

Diabetes and Kidney Disease in American Indians: Potential Role of Sugar-Sweetened Beverages

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Abstract

Since the early 20th century, a marked increase in obesity, diabetes, and chronic kidney disease has occurred in the American Indian population, especially the Pima Indians of the Southwest. Here, we review the current epidemic and attempt to identify remediable causes. A search was performed using PubMed and the search terms *American Indian and obesity*, *American Indian and diabetes*, *American Indian and chronic kidney disease*, and *American Indian and sugar or fructose*, *Native American*, *Alaska Native*, *First Nations*, *Aboriginal*, *Amerind*, and *Amerindian for American Indian* for articles linking American Indians with diabetes, obesity, chronic kidney disease, and sugar; additional references were identified in these publications traced to 1900 and articles were reviewed if they were directly discussing these topics. Multiple factors are involved in the increased risk for diabetes and kidney disease in the American Indian population, including poverty, overnutrition, poor health care, high intake of sugar, and genetic mechanisms. Genetic factors may be especially important in the Pima, as historical records suggest that this group was predisposed to obesity before exposure to Western culture and diet. Exposure to sugar-sweetened beverages may also be involved in the increased risk for chronic kidney disease. In these small populations in severe health crisis, we recommend further studies to investigate the role of excess added sugar, especially sugar-sweetened beverages, as a potentially remediable risk factor.

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The American Indian (Native American) represents 1.7% of the US population (5.2 million people) and consists of 566 federally recognized tribes, with the majority living in urban settings and 20% living in reservations or other federally allocated lands.¹ Like most American indigenous groups, the American Indian suffers from a high frequency of obesity, diabetes, and chronic kidney disease (CKD). Here, we document the rise in these diseases in the Native American and discuss potential genetic and environmental causes. Although multiple factors are likely involved in the increased risk for obesity, diabetes, and kidney disease in this population, we focus on the role of excess sugar-sweetened beverages as a risk factor for diabetes and CKD. We hope these new insights lead to clinical trials that could ultimately identify ways to decrease the burden of metabolic and kidney diseases on this population.

METHODOLOGY

A generalized search was performed using Entrez PubMed (September 2014), in which specific searches were performed for *American Indian and obesity* (1051 references), *American Indian and diabetes* (2058 references), *American Indian and chronic kidney disease* (174 references), and *American Indian and sugar or fructose* (4 references). We performed similar searches, substituting *Native American*, *Alaska Native*, *First Nations*, *Aboriginal*, *Amerind*, and *Amerindian* for *American Indian*. In addition, where appropriate, citations of baseline physiological data from Mexican Americans were used because they are often used as a proxy population to gain a deeper insight into epidemiology and genomics. All references were screened, and articles were selected on the basis of whether they provided general incidence and prevalence of obesity, diabetes, and CKD in the American Indian (primarily for the United States), as well as articles evaluating risk factors



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ARTICLE HIGHLIGHTS

- Forty percent of the American Indian population is obese, and 18% have diabetes. Among American Indian tribes, Pima Indians have the highest incidence rates of diabetes in the world.
- Both genetic and nongenetic factors are involved in the increased risk for obesity, diabetes, and chronic kidney disease in the American Indian population.
- Recent studies suggest that intake of sugar-sweetened beverages may be an important and modifiable risk factor for obesity, diabetes, and chronic kidney disease.

for these conditions. An attempt was made to identify old sources that predate the earliest PubMed references. This was done by reviewing the oldest PubMed articles on the subject and reviewing and backtracking the references in those articles as well as by using Google Scholar to find those old articles. This approach allowed us to identify not only some reports on the Pima Indians from the 1800s but also a transcript of Father Font's interaction with 1000 Pima Indians in 1775, which documented the presence of obesity in Pima women well before exposure to Western culture.²

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Table 1 demonstrates the gravity of the present situation, with nearly 40% of adult American

Indians being obese and 18% being diabetic.³⁻⁸ In parallel with an increased frequency of diabetes is an increase in CKD.⁷⁻¹⁰ Most cases are due to diabetic nephropathy, although the incidence of other kidney diseases such as IgA nephropathy has also increased in some American Indian populations.^{6,11-14} American Indians who are diabetic also show a 7-fold higher risk for progression to end-stage renal disease (ESRD) as compared with whites with diabetes,¹⁰ and the incidence of ESRD is 60% higher in American Indians than that observed in whites.^{6-8,13} Interestingly, the incidence of ESRD in the American Indian has decreased in the United States over the past decade (Table 1).⁶ This may be due to a better managed chronic care model that accesses quality of care similar to that used for whites, which is based on better training and policy adaptation to the cultural and social mores of the Native American communities.^{11,12}

Despite higher incidence rates of obesity, the American Indian population was initially reported to have lower frequencies of hypertension and coronary artery disease.^{14,15} The Strong Heart Study, which is a cross-sectional study that enrolled American Indians from the Southwest, South Dakota, and Oklahoma, noted that by the 1990s the incidence rates of hypertension had become similar to those found in whites, with a higher prevalence of diabetes and obesity.¹⁶ In contrast, coronary artery disease and stroke remain lower in this population than in whites (Table 1).⁵ With the increasing incidence rates of hypertension, this pattern may change.⁴ Indeed, the frequency of peripheral vascular disease is currently similar in American Indians and whites.¹⁷ However, genetic studies show that Native American ancestry protects Hispanic Americans against peripheral vascular disease.¹⁸

The overall pattern suggests a difference between American Indians and whites in that the incidence of obesity, diabetes, and CKD is higher in the American Indian population whereas that of stroke and coronary artery disease is lower.¹⁹ The lower incidence rates of vascular disease appear to be genetically based, but have decreased in recent years, likely because of the increasing frequencies of diabetes and obesity that confer increased risk for vascular complications. The genetic mechanisms underlying the reduced cardiovascular

TABLE 1. Health Conditions of Native Americans and Whites^a

Health condition	American Indian	White
Obesity (BMI > 30 kg/m ²) (age ≥ 18 y), 2004-2008 (%) ^b	39	24
Diabetes (age ≥ 18 y), 2004-2008 (%) ^b	18	7
Hypertension (age ≥ 18 y), 2004-2008 (%) ^b	34	26
ESRD, incidence, 2001 (cases per million) ^c	707	283
ESRD, incidence, 2011 (cases per million) ^c	453	286
Chronic kidney disease (defined as eGFR < 60 mL/min per 1.73 m ²)	17 ^d	5 ^e
Coronary artery disease, 2006 (deaths per 100,000) ^f	97	134
Stroke, 2006 (deaths per 100,000) ^f	29	42

^aBMI = body mass index; eGFR = estimated glomerular filtration rate; ESRD = end-stage renal disease.

^bData from the Family Core and the Sample Adult Core components of the 2004-2008 National Health Interview Surveys.⁴

^cData from the United States Renal Data System, 2013.⁶

^dData from the Kidney Early Evaluation Program (2000-2006).⁷

^eData from the Third National Health and Nutrition Examination Survey, which show the prevalence of only chronic kidney disease stages III-V.⁸

^fData from the Centers for Disease Control and Prevention Health Disparities & Inequalities Report.^{3,5}

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