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INTRODUCTION

Health Problem

Type 2 diabetes mellitus (T2DM) is a chronic metabolic condition in which the body is unable to effectively use insulin, leading to elevated blood glucose levels. Diabetes mellitus is a group of heterogeneous disorders that share a common feature of increased blood glucose (Harreiter & Roden, 2023). T2DM specifically develops from a combination of insulin resistance and relative insulin deficiency. Unlike type 1 diabetes mellitus (T1DM), an autoimmune condition in which the immune system destroys the insulin producing beta cells in the pancreas resulting in a complete absence of insulin that requires lifelong insulin therapy, T2DM develops when the body becomes resistant to insulin and can no longer use it effectively, though insulin production continues (Krause & De Vito, 2023). T2DM is diagnosed through fasting glucose tests, oral glucose tolerance tests, or hemoglobin A1c measurement, with the A1c test increasingly preferred in clinical practice because it is practical and reliable. There are several well documented risk factors that drive progression from prediabetes to T2DM, including age, male sex, family history of T2DM, high BMI, high waist circumference, smoking, physical inactivity, anxiety, depression, hypertension, and elevated triglycerides, all of which significantly predict T2DM development in people with prediabetes (*Hu et al.*, 2025). Where a person lives also plays a role. People living in socioeconomically disadvantaged areas have significantly higher odds of developing T2DM, with poverty, low educational attainment, and limited healthcare access all identified as contributing factors (*Schwartz et al.*, 2022).

T2DM does not affect all populations equally. Global Burden of Disease data from 204 countries and territories show that T2DM prevalence among adolescents aged 10 to 24 has

increased since 1990, with high income regions showing some of the fastest increases driven largely by rising obesity rates and changing dietary patterns; these trends are projected to continue through 2030, raising serious concerns about the long term burden of early onset T2DM (*Chen et al.*, 2025). People with T2DM have a higher risk of developing eating disorders, particularly binge eating disorder and night eating syndrome, both of which can interfere with diabetes management and worsen outcomes over time (*Celik Esmer et al.*, 2025). People from ethnic minority communities with T2DM also face real barriers to taking their medications consistently, including language barriers, low health literacy, and lack of access to culturally appropriate care (*Parmar et al.*, 2025). The relationship between mental health and T2DM is also well established in the research literature. Depression has been identified as both a risk factor for and a complication of T2DM: between 11% and 30% of patients with diabetes have comorbid depression, and depression is associated with hyperglycemia and an increased risk for diabetic complications (*Anderson et al.*, 2001). Relief of depression has also been associated with improved glycemic control, which positions mental health treatment as a meaningful component of T2DM management. This relationship proves to be significant as it has been documented in populations worldwide; among T2DM patients in China, depression is both highly prevalent and significantly associated with poorer glycemic outcomes, reinforcing that the mental health burden of T2DM extends across cultural and geographic contexts (*Zhang et al.*, 2022).

AI/AN populations have the highest T2DM prevalence of any racial or ethnic group in the United States, roughly twice that of the general population for T2DM and roughly three times that of the general population for diabetes mellitus in general. They are also more likely to develop T2DM earlier in life, experience more severe complications such as diabetic kidney disease, and have higher rates of diabetes related death. Disparities are influenced by biological

risk factors, behavioral contributors, and cultural or racial inequities. This review aims to examine the contributing factors that lead to higher rates of T2DM in AN/AI populations than other populations, to evaluate biological, psychological, social and structural determinants that contribute to these elevated levels, and to assess the effectiveness of existing interventions.

METHODS

A search was conducted across two databases to find peer reviewed studies on risk factors for T2DM in Native American and American Indian populations. To be included, articles had to be peer reviewed, available online, and published within the last ten years, with nothing earlier than 2015. Articles were excluded if the study sample was not based in the United States. Articles were selected through a three-step process. Titles were reviewed first to check for relevance to the research question, then abstracts were reviewed to see if the study fit into subtopics in the introduction, results or discussion sections, and finally full texts were reviewed to confirm that all inclusion criteria were met.

The first database searched was UGALibraries/EBSCO. The search terms used were: (type 2 diabetes OR T2DM OR diabetes mellitus type 2) AND (Native American OR American Indian OR Indigenous) AND (risk factors OR contributing factors). Results were filtered by publication date (2015 to present), peer reviewed status, online availability, diabetes mellitus, type 2, and upon the title review stage, United States based samples. The initial search yielded 1,099 articles. After filters were applied, 338 articles remained. Title screening, especially for United States based samples, reduced this to roughly 40 articles, which were then advanced to abstract review. After reviewing abstracts, 22 articles moved on to full-text review, and ten were ultimately included.

The second database searched was PubMed. The search terms used were type 2 diabetes AND Native American AND risk factors. The same criteria were applied, filtering for articles published in the last ten years, online availability, peer reviewed status, and upon the title review stage, United States based samples. Articles were also manually checked to confirm that study samples were based in the United States. The initial search yielded 63 articles. After filters were applied, 13 articles remained. Title screening reduced this to 11 articles, which were then advanced to abstract review. After reviewing abstracts, ten articles moved on to full-text review, and all ten were ultimately included.

RESULTS

Metabolic and Biological Risk Factors of Type 2 Diabetes Mellitus

Early metabolic risk factors play a significant role in the development of T2DM, particularly when they appear during youth. *Sauder et al.* (2018) examined metabolic clustering in a sample of obese American Indian children and adolescents and found that the degree of insulin resistance, not obesity alone, was the critical variable in determining T2DM risk. Severely insulin resistant youth showed significantly higher visceral adiposity, lower HDL, and an impaired balance between insulin sensitivity and beta cell compensation compared to moderately insulin resistant peers with similar BMIs. Elevated triglycerides compounded this risk further, making obesity, insulin resistance, and elevated triglycerides the three key early metabolic risk factors for T2DM development in this American Indian youth population. Building on these findings, *Wheelock et al.* (2016) followed 5,532 non-diabetic Pima Indian children between the ages of 5 and 19 for a median period of 12.4 years and found that 1,281 of those children eventually developed T2DM. High BMI and impaired glucose tolerance at

baseline were the strongest predictors of future T2DM incidence, while blood pressure and cholesterol were comparatively weaker predictors, underscoring the centrality of weight status and glucose regulation as early indicators of long-term risk. These risks are especially pronounced among AI/AN youth. *Wedekind et al.* (2021), in a review of T2DM epidemiology in Indigenous communities in the United States, found that T2DM prevalence and incidence in AI/AN youth are significantly higher than in the general U.S. youth population, and that early onset T2DM in these communities creates a particular challenge for preventing complications across the lifespan (*Sauder et al.*, 2018; *Wheelock et al.*, 2016; *Wedekind et al.*, 2021).

These metabolic vulnerabilities are especially concerning in American Indian communities, where a specific metabolic risk profile has been identified. *Rumbea* et al. (2025), studying middle aged and older American Indian adults, found that the hypertriglyceridemic waist phenotype, characterized by the combination of elevated triglycerides and increased waist circumference, was significantly associated with increased odds of T2DM. This metabolic risk profile is particularly prevalent in American Indian populations and strongly predicts T2DM development, pointing to the compounding effect of abdominal obesity and lipid dysregulation in these communities (*Rumbea et al.*, 2025).

Beyond metabolic risk factors, certain genetic variants unique to AI/AN/NA populations appear to further increase T2DM susceptibility. *Muller et al.* (2018), working with researchers at the Phoenix Epidemiology and Clinical Research Branch of the NIH, used whole genome sequence data from 335 American Indians to identify novel variants in the IGF1R gene, then analyzed their associations with T2DM in a population-based sample of 7,701 American Indians. They identified a novel glycine to aspartic acid substitution known as the G310D variant, which was associated with T2DM in a sex specific manner. In women, the risk allele was associated

with more than double the odds of developing T2DM (OR = 2.23; 95% CI = 1.54 to 3.23) and an earlier age of onset, suggesting that this variant may impair IGF1R signaling pathways in ways that meaningfully increase diabetes risk in this population (*Muller et al.*, 2018).

The ACAD10 gene represents another population specific genetic contributor to T2DM risk. *Bloom et al.* (2018) examined the link between ACAD10 deficiency and T2DM in the Pima Indian population, which has some of the highest rates of insulin resistance and T2DM of any group studied. The study investigated ACAD10, a gene that catalyzes mitochondrial fatty acid beta oxidation, as a candidate for T2DM given that dysregulation of this pathway plays a meaningful role in the development of insulin resistance. Variants in this gene were associated with T2DM, insulin resistance, and impaired lipid oxidation in American Indian populations. These findings indicate that disrupted fatty acid metabolism at the genetic level is a meaningful contributor to T2DM development in these communities (*Bloom et al.*, 2018).

Mental Health and Psychosocial Factors of Type 2 Diabetes Mellitus

The relationship between depression and T2DM outcomes has been documented in community based research. *Goins et al.* (2019) examined this relationship specifically within an American Indian population. The study drew from the Native Elder Care Study and included 222 community-dwelling American Indians aged 55 and older with existing T2DM diagnoses, from a federally recognized tribe of approximately 16,000 enrolled members. Depressive symptom severity was significantly associated with all-cause mortality, with participants in the third highest CES-D category facing more than twice the mortality risk of those in the lowest category (hazard ratio = 2.07; 95% CI = 1.07 to 4.04). These findings suggest that depression is not incidental to T2DM in AI/AN communities; it actively worsens outcomes and likely contributes

to disease development. *Wang et al.* (2025) extended this line of inquiry using data from the Behavioral Risk Factor Surveillance System, examining 2,272 self-identified non-Hispanic AI/AN adults with diabetes from 2018 to 2021. They found that 24.8% of participants had a diagnosed depressive disorder and that poor mental health was significantly associated with reduced engagement in diabetes management behaviors, including fewer foot checks and less participation in diabetes education (*Goins et al.*, 2019; *Wang et al.*, 2025).

Beyond depression, there are several psychosocial barriers that make prevention and management of T2DM more difficult in these communities. *Moore et al.* (2024) identified financial stress, limited access to food and other resources, and cultural norms around food as key lifestyle barriers for AI/AN/NA individuals at risk for or living with T2DM. *Rutledge et al.* (2024) expanded on this through qualitative interviews with Black, Hispanic, and American Indian adult males who were diagnosed with diabetes or identified as at risk, and found that mistrust of the healthcare system and low socioeconomic status compounded barriers related to the financial cost of healthy resources and limited access to care. That same study identified family support, self-efficacy, and awareness of health status as meaningful facilitators of healthier behavior, pointing to protective factors that prevention efforts could intentionally build upon. *Thiels et al.* (2017) noted an additional protective factor in early intervention efforts among youth populations. Through the Tribal Turning Point pilot study, a community based program targeting metabolic risk factors in AI/AN youth, *Thiels et al.* (2017) found that early intervention was effective in reducing T2DM risk factors before disease onset in youth populations. *Rodriguez Espinosa et al.* (2022) further examined this relationship in an urban Indigenous sample using a community-based approach and found that historical trauma was significantly associated with psychosocial risk factors including depression, anxiety, and food

insecurity among adults already at risk for diabetes, reinforcing the idea that the psychological weight of historical oppression does not diminish in urban settings and continues to shape T2DM vulnerability across geographic contexts. These barriers interact with depression and limited healthcare access to make it harder for people in these communities to get the care they need (*Moore et al.*, 2024; *Rutledge et al.*, 2024; *Thiels et al.*, 2017; *Rodriguez Espinosa et al.*, 2022).

Dietary and Environmental Factors and Healthcare Access of Type 2 Diabetes Mellitus

Diet and food access are closely linked to T2DM risk in AI/AN/NA communities. *Huyser et al.* (2025) examined the prevalence of obesity and the role of social determinants of health among 20,698 AI/AN young adults ages 18 to 24 drawn from the Indian Health Service Improving Delivery Data Project. The study found that 37% of the sample met obesity criteria, and that individuals living in counties with lower educational attainment and higher poverty rates had greater odds of obesity. Western food environments and food deserts in tribal areas were identified as structural contributors to T2DM risk in this population. *Love et al.* (2019), in the Tribal Health and Resilience in Vulnerable Environments study conducted with American Indians in rural Oklahoma, found that the prevalence of diabetes was higher among participants with inadequate food access (28.4%) compared to those with adequate food access (18.4%). Obesity and hypertension followed the same pattern, pointing to food insecurity as a direct contributor to T2DM risk in tribal communities (*Huyser et al.*, 2025; *Love et al.*, 2019).

Moore et al. (2024) looked more closely at what makes healthy eating difficult for AI/AN adults already living with or at risk for T2DM. The study used qualitative interviews with national content experts in diabetes nutrition, including registered dietitians, diabetes educators, and food insecurity specialists, as well as community key informants such as tribal health administrators, nutrition educators, Native elders, and tribal leaders across rural and urban

AI/AN sites. Rural and reservation dwelling participants identified loss of traditional foods as their primary barrier to healthy eating, while urban participants pointed to the high cost of healthy food and limited income. Across both groups, barriers included high food prices, limited cooking knowledge, food waste, and transportation challenges. Distance to grocery stores was a particularly significant access barrier in rural areas, all of which contribute directly to increased T2DM risk (*Moore et al.*, 2024). McKinley and Jernigan (2023) traced the origins of this disconnection from traditional foods to specific federal policies, including forced relocation and land dispossession, that systematically dismantled Indigenous food systems and replaced subsistence practices with dependence on government commodity foods. Qualitative research with Indigenous community members found that participants directly connected this diet transition to the rise of diabetes and obesity in their communities, positioning the loss of food sovereignty not merely as a nutritional problem but as an ongoing consequence of structural oppression (McKinley & Jernigan, 2023). *Satterfield et al.* (2016) demonstrated that tribally driven programs working to restore access to traditional foods across 17 tribal partner communities between 2008 and 2014 produced sustained improvements in community health behaviors, with quantitative results showing increased availability of healthy foods across community venues and qualitative findings underscoring that traditional foods were understood by participants as inseparable from land, identity, and cultural wellbeing. These findings point to food sovereignty as both a meaningful protective factor against T2DM and a necessary component of any culturally grounded prevention strategy in AI/AN communities (*Satterfield et al.*, 2016).

Structural and Systemic Determinants of Type 2 Diabetes Mellitus

The structural and systemic conditions that shape daily life in AI/AN/NA communities play a significant role in driving T2DM disparities. *Mitchell et al.* (2020) applied a social determinant of health framework to examine how historical and ongoing structural inequities, including forced relocation, land dispossession, and cultural suppression, contribute to disproportionate T2DM rates in AI/AN communities. It found that AI/ANs are diagnosed with T2DM more than twice as often as non-Hispanic White Americans, and that individual behavioral interventions alone do not adequately address the root causes of diabetes in these communities. Systemic racism and cultural trauma were identified as fundamental drivers of the health disparities that increase T2DM risk. *Gillson et al.* (2024) conducted a community-based participatory research study with five AI tribal communities and 192 AI adults living with T2DM. They found that personal and ancestral experiences of historical oppression, including boarding schools and forced relocation, were significantly associated with increased depressive and anxiety symptoms, showing that the psychological weight of structural racism directly worsens health outcomes in communities already managing T2DM (*Mitchell et al.*, 2020; *Gillson et al.*, 2024). *Warne et al.* (2025) documented a specific and measurable dimension of this structural disadvantage, finding that IHS per capita spending in 2017 was $4,708, a figure that stood in stark contrast to per capita spending of $13,185 for Medicare, $10,692 for the Veterans Health Administration, and $8,600 for federal prisoners. This chronic underfunding, compounded by provider shortages, geographic isolation, long travel distances to care, and a long-standing mistrust of the healthcare system rooted in lived and historical experiences of abuse and exploitation, creates compounding barriers to T2DM care and prevention that cannot be addressed through clinical interventions alone (*Warne et al.*, 2025).

Stotz et al. (2021), in a scoping review of multilevel diabetes prevention and treatment interventions for Native people in the United States and Canada, found that the most effective approaches addressed structural barriers in combination with individual and community level factors rather than treating them in isolation. The review reinforced the conclusion that behavioral change programs implemented without attention to the social, economic, and political conditions shaping AI/AN health are unlikely to produce lasting reductions in T2DM burden in these communities (*Stotz et al.*, 2021).

Lucero and Roubideaux (2022) documented the long-term consequences of these disparities through a comprehensive review. The review tracked American Indian and Alaska Native adults receiving care through Indian Health Service facilities over approximately 20 years of the Special Diabetes Program for Indians, representing a large and geographically diverse population across multiple IHS regions. Despite a 54% decrease in new cases of diabetes related kidney failure in AI/AN adults over the period studied, this disparity persists relative to other racial and ethnic groups. Age adjusted diabetes mortality rates in AI/AN communities remain 3.2 times greater than those of the overall U.S. population. The prevalence of diabetes in AI/AN adults decreased only slightly from 15.4% to 14.6% between 2013 and 2017, and diabetes remains the fourth leading cause of death for this population, emphasizing the severity of the ongoing disparity (Lucero and Roubideaux, 2022).

DISCUSSION

The findings of this review highlight the complex and layered nature of T2DM risk in American Indian and Alaska Native communities. Across each domain examined, disparities in T2DM prevalence, onset, and outcomes are shaped not by any single factor, but by the

interaction of biological, psychological, environmental, and structural forces that compound one another over time.

The metabolic and biological evidence makes clear that T2DM risk in AI/AN populations begins early and is biologically distinct. Insulin resistance, elevated triglycerides, abdominal obesity, and population specific genetic variants such as the IGF1R G310D mutation and ACAD10 polymorphisms all contribute to a risk profile that is both more prevalent and more severe in these communities than in the general U.S. population. Early onset T2DM in AI/AN youth is particularly concerning given that more years of disease exposure translates into earlier and more severe complications across the lifespan (*Hu et al.*, 2025).

Mental health plays a meaningful role in T2DM risk and management in AI/AN communities that is often overlooked in clinical practice. Depression is not only more common among people with T2DM but also interferes with the ability to manage the disease effectively, as shown by reduced participation in diabetes education and lower rates of self-care behaviors among AI/AN adults with diagnosed depressive disorders (*Anderson et al.*, 2001). Financial stress, limited access to food and resources, and cultural barriers around food further complicate disease prevention and management for this population (*Parmar et al.*, 2025).

Food access and dietary patterns are closely tied to T2DM risk, and the evidence points clearly to structural food insecurity as a major driver of poor health outcomes in tribal communities. The loss of traditional foods, the presence of food deserts on and near reservations, high food costs, and limited transportation all reduce access to the kinds of foods that support metabolic health, creating conditions in which healthy eating is difficult regardless of individual motivation or knowledge (*Schwartz et al.*, 2022).

At the broadest level, the structural and systemic forces shaping these disparities trace back to colonization, forced relocation, land dispossession, and the intergenerational trauma that followed. These are not background factors. They are active contributors to the chronic stress, disrupted food systems, limited healthcare access, and psychological burden that drive T2DM rates in AI/AN communities today. Individual and behavioral interventions, while valuable, cannot address these root causes on their own.

Despite the severity of these disparities, there is meaningful evidence that targeted, culturally grounded interventions can improve outcomes. Nutrition education programs designed for AI/AN adults with T2DM have shown improvements in dietary behaviors and self-efficacy around food choices, demonstrating that people in these communities are willing and able to engage with health interventions when they are delivered in culturally relevant ways. The Tribal Turning Point pilot study showed that community-based programming targeted at AI/AN youth was effective in addressing the metabolic risk factors that predispose young people to T2DM, pointing to the value of early intervention before disease onset. Across these efforts, the evidence consistently shows that community involvement, cultural relevance, and local ownership of programs are the factors most strongly associated with sustained engagement. Strategies that combine educational campaigns on diet and lifestyle with improved community access to care, such as mobile healthcare units that bring services directly to people who face transportation or geographic barriers, are particularly promising interventions for reaching the populations most affected by these disparities. Organizations such as the National Indian Council on Aging provide diabetes education resources specifically designed for AI/AN elders, representing one example of culturally relevant support infrastructure that complements clinical care (National Indian Council on Aging, n.d.).

Limitations

This review examined T2DM risk in AI/AN/NA populations across four areas: metabolic and biological risk factors, mental health and psychosocial burden, dietary and environmental conditions, and structural and systemic inequities. The evidence across all four areas points to a consistent and serious disparity in T2DM burden. However, there are several important limitations to note about both this review and the studies it draws from.

One limitation is that the disparities described in this review cannot be attributed to any single cause. While this review organizes findings into separate categories, in practice these factors do not operate independently. Biological risk, psychosocial burden, food insecurity, and structural racism all interact with and reinforce one another. Attributing T2DM disparities primarily to culture, for example, would overlook the degree to which poverty, limited healthcare access, and the lasting effects of colonization shape the conditions in which people live, regardless of cultural identity (*Schwartz et al.*, 2022).

Genetic susceptibility is also an important but partial explanation. The IGF1R and ACAD10 variants identified in American Indian populations do contribute to elevated T2DM risk, but they do not fully account for the scale of the disparity. The gap between AI/AN populations and the general U.S. population in T2DM rates is too large to be explained by genetics alone, and the evidence reviewed here makes clear that environmental and structural factors carry significant weight alongside biological ones (*Hu et al.*, 2025).

Another limitation is the scarcity of research on AI/AN/NA populations generally. Because many of these communities are geographically isolated and historically underrepresented in health research, the available literature is limited in both volume and scope. Many of the studies reviewed relied on small or regionally specific samples, which limits how

broadly the findings can be applied across the diversity of tribal nations and communities in the United States. More large scale, community partnered research is needed to fill these gaps.

Finally, the most positive outcomes identified in the studies reviewed were consistently tied to interventions that were culturally grounded and community driven. This is worth noting as a limitation of more general approaches to diabetes prevention and care. Programs that do not reflect the values, traditions, and social structures of AI/AN/NA communities are less likely to produce meaningful or lasting results, and the evidence reviewed here suggests that this is especially true for a population whose relationship with outside institutions has historically been defined by harm.

CONCLUSION

Type 2 diabetes mellitus remains one of the most serious health disparities facing Native American and American Indian communities in the United States. The evidence reviewed here shows that elevated T2DM rates in these populations are driven by early metabolic risk, dietary transitions away from traditional foods, psychosocial stressors that compound with age, structural inequities, and limited access to adequate healthcare. These factors interact with and reinforce one another in ways that make T2DM both more likely to develop and harder to manage once it does.

The research consistently shows that prevention works best when it is culturally relevant, community based, and initiated before T2DM develops. Programs that reflect the values of AI/AN/NA communities, involve community members in their design, and reach people before diagnosis have produced the strongest results. Waiting until after diagnosis to intervene means

missing the window when the most can be done to prevent or delay the disease and its complications.

Addressing T2DM in these communities requires more than clinical care. It requires attention to the structural conditions that drive risk, including food insecurity, limited transportation, inadequate healthcare infrastructure, and the ongoing effects of historical trauma and systemic racism. These communities are not simply at higher risk for T2DM. They are at higher risk because of conditions that are largely outside their individual control. Any meaningful effort to reduce these disparities must take that reality seriously.

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