

Understanding diabetes knowledge and awareness among the Hispanic/Latino population in San Antonio, Texas: Implications for diabetes prevention interventions

by

Idalis Reyes Santa

B.S., Arizona State University, 2020

A REPORT

submitted in partial fulfillment of the requirements for the degree

MASTER OF SCIENCE

Department of Food, Nutrition, Dietetics and Health
College of Health and Human Sciences

KANSAS STATE UNIVERSITY
Manhattan, Kansas

2024

Approved by:

Major Professor
Linda K. Yarrow, PhD

Copyright

© Idalis Reyes Santa 2024.

Abstract

Objective: The purpose of this report is to address some of the gaps in the understanding of diabetes knowledge and awareness in the Hispanic/Latino population residing in San Antonio, Texas. The report focuses on various factors, including physiological, environmental, healthcare system access, and cultural factors that influence diabetes prevalence and management.

Methods: A comprehensive literature review was conducted to gather data about diabetes knowledge and awareness on Hispanic/Latino populations in urban/suburban in the US. Sources for this report include peer-reviewed journal articles, community health information, and government health reports.

Results: San Antonio is mostly comprised of Hispanic/Latino population. Findings revealed that compared to other race/ethnic groups; Hispanic/Latino populations are at increased risk of type 2 diabetes. It was also revealed that compared to Texas, the San Antonio area had a higher mortality rate for diabetes and higher diabetes-related amputations.

Implications: Culturally interventions are required to target the specific needs of the Hispanic/Latino population in San Antonio, Texas. Recommendations include addressing language barriers, understanding cultural beliefs and family dynamics, promoting culturally competent healthcare that considers health literacy and education level, addressing physical inactivity and access to nutritious foods, and ways to effectively disseminate information to this specific population.

Conclusion: This report emphasizes the importance of implementing multifaceted strategies to improve diabetes knowledge and awareness among Hispanic/Latino populations in San Antonio, Texas. Addressing different physiological, environmental, healthcare systems, and cultural

factors could help improve diabetes knowledge and awareness in this population, thus improving diabetes outcomes and overall health.

Table of Contents

List of Figures.....	vi
List of Tables	vii
Acknowledgements	viii
Introduction	1
Background.....	4
Findings	9
Discussion.....	14
Recommendations	31
References	35
Glossary of Terms.....	44

List of Figures

Figure 1 Bexar County zip code map (TX for Sale, n.d.)	5
Figure 2 San Antonio median household income by zip code (Simple Maps, n.d.).....	6
Figure 3 Chronic health indicator for diabetes in Texas – 2020 (BRFSS, 2022) (15).....	9
Figure 4 Rates of diagnosed diabetes in adults based by race/ethnic background in the US (ADA, 2023)	11
Figure 5 San Antonio education attainment data from 2022 (United States Census Bureau, 2022)	12
Figure 6 Population by age and sex in San Antonio data from 2022 (United States Census Bureau, 2022).....	12
Figure 7 Chronic health indicator for diabetes by age group for Texas – 2021 (DSHS, 2021) ...	13
Figure 8 Prevalence of elevated glycemia in SEARCH study 2006-2013 (Hamman, et al., 2014)	15
Figure 9 Hospitalization rates for type 2 DM in children 10-17 years of age, Bexar County (Ugalde & Agha, 2022)	16

List of Tables

Table 1 San Antonio race and ethnicity data from 2020 (United States Census Bureau, 2022) ...	10
Table 2 Physical inactivity outside of work by race/ethnicity in Texas (CDC, 2024)	17

Acknowledgements

I would like to thank my family, specifically my son and my fiancé. Thanks to their support, I was able to get to this point.

I would also like to thank all my professors during this journey. They helped me gather every piece I needed for this big puzzle.

Introduction

Diabetes mellitus (DM) is a chronic disease that is characterized by high blood glucose levels. This is due to the body not producing enough insulin, or the body not being able to use insulin effectively, known as insulin resistance. In some cases, this can be due to both issues occurring at the same time. There are different types of diabetes, with the most common being type 1 DM, type 2 DM, and gestational diabetes.

Type 1 DM is characterized by the loss of pancreatic function, leading to decrease of insulin production, resulting in exogenous insulin therapy (NIH, 2023). It occurs when the body creates an autoimmune response against beta cells located in the pancreas. Environmental factors have been associated as potential contributors to type 1 DM pathogenesis (Quinn, Wong, & Narendran, 2021).

Gestational diabetes mellitus (GDM) refers to diabetes that occurs during pregnancy. Changes during the pregnancy, such as hormone changes and weight gain can lead to insulin resistance (CDC, 2024). Some risk factors that contribute to a high risk of GDM includes a history of GDM with previous pregnancy or pregnancies, being overweight, having family history of type 2 DM, being from certain racial/ethnic populations, and/or having disorders that affect hormone levels such as polycystic ovary syndrome (CDC, 2024). The difference between GDM and type 2 DM is that GDM occurs during pregnancy without history of DM, while the other occurs prior to the pregnancy.

Type 2 DM is the most common type of diabetes diagnosed. The main characteristic is insulin resistance. In some instances, it can also be accompanied by decreased insulin production, which then causes high blood glucose levels. The most common risk factors that could lead to type 2 DM includes being an individual that is overweight/obese, being over 45

years, lack of physical activity, being from a high-risk race/ethnicity population, family history of Type 2 DM, smoking. Most of these risks are modifiable, meaning that an individual can make lifestyle changes to prevent diabetes.

Approximately 38.4 million or 11.6% of the United States population has diabetes and of that number 8.7 million or 22.7% of those people are undiagnosed (CDC, 2024). This means that 1 in 10 people have diabetes with 1 in 5 people not knowing that they have it (CDC, 2024). In 2022, diabetes was considered the eight leading causes of death, accounting for 101,209 deaths for that year (CDC, 2024). Diabetes diagnosis could help improve an individual's health status, along with preventing major complications.

According to the American Diabetes Association, costs related to diagnosed diabetes in the US was \$412.9 billion in 2022 (Parker, et al., 2024). Individuals diagnosed with diabetes are likely to spend 2.6 times more in medical expenditures when compared to an individual without diabetes (Parker, et al., 2024). Around 65% of these costs are due to direct costs, which includes treatments, medications, and supplies. The other 35% of costs are attributed to indirect costs, which includes disability, reduced productivity in the workplace due to early death, and reduced productivity in the workplace due to the presence of illness and/or injury (Parker, et al., 2024). These are based solely on diabetes diagnosis and do not consider other complications that are associated with diabetes, such as nerve damage, nephropathy, hypertension, cardiovascular disease, retinopathy, among other complications.

Since most of the risk factors that could lead to type 2 DM are modifiable, it is important for individuals to not just understand this disease but also be aware of symptoms or complications that could occur. This knowledge could lead to early detection and treatment, that could reduce the burden on healthcare costs. In some cases, it could lead to prevention of type 2

DM on an individual with prediabetes. When populations grow quickly, especially in cities, diabetes prevention behaviors become increasingly harder to maintain because of convenience foods, lack of physical activity, and lack of resources available. One example is San Antonio Texas, it is one of the fastest growing cities and prevalence of diabetes continues to rise. Bexar County which is comprised of the whole city records that diabetes is the 2nd leading cause of death (Ugalde & Agha, 2022).

San Antonio is composed of diverse demographic groups that experience different degrees of health care access, which can affect the knowledge and awareness of chronic diseases like diabetes. Although different public health efforts that address diabetes prevention or self-management exist within the city, disparities still exist in many communities. This report addresses some of the gaps in the understanding of diabetes knowledge and awareness in Hispanic/Latino populations that might affect the San Antonio area. Some of the objectives that the report aims to achieve include understand diabetes knowledge, diabetes awareness, misconceptions, access to health care information, and to help identify any barriers that might affect Hispanic/Latino communities in San Antonio.

Background

Population

San Antonio is located inside Bexar County, with an estimated population of 2,115,167 in 2024 (World Population Review, 2024). According to the United States Census Bureau, San Antonio's population in 2023 was estimated to be 1,495,295 (United States Census Bureau, 2022). In 2023, it was considered the fastest growing city, and it had the 7th largest population in the United States (City of San Antonio, n.d.). When comparing this to 2010, the population has increased by 11.22%, with an expected growth of about 2% every year (World Population Review, 2024).

San Antonio is divided into six major areas, including North Central, Northwest Side, Downtown, West Side, East Side, and South Side, and it contains almost 90 different zip codes (Figure 1) (Salman, 2022). Some of these areas are known by residents for their characteristic features. The North Central area is well known for their upscale neighborhoods, while the Northwest area is where most educational institutions are, including The University of Texas at San Antonio. Other areas are more recognized depending on the population that makes up the majority. An example would be the North Central and South Side being comprised of a large Latino and Hispanic population.

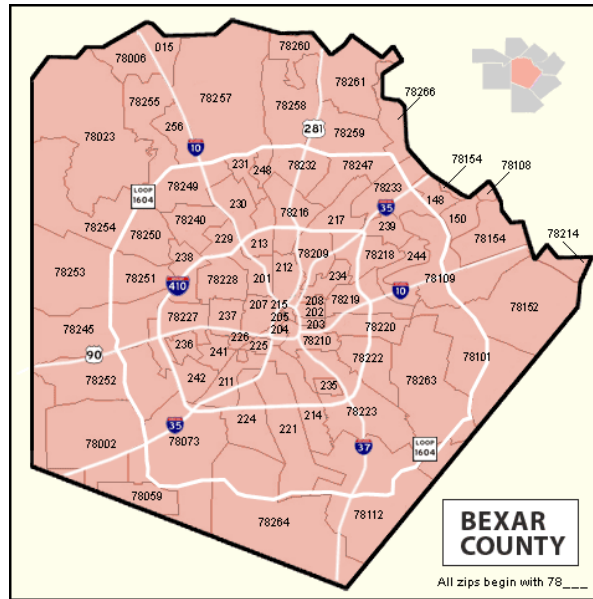


Figure 1 Bexar County zip code map (TX for Sale, n.d.)

As a fast-growing city, chronic disease incidence and prevalence also increase. Developing cities can transition from undernutrition to obesity due to changes to lifestyle and environment (Zhu, Ye, Li, Ding, & He, 2021). Texas BRFSS weight classification data from 2021 for the San Antonio area shows that 40.2% of the surveyed individuals (n=555) were categorized obese, 37.2% of individuals were categorized as overweight, 21.3% of individuals having a normal body mass index (BMI), and 1.3% being categorized as being underweight (CDC, 2021).

The urban health penalty idea proposes that cities can cause harm to urban dwellers, when compared to rural areas, due to the exposure to unhealthy factors that include harmful behaviors, stress, pollution, among other factors (Zhu, Ye, Li, Ding, & He, 2021). In contrast, the urban health advantage idea proposes that cities can offer access to health, support, and economic opportunities (Zhu, Ye, Li, Ding, & He, 2021). In developing cities, the urban health

penalty can outweigh urban health advantage, due to lack of infrastructure, funding, access to health care, and social support.

In San Antonio, areas outside the city limits are being developed with more communities forming. Some challenges that arise with urbanization include lifestyle changes, healthcare access and awareness, and socioeconomic factors. In terms of San Antonio, higher income households are seen outside the city limits, whereas lower-income households are more concentrated in the center of the city (Figure 2). Typically, higher income households can exhibit lower rates of diabetes prevalence, potentially due to access to healthcare resources (Chen, et al., 2023). Although this might be the case, expansion has caused more accessibility to processed foods that are high in sugars, unhealthy fats, and sodium, and these can contribute to diabetes risk.

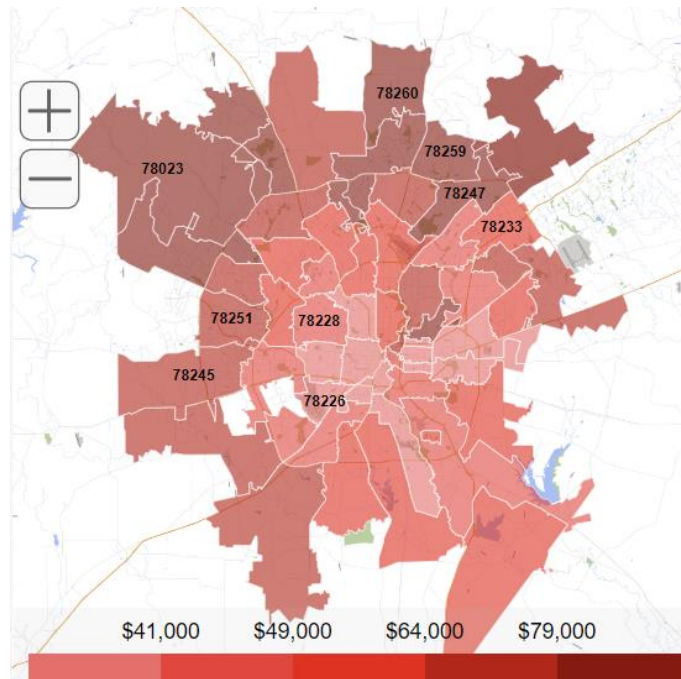


Figure 2 San Antonio median household income by zip code (Simple Maps, n.d.)

Expansion of the city's housing areas can also contribute to increased diabetes risk due to geographic disparities, dampened public health program efforts. Individuals outside the city limits might have more accessibility to healthcare due to the household income, regardless of the distance, but expanded areas have also seen a growth in many businesses, mostly focused on unhealthy food options. These include fast food restaurants, gas stations, food trucks, and grocery stores that promote calorie dense convenience foods. In terms of public health program efforts, the available diabetes prevention or self-management interventions do not reach these areas due to the current infrastructure. Efforts are more focused for communities closer to where the programs are provided, and information about them is not disseminated to areas outside the city limit. This is why it is important to assess different areas of San Antonio to better understand the status of diabetes knowledge and awareness in Hispanic/Latino communities.

Methodology

This report conducts a comprehensive literature review that focuses on diabetes knowledge and awareness on Hispanic/Latino populations in urban/suburban in the US. Sources for this report include peer-reviewed journal articles, community health information, and government health reports. Searches were conducted in databases such as PubMed, publications by the American Diabetes Association, and relevant health department websites. Relevant literature used was literature that has been published within the last 25 years, and only English language articles were used.

The data used for this report is composed of both quantitative data and qualitative data. Quantitative data was gathered from different health department websites, and demographic metrics. Qualitative data was gathered from different peer-reviewed journal articles and relevant articles by the American Diabetes Association. They were used to identify beliefs, barriers, and cultural norms that affect diabetes knowledge and awareness in Hispanic/Latino communities.

Key terms used for search criteria include ‘diabetes’, ‘knowledge’, ‘awareness’, ‘San Antonio’, ‘Hispanic’, ‘Latino’. These were used in combination with different key terms such as ‘culturally tailored’, ‘risk factors’, ‘prevalence’, ‘prevention’, ‘health literacy’, ‘health disparity’, and ‘healthcare access’.

For this report, San Antonio and Bexar County will be used interchangeably due to limited demographic data available. The report focuses on type 2 DM, and any use of “diabetes” throughout the report refers to such.

Findings

Demographics

Prevalence data gathered in Texas by the Behavioral Risk Factor Surveillance System (BRFSS) in 2020 shows that 12.6% of surveyed persons were told by their doctor that they have diabetes (Figure 3) (CDC, 2022). Cases of diabetes in Bexar County in 2020 account for 13.2% of the population, which is higher than the Texas wide gathered data (Ugalde & Agha, 2022).

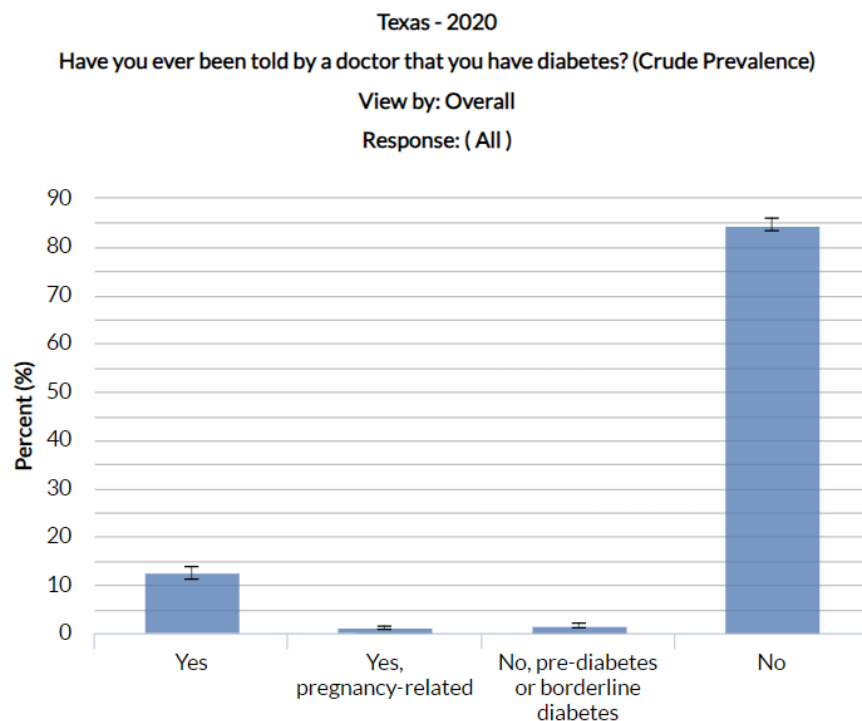


Figure 3 Chronic health indicator for diabetes in Texas – 2020 (BRFSS, 2022) (15)

In 2020, Bexar County had the highest mortality rate for all Texas, with an age-adjusted mortality rate of 32.2 (Ugalde & Agha, 2022). In San Antonio, hospitalizations related to diabetes complications are higher in the Central and Southern parts of the city when compared to other areas (Ugalde & Agha, 2022).

Race/Ethnicity

Census data from 2020 shows that San Antonio’s population is mainly composed of mostly Whites, followed by individuals that identified as two or more races (Table 1) (United States Census Bureau, 2022). Hispanic or Latino population is comprised of 916,010 individuals in San Antonio in 2020 (United States Census Bureau, 2022).

Table 1 San Antonio race and ethnicity data from 2020 (United States Census Bureau, 2022)

Race/Ethnicity	Population size
American Indian and Alaska Native	17,543
Asian	47,784
Black or African American	102,816
Hispanic or Latino	916,010
Native Hawaiian and Other Pacific Islander	2,142
Not Hispanic or Latino	335,813
Some Other Race	240,088
Two or More races	388,249
White	636,003

Specific data for rates of diagnosed diabetes in adults based by race/ethnic background is not available for San Antonio specifically, but hospitalizations due to diabetes were higher in Hispanic/Latino adults, when compared to national rates of diagnosed diabetes

(Figure 4) (Ugalde & Agha, 2022). In 2020, inpatient hospitalizations in San Antonio for diabetes related issues were higher in non-Hispanic black populations, followed Hispanic/Latinos (Ugalde & Agha, 2022).

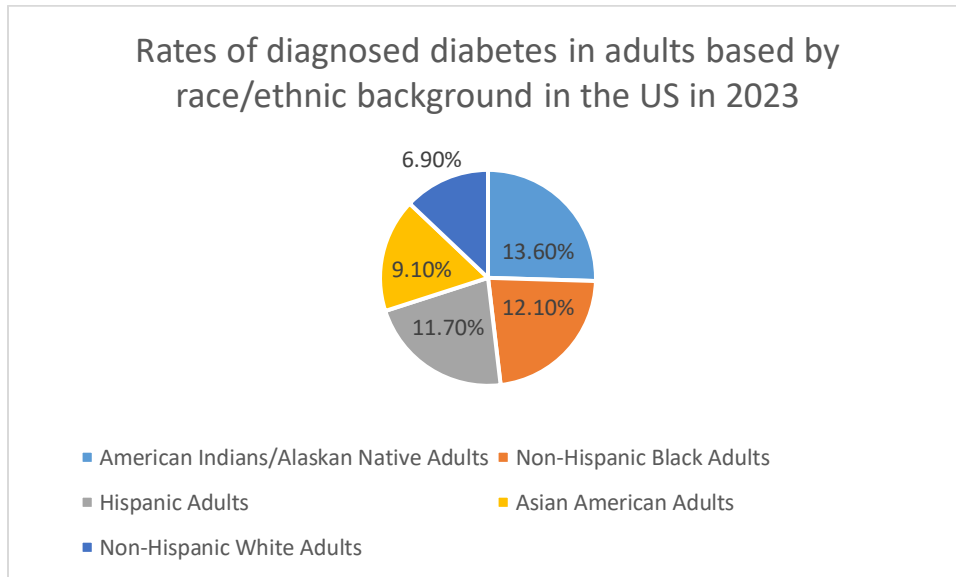


Figure 4 Rates of diagnosed diabetes in adults based by race/ethnic background in the US (ADA, 2023)

According to Texas BRFSS data from 2021, Black or African American (non-Hispanic) comprised the highest percentage of individuals being told by a healthcare professional that they have diabetes (13.8%), followed by Hispanic/Latinos (12.5%) (DSHS, 2021).

Education

In 2015, research from the Texas Demographic Center showed an inverse association between education level with diabetes prevalence (Robinson, et al., 2018). According to the US Census Bureau, most San Antonians have earned a high school or equivalent degree (25.6%) or followed by some college/no college degree (22.3%) (Figure 5) (United States Census Bureau, 2022). Results showed that prevalence was higher for individuals with less than a high school education (16.2%), compared to high school education (10.7%) and higher education (9.7%)

respectively (Robinson, et al., 2018). This aligns with established literature about the inverse association of education attainment and diabetes prevalence (Borrell, Dallo, & White, 2006).

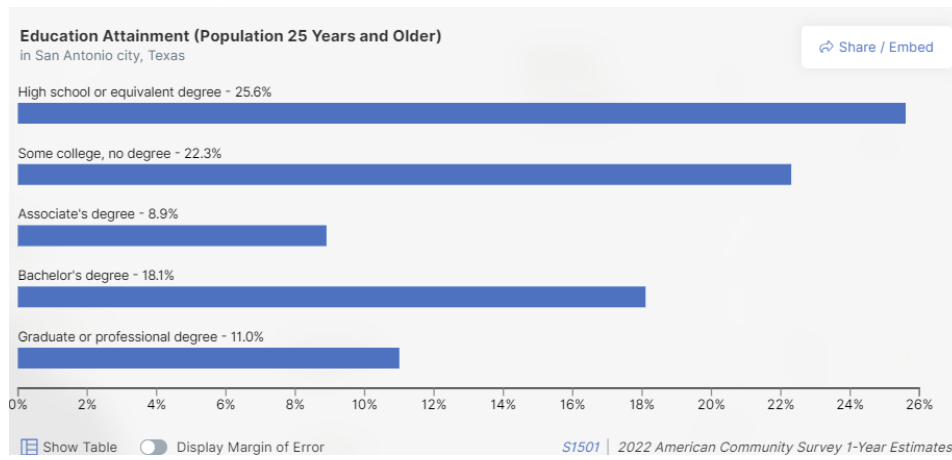


Figure 5 San Antonio education attainment data from 2022 (United States Census Bureau, 2022)

Age

San Antonio’s main population consists of individuals between the ages of 15 to 39 years (Figure 6) (United States Census Bureau, 2022).

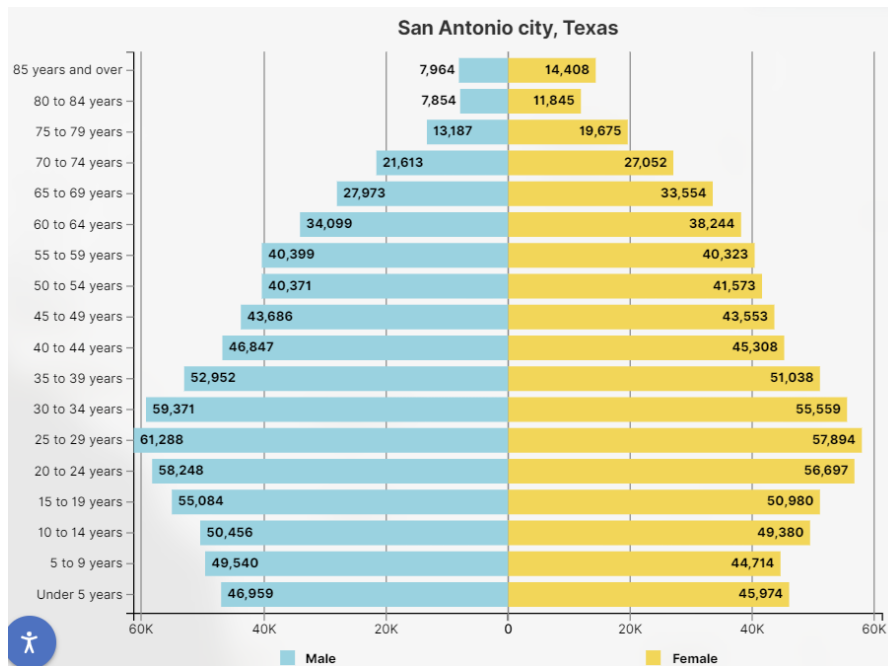


Figure 6 Population by age and sex in San Antonio data from 2022 (United States Census Bureau, 2022)

Although older adults can have deficits in diabetes knowledge and awareness due to cognitive decline, younger adults can also experience deficits in knowledge and awareness due to other factors, such as education, access to information, experience, among many other factors. Texas BRFSS data for 2021 showed that age group of 65+ years had a higher percentage of being told by a healthcare professional that they have diabetes, with percentages decreasing as age decreases (Figure 7) (DSHS, 2021).

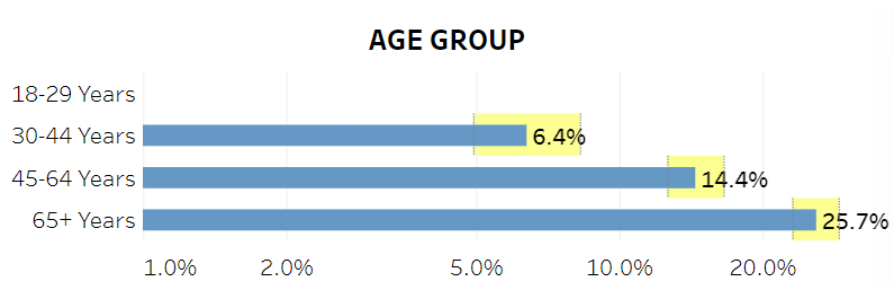


Figure 7 Chronic health indicator for diabetes by age group for Texas – 2021 (DSHS, 2021)

Discussion

There are many factors that affect diabetes knowledge and awareness in a population. Some of these include race and ethnicity, age, housing area, culture, and socioeconomic status (specifically education level). To gather accurate data, many factors need to be considered. Assessments should include culturally appropriate approaches to help with prevention of diabetes in populations that are considered minority (Haw, Shah, Turbow, Egeolu, & Umpierrez, 2021). Accurate data gathering can improve community public health interventions, including diabetes prevention programs.

Knowledge - What is diabetes?

Gathering knowledge of a specific population and/or area can help establish a baseline on how to address any knowledge gaps in a diabetes prevention program. Understanding of DM will not just help with early diagnosis but can also improve health outcomes on an individual (Akter, et al., 2022).

Although prevalence does not mean lack of knowledge, it has been seen that prevalence is higher in American Indian/Alaskan Native adults, non-Hispanic Black adults, and Hispanic/Latino adults (ADA, 2023). With the large population of Hispanic/Latino in San Antonio, it is important to have ways to assess diabetes knowledge that aligns with this population's baseline knowledge.

Diabetes affects different populations differently. It is not a one size fits all disease for every race and ethnicity. Groups that are more at risk of type 2 DM include American Indians, American Indian/Alaskan Native, non-Hispanic Black, and Hispanic/Latinos (Hill-Briggs, et al., 2020). Some risk factors that can have a bigger effect on certain populations might not have a big effect on other populations. Minorities can exhibit a combination of risk factors that might

increase prevalence of diabetes. These include already belonging to a specific race/ethnicity, family history of diabetes, being overweight or having obesity, being over 35 years of age, being a smoker, among other risk factors (Hill-Briggs, et al., 2020). In Bexar County, 65.7% of adults are either overweight or have obesity as of 2023 (Castro, 2023). Due to the increases in rates of overweight and obesity in children, diabetes is affecting individuals of younger ages as well.

According to the SEARCH study initiated in 2000, which addresses knowledge gaps of childhood diabetes, found that poor glycemic control was high among minority youth (Hamman, et al., 2014). Data gathered from 2006-2013 showed that prevalence of elevated blood glucose levels in 552 children <20 of age with type 2 DM was 27.4% in Hispanic children (Figure 8) (Hamman, et al., 2014). Some of the factors found to be associated with the prevalence elevated glycemia in these children include being overweight or obese, lack of physical activity, decreased consumption of fruits and vegetables, with a substantial portion of these children being from low-resource homes (Hamman, et al., 2014).

	Type 1	P value	Type 2	P value
Glycemia (28)	N = 3,947		N = 552	
A1C ≥9.5% (≥80 mmol/mol), all races (%)	16.8		26.6	
Non-Hispanic white	12.3	<0.0001 [‡]	12.2	<0.0001 [‡]
African American	35.5		22.3	
Hispanic	27.3		27.4	
Asian Pacific Islander	26.0		36.4	
American Indian	52.2		43.8	

Figure 8 Prevalence of elevated glycemia in SEARCH study 2006-2013 (Hamman, et al., 2014)

A study that gathered data from one of the largest healthcare systems in San Antonio from 2009-2015 examined the BMI of children ages between 2 and 17 years of age (Foster, Maness, & Aguino, 2017). It was found that for Hispanic children ages 2 to 5 were the highest

proportion of being overweight or obese when compared to other race/ethnic groups based on age (Foster, Maness, & Aguino, 2017). Data also showed that a decrease in obesity of 2.2% was seen in this age group, and for older children (12 to 17 years of age) there were no changes in overweight/obesity rates. The study proposes that this might be due to the city’s efforts to address obesity being more focused on younger children, rather than older children (Foster, Maness, & Aguino, 2017). Compared to other race/ethnic groups, Hispanic children were at higher risk of obesity when compared to White children (Foster, Maness, & Aguino, 2017).

Data for diabetes prevalence in children for San Antonio is limited, but hospitalization rates for children 10-17 years of age in Bexar County increased from 2019 to 2020 (Figure 9) (Ugalde & Agha, 2022). In 2020, males were hospitalized more than females, increasing hospitalizations by 107% for males during that year.

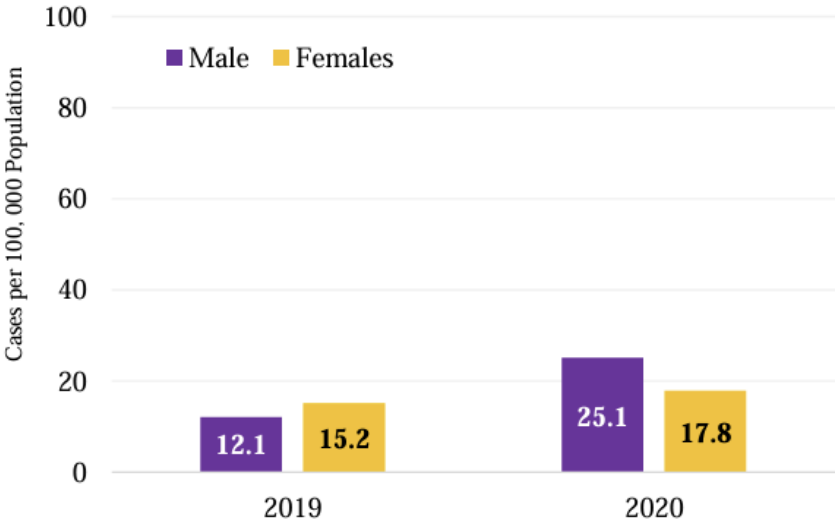


Figure 9 Hospitalization rates for type 2 DM in children 10-17 years of age, Bexar County (Ugalde & Agha, 2022)

A factor that can contribute to risk factors in Hispanic/Latino population is the location in which the individual resides. Individuals in areas that experience food insecurity are more at risk of diabetes risk when compared to an individual without that does not experience food insecurity

(Hill-Briggs, et al., 2020). Another barrier for Hispanic/Latino populations that can contribute to risk factors is access to healthcare to treat any comorbidities that increase the risk of type 2 diabetes. This can be due to distance to be traveled for healthcare, geographic shortages, or low availability of Spanish speaking health professionals or Hispanic healthcare professionals (Escarce & Kapur, 2006). Lack of areas to engage in physical activity can also increase incidence of some of the risk factors for diabetes. BRFSS data from 2017 – 2020 shows that Hispanic/Latino adults’ physical inactivity outside work in Texas is higher than other race/ethnicities, comprising $\geq 30\%$ (Table 2) (CDC, 2024). Lack of physical activity can contribute to overweight or obesity, which then increases risk of diabetes in an individual (Aguayo-Mazzucato, et al., 2019).

Table 2 Physical inactivity outside of work by race/ethnicity in Texas (CDC, 2024)

Race/Ethnicity	Prevalence
Non-Hispanic Asian adults	20% - <25%
Non-Hispanic White adults	20% - <25%
Non-Hispanic American Indian/Alaska Native adults	25% - <30%
Non-Hispanic Black adults	25% - <30%
Hispanic, Latino/a adults, or Spanish adults	$\geq 30\%$

Higher diabetes knowledge has been found in individuals that have higher education (Ferreira, et al., 2024) (Aguayo-Mazzucato, et al., 2019). This effect is associated with White and Hispanic populations, but not with Black populations, which proposes variations in

education and health depending on the racial/ethnic group (Borrell, Dallo, & White, 2006).

Diabetes incidence is higher in adults that have less than high school education, with having at least college education lowering the odds of diabetes (Hill-Briggs, et al., 2020). Education itself does not determine decreased risk of diabetes, since the individual can be affected by non-modifiable factors that might not allow management of risk factors feasible.

Another factor that affects diabetes knowledge is health literacy. About one in three adult Americans have low health literacy (Osborn, Cavanaugh, & Kripalani, 2010). Hispanic/Latinos health literacy levels are the lowest when compared to other racial/ethnic groups, mostly due to language barriers (OMH, 2023). In terms of diabetes, low health literacy is associated with poor health outcomes, which affects the individual's understanding of their own disease, which then results in lack of treatment or poor glycemic control (Osborn, Cavanaugh, & Kripalani, 2010).

Age can bring many challenges in terms of diabetes complications and diabetes management. The presence of comorbidities, physical limitations, polypharmacy, and cognitive decline can be contributors to inadequate diabetes management. According to a study based on Medicare enrollees, general health literacy declined drastically due to cognitive impairment, regardless of education attained (Souza, et al., 2014). For younger adult populations, the association of diabetes knowledge and age is multifactorial. Although age can be a non-modifiable risk factor itself, for younger generations, other factors contribute to increased risk of developing diabetes. Some factors that can contribute to the risk of developing diabetes includes lifestyle behaviors, culture, beliefs, education level, housing area, family, among others.

Cultural factors can also influence diabetes knowledge in different populations. Perceptions of the disease depending on the culture can affect prevention or treatment of the disease. Some cultures do not believe in looking for healthcare, unless it is completely necessary

(Tripp-Reimer, Choi, Kelley, & Enslein, 2001). Other cultures believe that expressing concern about a health problem can increase the likelihood of having the disease (Tripp-Reimer, Choi, Kelley, & Enslein, 2001).

In Hispanic/Latino communities, some cultural factors that can affect health behaviors include marital status, family dynamics, fatalism, religion, beliefs, and body image (Gast, Peak, & Hunt, 2017). Hispanic married men have been seen to engage in health protective behaviors, when compared to Hispanic nonmarried men (Gast, Peak, & Hunt, 2017). A proposed reason is that married men might be influenced by their spouse, which contributes to avoidance of risky behaviors like excessive alcohol use, smoking, and being more proactive about healthcare treatments. In Hispanic/Latino families, women are considered primary caretakers, and are also considered the most knowledgeable regarding healthcare (Aguayo-Mazzucato, et al., 2019). Although Hispanic women play an important role when seeking healthcare, decisions are made based on the opinion of multiple extended family members. This concept is known as “familismo”, which puts the family’s loyalty before the needs on an individual (Aguayo-Mazzucato, et al., 2019). ‘Familismo’ can ultimately affect an individual’s knowledge about chronic disease, including diabetes, since the individual might not necessarily put their needs first.

Fatalism is a belief of not being able to alter disease process due to the disease being part of the individual’s destiny (Aguayo-Mazzucato, et al., 2019). This belief can lead to decreased knowledge and engagement of treatment plans. A survey composed of 104 Hispanic individuals with diabetes showed that 78% percent of the individuals believed that their diabetes diagnosis was due to God’s will, and 81% of the individuals believed that the disease could only be controlled by God (Aguayo-Mazzucato, et al., 2019).

Body image is also a factor in diabetes knowledge and awareness in Hispanic/Latino populations, due to aesthetic ideals. A study that examined bodily aesthetic ideals in Latinas with diabetes found that a larger body size is considered ideal, when compared to non-Latino American women (Weitzman, Caballero, Millan-Ferro, Becker, & Levkoff, 2013). Compared to non-Latino White Americans, they are less likely to consider themselves as overweight or obese, do not consider excess weight as being a problem, and do not think that excess weight has associated health risks (Weitzman, Caballero, Millan-Ferro, Becker, & Levkoff, 2013). Some health beliefs include that being heavier or having physical robustness is equal to health or being well nourished, while thinness is believed to be related to being unhealthy (Aguayo-Mazzucato, et al., 2019).

Acculturation can also impact risk factors for diabetes. Black and Hispanic/Latino populations assimilation or integration into American culture has been positively associated with overweight or obesity (Hasson, et al., 2013). This effect is seen more on adults, rather than children, due to children and adolescents from middle to high socioeconomic levels being more exposed to cultural backgrounds, which expands their food options and opinions about food (Hasson, et al., 2013).

Symptoms – What are some common symptoms of diabetes?

Diabetes symptoms are characterized by three P's: polydipsia, polyuria, and polyphagia. These describe increased thirst and fluid intake, frequent urination, and increased appetite respectively. For type 2 diabetes, symptoms develop slowly, with most individuals noticing symptoms after several years. Damage to the body can start years before any symptoms are noticeable, making awareness imperative for early detection of diabetes. It does not only help

with early detection, but also helps educate the public, and could encourage the individual to be proactive about diabetes management.

Effective diabetes management starts with recognizing symptoms and understanding them. A study that examined diabetes-related symptoms among a Mexican American population with diabetes showed that individuals interpreted diabetes knowledge based on symptoms, and interpreted symptoms as being benign (Garcia, 2005). It was also found that from the 87 adults in the study, 74% of the participants treated symptoms by self-care strategies that alleviated the symptom, but not the cause. Overall studies have shown that an individual is more likely to seek medical treatment if the symptom is considered severe and affects functional status of the individual (Aguayo-Mazzucato, et al., 2019).

Complications – What are some complications with diabetes?

Complications of diabetes can be categorized by either being acute or chronic complications. Acute complications include diabetic ketoacidosis, hypoglycemia, and hyperglycemia. Diabetic ketoacidosis could potentially lead to diabetic coma, which can result in death if not treated. For chronic complications, the most common include diabetic retinopathy (affects the eyes), diabetic nephropathy (affects the kidneys), diabetic neuropathy (affects the nerves), heart disease, and hypertension. Some of these complications exacerbate other issues, such as damage to the nerves affecting blood flow to the feet. This can lead to limb amputations, which occur most commonly to the feet or legs.

CDC data gathered in 2018 showed that compared to non-Hispanic White, Hispanic/Latino populations have a higher ratio for visual impairment (1.5), higher hospital admissions for uncontrolled diabetes without complications (1.1), had higher hospital admission

for lower extremity amputations (1.1), and had higher incidence of end stage renal disease (2.0) (OMH, n.d.).

Data from San Antonio gathered in 2020 shows that diabetes related hospitalizations are higher in males when compared to females by a 35% (Ugalde & Agha, 2022). Hospitalizations are seen more in the Central and South side of the city in previous years, however due to the expansion of the city, these numbers might be higher in other areas of the city.

In the US, about 154,000 people that have diabetes undergo an amputation each year (ADA, n.d.). About 14,000 of these occur in Texas, and of those, more than 2,000 occur in Bexar County (Ugalde & Agha, 2022). San Antonio is considered to have one of the highest rates for diabetes-related amputations in the US. Lower limb amputations due to diabetes are preventable and increase healthcare spending, reduce productivity, and take a toll on the individual and their families (ADA, n.d.).

Management – How can diabetes be managed effectively?

Early detection and management of diabetes is crucial to prevent any complications associated with the disease. A study from John Hopkins University compared data between 1999 through 2018 and found that diabetes management improved from 1999 to the early 2010s, but diabetes management stalled and declined after 2010 (Bryan, 2021). This cross-sectional study found that between 2007-2010, the percentage of individuals with diabetes that achieved blood glucose control based on hemoglobin A1C levels or just A1C, was 57.4%, while in the 2015-2018 period, 50.5% of individuals with diabetes reported blood glucose control (Fang, Wang, Coresh, & Selvin, 2021). The study proposes that this shift might be due to published trials in 2008/2009 showing that intensive blood glucose control had not benefit for cardiovascular health, and that it increased risk of hypoglycemia. This led to more conservative diabetes

management plans focusing on lowering blood glucose levels through lifestyle changes rather than using medications, which then led to the decline of glycemic control. In Hispanic/Latino communities, this could mean decreased glycemic control, which can further affect diabetes management. A meta-analysis that evaluated A1C levels between Hispanic and non-Hispanic White adults combined 11 studies and results showed that A1C was higher in Hispanic/Latino adults when compared to non-Hispanic White adults by a mean difference of 0.5% (Kirk, et al., 2008).

Diabetes management in Hispanic/Latino communities might differ from management proposed to other populations due to multifactorial reasons. This includes physiologic factors, environmental factors, and healthcare system factors (Fortmann, Savin, Clark, Philis-Tsimikas, & Gallo, 2019). Physiologic factors include Hispanic/Latino populations have higher prevalence for insulin resistance, which puts them at higher risk of developing diabetes when compared to other populations (Fortmann, Savin, Clark, Philis-Tsimikas, & Gallo, 2019). Other physiological factors include presence of overweight or obesity, and recent studies have shown that there might be an association between altered gut microbiota and diabetes (Fortmann, Savin, Clark, Philis-Tsimikas, & Gallo, 2019). For this population, acculturation might play a role in the changes of the gut microbiota. A study that investigated the gut microbiota of uncontacted individuals in South American showed that this population had the highest diversity of bacteria when compared to adults in the US, which showed the least diversity of bacteria (Fortmann, Savin, Clark, Philis-Tsimikas, & Gallo, 2019).

Environmental factors also affect diabetes management in Hispanic/Latino populations. Although acculturation can decrease diet quality, nutrition preferences from the traditional diet can affect diabetes management. Foods considered traditional in Hispanic/Latino can be high in

fat and calories. Events and celebrations could lead to consumption of these types of foods, and family could pressure individuals into consuming foods that they should try to avoid (Fortmann, Savin, Clark, Philis-Tsimikas, & Gallo, 2019). For some Hispanic/Latino cultures, declining foods can be seen as impolite and disrespectful. Another factor that can affect management is physical activity and perception of body image. Hispanic/Latinos are less likely to engage in physical activity in the US, compared to non-Hispanic Whites (Fortmann, Savin, Clark, Philis-Tsimikas, & Gallo, 2019). Perception of body image is important in this culture, since having some weight or being slightly overweight is usually regarded as a sign of being nourished and having good financial status (Fortmann, Savin, Clark, Philis-Tsimikas, & Gallo, 2019). This perception not only affects adults, but also children. Children are encouraged to consume their whole meal to be healthy, even though this might ignore the child's physiological needs of hunger and fullness.

As for healthcare system factors, one of the biggest barriers to effective diabetes management is the language barrier. The biggest challenge faced by Hispanic/Latino populations when seeking healthcare is the inability to communicate with the healthcare professional due to Limited English Proficiency (LEP) (Escobedo, Cervantes, & Havranek, 2023). A study by (Escobedo, Cervantes, & Havranek, 2023) found that from 1,344 surveyed patients, 25% patients with LEP reported challenges when scheduling their own appointments, and that 29% of Spanish-speaking patients felt that they did not have a resolution of the medical issues after the doctor's appointment, when compared to English-speaking patients. This can lead to omission of important information to avoid additional conversations with the healthcare professional. An analysis comprised of 38 outpatient clinic conversations that compared Spanish and English-

speaking patients' interactions found that the Spanish-speaking patients mentioned less about their symptoms, expectations, feelings, and thoughts (Escobedo, Cervantes, & Havranek, 2023).

Inability to communicate with an individual that is seeking help to treat their blood glucose levels can result in further diabetes complications. This could also discourage the individual from seeking healthcare overall. A study comprised of 3,205 Latino LEP patients found that LEP is associated with less insulin adherence and lower oral diabetic medications when compared to 5,755 English-speaking Latino patients, and 21,878 English-speaking non-Latino patients (Escobedo, Cervantes, & Havranek, 2023).

Another issue related to healthcare system factors is access to the healthcare facility itself. This can be due to the distance to travel to the facility, affordability, immigration status, and fear of discrimination. An analysis based on the epidemic of diabetes in the Hispanic population living in the US found that cost was a barrier to seek treatment, that 1 in 5 Hispanics did not have health insurance, and that there were more concerns about costs for medications to treat diabetes (Fortmann, Savin, Clark, Philis-Tsimikas, & Gallo, 2019). It was also reported that transportation was limited at times and that facilities were not geographically within reach (Fortmann, Savin, Clark, Philis-Tsimikas, & Gallo, 2019).

Immigration status of an individual can also affect management of chronic diseases. This includes stresses that come from not being able to treat a condition effectively due to the inability to work legally, or difficulty in establishing good patient-physician relationship due to lack of understanding of the patient's experiences and past medical history (Escobedo, Cervantes, & Havranek, 2023). Difficulty in establishing a good patient-physician relationship can lead to distrust, which can lead to less engagement from the patient. Another factor related to immigration status, that can affect disease management includes fear of discrimination, which

can also include fear of deportation. An interview that included 60 Latino patients that had recently been hospitalized for COVID-19 found that these patients did not feel comfortable seeking medical care due to fear of discrimination and fear of being deported (Escobedo, Cervantes, & Havranek, 2023). Immigration status and LEP can also affect the quality of care that the patient chooses for management of a disease. An interview with 20 Latino patients with kidney failure that received hemodialysis showed that the patients were aware of receiving inferior care, as long as it did not affect their living arrangements, like being deported (Escobedo, Cervantes, & Havranek, 2023).

Current data does not assess diabetes management rates in San Antonio, but data from 2020 shows that inpatient hospitalizations and diabetic amputations were lower for the Hispanic/Latino population when compared to 2018 data (Ugalde & Agha, 2022). Although this might be seen as an improvement, more information is needed to assess if the lower inpatient hospitalization and diabetic amputations are due to increased diabetes self-management or if the factors previously discussed might be affecting Hispanic/Latino communities in San Antonio, which can lead to unreported cases or unreported health complications.

Prevention – How can diabetes be prevented?

Risk assessment is crucial to determine a population's risk of developing diabetes. To obtain effective reduction in risk for diabetes prevention interventions need to be culturally tailored to the population being assessed (McCurley, Gutierrez, & Gallo, 2017). Although established diabetes risk intervention programs are valuable, they might not be efficient for specific populations due to lack of relevance or viability based on income and culture (McCurley, Gutierrez, & Gallo, 2017).

A pilot project that evaluated effectiveness of the Diabetes Prevention Program (DPP) in Hispanic/Latino adults by implementing a text-message based communication (Formagini, et al., 2024). The program's purpose is to help individuals that are at high risk for diabetes to change lifestyle behaviors that will help either prevent or help delay the disease (NIH, 2023). The program consisted of two to three automated text messages in Spanish every day for 6 months that included information about five main topics, such as healthy eating, physical activity, lifestyle change motivation, problem-solving skills, and logistics, which includes keeping track of the program's goals, creating awareness of coach services, and information about the program itself (Formagini, et al., 2024). From the 26 participants, results showed that one third of the participants lost 5% of their weight, around 20% reversed their prediabetes A1C to normal A1C, and all participants feeling satisfied with the program with 87.5% of the participants perceiving the program as helpful in preventing diabetes (Formagini, et al., 2024).

Prevention efforts go hand and hand with knowledge about the disease and its risk factors. Individuals that are at higher risk for developing diabetes are less likely to engage in behaviors to prevent it if they do not know what diabetes is and its risk factors.

Awareness of programs – Have you participated in a diabetes awareness program?

There are many diabetes awareness programs, but DPP is very well known. Depending on the community, there might be other programs available that help with this same goal. The City of San Antonio has a variety of free programs, including diabetes prevention, diabetes self-management, and health and wellness resources (City of San Antonio , n.d.). The conduct workshops for individuals that have not been diagnosed with any type of diabetes (Diabetes Prevention program), or to teach self-management to individuals already diagnosed with diabetes (Diabetes Self-Management program).

Another source of diabetes awareness program in San Antonio is the YMCA Diabetes Prevention Program. This program is aimed at adults that are at risk of developing diabetes (YMCA, n.d.). The program aims to help individuals maintain healthy behaviors and lifestyles, and this is done over a 1-year span.

Although these programs can help improve healthy lifestyles to either prevent or self-manage the disease, not all the communities are able to get information about them due to barriers already discussed.

Information access – From what sources have you heard about diabetes?

Diabetes knowledge and awareness can be influenced by limitations on how the individual can access health information. Many barriers can affect this including access to internet, low health literacy skills, low literacy level, fear of technology, language barriers, trust placed on online healthcare information, among many barriers that can vary based on the population being assessed (Peña-Purcell, 2008).

Many sources of information about diabetes knowledge and awareness are based on technology, which already puts some Hispanics at disadvantage. A study by (Gonzalez, Sanders-Jackson, & Wright , 2019) showed that use of internet for healthcare information differed between different Hispanic communities. The study found that foreign-born Hispanic/Latino adults were less likely to look for healthcare information online when compared to non-Hispanic White adults (Gonzalez, Sanders-Jackson, & Wright , 2019). It was also found that foreign-born Hispanic/Latino adults have lower odds of communicating with a healthcare provider through email, and lower odds of filling prescriptions online (Gonzalez, Sanders-Jackson, & Wright , 2019). The authors found that Hispanic/Latino adults that were less proficient in technology and had LEP trusted the mediated sources less (Gonzalez, Sanders-Jackson, & Wright , 2019). Other

findings of this study included acculturated individuals being more likely to use technology for healthcare information, and age being a factor in health information dissemination. Individuals younger than 35 years were less likely to look up health information online and use patient portals (Gonzalez, Sanders-Jackson, & Wright, 2019). This was attributed to younger individuals having less health problems overall when compared to individuals that are older or individuals with chronic conditions. Dissemination channels being used by non-Hispanic/Latino adults might not necessarily be effective when communicating with Hispanic/Latino groups. This is why it is important to understand dissemination preferences for Hispanic/Latino populations, since it can determine if an awareness program is effective or not.

A study by (Clayman, Maganello, Viswanath, Hesse, & Arora, 2010) examined the communication preferences between non-English speaking Hispanic/Latino adults, and English-speaking Hispanic/non-Hispanic White adults. It found that non-English speaking Hispanic/Latino adults are more receptive to visual and aural channels, including television, word of mouth by family/friends/doctors, and radio messages, and that they might not be receptive to messages from the internet or printed media (Clayman, Maganello, Viswanath, Hesse, & Arora, 2010). English-speaking Hispanic/Latino adults and non-Hispanic White adults were more comfortable and had higher trust of health information that was from newspapers, the internet, and from magazines (Clayman, Maganello, Viswanath, Hesse, & Arora, 2010). The authors attributed these differences of information dissemination to language, overall media use differences, and cultural factors. Lack of bilingual healthcare information can lead to inaccurate healthcare information in Hispanic/Latino populations.

All these factors need to be considered when assessing diabetes knowledge and awareness in Hispanic/Latino communities in San Antonio, both inside and outside the city

limits. Although there are established diabetes self-management and risk score questionnaires, there is a need for culturally tailored assessments that can effectively determine the needs of a specific community.

Recommendations

To improve diabetes knowledge and awareness among the Hispanic/Latino population in San Antonio, a multifaceted approach is recommended. San Antonio's diabetes rate mortality in 2020 was 32.2, ranking the highest between all Texas' Counties. This report addresses some of the gaps in the understanding of diabetes knowledge and awareness in Hispanic/Latino populations and communities, which can potentially be translated into San Antonio's Hispanic/Latino residents. Literature shows that many factors can affect intervention programs, including physiologic, environmental, cultural, healthcare systems and processes, among many other factors.

San Antonio's population is mostly comprised of Hispanic/Latino individuals. Since Hispanic/Latino individuals are at increased risk for diabetes, it is important to create awareness of diabetes to encourage individuals to receive healthcare to prevent major complications. Dissemination of information can be done by targeting specific populations, such as offering age-appropriate educational materials or targeting by area based on race/ethnicity groups. An example would be using radio and television to disseminate information to non-English speaking Hispanic/Latino adults, while using other methods like magazines or internet for younger populations or for English-speaking Hispanic/Latinos. Creating awareness about risk factors that increase risk of diabetes can either help individuals recognize symptoms and issues that they might be experiencing related to diabetes, or it can help encourage individuals to find treatment to prevent major complications.

Targeting can also be done by race/ethnicity groups and their location. San Antonio's North Central and South Side are known for having large Hispanic/Latino populations. The most important consideration when addressing this population is to make the information available to

non-English speaking Hispanic/Latino individuals, such as providing any media to be shared in Spanish. Aside from promoting through radio and television, diabetes awareness can be provided by word of mouth by visiting different high trafficked areas to communicate verbally with individuals that might not have access to technology or might not be proficient with it. Doing this can also help overcome any geographic barriers and help underserved areas of the city.

Addressing environmental factors in a diabetes awareness intervention is important, since it can help improve other risk factors that increase risk of diabetes, like being overweight or obese. Most individuals can benefit from physical activity, and individuals with diabetes can lower their blood glucose levels and can reduce insulin resistance. Depending on where the individual is located, physical activity might not be as achievable, which is why coming up with other ways to engage in physical activity that can be done at home.

Another thing to consider when making a diabetes awareness intervention includes knowing if this community has access to nutritious foods. Recommending nutritious foods and recipes to individuals that do not have access to them might result in non-compliance with the intervention. Finding about the area and modifying recommendations to what is available can help improve engagement and could potentially lead to changes that can prevent diabetes itself or prevent any complications.

Culture has a big impact on diabetes knowledge on an individual. Intervention programs need to be tailored to have culturally sensitive information that considers different levels of health literacy and educational level. An example would be instead of expressing symptoms of diabetes as polyuria, polyphagia, and polydipsia, to express them as “urinating frequently,” “being constantly hungry,” and “being constantly thirsty.” Addressing cultural issues, including ‘fatalismo’ and ‘familismo’ can help the diabetes awareness program be effective, which is why

understanding the perspective of the individual regarding the disease is important. It would be important to emphasize that having diabetes is not necessarily a “death sentence” and that it is a manageable disease. This could help with misconceptions about the disease that could have potentially prevented lifestyle behaviors changes to prevent diabetes or delay of treatment for an individual that has diabetes but might not know it. As for the family component, an effective program must consider the family dynamics in Hispanic/Latino culture. Hispanic/Latino women are more likely to influence behaviors at the household, which is why teaching about risk factors could potentially change lifestyle behaviors for family members in the household.

Another factor that can affect diabetes knowledge and awareness in Hispanic/Latino groups is the perception of body image. Perceptions of body image can affect an individual’s health status, due to perceiving being overweight or obese as being “healthy” and not associating it with being a risk factor for diabetes and other chronic diseases. Creating awareness of BMI categories could be beneficial for a diabetes awareness program. An example of how to create BMI categories awareness would be to make simplified BMI categories that are easier to understand, along with visuals such as using pictures to help illustrate different BMI categories. Depending on the Hispanic/Latino groups in the area, generalizations of BMI categories can be used, such as explaining that for an individual that is 157.4cm (5’2”), a healthy/normal weight would be around 56.8kg (125lbs.). Most Hispanic/Latino populations use the metric system, but individuals that have gone through acculturation might be more familiar with the imperial system, which is why using both systems are important for dissemination of BMI category information.

Some Hispanic/Latino groups or communities might not have healthcare accessible or might not have access to providers that are culturally sensitive and that have language

proficiency. Programs that engage with the individual are more likely to result in engagement, due to the individual feeling heard. Communicating to Hispanic/Latino communities in their day-to-day language can help improve understanding of any potential risk factors or issues that the individual might be experiencing.

Related to healthcare access, there is also the fear of looking for healthcare services due to fear of deportation due to immigration status. Finding local programs that can help individuals regarding their immigration status can help prevention or self-management of the disease, thus preventing major complications. Advocating to inclusive healthcare policies regardless of immigration status could help improve diabetes prevention or self-management, since individuals would be encouraged to seek healthcare.

Understanding these gaps can improve health outcomes in the Hispanic/Latino population in San Antonio. Although this will not address all the disparities experienced by this population, it is a good start for preventive measures, including creating awareness of diabetes and educating the public about the disease, risk factors, and complications. The key is to develop culturally tailored programs that adjust for the community's needs. By integrating these strategies, diabetes knowledge and awareness could improve in the Hispanic/Latino population in San Antonio, which could then help achieve better diabetes outcomes and overall health.

Some limitations encountered with this report include data availability and generalizability. Demographic data for San Antonio is extensive, but for other sources, data was limited for San Antonio or Bexar County. This can limit the data on specific variables only applicable to San Antonio or similar, and data might not be replicated in other cities/urban areas.

References

- ADA. (2023, November 2). *Statistics About Diabetes*. Retrieved from American Diabetes Association: <https://diabetes.org/about-diabetes/statistics/about-diabetes>
- ADA. (n.d.). *Amputation Prevention Alliance*. Retrieved from American Diabetes Association: <https://diabetes.org/advocacy/amputation-prevention-alliance>
- Aguayo-Mazzucato, C., Diaque, P., Hernandez, S., Rosas, S., Kostic, A., & Caballero, A. E. (2019). Understanding the growing epidemic of type 2 diabetes in the Hispanic population living in the United States. *Diabetes/Metabolism Research and Reviews*, 35(2), e3097. Retrieved from <https://doi.org/10.1002/dmrr.3097>
- Akter, F., Mahbubur Rashid, S. M., Alam, N., Lipi, N., Qayum, M. O., Nurunnahar, M., & Mannan, A. (2022). Knowledge, attitude and practice of diabetes among secondary school-going children in Bangladesh. *Frontiers in Public Health*, 10, 1047617. Retrieved from <https://doi.org/10.3389/fpubh.2022.1047617>
- Borrell, L. N., Dallo, F. J., & White, K. (2006). Education and Diabetes in a Racially and Ethnically Diverse Population. *American Public Health Association*, 96(9), 1637-1642. Retrieved from <https://doi.org/10.2105/AJPH.2005.072884>
- Bryan, E. (2021, June 29). *Diabetes control worsened over the past decade*. Retrieved from National Institutes of Health: <https://www.nih.gov/news-events/nih-research-matters/diabetes-control-worsened-over-past-decade>

Castro, J. (2023, October 25). *Obesity Prevention*. Retrieved from CDC Archives :

https://archive.cdc.gov/www_cdc_gov/nccdphp/dch/programs/communitiesputtingpreventiontowork/communities/profiles/obesity-tx_sanantonio.htm

CDC. (2021). *BRFSS Prevalence & Trends Data*. Retrieved from Centers for Disease Control and Prevention:

https://nccd.cdc.gov/BRFSSPrevalence/rdPage.aspx?rdReport=DPH_BRFSS.ExploreByLocation&rdProcessAction=&SaveFileGenerated=1&irbLocationType=MMSA&isLocation=41700&isState=&isCounty=&isClass=CLASS14&isTopic=TOPIC09&isYear=2021&hidLocationType=MMSA&hidL

CDC. (2022). *BRFSS Prevalence & Trends Data*. Retrieved from Centers for Disease Control and Prevention:

https://nccd.cdc.gov/BRFSSPrevalence/rdPage.aspx?rdReport=DPH_BRFSS.ExploreByLocation&rdProcessAction=&SaveFileGenerated=1&irbLocationType=States&isLocation=48&isState=&isCounty=&isClass=CLASS03&isTopic=TOPIC18&isYear=2022&hidLocationType=States&hid

CDC. (2024, May 14). *A Report Card: Diabetes in the United States*. Retrieved from Centers for Disease Control and Prevention: <https://www.cdc.gov/diabetes/communication-resources/diabetes-statistics.html>

CDC. (2024, May 14). *About Gestational Diabetes*. Retrieved from Centers for Disease Control and Prevention: <https://www.cdc.gov/diabetes/about/gestational-diabetes.html>

- CDC. (2024, February 1). *Adult Physical Inactivity Outside of Work*. Retrieved from Centers for Disease Control and Prevention: <https://www.cdc.gov/physical-activity/php/data/inactivity-maps.html>
- CDC. (2024, May 2). *Leading Causes of Death*. Retrieved from Centers for Disease Control and Prevention: <https://www.cdc.gov/nchs/fastats/leading-causes-of-death.htm>
- CDC. (2024, May 15). *National Diabetes Statistics Report*. Retrieved from Centers for Disease Control and Prevention: <https://www.cdc.gov/diabetes/php/data-research/>
- Chen, Y., Zhou, X., Bullard, K. M., Zhang, P., Imperatore, G., & Rolka, D. B. (2023). Income-related inequalities in diagnosed diabetes prevalence among US adults, 2001–2018. *PLoS One*, *18*(4), e0283450. Retrieved from <https://doi.org/10.1371/journal.pone.0283450>
- City of San Antonio . (n.d.). *Diabetes Workshop*. Retrieved from City of San Antonio : <https://www.sanantonio.gov/Health/HealthyEating/ChronicDiseasePrevention#293494120-about>
- City of San Antonio. (n.d.). *Ron Nirenberg*. Retrieved from City of San Antonio: <https://www.sa.gov/Directory/Departments/Mayor-Council/Mayor/Biography>
- Clayman, M. L., Maganello, J. A., Viswanath, K., Hesse, B. W., & Arora, N. K. (2010). Providing Health Messages to Hispanics/Latinos: Understanding the Importance of Language, Trust in Health Information Sources, and Media Use. *Journal of health communication*, *15*(3), 252-263. Retrieved from <https://doi.org/10.1080/10810730.2010.522697>

- DSHS. (2021). *Health of Texas*. Retrieved from Texas Health Data BRFSS:
<https://healthdata.dshs.texas.gov/dashboard/surveys-and-profiles/behavioral-risk-factor-surveillance-system>
- Escarce, J. J., & Kapur, K. (2006). Hispanics and the Future of America. In M. Tienda , & F. Mitchell, *Access to and Quality of Health Care. In: National Research Council (US) Panel on Hispanics in the United States*. Washington DC: National Academies Press.
Retrieved from <https://www.ncbi.nlm.nih.gov/books/NBK19910/>
- Escobedo, L. E., Cervantes, L., & Havranek, E. (2023). Barriers in Healthcare for Latinx Patients with Limited English Proficiency—a Narrative Review. *Journal of general internal medicine*, 38(5), 1264-1271. Retrieved from <https://doi.org/10.1007/s11606-022-07995-3>
- Fang, M., Wang, D., Coresh, J., & Selvin, E. (2021). Trends in Diabetes Treatment and Control in U.S. Adults, 1999–2018. *The New England journal of medicine*, 384(23), 2219-2228.
Retrieved from <https://doi.org/10.1056/NEJMsa2032271>
- Ferreira, P. L., Morais, C., Pimenta, R., Ribeiro, I., Amorim, I., Alves, S. M., & Santiago, L. (2024, March 8). Knowledge about type 2 diabetes: its impact for future management. *Frontiers in Public Health*, 12, 1328001. Retrieved from <https://doi.org/10.3389/fpubh.2024.1328001>
- Formagini, T., Camargo, J. T., Perales-Puchalt, J., Drees, B. M., Fracachan Cabrera, M., & Ramirez, M. (2024). A culturally and linguistically adapted text-message Diabetes Prevention Program for Latinos: Feasibility, acceptability, and preliminary effectiveness.

Translational behavioral medicine, 14(2), 138-147. Retrieved from
<https://doi.org/10.1093/tbm/ibad053>

Fortmann, A. L., Savin, K. L., Clark, T. L., Philis-Tsimikas, A., & Gallo, L. C. (2019).

Innovative Diabetes Interventions in the U.S. Hispanic Population. *Diabetes Spectrum*, 32(4), 295-301. Retrieved from <https://doi.org/10.2337/ds19-0006>

Foster, B. A., Maness, T. M., & Aguino, C. A. (2017). Trends and Disparities in the Prevalence of Childhood Obesity in South Texas between 2009 and 2015. *Journal of obesity*, e1424968. Retrieved from <https://doi.org/10.1155/2017/1424968>

Garcia, A. A. (2005). Symptom prevalence and treatments among mexican americans with type 2 diabetes. *The Diabetes Educator*, 31(4), 543-554. Retrieved from
<https://doi.org/10.1177/0145721705278801>

Gast, J., Peak, T., & Hunt, A. (2017). Latino Health Behavior: An Exploratory Analysis of Health Risk and Health Protective Factors in a Community Sample. *American journal of lifestyle medicine*, 14(1), 97-106. Retrieved from
<https://doi.org/10.1177/1559827617716613>

Gonzalez, M., Sanders-Jackson, A., & Wright, T. (2019). Web-Based Health Information Technology: Access Among Latinos Varies by Subgroup Affiliation. *Journal of medical Internet research*, 21(4), e10389. Retrieved from <https://doi.org/10.2196/10389>

Hamman, R. F., Bell, R. A., Dabelea, D., D'Agostino, R. B., Dolan, L., Imperatore, G., . . .

Saydah, S. (2014). The SEARCH for Diabetes in Youth Study: Rationale, Findings, and

- Future Directions. *Diabetes Care*, 37(12), 3336-3344. Retrieved from <https://doi.org/10.2337/dc14-0574>
- Hasson, R. E., Adam, T. C., Pearson, J., Davis, J. N., Sprujit-Metz, D., & Goran, M. I. (2013). Sociocultural and Socioeconomic Influences on Type 2 Diabetes Risk in Overweight/Obese African-American and Latino-American Children and Adolescents. *Journal of Obesity*, 512914. Retrieved from <https://doi.org/10.1155/2013/512914>
- Haw, J. S., Shah, M., Turbow, S., Egeolu, M., & Umpierrez, G. (2021). Diabetes Complications in Racial and Ethnic Minority Populations in the USA. *Current Diabetes Report*, 21(1), 2. Retrieved from <https://doi.org/10.1007/s11892-020-01369-x>
- Hill-Briggs, F., Adler, N. E., Berkowitz, S. A., Chin, M. H., Gary-Webb, T. L., Navas-Acien, A., . . . Haire-Joshu, D. (2020, November 2). Social Determinants of Health and Diabetes: A Scientific Review. *Diabetes Care*, 44(1), 258-279. Retrieved from <https://doi.org/10.2337/dci20-0053>
- Kirk, J. K., Passmore, L. V., Bell, R. A., Narayan, V., D'Agostino, R. B., Arcury, T. A., & Quandt, S. A. (2008). Disparities in A1C Levels Between Hispanic and Non-Hispanic White Adults With Diabetes: A meta-analysis. *Diabetes Care*, 31(2), 240-246. Retrieved from <https://doi.org/10.2337/dc07-0382>
- McCurley, J. L., Gutierrez, A. P., & Gallo, L. C. (2017). Diabetes Prevention in U.S. Hispanic Adults: A Systematic Review of Culturally Tailored Interventions. *American Journal of Preventive Medicine*, 52(4), 519-529. Retrieved from <https://doi.org/10.1016/j.amepre.2016.10.028>

- NIH. (2023, May). *Diabetes Prevention Program (DPP)*. Retrieved from National Institute of Diabetes and Digestive and Kidney Diseases: <https://www.niddk.nih.gov/about-niddk/research-areas/diabetes/diabetes-prevention-program-dpp>
- NIH. (2023, April). *What is diabetes?* Retrieved from National Institute of Diabetes and Digestive and Kidney Diseases: <https://www.niddk.nih.gov/health-information/diabetes/overview/what-is-diabetes>
- OMH. (2023). *Hispanic Heritage Month*. Retrieved from US Department of Health and Human Services Office of Minority Health: <https://www.hhs.gov/sites/default/files/omh-hhm-2023-reading-list.pdf>
- OMH. (n.d.). *Diabetes and Hispanic Americans*. Retrieved from US Department of Health and Human Services Office of Minority Health: <https://minorityhealth.hhs.gov/diabetes-and-hispanic-americans>
- Osborn, C. Y., Cavanaugh, K., & Kripalani, S. (2010, January 1). Strategies to Address Low Health Literacy and Numeracy in Diabetes. *Clinical Diabetes*, 28(4), 171-175. Retrieved from <https://doi.org/10.2337/diaclin.28.4.171>
- Parker, E. D., Lin, J., Mahoney, T., Ume, N., Yang, G., Robert, G. A., . . . Bannuru, R. R. (2024). Economic Costs of Diabetes in the U.S. in 2022. *Diabetes Care*, 26-43. Retrieved from <https://doi.org/10.2337/dci23-0085>
- Peña-Purcell, N. (2008). Hispanics' use of Internet health information: an exploratory study. *Journal of the Medical Library Association*, 96(2), 101-107. Retrieved from <https://doi.org/10.3163/1536-5050.96.2.101>

Quinn, L. M., Wong, F. S., & Narendran, P. (2021, October 1). Environmental Determinants of Type 1 Diabetes: From Association to Proving Causality. *Frontiers in Immunology*, *12*, 737964. Retrieved from <https://doi.org/10.3389/fimmu.2021.737964>

Robinson, S., Valencia, L., You, H., Potter, L. B., Steve, W., & Jordan, J. A. (2018, December). *Diabetes in Texas*. Retrieved from Texas Demographic Center: <https://demographics.texas.gov/>

Salman, C. (2022, December 19). *San Antonio, TX*. Retrieved from World Atlas: <https://www.worldatlas.com/cities/san-antonio-texas.html>

Simple Maps. (n.d.). *Income Household Median*. Retrieved from Simple Maps: <https://simplemaps.com/city/san-antonio/zips/income-household-median>

Souza, J. G., Apolinario, D., Magaldi, R. M., Busse, A. L., Campora, F., & Jacob-Filho, W. (2014). Functional health literacy and glycaemic control in older adults with type 2 diabetes: a cross-sectional study. *BMJ Open*(4), e004180. Retrieved from <http://dx.doi.org/10.1136/bmjopen-2013-004180>

Tripp-Reimer, T., Choi, E., Kelley, L. S., & Enslein, J. C. (2001, January 1). Cultural Barriers to Care: Inverting the Problem. *Diabetes Spectrum*, *14*(1), 13-22. Retrieved from <https://doi.org/10.2337/diaspect.14.1.13>

TX for Sale. (n.d.). *San Antonio For Sale by Zip Code* . Retrieved from San Antonio Real State & Homes for Sale: <https://www.sanantoniotxforsale.com/homes-for-sale-zip-code-search/>

Ugalde , M., & Agha, G. (2022, June). *City of San Antonio* . Retrieved from Status of Diabetes in Bexar County, Texas - 2020 Update:

<https://www.sa.gov/files/assets/main/v/1/samhd/documents/health-data-statistics/diabetesreport2019-2020.pdf>

United States Census Bureau. (2022). *San Antonio city, Texas*. Retrieved from US Census

Bureau:

https://data.census.gov/profile/San_Antonio_city,_Texas?g=160XX00US4865000#education

Weitzman, P. F., Caballero, A. E., Millan-Ferro, A., Becker, A. E., & Levkoff, S. E. (2013).

Bodily aesthetic ideals among Latinas with type 2 diabetes: implications for treatment adherence, access, and outcomes. *The Diabetes Educator*, 39(6), 856-863. Retrieved from <https://doi.org/10.1177/0145721713507113>

World Population Review. (2024). *Bexar County, Texas Population 2024*. Retrieved from World

Population Review: <https://worldpopulationreview.com/us-counties/tx/bexar-county-population>

YMCA. (n.d.). *Evidence Based Wellness*. Retrieved from YMCA of Greater San Antonio :

<https://www.ymcasatx.org/programs/community/evidence-based-wellness>

Zhu, D., Ye, X., Li, W., Ding, R., & He, P. (2021, March 24). Urban health advantage or urban health penalty? Urban-rural disparities in age trajectories of physiological health among Chinese middle-aged and older women and men. *Health and Place*, 69, 102559.

Retrieved from <https://doi.org/10.1016/j.healthplace.2021.102559>

Glossary of Terms

BMI	Body Mass Index
BRFSS	Behavioral Risk Factor Surveillance System
DM	Diabetes Mellitus
DPP	Diabetes Prevention Program
GDM	Gestational diabetes mellitus
LEP	Limited English proficiency