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Disparities in Risk Factors and Birth Outcomes Among American Indians in North Dakota

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Abstract
Objectives High infant mortality rates among American Indians in North Dakota contribute to a 20-year gap in average age at death compared to whites. Geographic- and race-specific health disparities data to drive policy making and interventions are not well disseminated. The current study examines prenatal risk factors and birth outcomes between American Indian and whites in North Dakota. *Methods* A retrospective descriptive analysis of North Dakota live births from 2007 to 2012 was conducted. Period prevalence and prevalence ratios were calculated. *Results* The infant mortality rate from 2010 to 2012 for infants born to American Indian women was 3.5 times higher than whites. Racial disparities existed in education, teen births, tobacco use during pregnancy, and breastfeeding initiation. Disparities widened for inadequate prenatal care, illegal drug use during pregnancy, and infant mortality from 2007–2009 to 2010–2012 and narrowed for sexually transmitted infections and alcohol use during pregnancy. *Conclusions for Practice* American Indians are disproportionately affected by poor pregnancy and birth outcomes in North Dakota. Future geographic-specific American Indian research is warranted to aid current and future public health interventions.

Keywords American Indian · Birth outcomes · North Dakota · Racial disparities

Significance

Research has established significant health disparities between American Indians and the general population. Previous research also stated that geographic differences in American Indian health outcomes render nationwide information unsuitable for local policies. However, research surrounding birth outcomes among American Indians in the Midwest is limited. The current study found increased rates of poor pregnancy and birth outcomes among American Indians in North Dakota.

Background

Health Disparities

American Indian/Alaska Native (AI/AN) adults are more likely to die from diabetes, chronic liver disease, unintentional injuries, infectious diseases (e.g., tuberculosis, pneumonia), heart disease, suicide, and homicide compared to the U.S. all-races rate (CDC 2013a; Sarche and Spicer 2008). AI/AN also have higher rates of posttraumatic stress disorder, major depressive disorder, and dependence on alcohol (CDC 2013a; Sarche and Spicer 2008). Health disparities are apparent early in the life course, exemplified by high rates of infant mortality; among AI/AN, the infant mortality rate is two to three times higher than for whites, with the majority of the deaths occurring in the postneonatal period (Sarche and Spicer 2008). Other infant health outcomes, such as fetal alcohol spectrum disorder (Sarche and Spicer 2008)

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and preterm birth (Anderson et al. 2016), are also more prevalent among AI/AN infants. The increased risk of poor birth outcomes among AI/AN infants could be attributed to a host of factors. For example, inadequate prenatal care and smoking during pregnancy, known risk factors for preterm birth, are more common among AI/AN women compared to white women (e.g., CDC 2013b; Dorfman et al. 2015; LaVallie et al. 2003; Vintzileos et al. 2002).

The Centers for Disease Control and Prevention (CDC; 2018b) define social determinants of health as, "the circumstances in which people are born, grow up, live, work, and age, as well as the systems put in place to deal with illness," all of which are affected by the economy, policies, and political systems. The HealthyPeople.gov (2018) initiative recognizes that our social and physical environments profoundly impact our ability to experience good health. A strong relationship exists between socioeconomic disparities and poor birth outcomes (Kramer et al. 2000; Pearl et al. 2001). AI/AN people experience disproportionately high rates of poverty and unemployment compared to the general population, reflecting broader challenges related to economic development (Sarche and Spicer 2008). Experiences of trauma and historic stressors, and adverse childhood experiences (ACEs), can help explain the disproportionate burden of health disparities among AI/AN people. For example, recognition of historical trauma as a significant factor in the well-being of AIs continues to gain wider attention (Warne and Lajimodiere 2015). A study measuring historical trauma among AIs found perceptions of historical loss were not restricted to older generations, and historical losses were associated with emotional distress (Whitbeck et al. 2009). The significance of the original ACEs research, conducted by Anda and Felitti (Anda et al. 2006), has grown clearer with advances in neuroscience and epigenetics. Specifically, they reported that the potential impact of ACEs and historical trauma can be transmitted biologically to subsequent generations, increasing the risk for poor health outcomes (Anda et al. 2006). In a study of seven AI/AN tribes, 33% of adult participants reported high ACE scores (i.e., scores of 4+) (Koss et al. 2003). A study of parent-reported ACEs found that AI/AN children (0–17 years) had higher odds than white children of ACE scores of 2 or higher (Kenney and Singh 2016).

ACEs are of particular importance due to their association with high-risk behaviors across the life span such as drug use and unsafe sexual practices, physiological changes caused by toxic stress, and chronic conditions (e.g., depression and heart disease; Cuijpers et al. 2011; Mazzaferro et al. 2006; Miller et al. 2011). Previous research has also illustrated that disparities in racial-ethnic birth outcomes can be explained by stress (Lu and Halfon 2003). Conditions in utero, including stress, can affect individual health outcomes throughout the life cycle (Torche 2011). For example, previous studies have identified circumstances, including smoking during pregnancy and inadequate prenatal care (e.g., CDC 2013b; Vintzileos et al. 2002), which operate as risk factors for poor birth outcomes (e.g., preterm birth, infant mortality; O'Connor 2004). Previous studies have established that AI/AN women have higher proportions of many risk factors for poor birth outcomes (e.g., CDC 2013b; Cobb et al. 2014; LaVallie et al. 2003).

Geographic Differences in AI/AN Disparities

Health disparities are not experienced uniformly by AI/AN people in the United States (U.S.). A growing body of research has determined that significant geographic differences exist in health disparities among AI/ANs (e.g., IHS 2017; Johnson et al. 2010; Koss et al. 2003) and may render nationwide information unsuitable for policy making and interventions at tribal, state, and local levels (Johnson et al. 2010). Geographic differences among AI/ANs have also been found for maternal and child health-specific outcomes (e.g., Dorfman et al. 2015; IHS 2017; Raglan et al. 2016). A study investigating prenatal care utilization using vital statistics data for AI/AN populations in 12 states found significant differences in prenatal care utilization among states (Johnson et al. 2010). Additionally, a study of diabetes mellitus (DM) among AI/AN women with singleton births found that the strength of association between DM and preterm birth ranged sizably among the eight states studied, from an adjusted odds ratio of 1.51 in Oklahoma to 6.63 in Nebraska (Dorfman et al. 2015).

Previous literature has frequently reported that some of the worst health disparities among the AI/AN population can be found in the Northern Plains. For example, a study of parent-reported ACEs found that AI/AN children 0–17 in the Northern Plains had the highest odds of having 2 or more ACEs compared to AI/AN children in other parts of the country (Kenney and Singh 2016). Additionally, a study from the Indian Health Service (IHS) that examined health differences among its 12 regions across the U.S. reported that the Aberdeen Area, which includes North Dakota (ND) and three other states in the Northern Plains, had the highest age-adjusted death rates from 2005 to 2007, and the lowest life expectancy at birth, at 68.1 years (compared to the IHS average of 73.5 and the U.S. average for all races of 77.7; IHS 2017). It also had among the lowest median household incomes and among the highest rates of unemployed adults and people in poverty (IHS 2017).

AI/ANs are the largest minority population ND. In 2012, 5.5% of ND's population was AI/AN (identifying as one race only; ND Compass 2018) compared to 1.5% nationally (Sarche and Spicer 2008). Among ND children 0–17 years old, 9.1% were AI/AN (ND Compass 2018). Compared to non-Hispanic whites in ND from 2007 to 2011, AI/AN (of

any ethnicity) had a smaller proportion of adults 25 and older with a bachelors' degree or higher, a 50% smaller median household income, and a four times higher poverty rate for adults 15 and older (ND Compass 2018). From 2009 to 2011, over one-third (35.6%) of 25- to 54-year-old AI/ANs living in ND were unemployed (Austin 2013). From 2007 to 2012, the average age at death of an AI/AN was 20 years younger than a white person in ND (57.4 years and 77.4 years, respectively) (NDDVR 2014).

Purpose of the Study

Due to regional differences in health for AI/ANs across the country, decision making based on data collected from AI/ANs in other parts of the nation should be done with caution. Among current literature, the Northern Plains consistently ranks highest for AI/AN health disparities. Analysis of ND data can illuminate differences that may exist within the Aberdeen Area; however, data on AI/AN health disparities in ND are limited. Additionally, only a couple of risk factors for poor birth outcomes were included in the IHS (2017) regional comparison. Thus, the current study describes racial disparities for additional risk factors and birth outcomes among AI/ANs living in ND from 2007 to 2012. Our study aims to illustrate that state-specific analyses are essential for future statewide policymaking and interventions to reduce health disparities.

Methods

The present study analyzed publicly available, aggregate data from 2007 to 2012 obtained from the ND Division of Vital Records (NDDVR). Because no identifiable information was obtained, institutional review board certification was not required. The NDDVR collected information using birth certificates and medical certifier's worksheets. The certifier's worksheet is completed by the birthing facility and uses information from the women's prenatal, medical, and labor and delivery records. For home births, the worksheet is completed by the professional delivering the child or is self-reported by the mother.

Study Population

ND women who had a live birth from 2007 to 2012, self-reported as AI/AN (including women who identified as multiple races; N = 5776), and who identified themselves as "white" only (N = 46,068), were included in the aggregate dataset provided by the NDDVR. Due to small numbers among other racial categories (N = 3273) in the state, only AI/AN and white women were compared. Thus, our aggregate dataset represented the experiences of 51,844 women (Hispanic and non-Hispanic) with live births in ND from 2007 to 2012. Approximately 4% of ND youth 0–17 and 2.5% of the state's overall population were Hispanic in 2012 (ND Compass 2018).

Definition of Study Variables

For the present study, risk factors selected for analysis have been demonstrated in existing research to be significantly correlated with poor birth outcomes (e.g., Vintzileos et al. 2002) and were available from the NDDVR. Risk factor information from the birth certificate included age (i.e., teen women < 20 years old, women age 35 and older), level of education, cigarette use during pregnancy, and alcohol use during pregnancy. Risk factor information from the medical certifier's worksheet included medical risk factors (gestational diabetes, illegal drug use during the pregnancy), inadequate prenatal care (i.e., beginning after the first trimester), presence of sexually transmitted infections (STIs) during pregnancy (i.e., gonorrhea, syphilis, chlamydia, Hepatitis B, Hepatitis C, HIV/AIDS), and breastfeeding at the time of discharge from the hospital.

Birth outcomes included preterm birth (< 37 weeks gestation), low birth weight (< 2500 g/5 pounds, 8 ounces), and newborn admission to the neonatal intensive care unit (NICU). The number of infant deaths was provided as an overall count and by age at death: neonatal deaths (7 days or less), perinatal deaths (8–28 days), and postnatal deaths (29 days–1 year). Deaths attributed to Sudden Unexpected Infant Death (SUID) were also included in the analysis. Study variables were dichotomized for analysis. Missing data was minimal (less than 1%), and where applicable, was included in the category representing less risk in order to provide more conservative estimates of period prevalence. Additional characteristics included in the study for demographic context were marital status, whether the woman gave birth to multiples (e.g., twins), whether Cesarean section was the mode of delivery, and whether labor was induced.

Analysis

The current study is a retrospective descriptive analysis of live births in ND from 2007 to 2012. Data were examined statewide by race as 3-year aggregates (2007–2009 and 2010–2012) in order to address issues caused by small numbers of events. The period prevalence of risk factors and birth outcomes was calculated by dividing the number of births with a characteristic by the total number of live births, for AI/AN women and white women. The period prevalence is presented as a rate per 1000 live births. We conducted Chi Square analyses of the differences in observed proportions between the two racial groups for 2010–2012. To provide greater context for the differences between the two racial

groups, ratios were calculated by dividing the period prevalence for each risk factor and birth outcome among AI/AN women by the period prevalence among white women. The resulting statistic represented how common the risk factors and birth outcomes were among AI/AN women relative to white women.

Results

The majority of births were to women 20–29 years old (62.5% of births to AI/AN women and 58.9% of births to white women); 18.6% of births were to AI/AN teenage women and 5.2% to white teenage women. Over half (58.2%) of births were to AI/AN women with no more than a high school diploma compared to over a quarter (23.7%) of births to white women. Furthermore, 18.1% of AI/AN births were to married women compared to 72.7% among whites (Table 1); cohabiting status was not asked on the birth certificate.

The ratios of the risk factors for 2010–2012 showed several significant differences by race (Table 1). AI/AN women were 2.5 times more likely to have no more than a high school education and 3.6 times more likely to be teens. AI/AN women were 2.7 times more likely to have smoked during pregnancy, 8.3 times more likely to have inadequate prenatal care, and 2.7 times less likely to be breastfeeding when discharged from the hospital. Although the number of observations for the following factors is limited, AI/ANs were 13.3 times more likely to use illicit substances, 2.1 times more likely to have had alcohol during pregnancy, 1.3 times more likely to have had gestational diabetes, and 5.2 times more likely to have selected STIs during pregnancy compared to white women.

Rates for poor birth outcomes were also consistently higher among AI/AN women and their infants in ND compared to whites (Table 2). Infants born to AI/AN women from 2010 to 2012 were 1.4 times more likely to be born preterm and 1.3 times more like to be born at a low birth weight, compared to infants born to white women. The AI/AN infant mortality rate was 3.5 times higher than the infant mortality rate for whites. Infants born to AI/AN women were 3.1 times more likely to die during the neonatal period and 7.9 times more likely to die during the postnatal period,

Table 1 Period prevalence of demographics and risk factors per 1000 live births among American Indian/Alaska Native (AI/AN), White, and the North Dakota (ND) Population, and AI/AN to White Prevalence Ratios: 2007–2009 and 2010–2012

Rates per 1000 live births	2007–2009				2010–2012			
Demographics	AI/AN	White	ND	AI/AN white ratio	AI/AN	White	ND	AI/AN white ratio
Married[a]	250.7	723.8	670.8	0.3	181.3	727.1	671.7	0.2*
Gave birth to multiples	31.6	33.9	33.1	0.9	25.2	32.6	31.6	0.8*
Delivered by cesarean section	369.8	275.7	286.0	1.3	309.4	274.9	279.0	1.1*
Induction of labor	239.9	310.4	300.6	0.8	269.7	310.2	299.8	0.9*
Risk factors								
High school diploma or less	570.7	242.6	293.5	2.4	582.2	236.8	283.4	2.5*
Not breastfeeding at hospital discharge	500.0	193.2	227.3	2.6	497.2	182.2	213.9	2.7*
Smoking during pregnancy	405.9	157.3	179.7	2.6	390.5	142.6	163.0	2.7*
Inadequate prenatal care	226.4	30.5	54.3	7.4	244.1	29.4	56.4	8.3*
Teen birth < 20 years	208.7	57.2	75.8	3.6	185.8	50.9	67.1	3.7*
Birth to woman age 35 +	51.7	106.5	100.9	0.5	63.5	99.4	96.5	0.6*
Illegal drug use as a risk factor	55.2	8.7	13.7	6.4	81.8	6.2	13.6	13.3*
Gestational diabetes	43.1	33.5	35.3	1.3	55.6	42.8	44.6	1.3*
STIs present during pregnancy	60.8	7.1	14.1	8.6	46.6	8.9	13.7	5.2*
Alcohol use during pregnancy	34.0	11.1	13.6	3.1	22.4	10.5	11.9	2.1*

Education level, smoking and alcohol use during pregnancy, and age at time of delivery were self-reported by the woman on the birth certificate (available at http://www.ndhealth.gov/vital/forms/parent.pdf). Not breastfeeding at time of discharge, inadequate prenatal care, illegal drug use as a risk factor, gestational diabetes, and selected STIs present during pregnancy were selected as a "medical risk factor for this pregnancy" on the Medical Certifier's Worksheet completed at time of delivery (available at https://www.ndhealth.gov/vital/forms/certifier.pdf). *Inadequate prenatal care* care started after the end of the first trimester, *Selected sexually transmitted infections (STIs) present during pregnancy* gonorrhea, syphilis, chlamydia, Hepatitis, B, Hepatitis C, HIV/AIDS

*Denotes a statistically significant difference in prevalence by race for 2010–2012 calculated using Chi Square tests at $p < .05$

[a]The ND birth certificate asks for woman's marital status, and does not inquire about unmarried partners who are cohabiting

Table 2 Period prevalence of birth outcomes per 1000 live births among American Indian/Alaska Native (AI/AN), White, and the North Dakota (ND) Population, and AI/AN to White Prevalence Ratios: 2007–2009 and 2010–2012

Rates per 1000 live births	2007–2009				2010–2012			
Birth outcome	AI/AN	White	ND	AI/AN white ratio	AI/AN	White	ND	AI/AN white ratio
Preterm birth	117.4	92.8	95.0	1.3	122.6	85.4	90.1	1.4*
Low birth weight	78.8	62.5	65.0	1.3	78.7	60.7	64.3	1.3*
NICU admission	101.7	83.8	85.5	1.2	88.1	90.0	90.3	1.0
Overall infant mortality rate	15.3	5.5	6.4	2.8	17.6	5.1	6.1	3.5*
Neonatal deaths	4.5	3.0	3.1	1.5	5.5	2.8	3.2	2.0*
Perinatal deaths	1.0	0.9	1.0	1.1	1.0	0.6	0.6	1.7
Postnatal deaths	10.1	1.4	2.3	7.2	11.0	1.4	2.3	7.9*
Infant deaths due to SUID[a]	3.5	0.6	0.9	5.8	3.8	0.5	0.8	7.6*

Preterm birth < 37 weeks gestation, *Low birthweight* < 2500 g/5 pounds, 8 ounces, *NICU* neonatal intensive care unit, *Neonatal deaths* 7 days or less, *Perinatal deaths* 8–27 days, *Postnatal deaths* 28 days–1 year

*Denotes a statistically significant difference in prevalence by race for 2010–2012 calculated using Chi Square tests at $p < .05$

[a]*SUID* sudden unexpected infant death. The NDDVR indicated that Sudden Infant Death Syndrome (SIDS) and SUID have the same ICD 10 code; therefore, they are grouped together and the NDDVR is unable to ascertain individualized frequencies

compared to whites. Infant death rates due to SUID were 7.6 times higher among AI/AN women compared to whites. The infant mortality rate for white infants (5.1 deaths per 1000 live births) was very similar to the overall infant mortality rate for the state (6.1) from 2010 to 2012. In contrast, the infant mortality rate for AI/ANs over the same period was 17.6 deaths per 1000 live births.

Comparisons of ND 2010–2012 data to 2007–2009 data showed that some of the prevalence ratios comparing AI/AN to whites worsened (Table 1), reflecting growing disparities in risk factors like inadequate prenatal care and illegal drug use and outcomes including infant mortality and SUID. In contrast, prevalence ratios by race for the presence of selected STIs and alcohol use during pregnancy narrowed.

For some indicators, prevalence decreased from 2007–2009 to 2010–2012 for AI/AN and white women: smoking during pregnancy, teen births, and alcohol use during pregnancy (Table 1). Prevalence of selected STIs during pregnancy and admission to the NICU declined for AI/AN women but did not change for white women. The prevalence of illegal drug use increased for AI/AN women, but not white women. The overall infant mortality rate and infant deaths due to SUID also increased among AI/AN women, and decreased among white women.

Discussion

The present study showed that AI/AN women in ND had higher prevalence of several factors known to increase the risk of poor birth outcomes, including inadequate prenatal care; being a teen at time of birth; smoking, alcohol, or drug use during pregnancy; and gestational diabetes compared to white women—which is consistent with previous studies (CDC 2013a, 2018a; LaVallie et al. 2003). Compared to infants born to white women in ND, infants born to AI/AN women were more likely to experience preterm birth and low birthweight.

Our study illustrates that the state's infant mortality rate may not highlight a major issue in ND; however, the overall rate can unintentionally obscure significant needs among AI/AN women and infants. While ND's overall infant mortality rate was close to the national average (Mathews et al. 2015), the infant mortality rate for AI/ANs in ND was much higher, more comparable to developing nations such as Egypt and Viet Nam (UN Children's Fund 2013). The disproportionate rates of AI/AN women with poor birth outcomes and prenatal risk factors may in part be due to social determinants of health such as the high proportion of unemployment and poverty among AI/ANs.

While the results of our analysis were consistent with the health challenges for the Aberdeen Area overall (IHS 2017), ND specific rates were sometimes higher, illustrating the importance of state-specific analyses. While the Aberdeen Area's infant mortality rate (10.7 deaths per 1000 live births; IHS 2017) was among the highest in the nation (all-races national rate was 6.0 in 2012; Mathews et al. 2015), the rate was substantially lower than ND's AI/AN rate of 17.6 from 2010 to 2012. Accounting for 26% of infant deaths from 2005 to 2007, SUID was the leading cause of infant mortality in the Aberdeen Area (compared to being the second most common cause among all IHS areas at 12%; IHS 2017). In ND, SUID accounted for 22% of deaths in 2007–2009 and 2010–2012.

To the authors' knowledge, this study is the first to describe health disparities for birth outcomes among ND's largest minority group, AI/ANs. While not generalizable to other populations, our study design can be used as a model for examining disparities at smaller levels of geography and can provide context to other states that may want to explore period prevalence. The present study aims to draw attention to the dramatic AI/AN health disparities in ND across the life course. Because notable geographic differences exist among AI/AN across the nation, and even within the IHS Aberdeen Area, our findings make a valuable contribution to the literature by describing the perinatal risk behaviors and birth outcomes among AI/ANs in ND. Research on disparities is timely due to continued high rates of AI/AN infant mortality, and the national focus on improving birth outcomes.

Despite its strengths, our study has some limitations. We analyzed publically available, aggregated data. When risk factors and birth outcomes had very small numbers, data were either repressed to protect anonymity or data were pooled across multiple years to meet the necessary minimum reporting threshold. The aggregate data limits the types of statistical analyses we can perform. For example, due to data limitations, the relationship between risk factors and birth outcomes among the women in our study could not be conducted; however, extant maternal and child health research provides a solid foundation for understanding the root causes of infant mortality and other birth outcomes (e.g., CDC 2013b; Dorfman et al. 2015; Vintzileos et al. 2002). ND vital statistics data includes self-report measures, such as alcohol and tobacco use during pregnancy, which is subject to recall and social desirability bias. The data reflect infants born to women who self-identify as AI/AN, which can result in an undercount of the number of infants born to AI/AN women. Additionally, AI/AN women may have been misclassified as white women which could impact reported data. Further, infants born to white women and AI/AN men were not included in the dataset, potentially contributing to underestimation of actual rates of risk factors and poor outcomes. Lastly, birth records document county of residence but not tribal enrollment, so reservation-specific data from the NDDVR were not available.

Public Health Implication

Findings from our study show AI/ANs in ND are disproportionately affected by prenatal risk factors and poor birth outcomes. Consideration of the impacts of historical trauma, social determinants of health, and parents' adverse childhood experiences can provide understanding of how health disparities for many AIs may begin before conception, continue during the prenatal period, and carry long-lasting implications across the life span (Cuijpers et al. 2011; Miller et al. 2011; O'Connor 2004). The elevated rates demonstrate maternal and child health and health equity as major ND public health challenges. Public health policy and intervention efforts can make a lasting impact. Statewide efforts that include a focus on social determinants of health and actively seek AI/AN input—such as the ND Department of Health's Infant Mortality Collaborative Improvement and Innovation Network (CoIIN)—are needed to improve outcomes for AI/AN children. Multifaceted programs aimed at addressing health disparities among AI/AN must be developed and implemented in close partnership with AI/AN communities.

Due to the lack of geographic-specific AI/AN information found in ND and other regions, future research is warranted. Analyses of non-aggregated data would allow for more in-depth exploration of relationships between risk factors and birth outcomes among AI/ANs in ND. Additional factors including length of NICU stay, gestational age at birth, macrosomia, and very low birthweight could also be included. Examining differences by race is a useful starting point for a larger conversation about contributors to health disparities. Because racial differences can often be explained in terms of social and economic factors (Kenney and Singh 2016), the ability to control for these factors would provide a better understanding of within-group and between-group differences, and areas that can be targeted for intervention (e.g., Whitfield et al. 2008). Qualitative research with AI/AN women, as well as men and elders, could provide a valuable perspective on how to promote healthy pregnancies and infants. Research with social service providers and policy makers could also provide important insights into challenges and opportunities for improving health equity.

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