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MANUSCRIPT

Splenda and Health Disparities: Examining its Effects on Adults with Type 2 Diabetes in the Texas-Mexico Border

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Introduction

This literature review investigates the complex relationship between sucralose (Splenda), a widely used artificial sweetener, and health disparities among adults with type 2 diabetes (T2D) in the Texas-Mexico border region. The review explores the interplay of factors contributing to the disproportionate burden of T2D and its complications in this population while examining Splenda's potential role in exacerbating or mitigating these health challenges. Sucralose, a chlorinated sucrose derivative, is approximately 600 times sweeter than sucrose and is largely excreted unchanged in urine. This characteristic has led to its promotion as a calorie-free alternative to sugar. However, the long-term health effects of sucralose, especially in vulnerable populations like those with T2D, remain a subject of ongoing debate. This review will synthesize existing research on Splenda's effects on metabolic health, critically evaluate studies examining health disparities in the border region, and investigate the potential interaction between Splenda consumption and the various factors contributing to those disparities.

Health Disparities in the Texas-Mexico Border Region

The Texas-Mexico border region is characterized by significant health disparities, particularly among Latino populations.[1-3] These disparities manifest as higher rates of chronic diseases like T2D, limited healthcare access, lower socioeconomic status, and cultural and linguistic barriers to healthcare navigation.[4-6] The binational nature of the region further complicates healthcare access, with many residents utilizing healthcare systems in both the United States and Mexico.[2] This complex interplay of socioeconomic, cultural, and geographical factors creates a

challenging context for examining the health effects of dietary choices, including artificial sweetener consumption.[7]

Poverty is a pervasive issue, with a substantial portion of the population below the federal poverty level.[3.5-6] This impacts access to nutritious food, safe housing, and reliable transportation.[1,5] The region also faces challenges related to access to clean water and sanitation.[5] The significant presence of undocumented immigrants creates additional barriers to healthcare access due to fear of deportation and lack of legal protection.[2,6] Limited culturally competent healthcare providers and language barriers further complicate the issue.[1,7] Cultural norms and beliefs influence health behaviors and healthcare-seeking.[7,8] The cumulative effect of these social determinants creates a cycle of poor health outcomes.[3,9]

The Texas-Mexico border region exhibits alarmingly high rates of diabetes and related chronic diseases.[4,5,10] T2D is significantly prevalent among Latinos in this area, often linked to poor dietary habits, limited physical activity, and genetic predispositions.[4,5] This high prevalence contributes to increased rates of cardiovascular disease, kidney disease, and other diabetes-related complications.[4,11] Obesity, a major risk factor for several cancers and T2D, is another significant health concern.[5,12] The high rates of these chronic diseases place a substantial burden on individuals, families, and the healthcare system.[4,13] The high rate of uninsured individuals further exacerbates these issues, limiting access to preventative care and timely treatment.[2-3,6]

Several factors hinder access to quality healthcare and nutritional education. Financial constraints are a major barrier, with many individuals lacking health insurance or facing high out-of-pocket costs.[2-3,5] Limited access to transportation makes it difficult to reach healthcare facilities and participate in educational programs.[1,4] Language barriers also present a significant challenge, as many individuals may not be fluent in English.[4,7] Cultural barriers, including mistrust of the healthcare system and differing cultural beliefs about health and illness, further complicate access to care.[7-8] The lack of culturally tailored health education programs further limits the effectiveness of preventative measures.[12] The fragmented nature of the healthcare system, with limited access to specialists and integrated care, makes it challenging to manage chronic conditions effectively.[9,10] The lack of adequate resources, both financial and human, within the healthcare system often limits the capacity to provide comprehensive care and effective health education programs.[6,10] This is further compounded by the increasing demand for services in a region already experiencing significant shortages of healthcare professionals, particularly specialists.[10]

Impact of Artificial Sweeteners on Health

Artificial sweeteners have become increasingly prevalent as low-calorie alternatives to sugar. While their use is driven by weight management and reduced caloric intake, their long-term health implications remain a subject of debate. This section reviews the literature on the effects of

artificial sweeteners, focusing on their impact on metabolic health, glycemic control, and potential risks associated with long-term consumption.

Numerous studies have investigated the effects of artificial sweeteners on various aspects of metabolic health. These studies have employed diverse methodologies, including randomized controlled trials (RCTs) and observational studies, leading to a complex and sometimes contradictory body of evidence.[14-15] Some research suggests a potential link between artificial sweetener consumption and adverse metabolic outcomes, such as an increased risk of stroke, coronary heart disease, and mortality.[14] However, observational studies cannot definitively establish causality. Other studies have found no significant association between artificial sweetener use and negative metabolic effects.[15] The discrepancies may be due to differences in study design, participant populations, types and amounts of artificial sweeteners consumed, and the duration of consumption.

Sucralose, often marketed as a suitable alternative for individuals with diabetes due to its negligible impact on blood glucose levels, is a widely used artificial sweetener. While acute studies show minimal effect on immediate blood glucose, the long-term effects on glycemic control remain less clear. Some research suggests that regular consumption may affect gut microbiota composition and function, potentially altering metabolic processes and influencing insulin sensitivity.[16] This could indirectly affect glycemic control, although the mechanisms and extent of this influence need further investigation. Some evidence suggests that long-term consumption could contribute to insulin resistance, potentially impairing glycemic control.[14] However, other studies have not found a clear link between artificial sweetener use and changes in insulin sensitivity or HbA1c levels.

Concerns remain regarding potential long-term health risks associated with artificial sweeteners. These include potential adverse cardiovascular events and disruptions to the gut microbiota, leading to metabolic disturbances.[14,16] Some research suggests a potential link between artificial sweetener consumption and certain cancers, although more research is needed to establish a definitive causal relationship. Another critical area of concern is the potential impact on weight management. While artificial sweeteners are often used to aid weight loss, some studies have reported a paradoxical association between artificial sweetener consumption and weight gain.[14] This may be due to several mechanisms, including altered gut microbiota, increased appetite, and changes in energy balance. The impact of artificial sweetener consumption on kidney function and the risk of chronic kidney disease is currently unclear. The majority of research on artificial sweeteners focuses on their direct effects, often overlooking the complex interplay between dietary habits, lifestyle factors, and overall health. Future research should prioritize studies that consider these interactions to provide a more comprehensive understanding of the long-term health implications of artificial sweeteners.

Cultural Considerations

The cultural nuances surrounding sweetener consumption, particularly Splenda, and their implications for health behaviors among adults with T2D in the Texas-Mexico border region. Understanding these cultural factors is crucial for designing effective and culturally sensitive interventions to improve diabetes management. We will explore cultural attitudes towards sweeteners and dietary habits within the Latino population, the influence of acculturation on dietary choices and health behaviors, and strategies for developing health education interventions that resonate within the specific cultural contexts of this border region.

The Latino population encompasses a vast array of cultural groups, each with unique traditions and dietary practices.[8] Traditional Latino diets often incorporate naturally sweet foods like fruits and honey, but the increasing availability and marketing of processed foods and sugar-sweetened beverages have significantly altered dietary habits.[8] This shift is particularly pronounced in urban areas and among more acculturated populations.[8] The preference for specific sweeteners, including the acceptance or rejection of artificial sweeteners like Splenda, is likely influenced by various factors, including taste preferences, perceived health benefits, and cultural beliefs about food and health.[8] Studies examining the specific perceptions and attitudes toward Splenda amongst different Latino subgroups within the border region are limited, highlighting a critical gap in the current research.[8]

Acculturation significantly shapes dietary choices and health behaviors among Latinos in the U.S.-Mexico border region.[8] Less acculturated individuals may maintain traditional diets higher in fruits and vegetables, while more acculturated individuals may adopt diets more similar to those of the mainstream American population, often characterized by higher consumption of processed foods, sugar-sweetened beverages, and artificial sweeteners.[8] This shift in dietary habits can contribute to an increased risk of T2D and related complications.[8] The impact of acculturation on the use of artificial sweeteners like Splenda requires further investigation.[8] Acculturation can also affect other health behaviors, including access to and utilization of healthcare services.[2] Language barriers, cultural beliefs about healthcare, and immigration status can all influence the extent to which individuals seek medical care and adhere to treatment plans.[2,7]

Developing effective health education interventions requires careful consideration of cultural contexts. [12] Interventions must be culturally sensitive and tailored to address the specific needs and beliefs of the target population.[12] This includes using appropriate language, employing culturally relevant communication strategies, and incorporating culturally sensitive educational materials.[12] The design of interventions should reflect an understanding of the cultural attitudes towards sweeteners and dietary habits within the specific Latino subgroups of the border region.[12] The role of family and community in health decision-making should also be considered.[7] Interventions should incorporate the family and community as partners in promoting healthy behaviors.[7] Addressing potential health literacy challenges is also crucial.6 Health

education materials should be clear, concise, and easy to understand.[6] The broader socioeconomic context must be considered.[5] Interventions should address these broader social determinants of health in addition to focusing on individual behaviors.[5]

Methodological Approaches for Assessing Effects

This section examines the methodological approaches used in research assessing the effects of sucralose (Splenda) on health outcomes, particularly its impact on adults with T2D in the Texas-Mexico border region. A critical evaluation of these methods is crucial for understanding the strengths and limitations of existing evidence and identifying areas requiring further investigation. The review will address the types of research designs used, the importance of longitudinal studies for capturing long-term effects, and the value of mixed-methods approaches for incorporating qualitative data on patient experiences.

Studies investigating the effects of Splenda on health have utilized a range of methodologies, including randomized controlled trials (RCTs) and observational designs, such as cohort studies and case-control studies.[14-15,17-18] RCTs are considered the gold standard for establishing causality, but they often have limitations in terms of generalizability, particularly when studying specific populations like those in the Texas-Mexico border region.[8] Furthermore, the duration of many RCTs is relatively short, limiting their ability to assess long-term effects.[17] Observational studies are useful for investigating long-term effects and exploring multiple risk factors, but they cannot definitively establish causality due to the presence of potential confounding variables.[14]

Longitudinal studies, which track participants over time, are crucial for understanding the cumulative effects of Splenda consumption and the potential development of chronic diseases.[15] Longitudinal studies can help elucidate how Splenda consumption interacts with other factors, such as access to healthcare, diet, and lifestyle, to influence health outcomes in this vulnerable population.[8] Mixed-methods approaches, which integrate quantitative and qualitative methods, can provide a more comprehensive understanding by incorporating patients' lived experiences and perspectives.[19] Qualitative data, such as in-depth interviews or focus groups, can provide rich insights into how Splenda use affects individuals' daily lives, their perceptions of its effects, and their decision-making processes regarding its consumption.[7] In the context of the Texas-Mexico border region, a mixed-methods approach is particularly valuable for addressing cultural factors and health disparities.[8]

Several methodological gaps remain. Many studies lack sufficient sample sizes, limiting the statistical power and generalizability of their findings.[19] Furthermore, the studies often fail to adequately account for confounding variables, making it difficult to isolate the effects of Splenda. Future research should prioritize larger, well-designed longitudinal studies that incorporate mixed-methods approaches to address these limitations.[8] These studies should specifically address the unique context of the Texas-Mexico border region, considering the socioeconomic, cultural, and healthcare access factors that influence diabetes management and

Splenda use.[8] Studies should focus on developing and validating culturally appropriate assessment tools and questionnaires to ensure accurate data collection in this diverse population.[19]

Conclusion

This literature review examined the effects of Splenda on the health of adults with Type 2 Diabetes (T2D) in the Texas-Mexico border region. The lack of direct research on Splenda in this specific context highlights a critical gap in the current literature, underscoring the need for future investigations.

The reviewed studies reveal a complex interplay of factors influencing diabetes management and outcomes in the Texas-Mexico border region. High rates of T2D among Latinos in this area are well-documented, and these disparities are linked to several factors, including socioeconomic status, access to healthcare, language barriers, and a lack of social and environmental support for disease management. The studies highlight the significant challenges faced by this population, including limited health insurance coverage, insufficient provider capacity, and barriers related to transportation, cost, and fear of deportation. These challenges are exacerbated by the unique binational environment of the region, where access to healthcare in Mexico may be a factor for some individuals. Additionally, the influence of environmental factors, such as proximity to industrial sites, may further contribute to health disparities.

The existing research on artificial sweeteners presents both potential benefits and risks. Some studies suggest that artificial sweeteners may aid in weight management and not directly impact blood glucose levels, which could be beneficial for managing T2D. However, other research raises concerns about potential negative impacts on gut microbiota, insulin sensitivity, and even weight gain. The long-term effects of artificial sweeteners remain unclear, and conflicting findings highlight the need for more research. The absence of research directly investigating Splenda's impact on the metabolic health of adults with T2D in this specific border region leaves a significant gap in our understanding. This gap is particularly concerning given the already existing health disparities within this vulnerable population.

Several crucial areas require further investigation. First, a dedicated study is needed to specifically assess the effects of Splenda consumption on adults with T2D in this region. This study should consider the unique socioeconomic and environmental factors affecting this population. The study design should account for potential confounding variables, such as diet, lifestyle, access to healthcare, and other health conditions, to isolate the effects of Splenda. Second, research should explore the potential interaction between Splenda consumption and the gut microbiome within this population. The gut microbiome plays a critical role in metabolic health, and alterations to its composition could significantly impact diabetes management. This research should employ advanced techniques to analyze the gut microbiome's composition and function in response to Splenda consumption. Third, research should investigate the long-term

effects of Splenda consumption on cardiovascular health and other diabetes-related complications in this population. The existing literature on artificial sweeteners shows conflicting results regarding their long-term effects, and this needs clarification specifically in the context of the Texas-Mexico border region. Longitudinal studies are necessary to track the health outcomes of individuals consuming Splenda over an extended period. Fourth, qualitative research methods could provide valuable insights into the perspectives and experiences of individuals with T2D in this region regarding their dietary choices and perceptions of artificial sweeteners. Understanding the cultural context and social determinants of health is crucial for designing effective interventions. Finally, comparative studies are needed to assess the relative effectiveness of Splenda versus other sweeteners or dietary approaches in managing T2D within this population. This will help determine if Splenda offers any advantages or disadvantages compared to other options.

Given the existing health disparities and the lack of specific research on Splenda's effects in the Texas-Mexico border region, healthcare practitioners should exercise caution when recommending artificial sweeteners to their patients with T2D. While some individuals might find artificial sweeteners helpful for managing weight or improving glycemic control in the short term, the long-term consequences remain uncertain. Healthcare providers should prioritize a holistic approach to diabetes management, emphasizing lifestyle modifications such as dietary changes, physical activity, and stress management. It's crucial to consider individual patient needs and preferences while providing personalized dietary guidance. Patients should be educated about the potential benefits and risks of various dietary options, including artificial sweeteners. Healthcare providers should also address the broader social determinants of health that influence dietary choices and diabetes management, such as access to healthy foods, socioeconomic factors, and cultural beliefs.

Furthermore, they should actively work to improve access to comprehensive diabetes care, including culturally sensitive education and support programs, for this vulnerable population. Given the high prevalence of diabetes and the existing health disparities in the Texas-Mexico border region, a multi-faceted approach is essential to effectively manage and prevent this chronic disease. The integration of culturally tailored interventions, alongside efforts to address social determinants of health, is vital to improving diabetes outcomes and promoting health equity in this region. Until more research is available specifically on Splenda's impact within this population, a cautious and comprehensive approach to diabetes management is paramount.

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References

1. Martinez-Gómez V, Walker GC, Davis M, Aviles JL, Flynn A, Cho S. Prevention Care Management Unit: Telephone Care Management to Improve Appointment Compliance along the South-Texas Mexico Border. *International Journal of Nursing and Health Care Research*. Published online January 1, 2019.

2. Bastida E, Brown HS, Pagán JA. Persistent Disparities in the Use of Health Care along the US–Mexico Border: an Ecological Perspective. *American Journal of Public Health*. 2008;98(11):1987-1995. doi:https://doi.org/10.2105/ajph.2007.114447

3. Castañeda H. Is Coverage enough? Persistent Health Disparities in Marginalised Latino Border Communities. *Journal of Ethnic & Migration Studies*. 2017;43(12):2003-2019. doi:https://doi.org/10.1080/1369183X.2017.1323448

4. Casey RP, Rouff MA, Jauregui-Covarrubias L. Diabetes among Latinos in the Southwestern United States: Border Health and Binational cooperation. *DOAJ (DOAJ: Directory of Open Access Journals)*. 2014;36(6):391-395.

5. Mangadu T, Kelly M, Orezzoli MCE, Gallegos R, Matharasi P. Best Practices for Community Gardening in a US–Mexico Border Community. *Health Promotion International*. 2016;32(6):daw025. doi:https://doi.org/10.1093/heapro/daw025

6. Boom K, Lopez M, Daheri M, et al. Perspectives on Cervical Cancer Screening and prevention: Challenges Faced by Providers and Patients along the Texas–Mexico Border. *Perspectives in Public Health*. 2018;139(4):199-205. doi:https://doi.org/10.1177/1757913918793443

7. Escobar R, Gonzalez J, Longoria D, Rodriguez N. Challenges Faced by Mexican Americans When Accessing Mental Health Care Service Utilization along the South Texas – Mexico Border. *Journal of Mental Health and Social Behaviour*. 2021;3(1). doi:https://doi.org/10.33790/jmhsb1100128

8. Ghaddar S, Brown CJ, Pagán JA, Díaz V. Acculturation and Healthy Lifestyle Habits among Hispanics in United States-Mexico Border Communities. *Revista Panamericana De Salud Pública*. 2010;28(3). doi:https://doi.org/10.1590/s1020-49892010000900009

9. Burkhalter N, Walker SS, Davis M, Flynn A. Integrating primary, Behavioral and Spiritual Health Care to Improve Patient Outcomes. *Journal of Behavioral Health and Psychology*. 2021;10(4). doi:https://doi.org/10.33425/2832-4579/21033

10. Valentine Sampson Alia, Ed Wong Alvarado, Diaz EM, Reinhart H. Disparities in Available Surgeons and Specialty Physicians Providing Endocrine-related Health Care Coverage to Populations in South Texas and the Rio Grande Valley. *Journal of the*

Endocrine Society. 2023;7(Supplement_1). doi:https://doi.org/10.1210/jendso/bvad114.1865

11. White G, Dentistry P. Citation: White GE. See Cavities, Think Systemic Disease. *J Oral Bio*. 2016;3(2).

12. Miller M, Valenzuela R, Salinas JJ. Change in Nutrition Behavior after Participating in an Obesity-Related Cancer Education Program in El Paso, Texas. *Cancer Control*. 2024;31. doi:https://doi.org/10.1177/10732748241261567
Diaz FC, Osuna-Salazar EN, Robledo C, Machiorlatti M, Sarhill N, Kwang H. Trends and Variations in Female Breast Cancer along the Texas-Mexico Border Trends and Variations in Breast Cancer along the Texas-Mexico Border. *Cancer Research*. 2020;80(4_Supplement):P6-1104-P611-04. doi:https://doi.org/10.1158/1538-7445.sabcs19-p6-11-04

13. M M, Vellapandian C. Exploring the Long-Term Effect of Artificial Sweeteners on Metabolic Health. *Cureus*. Published online September 23, 2024. doi:https://doi.org/10.7759/cureus.70043

14. Guru SK, Li Y, Savinova OV, Zhang Y. Long-term Consumption of Artificial Sweeteners Does Not Affect Cardiovascular Health and Survival in Rats. *PeerJ*. 2022;10:e13071. doi:https://doi.org/10.7717/peerj.13071

15. Matcha Angelin, Kumar J, Leela Kakithakara Vajravelu, Abhishek Satheesan, Venkata Chaithanya, Murugesan R. Artificial Sweeteners and Their Implications in diabetes: a Review. *Frontiers in Nutrition*. 2024;11. doi:https://doi.org/10.3389/fnut.2024.1411560

16. Li PWC, Yu DSF, Chong SOK, Lin RSY. A Systematic Review on the Effects of Nonpharmacological Sleep Interventions on Cardiometabolic Risk or Disease Outcomes. *Journal of Cardiovascular Nursing*. 2020;35(2):184-198. doi:https://doi.org/10.1097/jcn.0000000000000662

17. Link to external site this link will open in a new tab. Protocol for a Randomized Controlled Trial Comparing a Very low-carbohydrate Diet or moderate-carbohydrate plate-method Diet for Type 2 diabetes: the LEGEND (Lifestyle Education about Nutrition for Diabetes) Trial. *ProQuest*. Published online December 1, 2023:463. doi:https://doi.org/10.1186/s13063-023-07512-9

18. Avila A, Cordero J, Osinachi Ibilah, Frietze G, Moya EM. Hispanic Survivors and Caregivers of Human Papillomavirus–Associated Cancers: Lived Experiences in a U.S.–Mexico Border Community. *Health Education & Behavior*. 2022;50(5):595-603. doi:https://doi.org/10.1177/10901981221139179

19. Staudt K, Dane'el M, Márquez-Velarde G. In the Shadow of a Steel Recycling Plant in These Neoliberal times: Health Disparities among Hispanics in a Bordercolonia. *Local Environment*. 2015;21(5):636-652. doi:https://doi.org/10.1080/13549839.2015.1016902

20. Putra KWR, Toonsiri C. Factors Influencing Health Behavior among Type 2 Diabetes Mellitus Patients: an Integrative Review. *Belitung Nursing Journal*. 2017;3(1):32-40. doi:https://doi.org/10.33546/bnj.46

21. Gunter KE, Peek ME, Tanumihardjo JP, et al. Population Health Innovations and Payment to Address Social Needs among Patients and Communities with Diabetes. *The Milbank Quarterly*. 2021;99(4):928-973. doi:https://doi.org/10.1111/1468-0009.12522

22. Hu L, Lin NF, Shi Y, et al. The INtegrating CuLtUral Aspects into Diabetes Education Study to Prevent Diabetes in Chinese immigrants: Protocol for a Randomized Controlled Trial (Preprint). *JMIR Research Protocols*. 2024;13:e65455-e65455. doi:https://doi.org/10.2196/65455