lower aPR compared to NH Whites. These defects were hypoplastic left heart syndrome (aPR= 0.52, 95% CI= 0.23-0.98) and hypospadias (aPR= 0.64, 95% CI= 0.45-0.88). Defects with a greater than 3-fold increased risk among AI/AN included biliary atresia (aPR= 4.63, 95% CI= 1.62-10.22), anotia/microtia (aPR= 3.27, 95% CI= 1.97-5.05), and holoprosencephaly (aPR= 3.05, 95% CI= 1.04-6.8). Additionally, elevated aPRs were observed for cleft lip with cleft palate (aPR= 2.68; 95% CI= 1.91-3.64), clubfoot (aPR= 1.48; 95% CI= 1.03-2.04), and esophageal atresia/tracheoesophageal fistula (aPR= 1.36; 95% CI= 1.04-1.75). Although statistically significant, some of these results are based on small numbers, for example the high aPR seen for biliary atresia was based on only 4 cases in AI/ANs.

Table 2: Prevalence of Selected Birth Defects Among Maternal Racial/Ethnic Groups, Texas, 1999-2015

	<b>Total</b>		<b>Non-Hispanic White</b>		<b>Non-Hispanic Asian</b>		<b>Any AI/AN</b>	
<b>Birth Defect</b>	n	Prevalence (95% CI)	n	Prevalence (95% CI)	n	Prevalence (95% CI)	n	Prevalence (95% CI)
<b>Central Nervous System</b>								
Anencephalus	496	1.92 (1.75-2.09)	448	1.94 (1.76-2.12)	43	1.67 (1.21-2.26)	5	3.29 (1.07-7.69)
Spina bifida without anencephalus	827	3.2 (2.98-3.42)	788	3.40 (3.17-3.64)	33	1.28 (0.88-1.80)	6	3.95 (1.45-8.61)
Encephalocele	184	0.71 (0.61-0.81)	161	0.70 (0.59-0.80)	21	0.82 (0.51-1.25)	2	1.32 (0.16-4.76)
Holoprosencephaly	215	0.83 (0.72-0.94)	194	0.84 (0.72-0.96)	17	0.66 (0.39-1.06)	4	2.64 (0.72-6.75)
<b>Ear/Eye</b>								
Anophthalmia/microphthalmia	720	2.78 (2.58-2.99)	659	2.85 (2.63-3.06)	53	2.06 (1.55-2.70)	8	5.27 (2.28-10.39)
Congenital cataract	475	1.84 (1.67-2)	442	1.91 (1.73-2.09)	31	1.21 (0.82-1.71)	2	1.32 (0.16-4.76)
Anotia/microtia	545	2.11 (1.93-2.28)	472	2.04 (1.86-2.22)	63	2.45 (1.89-3.14)	10	6.59 (3.16-12.12)
<b>Cardiovascular</b>								
Common truncus (truncus arteriosus)	161	0.62 (0.53-0.72)	150	0.65 (0.54-0.75)	10	0.39 (0.19-0.72)	1	0.66 (0.02-3.67)
Transposition of great arteries (TGA)	1250	4.83 (4.57-5.1)	1131	4.89 (4.6-5.17)	108	4.21 (3.41-5)	11	7.25 (3.62-12.97)
Ventricular septal defect	13505	52.22 (51.34-53.1)	12220	52.8 (51.87-53.74)	1203	46.84 (44.2-49.49)	82	54.04 (42.98-67.07)
Atrial septal defect	15749	60.89 (59.94-61.84)	14301	61.79 (60.78-62.81)	1357	52.84 (50.03-55.65)	91	59.97 (48.28-73.63)
Atrioventricular septal defect (endocardial cushion defect)	1176	4.55 (4.29-4.81)	1093	4.72 (4.44-5)	77	3 (2.37-3.75)	6	3.95 (1.45-8.61)
Pulmonary valve atresia and stenosis	2166	8.37 (8.02-8.73)	1986	8.58 (8.2-8.96)	163	6.35 (5.37-7.32)	17	11.2 (6.53-17.94)
Tricuspid valve atresia and stenosis	437	1.69 (1.53-1.85)	387	1.67 (1.51-1.84)	48	1.87 (1.38-2.48)	2	1.32 (0.16-4.76)
Ebstein's anomaly	179	0.69 (0.59-0.79)	159	0.69 (0.58-0.79)	18	0.7 (0.42-1.11)	2	1.32 (0.16-4.76)
Aortic valve stenosis	681	2.63 (2.44-2.83)	638	2.76 (2.54-2.97)	39	1.52 (1.08-2.08)	4	2.64 (0.72-6.75)
Hypoplastic left heart syndrome	625	2.42 (2.23-2.61)	593	2.56 (2.36-2.77)	30	1.17 (0.79-1.67)	2	1.32 (0.16-4.76)
Coarctation of aorta	1419	5.49 (5.2-5.77)	1312	5.67 (5.36-5.98)	99	3.85 (3.13-4.69)	8	5.27 (2.28-10.39)
Total anomalous pulmonary venous	314	1.21 (1.08-1.35)	270	1.17 (1.03-1.31)	41	1.6 (1.15-2.17)	3	1.98 (0.41-5.78)

connection							
Single ventricle	195	0.75 (0.65-0.86)	179	0.77 (0.66-0.89)	14	0.55 (0.3-0.91)	2 1.32 (0.16-4.76)
Interrupted aortic arch	147	0.57 (0.48-0.66)	136	0.59 (0.49-0.69)	11	0.43 (0.21-0.77)	0 -
<b>Orofacial Clefts</b>							
Cleft palate alone	1702	6.58 (6.27-6.89)	1523	6.58 (6.25-6.91)	170	6.62 (5.62-7.61)	9 5.93 (2.71-11.26)
Cleft lip alone	1008	3.9 (3.66-4.14)	920	3.98 (3.72-4.23)	81	3.15 (2.5-3.92)	7 4.61 (1.85-9.5)
Cleft lip with cleft palate	1828	7.07 (6.74-7.39)	1624	7.02 (6.68-7.36)	175	6.81 (5.8-7.82)	29 19.11 (12.8-27.45)
<b>Gastrointestinal</b>							
Choanal atresia	361	1.4 (1.25-1.54)	339	1.46 (1.31-1.62)	21	0.82 (0.51-1.25)	1 0.66 (0.02-3.67)
Esophageal atresia/ tracheoesophageal fistula	604	2.34 (2.15-2.52)	564	2.44 (2.24-2.64)	35	1.36 (0.95-1.9)	5 3.29 (1.07-7.69)
Rectal and large intestinal atresia/stenosis	1293	5 (4.73-5.27)	1173	5.07 (4.78-5.36)	110	4.28 (3.48-5.08)	10 6.59 (3.16-12.12)
Biliary atresia	174	0.67 (0.57-0.77)	133	0.57 (0.48-0.67)	37	1.44 (1.01-1.99)	4 2.64 (0.72-6.75)
Small intestinal atresia/stenosis	788	3.05 (2.83-3.26)	730	3.15 (2.93-3.38)	54	2.1 (1.58-2.74)	4 2.64 (0.72-6.75)
<b>Genitourinary</b>							
Renal agenesis/hypoplasia	1475	5.7 (5.41-5.99)	1330	5.75 (5.44-6.06)	134	5.22 (4.33-6.1)	11 7.25 (3.62-12.97)
Bladder exstrophy	77	0.3 (0.23-0.37)	73	0.32 (0.25-0.4)	4	0.16 (0.04-0.4)	0 -
Hypospadias	10639	80.18 (78.66-81.71)	9802	82.61 (80.97-84.24)	796	60.07 (55.90-64.25)	41 52.69 (37.81-71.47)
Congenital posterior urethral valves	267	1.03 (0.91-1.16)	236	1.02 (0.89-1.15)	29	1.13 (0.76-1.62)	2 1.32 (0.16-4.76)
<b>Musculoskeletal</b>							
Gastroschisis	1234	4.77 (4.51-5.04)	1164	5.03 (4.74-5.32)	59	2.3 (1.75-2.96)	11 7.25 (3.62-12.97)
Omphalocele	549	2.12 (1.95-2.3)	499	2.16 (1.97-2.35)	44	1.71 (1.24-2.3)	6 3.95 (1.45-8.61)
Diaphragmatic hernia	700	2.71 (2.51-2.91)	644	2.78 (2.57-3)	53	2.06 (1.55-2.7)	3 1.98 (0.41-5.78)
Limb deficiencies (reduction defects)	1404	5.43 (5.14-5.71)	1298	5.61 (5.3-5.91)	87	3.39 (2.71-4.18)	19 12.52 (7.54-19.55)
Craniosynostosis	1644	6.36 (6.05-6.66)	1560	6.74 (6.41-7.08)	76	2.96 (2.33-3.7)	8 5.27 (2.28-10.39)
Clubfoot	4098	15.84 (15.36-16.33)	3815	16.48 (15.96-17.01)	246	9.58 (8.38-10.78)	37 24.38 (17.17-33.61)

<b>Chromosomal</b>							
Trisomy 13	304	1.18 (1.04-1.31)	264	1.14 (1-1.28)	39	1.52 (1.08-2.08)	1 0.66 (0.02-3.67)
Trisomy 21 (Down syndrome)	3193	12.35 (11.92-12.77)	2891	12.49 (12.04-12.95)	287	11.18 (9.88-12.47)	15 9.88 (5.53-16.3)
Trisomy 18	639	2.47 (2.28-2.66)	561	2.42 (2.22-2.62)	74	2.88 (2.26-3.62)	4 2.64 (0.72-6.75)
Turner syndrome	274	2.18 (1.92-2.43)	255	2.26 (1.98-2.54)	19	1.53 (0.92-2.39)	0 -
Deletion 22q11.2	115	0.44 (0.36-0.53)	103	0.45 (0.36-0.53)	10	0.39 (0.19-0.72)	2 1.32 (0.16-4.76)

Note: AI/AN= American Indian/Alaska Native; CI= confidence interval

Hypospadias restricted to males

Turner syndrome restricted to females

Table 3. Adjusted Prevalence Ratios of Selected Birth Defects Among Maternal Racial/Ethnic Groups, Texas, 1999-2015

	Non-Hispanic Asians		Any AI/AN	
Birth Defect	n	Adjusted PR (95% CI)	n	Adjusted PR (95% CI)
<b>Central Nervous System</b>				
Anencephalus	43	0.89 (0.47-1.53)	5	1.67 (0.55-3.77)
Spina bifida without anencephalus	33	<b>0.38 (0.25-0.54)</b>	6	1.17 (0.6-2.01)
Encephalocele	21	1.18 (0.84-1.62)	2	1.89 (0.76-3.81)
Holoprosencephaly	17	0.83 (0.35-1.65)	4	<b>3.05 (1.04-6.8)</b>
<b>Ear/Eye</b>				
Anophthalmia/microphthalmia	53	<b>0.69 (0.48-0.97)</b>	8	1.9 (0.8-3.75)
Congenital cataract	31	<b>0.63 (0.47-0.83)</b>	2	0.69 (0.01-4.06)
Anotia/microtia	63	<b>1.19 (1.14-1.24)</b>	10	<b>3.27 (1.97-5.05)</b>
<b>Cardiovascular</b>				
Common truncus (truncus arteriosus)	10	<b>0.58 (0.43-0.75)</b>	1	1.05 (0.43-2.08)
Transposition of great arteries (TGA)	108	<b>0.83 (0.71-0.97)</b>	11	1.52 (0.83-2.5)
Ventricular septal defect	1203	<b>0.86 (0.83-0.89)</b>	82	1.04 (0.98-1.11)
Atrial septal defect	1357	<b>0.84 (0.76-0.92)</b>	91	0.98 (0.81-1.17)
Atrioventricular septal defect (endocardial cushion defect)	77	0.58 (0.3-1)	6	0.89 (0.47-1.5)
Pulmonary valve atresia and stenosis	163	<b>0.73 (0.56-0.94)</b>	17	1.31 (1-1.69)
Tricuspid valve atresia and stenosis	48	1.11 (0.8-1.5)	2	0.79 (0-7.24)
Ebstein's anomaly	18	1 (0.77-1.29)	2	1.93 (0.71-4.11)
Aortic valve stenosis	39	<b>0.54 (0.31-0.88)</b>	4	0.96 (0.46-1.75)
Hypoplastic left heart syndrome	30	<b>0.46 (0.29-0.67)</b>	2	<b>0.52 (0.23-0.98)</b>
Coarctation of aorta	99	<b>0.66 (0.62-0.7)</b>	8	0.94 (0.52-1.55)
Total anomalous pulmonary venous connection	41	<b>1.36 (1.07-1.71)</b>	3	1.69 (0.64-3.56)
Single ventricle	14	0.69 (0.36-1.18)	2	1.74 (0.87-3.07)
Interrupted aortic arch	11	<b>0.71 (0.59-0.85)</b>	0	-
<b>Orofacial Clefts</b>				
Cleft palate alone	170	1 (0.9-1.11)	9	0.9 (0.33-1.92)
Cleft lip alone	81	0.81 (0.54-1.15)	7	1.15 (0.58-2.02)
Cleft lip with cleft palate	175	0.99 (0.79-1.22)	29	<b>2.68 (1.91-3.64)</b>
<b>Gastrointestinal</b>				
Choanal atresia	21	<b>0.54 (0.35-0.79)</b>	1	0.46 (0-4.57)
Esophageal atresia/ tracheoesophageal fistula	35	<b>0.55 (0.31-0.89)</b>	5	<b>1.36 (1.04-1.75)</b>
Rectal and large intestinal atresia/stenosis	110	<b>0.84 (0.77-0.92)</b>	10	1.3 (0.74-2.09)

Biliary atresia	37	<b>2.5 (2.06-3.01)</b>	4	<b>4.63 (1.62-10.22)</b>
Small intestinal atresia/stenosis	54	<b>0.67 (0.51-0.86)</b>	4	0.82 (0.26-1.89)
<b>Genitourinary</b>				
Renal agenesis/hypoplasia	134	0.9 (0.79-1.02)	11	1.27 (0.7-2.08)
Bladder exstrophy	4	0.5 (0.19-1.04)	0	-
Hypospadias	796	<b>0.72 (0.67-0.76)</b>	41	<b>0.64 (0.42-0.93)</b>
Congenital posterior urethral valves	29	1.1 (0.89-1.33)	2	1.3 (0.19-4.25)
<b>Musculoskeletal</b>				
Gastroschisis	59	0.63 (0.33-1.07)	11	1.19 (0.6-2.07)
Omphalocele	44	<b>0.76 (0.66-0.86)</b>	6	1.88 (0.95-3.29)
Diaphragmatic hernia	53	0.74 (0.54-1)	3	0.71 (0.04-3.2)
Limb deficiencies (reduction defects)	87	<b>0.62 (0.56-0.69)</b>	19	2.18 (0.73-4.91)
Craniosynostosis	76	<b>0.42 (0.39-0.46)</b>	8	0.8 (0.3-1.69)
Clubfoot	246	<b>0.58 (0.46-0.73)</b>	37	<b>1.48 (1.03-2.04)</b>
<b>Chromosomal</b>				
Trisomy 13	39	1.2 (0.94-1.51)	1	0.61 (0.21-1.35)
Trisomy 21 (Down syndrome)	287	<b>0.74 (0.69-0.78)</b>	15	0.9 (0.55-1.36)
Trisomy 18	74	0.96 (0.77-1.2)	4	1.25 (0.1-4.94)
Turner syndrome	19	<b>0.69 (0.51-0.90)</b>	0	-
Deletion 22q11.2	10	0.85 (0.49-1.38)	2	3.02 (0.26-12.01)

Note: AI/AN= American Indian/Alaska Native; PR= prevalence ratio; CI= confidence interval

Hypospadias restricted to males

Turner syndrome restricted to females

all aPRs are adjusted for maternal age; non-Hispanic Whites are the referent group

## DISCUSSION

Overall, there were 34 statistically significant prevalence ratios. Among NH Asians, 23 (52%) defects showed a lower aPR and 3 (7%) had a higher aPR out of the 44 defects studied. Furthermore, AI/ANs had 2 (5%) defects with lower aPRs and 6 (14%) with higher aPRs out of the 44 defects studied. Based on the 44 birth defects and 2 independent race/ethnic groups that were not NH White, by chance alone ( $p < 0.05$ ) we would expect that 4 prevalence ratios would have been statistically significant (i.e.,  $44 \times 2 \times 0.05$ ). Yet we

observed 34 statistically significant prevalence ratios, which suggests that the results were not a chance finding.

The aPRs calculated for AI/ANs were consistent with findings from the previous national studies examining this population.<sup>15,16</sup> Specifically, anotia/microtia and cleft lip with cleft palate were both found to be significantly elevated among AI/ANs relative to NH Whites in the current study and previous national studies. Furthermore, for the NH Asian population, the previous national study found that the majority of birth defects studied (16 out of 27, or 59%) had a significantly lower aPR. There were 11 defects that were found to be significant in both the previous and current studies, these defects include: spina bifida without anencephalus, anotia/microtia, common truncus, aortic valve stenosis, hypoplastic left heart syndrome, coarctation of the aorta, esophageal atresia, hypospadias, omphalocele, limb deficiencies, and trisomy 21. For defects that were significant in the previous study but were not in the current one, perhaps this is due to the smaller sample size and decreased power as analyses were conducted using data from only Texas rather pooled data from 12 states.

The lower prevalence rates observed for over half of the studied defects among the NH Asian population may be explained by various sociodemographic predictors for health. According to data from the National Vital Statistics System, compared to all U.S. mothers, NH Asian mothers were less likely to be teenagers and receive food prenatally via the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) and were more likely to be 30 years or older, be married, and have higher educational attainment.<sup>20</sup> These measures may be indicators of socioeconomic status, suggesting that NH Asian



mothers may have better access to prenatal care or are less exposed to risk factors that may cause birth defects. Furthermore, in the U.S. in 2016, 82.7% of NH Asian mothers were foreign-born.<sup>20</sup> Therefore it is possible that the lower prevalence observed may be due to the “healthy immigrant effect”.<sup>21</sup> Studies have found that foreign-born individuals tend to have better health outcomes compared to those who are U.S.-born. Immigrants are generally less likely to have cardiovascular disease, obesity, mental disorders, certain cancers, and low birth weight babies.<sup>21</sup>

This study had several limitations. Because the analyses were conducted on rare outcomes (biliary atresia, holoprosencephaly, etc.) and among minority groups, some aPRs were calculated based on cell sizes with 5 cases or less. This was true for 20 defects for AI/ANs and 1 defect for NH Asians. This results in imprecise estimates, larger confidence intervals, and weaker associations. However, it is still important for this data to be shown because these two race/ethnic groups have been historically understudied due to small sample sizes. The small numbers also disabled us from adjusting for additional covariates and to further separate NH Asians into specific subgroups (e.g., Vietnamese, Chinese, etc.) and AI/ANs into specific tribes (e.g., Cherokee, Navajo, etc.).

Despite the limitations, this study had several strengths. By using Texas data over many years, there was a large enough birth population to be able to make statistical inferences on the prevalence of selected birth defects for these lesser studied groups. Additionally, the current dataset included a more recent time period and a wider range of birth defects than the data used in the Canfield or Marengo study.<sup>15,16</sup> The additional birth defects in the current study were: holoprosencephaly, anophthalmia/microphthalmia, atrial

septal defect, pulmonary valve atresia and stenosis, tricuspid valve atresia and stenosis, Ebstein's anomaly, hypoplastic left heart syndrome, total anomalous pulmonary venous connection, single ventricle, interrupted aortic arch, choanal atresia, biliary atresia, small intestinal atresia/stenosis, renal agenesis/hypoplasia, bladder exstrophy, congenital posterior urethral valves, craniosynostosis, clubfoot, Turner syndrome, and deletion 22q11.2.

Although the population was smaller relative to national studies, the smaller size allowed the free text variable of race/ethnicity description to be further assessed, reclassified, and corrected. Specifically, we reclassified individuals in the NH and Hispanic "Other" race/ethnic group. Through these additional data cleaning steps, we identified 13 additional AI/AN cases, 306 additional AI/AN livebirths, 206 additional NH Asian cases, and 4,614 additional NH Asian livebirths, adding power to analysis.

## **CONCLUSION**

This study examined the association between understudied race/ethnicity and a wide range of birth defects within Texas using the most current data available. We found a number of birth defects with statistically significantly higher or lower prevalence ratios in NH Asians and AI/ANs, including some showing strong associations. Future research should explore additional covariates that may impact the prevalence of birth defects such as maternal parity, maternal and paternal education, paternal race/ethnicity, infant sex, smoking, and diabetes, where there are sufficient numbers. Additionally, NH Asians should be stratified into mothers' specific countries of origin or nativity (U.S.-born vs. foreign-born) to determine impact of country of origin or nativity on prevalence. Additionally, where data are sufficient,

birth defects should be separated into isolated cases, vs. those co-occurring with other birth defects or chromosomal or syndromic conditions. Defects with higher prevalence among AI/ANs warrants additional research within larger populations.

## REFERENCES

1. Centers for Disease Control and Prevention. Update on Overall Prevalence of Major Birth Defects—Atlanta, Georgia, 1978-2005. *MMWR Morb Mortal Wkly Rep.* 2008;57(1):1-5.
2. “Report of Birth Defects Among 1999 - 2015 Deliveries.” Texas Department of State Health Services, 19 Oct 2018, [http://dshs.texas.gov/birthdefects/data/BD\\_Data\\_99-15/Report-of-Birth-Defects-Among-1999---2015-Deliveries/](http://dshs.texas.gov/birthdefects/data/BD_Data_99-15/Report-of-Birth-Defects-Among-1999---2015-Deliveries/). Accessed 7 Nov 2018.
3. Kochanek KD, Murphy SL, Xu J, Arias E. Mortality in the United States, 2016. Centers for Disease Control and Prevention. 2017; *NCHS Data Brief* 293:1-8.
4. “Infant Mortality.” Centers for Disease Control and Prevention, 3 Aug 2018, <https://www.cdc.gov/reproductivehealth/maternalinfanthealth/infantmortality.htm>. Accessed 7 Nov 2018.
5. Williams J, Mai CT, Mulinare J, Isenburg J, Flood TJ, Ethen M, Frohnert B, Kirby RS. Updated Estimates of Neural Tube Defects Prevented by Mandatory Folic Acid Fortification — United States, 1995–2011. *MMWR.* 2015;64(1):1-5.
6. CDC. Improved National Prevalence Estimates for 18 Selected Major Birth Defects --- United States, 1999—2001. *MMWR.* 2006;54(51&52);1301-1305.
7. Canfield MA, Honein MA, Yuskiv N, Xing J, Mai CT, Collins JS, Devine O, Petrini J, Ramadhani TA, Hobbs CA, Kirby RS. National estimates and race/ethnic-specific variation of selected birth defects in the United States, 1999-2001. *Birth Defects Res A Clin Mol Teratol.* 2006;76(11):747-756.
8. Williams LJ, Rasmussen SA, Flores A, Kirby RS, Edmonds LD. Decline in the Prevalence of Spina Bifida and Anencephaly by Race/Ethnicity: 1995–2002. *Pediatrics.* 2005;116(3).

9. CDC. Update on Overall Prevalence of Major Birth Defects --- Atlanta, Georgia, 1978—2005. *MMWR*. 2008;57(1):1-5.
10. Egede LE. Race, Ethnicity, Culture, and Disparities in Health care. *J Gen Intern Med*. 2006;21(6):667-669.
11. Khokha MK, Mitchell LE, Wallingford J. An Opportunity to Address the Genetic Causes of Birth Defects. *Pediatr Res*. 2017;81(2):282-285.
12. Mersha TB, Abebe T. Self-reported race/ethnicity in the age of genomic research: its potential impact on understanding health disparities. *Hum Genomics*. 2015;9(1):1.
13. Hoeffel EM, Rastogi S, Kim MO, Shahid H. The Asian Population: 2010. U.S. Census Bureau. 2012; 2010 Census Briefs:1-23.
14. Norris T, Vines PL, Hoeffel EM. The American Indian and Alaska Native Population: 2010. U.S. Census Bureau. 2012; 2010 Census Briefs:1-21.
15. Canfield MA, Mai CT, Wang Y, O'Halloran A, Marengo LK, Olney RS, Borger CL, Rutkowski R, Fornoff J, Irwin N, Copeland G, Flood TJ, Meyer RE, Rickard R, Alverson C, Sweatlock J, Kirby RS, National Birth Defects Prevention Network. The association between race/ethnicity and major birth defects in the United States, 1999-2007. *Am J Public Health*. 2014;104:e14-e23.
16. Marengo LK, Flood TJ, Ethen MK, Kirby RS, Fisher S, Copeland G, Meyer RE, Dunn J, Canfield MA, Anderson T, Yazzie D, Mai CT, for the 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 Res*. 2018; doi: 10.1002/bdr2.1397. [Epub ahead of print]

17. MacDorman MF, Matthews TJ, Mohangoo AD, Zeitlin J. International comparisons of infant mortality and related factors: United States and Europe, 2010. *Natl Vital Stat Rep.* 2014;63(5):1-6.
18. Feldkamp ML, Carey JC, Byrne JL, Krikov S, Botto LD. Etiology and clinical presentation of birth defects: population based study. *BMJ.* 2017;357:j2249.
19. National Birth Defects Prevention Network. Guidelines for conducting birth defects surveillance. 2004; Atlanta, GA, USA.
20. Driscoll AK. Asian-American Mothers: Demographic Characteristics by Maternal Place of Birth and Asian Subgroup, 2016. *National Vital Statistics Reports.* 2018;67(2):1-11.
21. Argeseanu Cunningham S, Ruben JD, Narayan KM. Health of foreign-born people in the United States: a review. *Health Place.* 2008;14(4):623-635.

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December 03, 2018

HSC-SPH-18-1023 - The prevalence of selected birth defects among Asians, and American Indians/Alaska Natives in Texas, 1999-2015

The above named project is determined to qualify for exempt status according to 45 CFR 46.101(b)

**CATEGORY #4** : *Research, involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified directly or through identifiers linked to the subjects.*

**CHANGES:** Should you choose to make any changes to the protocol that would involve the inclusion of human subjects or identified data from humans, please submit the change via iRIS to the Committee for the Protection of Human Subjects for review.

**INFORMED CONSENT DETERMINATION:**

Waiver of Consent Granted

**INFORMED CONSENT:** When Informed consent is required, it must be obtained by the **HEALTH INSURANCE PORTABILITY and ACCOUNTABILITY ACT (HIPAA):**  
Information to be retained:

**Exempt from HIPAA**

**STUDY CLOSURES:** Upon completion of your project, submission of a study closure report is required. The study closure report should be submitted once all data has been collected and analyzed.

Should you have any questions, please contact the Office of Research Support Committees at 713-500-7943.