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**Type 2 Diabetes Mellitus in Native Americans in US: A Brief Analysis**

**Introduction**

The term ‘Diabetes’ has its origin from Greek meaning Siphon, i.e., to pass through.1 There are two types of Diabetes, and interestingly, one is very common- Diabetes Mellitus and the other- Diabetes Insipidus is very rare. In Diabetes Insipidus, patients make too much urine, up to 20 quarts a day, compared to healthy patients who make 1-3 quarts of urine a day.2 Diabetes Mellitus (Mellitus, having a Latin origin, meaning Sweet1) is a chronic, metabolic disorder in which there is an increase in blood glucose levels. It can be further be divided into several types- type 1(T1DM), type 2(T2DM), maturity-onset diabetes of the young, gestational diabetes, neonatal diabetes, and secondary causes due to endocrinopathies, steroid use, etc. 1 in 10 Americans, or more than 37 million people, have diabetes, and 90–95% of them have T2DM.3 According to 2018–2019 National Health Interview Survey, American Indians and Alaska Natives (14.5%) had the greatest prevalence of diagnosed diabetes among both men and women (see fig 1, appendix)4. This paper analyses T2DM in the United States with Native Americans as the vulnerable population. I have used Native Americans or American Indians or Alaska Natives interchangeably, as all these mean the same.5

**Public Health Problem**

An increase in blood sugar after a meal triggers the production of insulin by the pancreatic beta cells in healthy persons. In reaction, insulin stimulates cellular uptake of plasma glucose. In T2DM, the body either doesn't produce enough insulin to meet its needs or develops insulin resistance, resulting in increase in blood glucose levels. 6 In a diabetic individual, the fasting blood glucose levels (nothing eaten or drank for at least 8 hours) are 126 mg/dl or higher compared to a healthy individual who has fasting blood glucose levels as less than 100 mg/dl.7 High blood glucose can cause heart problems, vision loss and/or kidney problems. Physical inactivity, insulin resistance, obesity and family history are some of the most common causal factors for T2DM.8

**Magnitude Analysis**

Diabetes stands as a substantial global challenge, impacting the health, well-being, and fabric of individuals, families, and societies worldwide. According to the 2021 key global findings 1 in 10 individuals (20-79 years old) have diabetes, which is 537 million people.8 By 2030, this figure is expected to reach 643 million, and by 2045, it will reach 783 million.9 Between 2001 and 2020, diabetes prevalence significantly increased among US individuals aged 18 and above, now affecting 37.3 million individuals, or 11.3% of the population.10 Of these, 28.7 million people were diagnosed with T2DM whereas 8.5 million people have not been diagnosed and are unaware of their condition.10 Care for people with diagnosed diabetes accounts for one-fourth of all health-care spending in the United States, with diabetes accounting for more than half of that expenditure.11 In US, in 2017, the overall projected cost of diagnosed diabetes was $327 billion.11 According to the 2017-18 survey, among US adults with age 18 and above, American Indian/Alaska Native men had a notably higher prevalence of diagnosed diabetes (14.5%) compared to non-Hispanic black (11.4%), non-Hispanic Asian (10.0%), and non-Hispanic white (8.6%) men, and American Indian/Alaska Native women exhibited the highest prevalence of diagnosed diabetes at 14.8%. 12 In 2020, 7.1 million Americans identified as American Indian or Native Alaskan, either alone or in combination with other race groups.13 A related study found a 68% increase in cases of confirmed type 2 diabetes among American Indian and Alaska Native young people (aged 15-19 years) from 1994 to 2004.14 In an interesting study, it was observed that racial/ethnic minorities exhibited a higher burden of diabetes and prediabetes than whites at lower BMIs, implying that variables other than obesity play a role in racial/ethnic differences in diabetes and prediabetes risk, emphasizing the need for specialized screening and prevention methods. Diabetes was found in 9.6% of Native Americans who were of normal weight, compared to whites who had 5% of diabetes prevalence at normal weight.

**Determinants Analysis**

T2DM is a complex illness influenced by several factors, including obesity, genetic susceptibility, behavioural habits, and food choices. Native American young adults were shown to have higher haemoglobin A1c values, higher self-reported blood glucose, self-reported diabetes, and obesity in a longitudinal investigation of a larger general U.S. sample group than Non-Hispanic White Population.15 The impact of behavioural and psychosocial factors is exacerbated in Indigenous groups by Native Americans in the United States diagnosed with T2DM, a significant number of participants reported adverse childhood experiences which were found to be linked to an increased likelihood of screening positive for current depression, with a clear pattern of higher odds associated with a greater number of adverse experiences. 16 Furthermore, given genetic distances and heritability, disparities in diabetes prevalence between Indigenous Americans and other ancestry groups (African Americans, European Americans) are consistent with predictions under evolutionary neutrality.17

**Conclusion**

The prevalence of Type 2 Diabetes Mellitus (T2DM) is a serious global health issue. Millions of people in the United States are now affected by it, and this analysis identified Native American communities as particularly affected by its dramatic increase in prevalence. Moreover, this analysis showed, T2DM as a complicated issue to manage because it is influenced by a variety of factors, including genetics, behaviour, and psychosocial components, particularly among young Native Americans. The next analysis will highlight determinants of T2DM with respect to Native Americans using the Socio-Ecological Model.

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**Literature Review**

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| **Author/Year** | **Study Objectives** | **Location and Participants** | **Key Findings** | **Strengths/Limitations/Implications** |
| Jean M Lawrence et al, 202118 | To calculate variations in type 1 and type 2 diabetes prevalence among kids in the US between 2001 and 2017. | For the years 2001, 2009, and 2017, the number of people under 20 with diabetes who had a doctor's diagnosis was counted in six different locations around the US (4 geographic areas, 1 health plan, and a few American Indian reservations). | The estimated prevalence of type 1 and type 2 diabetes among children and adolescents increased in 6 locations of the US between 2001 and 2017. | * Longitudinal analysis * Inclusivity of diverse populations * Due to cross sectional design, it limits the ability to establish a causal relationship. |
| John M Clements et al, 201919 | To confirm racial inequalities in diabetes mortality rates, see if race predicts the presence of multiple chronic diseases (MCC) that are the leading causes of death (LCD), and see if diabetes combined with MCC acts as a mediator between race and mortality. | Used 2012 claims data from the Centres for Medicare and Medicaid Services (CMS) for all Medicare beneficiaries in the State of Michigan | In the cohort, Black/African Americans had higher chances of the majority of MCC combinations than Whites did, as well as a higher mortality risk that persisted even after accounting for MCC combinations. | * Large sample size * Comprehensive analytical approach * Since retrospective study, hence chances of missing data. |
| Yeyi Zhu et al, 201920 | To look at differences by BMI category in the prevalence of diabetes and prediabetes among different racial/ethnic groups. | Data for this study were from the Patient Outcomes Research to Advance Learning (PORTAL) Network, one of the 13 Clinical Data Research Networks in the National Patient-Cantered Clinical Research Network.  4,906,238 individuals aged ≥20 years during 2012–2013 were included | Racial and ethnic inequalities in diabetes and prediabetes risk may be due to variables other than obesity, which highlights the need for specialized screening and prevention methods. Racial and ethnic minorities had a higher burden of diabetes and prediabetes at lower BMIs than whites. | * Large sample size * It relies on cross sectional study data, due to which temporal sequence inference cannot be determined accurately |
| Even L. Reynolds et al, 202121 | To ascertain if metabolic syndrome (MetS) influences the long-term progression of diabetic sequelae in American Indians with type 2 diabetes, such as neuropathy, cardiovascular autonomic neuropathy (CAN), and kidney disease. | The study included 141 participants, with the majority (73.1%) being female. On average, they were approximately 50 years old, had been living with diabetes for about 20 years, and were followed for an average of 3 years during the study. | Despite steady to improving MetS components, neuropathy and renal disease increased during follow-up in participants with long-standing diabetes, indicating the need for early metabolic management to avert problems in such patients. SBP was linked to each problem, and the number of MetS components was linked to a faster rate of neuropathy progression. | * Comprehensive assessment of complications * The mean follow-up time, i.e., 3 years id less |
| Jessica H L Elm, 202016 | * To examine if moderate and high levels of Adverse Childhood Effects (ACEs) exposures have differential, increasing risk associated with internalizing symptoms for a sample of AI people with T2DM. * To estimate frequencies of eight categories of ACEs. to assess the risk for internalizing symptoms by each ACE category. | The population comprised of recent diagnosis of T2DM, age 18 or older and self-reported Native American Population | Physical abuse was strongly related with anxiety symptoms, while sexual and physical abuse, neglect, and domestic mental illness were positively connected with depressive symptoms. In a dose-response manner, exposure to moderate and high levels of ACEs was linked to higher probabilities of screening positive for current depression, and hence T2DM and related comorbidities. | * Good sample size * Participants may not be able to recall correctly about their childhood experiences * Since it is for tribal population, it can not be generalised for other population |

**AI Appendix**

I used Chat GPT as the AI tool to generate text for my prompt- “Diabetes Mellitus type 2 in Native Americans” and it generated the following text-

‘Diabetes mellitus type 2 (often referred to as type 2 diabetes) is a chronic metabolic disorder characterized by high levels of blood sugar (glucose) resulting from the body's inability to effectively use insulin or produce enough insulin. It is a complex condition influenced by genetic, lifestyle, and environmental factors. Native Americans, particularly some tribes, have a higher prevalence of type 2 diabetes compared to the general population. Here are some key points to consider regarding type 2 diabetes in Native American populations:

1. \*\*Prevalence\*\*: Native Americans, as a group, have one of the highest prevalence rates of type 2 diabetes in the United States. The prevalence varies among tribes and regions, but it is generally higher than the national average.

2. \*\*Genetic Predisposition\*\*: Genetics plays a role in the higher susceptibility of some Native American populations to type 2 diabetes. Certain genetic variations can increase the risk of developing the condition.

3. \*\*Lifestyle Factors\*\*: While genetics contribute to the risk, lifestyle factors such as diet and physical activity also play a crucial role. Many Native American communities have experienced significant dietary and lifestyle changes over the years, with traditional diets being replaced by more processed and high-sugar foods, and sedentary lifestyles becoming more common.

4. \*\*Obesity\*\*: Obesity is a significant risk factor for type 2 diabetes, and it is prevalent among Native American populations. High rates of obesity contribute to the increased incidence of diabetes.

5. \*\*Access to Healthcare\*\*: Access to healthcare services can be limited in some Native American communities, which may affect the diagnosis and management of diabetes. Regular monitoring, access to medications, and healthcare education are essential for diabetes management.

6. \*\*Cultural Factors\*\*: Cultural beliefs and practices can influence healthcare decisions and diabetes management in Native American communities. It's important to consider cultural sensitivity and incorporate traditional practices when providing healthcare services.

7. \*\*Complications\*\*: Diabetes can lead to various complications, including cardiovascular disease, kidney disease, and nerve damage. Native Americans with diabetes may face a higher risk of these complications.

8. \*\*Prevention and Management\*\*: Preventing and managing type 2 diabetes in Native American populations require a comprehensive approach that includes education, lifestyle modifications, and access to healthcare. Community-based programs and interventions that address the specific needs of these populations can be effective.

9. \*\*Research and Collaboration\*\*: Ongoing research and collaboration between healthcare providers, researchers, and Native American communities are essential to better understand the factors contributing to type 2 diabetes and develop culturally appropriate prevention and management strategies.

Overall, addressing the high prevalence of type 2 diabetes in Native American populations requires a holistic approach that considers genetic, cultural, and socio-economic factors while promoting healthier lifestyles and improving access to healthcare.’