

Sugary Beverage Consumption and Risk for Type 2 Diabetes among People of Mexican
Origin: An Exception to the “Epidemiologic Paradox”

Hilary Mislán
May 9, 2009
Haverford College Class of 2009

Advisers: Professor Kaye Edwards (Independent College Programs) and Professor Jenni Punt
(Biology)

Abstract

This thesis hypothesizes that high rates of type 2 diabetes among people of Mexican origin may be related to sugary beverage consumption in this group. To test my hypothesis, I have conducted a detailed review of the literature on sugary beverage consumption and its health risks, type 2 diabetes causation, especially in relation to sugary beverage consumption and obesity, and type 2 diabetes and beverage consumption in people of Mexican origin. Additionally, to test the availability of sugary beverages in the Mexican community, I measured and analyzed beverage shelf space in several grocery stores. To my knowledge, the relationship between sugary beverage consumption and type 2 diabetes among people of Mexican origin has not been studied. Therefore, a product of this thesis is the creation of a survey for future research on this topic that asks about beverage consumption habits and attitudes, type 2 diabetes diagnosis and familiarity, and country of origin and family heritage. As an educational intervention, I plan to design an information sheet on sugary beverage nutrition for patients who may be at high risk for type 2 diabetes.

Through my literature review, I found that sugary beverage consumption is related to obesity, one of the principle risk factors for type 2 diabetes. I also found that people of Mexican origin do indeed have a higher rate of sugary beverage consumption than the total population. Through administering a pilot of my survey to Haverford students, I established that those students who were aware of a family member diagnosed with diabetes were more likely to have increased awareness of beverage sugar content. Finally, my pilot shelf measurement project revealed that the Mexican-owned grocery store where I measured shelves had more high sugar beverages available than low sugar beverages, though further research may be necessary to confirm these results. I concluded that my literature review and shelf measurement project provided solid support for my hypothesis and that further research should be conducted via the administration of my survey to more thoroughly determine the nature of the relationship between sugary beverage consumption and risk for type 2 diabetes in people of Mexican origin.

Table of Contents

Table of Contents.....	3
Introduction	4
<i>Sugary Beverage Anecdotes: Observations that led to my hypothesis</i>	5
Chapter 1: The “Epidemiologic Paradox” in Mexican Immigrants and Health among People of Mexican Origin in the United States	9
<i>Type 2 Diabetes: an Exception to the “Epidemiologic Paradox”</i>	14
Chapter 2: Type 2 Diabetes as a growing health problem in the U.S. and in Mexican Americans	17
<i>Type 2 Diabetes: Molecular Mechanisms and Complications</i>	18
<i>Epidemiologic Overview of Type 2 Diabetes</i>	19
<i>Philadelphia-Specific Demographics on Type 2 Diabetes and Mexicans</i>	20
Chapter 3: Sugary Beverages and Their Consumption in the Mexican Community	24
<i>Specific Nutrition Information Regarding Sugary Beverages</i>	24
<i>Sugary Beverage Consumption in the Mexican Community</i>	25
<i>Shelf Measurement Description and Analysis</i>	27
<i>Aims</i>	27
<i>Materials and Methods</i>	27
<i>Results</i>	29
<i>Discussion and Conclusions</i>	30
<i>A Culture of Sugary Beverage Consumption in the Mexican Community</i>	32
Chapter 4: A Pilot Survey to Study Beverage Consumption	34
<i>Applications for a Survey and Beverage Information Sheet</i>	34
<i>A Survey for People of Mexican Origin to Determine Beverage Consumption Habits and Attitudes and Type 2 Diabetes Familiarity (Pilot)</i>	35
<i>Explanation for Survey Questions</i>	37
<i>Pilot Survey Analysis and Revision</i>	41
<i>Analysis of Haverford Students’ Responses</i>	42
<i>Uncertainties and Reasons for Changes to Pilot Survey</i>	44
<i>Final Survey with Revisions Based on Pilot Responses</i>	45
<i>An Educational Sugary Beverage Information Sheet as an Intervention Tool</i>	48
Acknowledgements	52
References	53

Introduction

Based on my personal experience with Hispanic cultures, both in the United States and in Latin American countries, I have noticed certain dietary patterns that have led me to suspect the existence of a relationship between sugary beverage consumption and rates of type 2 diabetes in Hispanics, which are higher than in non-Hispanic whites. Given the association between glucose intake and development of type 2 diabetes, I predict consuming more sugary beverages such as sodas and sugar-sweetened juices would increase the risk of developing the disease. From what I have observed, Hispanic cultures consume beverages in a pattern that is distinct from that of mainstream American culture, and I also predict that sugary beverages are more popular among U.S. Hispanics than among the general population.

In this thesis, I will explore the relationship between sugary beverage consumption and type 2 diabetes rates among people of Mexican origin in the United States. I will do this in the context of a phenomenon in health statistics among Hispanics, and, specifically, among people of Mexican origin, known as the “epidemiologic paradox”. Despite high risk factors for poor health such as low educational attainment and low income, Hispanics have higher life expectancy, and better health on many levels, than would be expected. The paradox is most apparent in recent immigrants, but as individual time spent in the U.S. increases and generations proceed, it appears that health status declines. However, type 2 diabetes statistics demonstrate a unique pattern, insofar as people of Mexican origin are particularly affected by the condition, with higher rates of it than non-Hispanic whites. My hypothesis, which has been developed based on some anecdotal experience and supported through a review of literature on the topic as well as a pilot study and analysis I conducted on beverage

availability in different grocery stores, predicts that the high type 2 diabetes rates are due in part to a high rate of sugary beverage consumption among people of Mexican origin.

As a product of this thesis, I have developed a survey intended to be used to conduct a research study to more rigorously test my hypothesis. The survey asks about beverage consumption, diabetes diagnosis or family history, and country of origin and time spent in the United States. Health care practitioners could also use this survey to gauge individual patients' attitudes and understand their beverage consumption habits. Additionally, I present an educational information sheet about beverage sugar content and nutrition designed for people of Mexican origin as a tool for practitioners. This may be useful based on evidence I present that among people of Mexican origin beverage sugar content is not a major aspect of health awareness.

Sugary Beverage Anecdotes: Observations that led to my hypothesis

The principle reason for my prediction that sugary beverage consumption may place Hispanics at a greater risk than the rest of the population for type 2 diabetes is based on my observation that Hispanic attitudes toward sugary beverages seem different than those of non-Hispanic whites. The anecdotes that have led to my hypothesis are specific examples of my own experiences, and I do not seek to make generalizations based upon them. These stories are not evidence of a specific phenomenon, but rather are my reason for deciding to explore the relationship between beverage consumption and type 2 diabetes. While they do not provide any statistical power and do not necessarily demonstrate patterns that can be generalized to entire populations, they are valuable in structuring a foundation for my

hypothesis and in providing some qualitative examples of sugary beverage consumption patterns.

During volunteer work experiences in Guatemala in 2006, 2007, and 2009 and work and study experiences in Chile in 2008, I had noticed that both the occasions when sugary beverages were consumed and the attitudes toward these beverages indicated a cultural pattern distinct from what I had experienced in the United States. Sugary beverages, especially sodas, were served to everyone at every special occasion. Whether or not the person requested the beverage, it was distributed as a party staple. When I asked for water at a celebration for health clinic workers at Consultorio Placilla where I interned in Chile during the spring of 2008, my co-workers laughed at me. The non-alcoholic beverage of choice at celebrations is cola (usually Coke). In daily life as well, not just at parties, I noticed high rates of sugary beverage consumption; instead of carrying a water bottle around, as many students at American universities do, Chilean students would often have soda.

I experienced the same pattern of sugary beverage consumption in Guatemala: at a large Mayan wedding I attended in January 2009, every guest was served generic cola. When I asked my Mayan friend and colleague Jose Luis Gil Lopez about the choice of beverage, he explained that sodas are always drunk at special events like these. He also commented that many people in Mayan communities drink these beverages on a regular basis without realizing the health consequences.

Another experience I had in the U.S. reminded me of the sugary beverage consumption patterns I had noticed in Latin America and caused me to make a connection between sugary beverage consumption and type 2 diabetes. As an intern in July 2007 at the

Windsor Street Clinic, which serves a large Salvadorian population in Cambridge, MA, I recruited subjects and translated for a bilingual English-Spanish type 2 diabetes education group. When I called patients to ask about their diabetes care, one of the recommendations from the nutritionist was to ask what beverages the patient normally drank; my task was to encourage water drinking and to suggest minimizing juice consumption. One patient on the diabetics list told me that she did not have diabetes, and so I asked the nurse about her. She explained to me that this patient had been diagnosed with type 2 diabetes because of her high blood sugar levels, but it turned out that she was actually drinking two liters of soda per day, causing artificially high blood glucose level test results. When she stopped drinking so much soda, her blood glucose level went down. While I do not recall whether or not this patient was Hispanic, this anecdote does speak to the power of sugary beverage consumption and its effect on the human body.

I recognize that major differences exist between the various Hispanic cultures I have observed in two very different parts of Latin America and in the U.S., but the patterns of soda consumption consistently caught my attention. In my experience, Hispanic cultures, mainly outside of the U.S., categorize sugary beverages differently than the general U.S. population does: while many Americans drink sodas, the health risks are publicly known and recognized— though they are often ignored, but in Latin American countries people seem to drink soda without regard for the health risks. Especially among middle and upper class populations in the U.S., soda consumption is not taken for granted at large events- it is not necessarily the preferred beverage for all. However, sodas are indeed mainstream American products, and based on my observations, this may actually enhance their appeal in Latin American cultures. The fast food, music, celebrities, and fashion of American popular culture

are frequently admired in the areas I stayed in both Guatemala and Chile (though in different manifestations in each of these two countries). It seems quite possible that the American soda would be one more lifestyle aspect to adopt or aspire to.

Although I have identified sugary beverage consumption patterns in Hispanic cultures as distinct from those in American culture, I think it is important to recognize the popularity of sugary beverages in the United States. Sweetened juices and sodas line grocery store shelves and dominate advertisements, and vending machines with these beverages are conveniently located in schools and workplaces. As I shall show when I analyze literature on beverage consumption patterns, sugar-sweetened beverages have become more and more popular in the U.S. over the past decades, following a similar pattern to the increase in type 2 diabetes. The extreme popularity of sweetened beverages causes a public health risk for the U.S. (and global) population and may contribute to the high rates of type 2 diabetes.

Chapter 1: The “Epidemiologic Paradox” in Mexican Immigrants and Health among People of Mexican Origin in the United States

In the U.S., research has consistently revealed a phenomenon known as the “epidemiologic paradox” in Hispanics (Markides & Coreil, 1986; Hummer, Powers, Pullum, Gossman, & Frisbie, 2007). This term describes relatively positive health outcomes such as higher life expectancy and lower rates of death from certain diseases that Hispanics as a group experience than would be predicted by the social and environmental health risks they face. The paradox is most readily apparent in new Hispanic immigrants; as time spent in the U.S. increases, and as subsequent generations follow, the good health status markers go down. Measurements of acculturation, which often correlate with time spent in the U.S., are also relevant in studying the “epidemiologic paradox”; the more acculturated populations have worse health outcomes.

People of Mexican origin make up about 64% of the U.S. Hispanic population and 9.1% of the total U.S. population (U.S. Census Bureau, 2007), and health statistics for Mexican immigrants demonstrate the “epidemiologic paradox”. While much research regarding Hispanic health and the “epidemiologic paradox” groups Hispanics as a single category, a problem which I will revisit later in this thesis, more statistical information is available from the CDC and Census Bureau for Mexican Americans than for other Hispanic groups. Because of its size and influence, and because much of the literature on Hispanics focuses on Mexicans, this group will be the focus of my investigation.

The relationship between income and health is also relevant to understanding the “epidemiologic paradox” in Hispanics. For the general population, though not for Hispanics, persistently low income is a good predictor of mortality and of other negative health

indicators. Although people are often categorized by race in data collection regarding health, a study by Williams, in association with the Robert Wood Johnson Foundation (2001), found that income is in fact the most relevant variable to health outcome. To examine the paradoxical health outcomes in Mexicans, then, I will evaluate the group's economic status and subsequently show that the "epidemiologic paradox" still holds: despite risk factors for poor health, including low income, Mexicans in the U.S. have much better overall health for indicators such as infant mortality, life expectancy, and mortality from cardiovascular disease than expected.

While the median household income in the U.S. is \$50,007, Mexican households earn a median of \$38,823, approximately 22% less than the median U.S. household. Accordingly, Mexicans also live at higher rates of poverty (20.8%) than the total U.S. population (9.8%) (United States Census Bureau, 2007). Low income is associated with low educational attainment level, and Hispanics are at high risk in this area as well; Hispanics are four times more likely to have less than a ninth grade education level and less than half as likely than the total population to be college graduates (Pew Hispanic Center, 2005). Mexicans in the U.S. follow the low educational attainment trend of Hispanics in general: 46.5% of Mexicans over the age of 25 have less than a high school diploma, compared with 16% of the total population of that age range and 40.1% of Hispanics (U.S. Census Bureau, 2007). Given these statistics, poor health outcomes would be expected for Mexicans in the U.S.

Despite the grim socioeconomic circumstances of U.S. Mexicans, many important health indicators show that Mexicans have a better level of health than expected based on socioeconomic status. Life expectancy for Hispanics is consistently higher than that of non-Hispanic whites. In 2006, Hispanics (a group of which Mexicans constitute 64%) had a death

rate of 550 per 100,000 compared with 778 per 100,000 in non-Hispanic whites (Brown, 2008), however these data do not account for average age in each of these groups. The studies I will discuss in this section review low birth weight, infant mortality, and cardiovascular disease, several indicators that help to provide an overall picture of a population's health.

One commonly used statistic to indicate population health is that of low birth weight. A large-scale analysis of U.S. Natality Detail Data showed that foreign-born status was a protective factor against low birth weight in Mexican women in the U.S.: Mexican-born women in the U.S. are 25% less likely than U.S.-born women of Mexican origin to have a low birth weight baby. The same study showed that educational attainment also helped protect against low birth weight (Acevedo-García, Soobader & Berkman, 2007). Although the study did not compare these two groups to non-Hispanic women, these data are consistent with one aspect of the “epidemiologic paradox” as described above because according to the paradox, subsequent generations have less positive health outcomes. However, it may be important to note that the study does not control for gestational diabetes, a condition that can lead to higher birth weight.

In another study, Hummer, et al. (2007) found that infants born to Mexican immigrant women had 10% lower mortality in the first hour, day, and week of life than those born to non-Hispanic white women, and that babies of U.S.-born Mexican American women had equal infant mortality to those of non-Hispanic white women. The level of infant mortality in U.S.-born Mexican Americans was lower than that in blacks, despite similar socioeconomic statuses.

Additionally, Hispanics consistently have lower rates of death due to cardiovascular disease, the top cause of death in the U.S., than both Whites and African Americans (Pérez-Stable, Juarbe, & Moreno-John, 2001). Latina women have a lower death rate from cancer than white women (85 and 141 per 100,000, respectively), and have a lower death rate from stroke as well (WHYY, 2002). Overall, people of Hispanic origin have a higher life expectancy (77.1 years for males and 83.7 years for females) compared to the total population (74.0y for males and 79.7y for females) (U.S. Census Bureau, 2000). These data clearly illustrate the conundrum that is the “epidemiologic paradox” and the interesting patterns we see in health outcomes in people of Mexican origin.

Several explanations have been offered to account for the “epidemiologic paradox” in Hispanics including acculturation, nutrition, stress level and stigma/discrimination, and even genetics. One group of researchers found that Mexican citizens living in the U.S. were more likely to use religion and positive reframing in an attempt to put a negative or stressful situation in a positive light, and less likely to turn to substance abuse to cope with stress. In the same study self-identified Mexicans and Mexican Americans were both more likely to have better self-reported physical and mental health than non-Hispanic whites (Farley, Galves, Dickinson, & Diaz Perez, 2005). Another group of researchers found that although Hispanics had higher average body mass index (BMI, a measure of body weight per height) than the non-Hispanic whites they were being compared to, they also drank less alcohol and smoked less, indicating a few better health behaviors among Hispanics (Abraído-Lanza, Chao, & Flórez, 2005).

Hayes-Bautista (2002) questions the mainstream view on the “epidemiologic paradox” using California—a state in which, in 1998, 47.5% of newborn babies were

Hispanic compared with 33.9% non-Hispanic white—as an example. He explains, “The question should not be ‘Why are Latino children doing so well in spite of high risk factors?’ but instead, ‘Why are non-Hispanic white children doing so poorly in spite of all their advantages?’”. A great variety of factors seem to be associated with this paradox, and while it may be difficult to explore them all at once, their interplay is crucial in analyzing Hispanic health.

Despite widespread evidence supporting the paradox, other researchers have made the case that the apparent pattern stems from data reporting errors. Smith and Bradshaw (2006) look to possible underreporting of Hispanic origin on death certificates and discrepancy between census reports and death certificates that make morbidity and mortality in Hispanics *appear* lower. Their arguments focus on a change that the Census Bureau made in method for counting Hispanics; in 1980 they switched from using Spanish surname as defining Hispanic origin to self- or informant-identified Hispanic origin. This change, the researchers claim, resulted in mortality rates appearing lower in Hispanics.

However, the authors from the study that originally sought to deny the existence of the “epidemiologic paradox”, along with other colleagues, later questioned the validity of the original conclusion (that the apparent paradox is due to data reporting errors) by proposing that Smith and Bradshaw had failed to take into account linked data file studies and national data—they had only closely examined statistics for Texas. The new publication also noted the fact that mortality rates between Hispanic subgroups varies greatly, a factor that indicates more complexity to the paradox than a Hispanic/non-Hispanic issue (Ho, Shih, Simon, Smith, & Bradshaw, 2007). One review on the “epidemiologic paradox” also recognizes the diversity both in culture and in health outcomes between and among Hispanic subgroups and

suggests that labeling the issue as a purely Hispanic phenomenon is overly simplistic (Perez-Escamilla & Putnik, 2007). This latter study does not deny the existence of a health paradox but identifies the phenomenon as so multi-causal that it may be problematic to label the paradox as such without examining factors other than ethnicity.

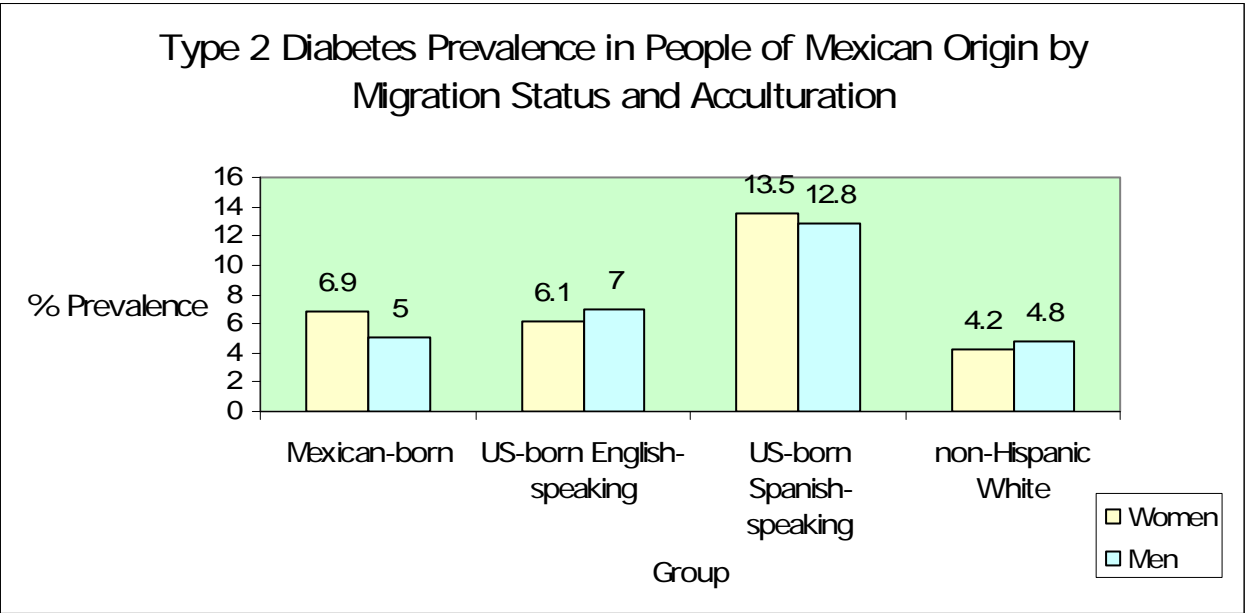
Because the majority of studies have found evidence that is supportive of the “epidemiologic paradox” in Hispanic health, I believe that such a pattern does indeed exist, and I recognize that acknowledging cultural and environmental differences between and among Hispanic subgroups is essential in analyzing this pattern. For this reason, I will examine type 2 diabetes rates among people of Mexican origin in the context of the “epidemiologic paradox”. Type 2 diabetes is the focus of this thesis because it distinguishes itself as a health condition that defies the “epidemiologic paradox.” I will examine migration status and acculturation as factors that may contribute to health status but will also emphasize that rates of type 2 diabetes vary substantially even within people of Mexican origin.

Type 2 Diabetes: an Exception to the “Epidemiologic Paradox”

Type 2 diabetes presents a remarkable epidemiologic pattern that deviates strikingly from the “epidemiologic paradox”. Despite consistent findings that people of Mexican origin have better health than would be expected based on income and education, this group is adversely and disproportionately affected by type 2 diabetes. According to the Centers for Disease Control (CDC, 2007), the prevalence of diabetes in Mexican Americans is on average 1.9 times that of non-Hispanic whites, although this number varies immensely depending on certain factors. Through a literature review I will test my hypothesis that the high rate of type 2 diabetes in Mexican Americans is in part due to increased sugary beverage consumption in this group. Additionally, obesity, which is one of the major risk factors for

type 2 diabetes, increases in Hispanic immigrants with time spent in the United States, regardless of language spoken (Akresh, 2007).

While overall type 2 diabetes rates clearly contradict the “epidemiologic paradox”, studies that examine varying type 2 diabetes rates based on generation, acculturation, or length of time in the U.S. have been inconclusive, demonstrating the complex interplay of these factors. For example, migration status and language spoken are two commonly-used measurements of acculturation. Figure 1, below, which displays type 2 diabetes rates in people aged 25 to 64 by migration status and language spoken, demonstrates that acculturation may not be as simplistic a concept as it is sometimes assumed to be (Sundquist and Winkleby, 1999). The data displayed below have been adjusted for educational attainment as a measure of socioeconomic status, and great disparities between groups still exist. Although the three Mexican origin groups all have higher type 2 diabetes rates than the non-Hispanic white group, U.S.-born English speaking and Mexican-born groups have similar rates. However, the nearly two-fold difference in type 2 diabetes prevalence between U.S.-born English speaking and U.S.-born Spanish speaking people of Mexican origin represents one of the major issues faced in defining “acculturation”. The authors of the study suggest that while U.S.-born English speakers are likely to have assimilated well to the American lifestyle, and Mexican-born people have likely retained a significant amount of Mexican culture, U.S.-born Spanish speakers may be left without a strong cultural support network.



*Non-Hispanic white included for comparison purposes.

Figure 1: Diabetes Prevalence in People of Mexican Origin by Migration Status and Acculturation

Type 2 diabetes rates contradict the simplistic notion of the “epidemiologic paradox” in part because they are higher than those of non-Hispanic whites, but also because, in reference to Fig. 1, rates are lower among groups with what might be considered low acculturation (Mexican born) and high acculturation (U.S.-born English speaking) but higher with a “medium” level of acculturation (U.S.-born Spanish speaking). However, overall type 2 diabetes rates are surprisingly high in people of Mexican origin, and this thesis examines one cultural/behavioral factor, sugary beverage consumption, that may contribute to those high rates.

Chapter 2: Type 2 Diabetes as a growing health problem in the U.S. and in Mexican Americans

Type 2 diabetes, also known as non-insulin dependent or adult onset diabetes, is one of the major health problems in the United States. Type 2 diabetes accounts for 90 to 95% of all diabetes cases in the U.S. and has been historically associated with older age. This is in contrast to type 1 diabetes, which is most often diagnosed in children and makes up only 5 to 10% of U.S. diabetes cases (American Diabetes Association, 2009). While type 2 diabetes causation is complex and not completely understood, causal factors include older age, genetics, diet, and sedentary lifestyle (Rewers & Hamman, 1995). One gene has not been identified to explain type 2 diabetes, however, and it has in recent years become more common in younger populations (Dean & McEntyre, 2004).

Many lifestyle, genetic, and nutritional factors also contribute to type 2 diabetes risk. The disease is associated with old age, obesity, type 2 diabetes family history, gestational diabetes history, impaired glucose metabolism, and non-white race/ethnicity. Even when statistics are adjusted for socioeconomic status, African Americans, Hispanics, and American Indians all have higher risk for type 2 diabetes than non-Hispanic whites (National Diabetes Fact Sheet, CDC, 2007). Pertinent to my thesis is the effect of nutrition and intake of various sugars on risk for type 2 diabetes. Glucose and fructose intake has in many studies predicted risk for type 2 diabetes, although these sugar intakes could be related to other factors, such as decreased physical activity or increased fat intake that also enhance risk (Montonen, Jarvinen, Knekt, Heliovaara, & Reunane, 2007).

Type 2 Diabetes: Molecular Mechanisms and Complications

The two major events behind type 2 diabetes development are insulin resistance and pancreatic islet β -cell dysfunction. β -cells release insulin, the most important hormone needed for glucose metabolism. Insulin release triggers many important metabolic processes including: removal of glucose from the blood by fat and muscle cells, conversion of glucose to ATP through glycolysis and the citric acid cycle, short-term glucose storage in the liver and muscle as glycogen, long-term glucose storage in adipose tissue as fat, and cellular use of glucose in protein synthesis (Dean & McEntrye, 2004). Under normal circumstances, when the body develops insulin resistance (meaning that the body becomes less sensitive to insulin), β -cells produce more insulin to make up for the low insulin sensitivity, and glucose tolerance remains normal. However, when a combination of insulin resistance is accompanied by lower insulin production by β -cells, type 2 diabetes occurs (Dean & McEntrye, 2004). Insulin resistance is associated with obesity, but also occurs during puberty, pregnancy, and ageing. Obesity very often leads to insulin resistance because adipose (fat) tissue releases non-esterified fatty acids (NEFAs), glycerol, leptin, adiponectin, and proinflammatory cytokines, all products whose production increases in obese individuals and that perform various functions that may increase insulin resistance. Specifically, obese and type 2 diabetic individuals have high NEFA levels, and insulin resistance can be detected within hours of elevated NEFA levels in the plasma (Kahn, Hull, & Utzschneider, 2006).

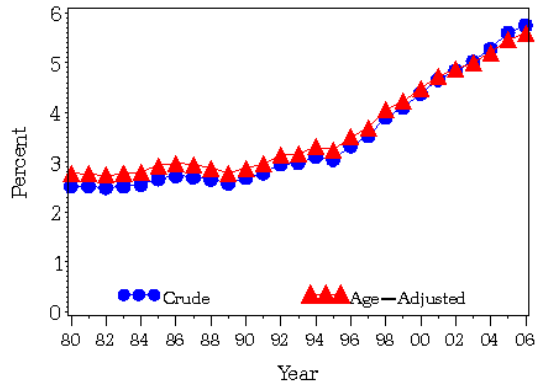
When insulin cannot remove glucose from the blood, levels of glucose in the blood remain high, a condition known as hyperglycemia. High blood glucose levels cause proteins in the blood to acquire glucose molecules (becoming “glycosylated”). When proteins involved in blood vessel structure that are not supposed to be glycosylated become so, the

blood vessels can lose elasticity and high blood pressure results (J. Owens, personal communication, April 17, 2009). For this reason, high blood pressure, which can lead to coronary heart disease and stroke, is one of the common health risks associated with type 2 diabetes.

Over longer periods of time, having high blood glucose can have serious damaging effects on the eyes, kidneys, nerves, and heart (American Diabetes Association, 2009). An example of risk for eye damage that is associated with hyperglycemia is retinopathy, a condition characterized by alterations in small retinal blood vessels that can cause impaired vision or blindness (R. Klein & B. Klein, 1995). Lower extremity arterial disease (LEAD) is another serious complication of diabetes caused in large part by high blood pressure, and it can lead to lower limb amputation (Palumbo & Melton, 1995).

Epidemiologic Overview of Type 2 Diabetes

The prevalence of type 2 diabetes in the total U.S. population has increased drastically in recent years. Type 2 diabetes rates in the U.S. were constant before the 1980's, but between 1980 and 2006, crude prevalence rates increased by 132% (CDC, 2006). The graph below shows crude and age-adjusted rates of type 2 diabetes in the U.S. from 1980 to 2006. The fact that the age-adjusted rate is very close to the crude rate demonstrates that the increase in type 2 diabetes cannot be attributed to a shifting age demographic in the population.



Source: CDC National Center for Health Statistics.

Figure 2: Graph of Diabetes Rates

The increased prevalence of type 2 diabetes may be due in part to increased rates of its diagnosis. The American Diabetes Association (2009) purports that the rate of undiagnosed diabetes has gone down from 50% to 24% in the past 10 years. However, it is unclear how this statistic was calculated, as undiagnosed disease rates can only truly be estimates.

As I mentioned earlier, Hispanics, and in particular Mexican Americans, are at a higher risk than the general population for type 2 diabetes. Among U.S. Hispanics, Mexican Americans have a higher age-adjusted diabetes rate of 11.8% compared with 10.5% in all Hispanics (Department of Health and Human Services, 2006). Based on these data, it is apparent that type 2 diabetes is a grave health problem for both the general U.S. population and particularly for people of Mexican origin.

Philadelphia-Specific Demographics on Type 2 Diabetes and Mexicans

According to a recent Brookings Institution (2008) report, the Mexican immigrant population in Philadelphia has been increasing steadily in recent years. Between 1990 and

2006, Mexico went from not ranking in the top 10 countries of origin for the foreign-born Philadelphia area population to ranking second. The Philadelphia metropolitan area Mexican population more than doubled from 20,643 in 2000 to 42,410 in 2006. In Philadelphia County, the 2000 U.S. Census estimated a population of 6,220, but community leaders estimated a Mexican population of over 12,000 in 2003 (Welcoming Center for New Pennsylvanians, 2009). The rapid growth in recent years would predict an additional increase since the latest available data from 2006.

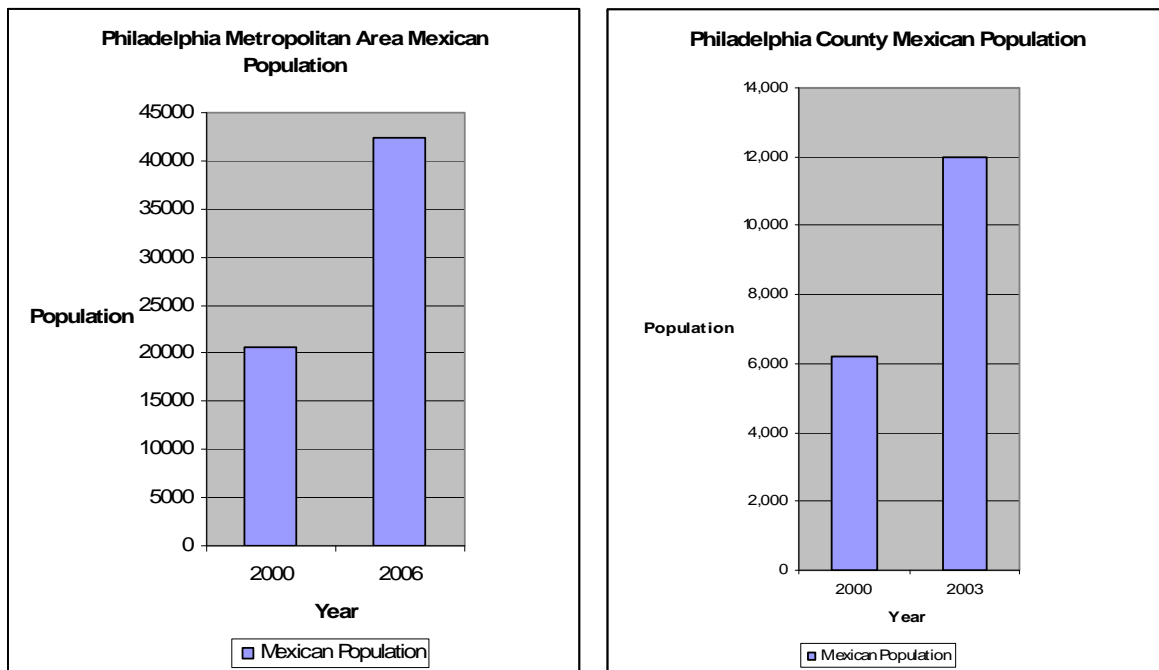


Figure 3: Philadelphia Metropolitan Area and Philadelphia County Mexican Population

The reported numbers for census are likely to be underestimates because those residents who speak limited English are less likely to be counted in censuses (Brookings Institution, 2008). Additionally, based on conversations that I have had with Philadelphia immigrant healthcare providers Dr. Steve Larsen and Nurse Rebecca Bixby in fall and winter 2008, it seems that Philadelphia is home to many undocumented Mexicans, a sub-population that is often uncouncted by the census and very difficult to measure (Dr. Steven Larsen,

personal communication, September 12, 2008; Nurse Rebecca Bixby, personal communication, November 20, 2008). Therefore, it can be assumed that the Mexican population of metropolitan Philadelphia is quite possibly significantly larger than the 2006 estimate of 42,410.

In Philadelphia, diabetes affects 11.1% of Latinos (though not specifically Mexicans) but only 8.5% of whites (Public Health Management Corporation [PHMC], 2006). Because of the growing Mexican-born population in Philadelphia, health care providers face an increasingly diverse patient population with the accompanying need to produce culturally-competent health education and information materials. As diabetes affects such a large proportion of Mexican immigrants, it seems fitting that information regarding this condition in particular should be available at the health centers that Mexicans visit.

The Hispanic population in Philadelphia also suffers from a lack of access to health care. Of respondents who completed the 2006 Community Health Survey in Spanish, 72% reported having a regular source of care, compared with 88% of Philadelphians (Philadelphia Department of Health, 2008). However, as of 2000, Mexicans made up less than 5% of Philadelphia's Hispanic population (U.S. Census Bureau, 2000), so a measure of Spanish-speakers is not specific enough to predict characteristics of Mexicans. Additionally, the survey was conducted via landline telephone, a method that is unfriendly to immigrants who may avoid many types of authority. While it is clear from this survey that the Hispanic population of Philadelphia lacks a regular source of health care, the same cannot necessarily be said for the Mexican-origin population. However, because the Mexican-origin population is highly undocumented it is likely that its access to health care is also low and may be even

lower because of a fear that encounters with the public system could lead to discovery of undocumented status.

Type 2 diabetes patterns in the Philadelphia area demonstrate its increasing effect. The two sources of data on diabetes in Philadelphia are the CDC and the PHMC. The PHMC is an organization which collects detailed information about the health of Southeastern Pennsylvania residents and is considered the best source for health information in the Philadelphia area. It collects its data through random digit dial telephone surveys, asserting that this method allows for geographic area and population subgroup representation. The PHMC does present findings based on ethnic group, but lists Hispanics without specific subgroups (PHMC, 2006). Philadelphia's public health department does not collect (or at least does not publicize) information as detailed as that presented by the PHMC.

As of 2005, the CDC's National Diabetes Surveillance System (2005) listed the prevalence of type 2 diabetes in Philadelphia County as 9.7%, which is 24% above the 7.8% state average. Additionally, the PHMC (2006) reported a 100% increase in diabetes prevalence rates in Southeastern Pennsylvania from 4.3% in 1991 to 9.6% in 2004. However, PHMC listed the rate of type 2 diabetes as 12% among Philadelphia adults as of 2006, a figure 24% higher than CDC's 2005 finding. This may be because the CDC included the entire population and PHMC only included adults, and type 2 diabetes does not occur as often in children. Additionally, according to the PHMC's 2008 Household Health Survey, 29.1% of all adults in the Philadelphia County are obese, presenting one of the principle type 2 diabetes risk factors. The poor of Philadelphia are also adversely affected by diabetes: of adults below the poverty line, 14.2% have the disease, but just 11.6% of the non-poor have it (PHMC, 2006).

Chapter 3: Sugary Beverages and Their Consumption in the Mexican Community

Specific Nutrition Information Regarding Sugary Beverages

In the National Health and Nutrition Examination Survey (NHANES) sugar sweetened beverages are defined as sodas and sweetened juices. These drinks generally contain between 35 and 50 grams of sugar per 12-oz serving (Coca-Cola Company Nutrition Information, 2009). As explained in the previous chapter, sugary beverage consumption has consistently increased in the U.S. in recent decades. Sugary beverage consumption has been linked to both weight gain and type 2 diabetes, and different types of sugars pose different health risks. Montonen et al. (2007) found that development of type 2 diabetes was associated with intakes of fructose and glucose, both separately and combined.

Additionally, Malik, Schulze, and Hu (2006) found through a systematic literature review that sugar sweetened beverage intake is positively correlated with weight gain and obesity. While not all the findings were completely clear because of differences in the ways in which studies were conducted, the researchers concluded that enough literature-based evidence exists that sugary drink consumption should be discouraged.

More recently, researchers conducting a prospective study on dietary patterns and health results found that subjects reducing sugar sweetened beverage intake demonstrated significant weight loss, but reduction in sugar sweetened solid foods did not have the same effect. The researchers rationalized these results with the following explanations: that an absence of chewing during sugary beverage consumption could lead to decreased endocrine and exocrine responses in the pancreas, that sugary beverages produce less satiation because of a lack of protein and fat content, and that the high fructose content of many sugary beverages promotes more fat storage (Chen, et al., 2009). In the context of my hypothesis,

these findings support the notion that consumption of sugary liquids in particular increases risk for type 2 diabetes.

Sugary Beverage Consumption in the Mexican Community

Through reviewing literature, conversing with members of the Mexican immigrant community, and observing attitudes toward sugary beverages in Chile (2008) and Guatemala (2006, 2007, and 2009), I have noticed consistent trends among Hispanics that indicate a preference for sugary beverages. The qualitative experiences of noticing the popularity of sugary beverages in Chile and Guatemala, which are very distinct Hispanic cultures, motivated me to explore the quantitative research on beverage consumption in Hispanics. I found that in the U.S., Mexican Americans do consume more sugary beverages than the rest of the population.

Much of the existing data concerning beverage consumption in various ethnic groups comes from examinations of various versions of the National Health and Nutrition Examination Survey (NHANES) published by the CDC. When Bleich, Wang, & Gortmaker (2009) analyzed this survey, they found that American adults who consumed sodas or sugar-sweetened juices on a given day increased from 58% in 1988-1994 to 63% in 1999-2004. Though the exact amount of increase varied across age and ethnic groups, the trend of increasing sweetened beverage intake is clear. Their analysis showed that 70% of Mexican Americans consumed soft drinks on a given day during the 1999-2004 survey period compared to 63% of the overall population. Among age sub-groups, the most notable increase in sugar sweetened beverages occurred in Mexican American adults aged 65 and over, whose sugar sweetened beverage intake jumped from 35% in 1988-1994 to 46% in

1999-2004 (Bleich et al., 2009). This increase is noteworthy in studying type 2 diabetes because the condition more often occurs in people of older age.

A study conducted in Houston, TX found that Mexican American students in grades 4 through 6 consumed soft drinks as 34% of daily beverage intake. Their African American, Asian American, and European American counterparts consumed soft drinks as 28%, 22%, and 23% of their total beverages, respectively. When fruit flavored beverages were added to soft drinks, sugar-sweetened beverages made up 55% of the Mexican American children's beverage consumption. The same study also determined that those children who consumed the most sweetened beverages also consumed about 330 more calories per day and 57% less fruit than the rest of the students (Cullen, Ash, Warneke, & Moor, 2002). Based on the nutritional risk factors for type 2 diabetes, both of these figures put Mexican American children at a higher risk than their classmates. Developing a habit of sweet beverage consumption at a young age may lead to higher risk for continued consumption later in life.

My qualitative observations and conversations with patients at Latina Community Health Services who have served as my collaborators from the Philadelphia Mexican immigrant community also support findings on the high rate of sugary beverage consumption. Many small Mexican grocery stores line the streets of the Southeast Philadelphia neighborhood where most Mexicans have settled, and based on my observations from visits in February and April, 2009, the beverages available in these stores are mainly sodas and sugar-sweetened juice and nectar drinks. Many of them are Mexican brands or imports, and some of these grocery stores import Mexican-produced American soft drink brands such as Coca Cola. While these types of beverages are also available at larger supermarkets, a culture of sugary beverage consumption seems to exist in the Mexican

community. In order to test whether sugary beverages are indeed more popular or available in Mexican neighborhoods, I conducted a pilot experiment to compare the proportion of sugary beverages in several different grocery stores. The description and analysis of this study follows.

Shelf Measurement Description and Analysis

Aims

In order to test my hypothesis that people of Mexican origin may have increased access to sugary beverages, I measured the area of shelves devoted to different beverage types in four grocery stores. The goal of this project was to determine whether places where people of Mexican origin shop for food are likely to have more sugary beverages than other stores. This project is a pilot intended to encourage future research; as I will discuss later, there are several problems with the project design that limit the generalizability of my results.

Materials and Methods

The grocery stores and their locations were the following: Trader Joe's in Ardmore, PA (affluent suburban area), SuperFresh in Wynnewood, PA (affluent suburban area), Save-a-Lot at 13th St. and Washington St. in Philadelphia, PA (lower-middle class urban area), and Lupita Groceria at 9th St. and Federal St. in Philadelphia, PA (lower-middle class urban area). Each store has a different selection of beverages whose sugar content and type of sugar varied immensely. Trader Joe's is a medium-sized grocery store with a focus on natural and healthy food; none of the beverages sold there contain high fructose corn syrup. The brands of beverage sold are either independent brands or Trader Joe's own brand. SuperFresh is a large supermarket with a beverage selection marked by many mainstream brands such as

OceanSpray, Coca-Cola, and Pepsi-Cola and its own label, America's Choice. The beverage selection is extensive: more than two whole supermarket aisles shelve beverages such as sodas, juices, and fruit-flavored drinks. Several "natural" beverage choices with sugar (sucrose) rather than high fructose corn syrup are available, but many beverages contain high fructose corn syrup. Save-a-Lot is a medium-sized supermarket with mainstream as well as generic drink brands. Most, but not all, of the beverages contain high fructose corn syrup. The clientele appears to be mostly African American. Lupita Groceria is a small Mexican-owned and -themed grocery store several blocks away from Save-a-Lot. It has a beverage selection that includes mainstream soda brands as well as several imported brands from Mexico, including the Mexican-produced version of American soda brands. The clientele appears to be mainly Mexican.

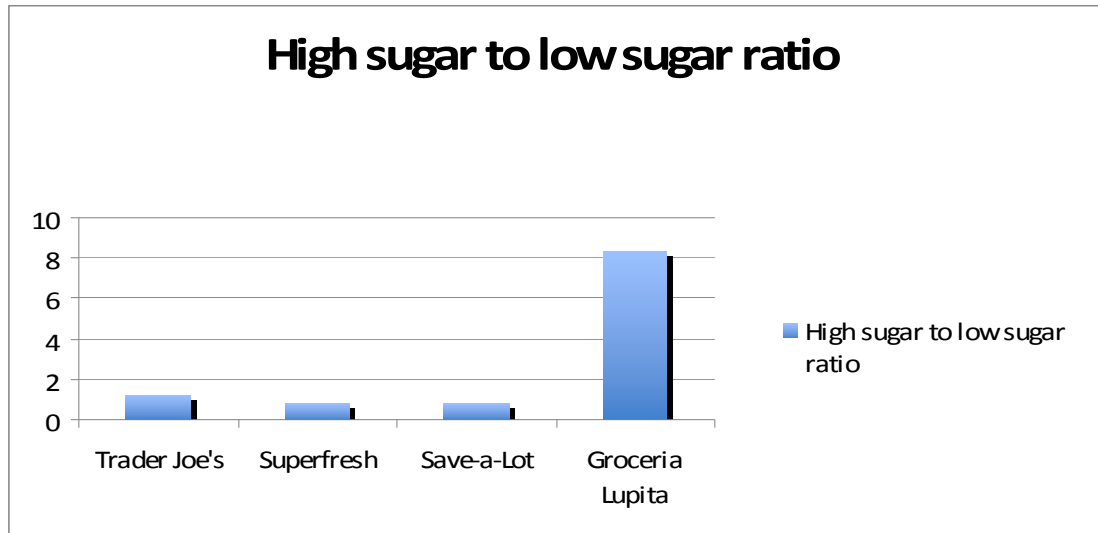
In each of the four stores, I used a tape measure to measure shelf space dedicated to various types of beverages. I included both refrigerated and non-refrigerated beverages in my measurements and analysis. I also included juice box packs and bottled water, but did not include powdered drinks or frozen concentrates. To evaluate sugar content of beverages, I used nutrition labels, which listed grams of sugar per serving, and then measured the space those beverages occupied, including height and length of shelf. Serving size on nutrition labels was typically 8 oz., but ranged between 4 oz. and 12 oz. Types of sugar varied by beverage and brand but included added sugar, high fructose corn syrup, or naturally-occurring sugar from fruit juice. In the first store where I measured shelves, Trader Joe's, I noticed that beverages with over 25 g of sugar seemed to have added sugar, whereas beverages with less than 25 g were often pure fruit juices. For this reason, I recorded

beverages in one of two categories, ≥ 25 g sugar, and < 25 g sugar. However, many fruit juices with no sugar added contained approximate 25 g sugar and often more.

Data for each store were recorded in two columns, one for beverages with less than 25 g sugar and the other for those with 25 g or more. While I did not record individual beverage sugar content, I found that sugar content varied between 0 g and 40 g. Beverages with 0 g of sugar included water and flavored water and diet sodas and juices with artificial sweeteners. Low sugar juices with less than 15 g were sometimes advertised as more watered-down than other juices. Orange juices and apple juices tended to have 22-25 g sugar, and juices with high sugar, both added and naturally occurring, as well as non-diet sodas had sugar content anywhere from the high 20's to 40 g.

Results

Because the stores where I measured shelves varied greatly in size, I used the ratio of high sugar (≥ 25 g) to low sugar (< 25 g) beverage shelf space rather than an absolute shelf space figure. I calculated this ratio by first totaling the shelf space occupied by “high sugar” and “low sugar” beverages in square feet. For instance, if beverages with 25 g of sugar or more per serving occupied 200 square feet and beverages with less than 25 g sugar per serving occupied 100 square feet, the high sugar to low sugar ratio calculation would be $200 \text{ ft.}^2 / 100 \text{ ft.}^2 = 2$. The results are shown in the graph below.



While Trader Joe’s, the store that purports to be the “healthiest”, had a high sugar to low sugar ratio of 1.22, SuperFresh and Save-a-Lot had ratios of 0.78 and 0.79, respectively. Groceria Lupita’s high sugar to low sugar ratio topped these by far at 8.3, which is over a six-fold difference from Trader Joe’s and over an over a ten-fold difference from SuperFresh and Save-a-Lot. This observation indicating a much higher proportion of high sugar beverages at Groceria Lupita is startling. The data clearly support my hypothesis that sugary beverages are more popular and more accessible in Mexican neighborhoods, but I did not expect such a large margin of difference. However, aside from the idea that sugary beverages are more popular in the Mexican community, several critical factors in my experiment design, which I will discuss below, may have led to the high ratio observed in Lupita Groceria.

Discussion and Conclusions

My results are certainly striking, but are preliminary and are not yet generalizable. Numerous confounding factors are likely to have affected my analysis. Most importantly, I did not randomize the stores in which I chose to measure shelves to control for confounding

factors. I only measured one Mexican grocery store, Lupita Groceria, which I visually estimated was similar to the other stores on the block. I had entered between five and ten grocery stores and examined their beverage selections, but I had no quantitative measure to support that Lupita Groceria was representative of the neighborhood's grocery stores. Randomizing the stores in the neighborhood and using a larger sample size of stores would help to identify a more representative sample.

Additionally, Lupita Groceria was significantly smaller than the other stores whose shelves I measured, and perhaps its size did not allow for a great variety of beverages. Lupita Groceria contained only 56 sq. feet of beverage shelf space, compared with 124 sq. feet, 1025 sq. feet, and 259 sq. feet at Trader Joe's, SuperFresh, and Save-a-Lot, respectively. It is also possible that smaller stores tend to have fewer healthy options. To control for this in future experiments I would advise controlling for size by evaluating smaller stores in a suburban area as well.

While the clientele at Lupita Groceria appeared to be mainly Mexican, it is not necessarily the case that people of Mexican origin in the area buy all their beverages at stores such as this one. While sugary beverages are clearly readily available, the population does not have to drink them; thus another useful component to add to this experiment for future research would involve surveying neighborhood residents to determine where they most frequently buy beverages.

Another factor that may have affected my results is the size of different beverages available in each of the stores whose shelves I measured. While Trader Joe's had a higher ratio of high sugar to low sugar beverages than SuperFresh and Save-a-Lot (1.22 compared with 0.78 and 0.79), both of the latter stores had significant amounts of shelf space dedicated

to juice boxes, which seemed to have low sugar content based on their small serving size (often 4 or 6 oz. as opposed to the regular 8 oz.). Additionally, I observed sugar content and did not complete this analysis based on type of sugar, another component of sugary beverage consumption which, as described earlier, may affect consumer health.

Overall, while the results of my shelf measurements cannot simply be taken at face value, I do think the clear high ratio of high sugar to low sugar beverages at Lupita Groceria my impression about the popularity and accessibility of sugary beverages in the Mexican community. The results of this pilot study present motivation for future research on this topic, which could effectively be conducted with the recommendations outlined above.

A Culture of Sugary Beverage Consumption in the Mexican Community

Mexican-born collaborators who are patients at Latina Community Health Services, a women's health clinic in Philadelphia, where I spent several days during the winter of 2009 volunteering, observing, and conversing with patients, supported the idea that soft drinks and sugary beverages are consumed at a high rate in the Mexican community. In addition to drinking sugary beverages on a daily basis, patients described community members as not being conscious of the effects of consuming so much sugar. While they expressed knowledge of sugar intake as related to diabetes, they explained that community members only alter sugary beverage and other sugar consumption if actually diagnosed with diabetes. Soda consumption seems popular in the Mexican community because of the sweet taste and also because of the availability. Nurse Rebecca Bixby, who works at the clinic, explained that soda consumption may be viewed as a positive habit, especially among men, because it is an alternative to alcohol (personal communication, February 17, 2009). In order to develop a survey and an education plan on the sugar content of sweetened beverages, one must

understand the cultural factors that encourage sugary beverage consumption in the Mexican American community.

The pattern of increased sugar beverage consumption observed in the U.S. and in Mexican Americans appears to translate to Mexico as well and may help explain why type 2 diabetes does not fit the “epidemiologic paradox.” Between 1999 and 2006, Barquera et al. (2008) found that sugary beverage consumption (including soft drinks, sweetened juices, and sugared coffee) tripled for adolescents and doubled for adult women living in Mexico. These researchers noted that even as energy intake from beverages increased, energy intake from food remained constant, signifying increased calorie consumption from beverages, but not from solids. They also hypothesized that as average income in Mexico continues to rise, sugary beverage consumption will rise as well. The data from this study can help in further investigating beverage intake in Mexican immigrants. Studies of acculturation of Mexican immigrants to U.S. lifestyle have reviewed dietary changes upon immigration and the health risks or protective factors that accompany them (Pérez-Escamilla & Putnik, 2007), and while not all of them specifically consider diet and nutrition behaviors in Mexico, I believe it is an important aspect to take into account when studying acculturation and health. This may help to explain a higher rate of sugary beverage consumption among Mexican immigrants as well as other dietary patterns that could positively or negatively effect health.

Chapter 4: A Pilot Survey to Study Beverage Consumption

Applications for a Survey and Beverage Information Sheet

Given my experience with Hispanic cultures and their attitudes and behaviors towards sodas and other sugary drinks, together with the fact that Mexican Americans have a much higher rate of type 2 diabetes than the total population, I hypothesized that sugar-sweetened beverage consumption is related to the high rates of type 2 diabetes in Mexican Americans. While I focused on testing this hypothesis through a literature and statistics review, this hypothesis could also be tested via a beverage consumption survey that I will propose.

The survey presented at the end of this section will serve the purpose of evaluating type 2 diabetes risk in Mexican Americans based on beverage consumption. I believe that asking a series of brief questions about the types of beverages consumed and attitudes toward them will be useful in gaining a perspective on beverage consumption in the Mexican immigrant community and the cultural factors that contribute to which beverages people choose. Indeed, the survey could be used in any community, though my research has focused specifically on people of Mexican origin. Rebecca Bixby, the nurse coordinator at Latina Community Health Services, a free clinic in Philadelphia that serves a mainly undocumented, Mexican female population, agreed that such a survey would be useful to apply both in her practice and in other Mexican immigrant health services (personal contact, February 17, 2009). Once data were collected from the survey, if my hypothesis proves true, diabetes prevention care could be better focused to target beverage consumption habits and the reasons behind them.

In addition to being a tool for public health research, I believe this survey could also be administered by health practitioners. While a researcher using the survey would only

make recommendations based on its results, health care providers could apply the survey to their individual patients. For beverage-based management or prevention of type 2 diabetes it would be useful for providers to know their patients' beverage consumption habits and attitudes. These providers could use the survey results to provide more personalized care to patients. When behavior change is part of an intervention, it is important to know what beliefs and causes lie behind that behavior; therefore I hope to identify beliefs about and reasons for beverage consumption through this survey.

Haverford's Institutional Review Board approved a pilot distribution of this survey to Haverford students to make sure that my questions are worded clearly, directed effectively, and that multiple choice offered made sense to people. Although the sample size of Hispanic students that completed the survey was not large enough to draw any conclusions about Hispanic origin and beverage consumption, the administration of the survey to Haverford students did produce interesting results.

I present the initial below, followed by a revised one. The survey should also be carefully translated into Spanish for its use with non-English speaking participants, though a translation is not included in this thesis.

A Survey for People of Mexican Origin to Determine Beverage Consumption Habits and Attitudes and Type 2 Diabetes Familiarity (Pilot)

1. How many servings of each of the following types of beverage do you drink per day?
 - a. Water _____
 - b. Milk _____
 - c. Non-diet soda _____
 - d. Diet soda _____

e. Sweetened juice _____

f. Other _____ (please specify type of beverage)

other beverage:

2. Rank the following qualities in order of importance when choosing a beverage to drink:

(1=most important, 5=least important).

a. Thirst-quenching _____

b. Healthy _____

c. Tastes good _____

d. Convenient- it is readily available _____

e. Cheap- it is the least expensive option _____

3. When you drink soda or sugar-sweetened juice beverages, where are you more often?

Please check all that apply.

a. Home _____

b. School _____

c. Work _____

d. At a restaurant _____

e. At a party _____

f. Other _____ (please specify)

other location:

4. Which of the following statements most applies to you?

a. I never think about the sugar content of the beverages I am drinking.

b. I sometimes think about sugar content, but it rarely influences which beverages I drink.

- c. I sometimes think about sugar content, and it sometimes influences which beverages I drink.
- d. I am highly aware of beverage sugar content; I choose certain beverages and avoid others based on their sugar content.
5. In what country were you born? _____
6. What is your age? _____
7. If you were not born here, for how many years have you lived in the United States? _____
8. Have you ever been diagnosed with diabetes? _____
9. Has anyone in your family ever been diagnosed with diabetes? _____

Explanation for Survey Questions

I have carefully designed this survey to be brief, to provide information to test my hypothesis, and to obtain information that may be useful for practitioners including primary care providers, nutritionists, and public health workers in targeting interventions and providing diabetes education. Explanations for each of my survey questions and possible applications of the data to be obtained are listed below.

1. This question seeks to evaluate sugary beverage consumption by simply asking how much of each type of common beverage one consumes per day. Its direct relation to my hypothesis is its purpose to obtain basic beverage consumption information. Researchers can use the results from this question to analyze data on beverage consumption, specifically when variables from the subsequent questions are considered. Additionally, the results may serve

nutritionists and other health care providers in recognizing beverage consumption habits and targeting health behavior interventions.

2. I ask this question because I think that in studying sugary beverage consumption and in making recommendations for reducing consumption, it is important to understand reasons for beverage choice. Intervention designers could benefit from knowledge of these choices, especially in terms of replacements to suggest. The data obtained from responses to this question could be compared in respondents of Mexican origin, second and third generation Mexicans, and those not of Mexican origin to determine whether reasons for sugary beverage consumption differ between the two groups. This question also speaks to the issue of beverage access; if respondents choose beverages based on availability or price, neighborhood and socioeconomic status could play important roles in beverage choice. This information could subsequently be used by healthcare providers or nutritionists to gain perspective on their patients' standpoints and establish better methods for education about beverage choice.

3. This question stemmed from a study by Wang, Bleich, & Gortmaker (2008) that examined sugary beverage consumption among youth and asked the subjects where they consumed different types of beverages. Gathering data on beverage consumption location is important in considering my assertion that Mexican culture plays a role in the increased sugary beverage consumption in the Mexican community. If sugary beverages are drunk most often in the home (as opposed to school or workplace, where we might, in some cases, expect to find a more ethnically diverse population), this may indicate a cultural origin to sugary

beverage consumption. The responses to this question could be used by public health workers in determining where to target interventions.

4. The intention of this question is to gauge awareness of the nutritional content of beverages and to determine whether beverage consumption behavior is knowledge-based. While people who have been diagnosed with type 2 diabetes are likely to have been educated about the sugar content of different beverages, those who have not been diagnosed with the condition may not consider the health risk that comes with sugary beverage consumption. Responses to this question could be used by providers on an individual level with their patients; those who are not at all aware of sugar content in the beverages they consume could perhaps benefit from an educational intervention, utilizing the sugary beverage health information sheet.

5. Responses to this question could be used in conjunction with the earlier questions to determine if country of origin plays a role in sugary beverage consumption. While this thesis studies all people of Mexican origin, distinguishing between Mexican immigrants and Mexican Americans may be useful in determining if differences exist between the two groups. This question could also be used as a measure of acculturation and could help to determine if there is a relationship between acculturation and beverage consumption habits. Additionally, in actual administration of the survey, it should be noted whether the respondent fills out an English or Spanish survey. The nature of the survey also assumes literacy, and some respondents may need the survey administered orally, another factor that should be noted.

6. Because type 2 diabetes generally occurs in people over the age of 30, it may be important to determine if the people filling out the survey are in an at-risk age group. Additionally, nutrition knowledge may increase with age. The responses to this question, when viewed with respect to the other questions, could also be used by public health workers to ascertain which age groups present the highest risk behavior in their beverage consumption habits and consequently where to target interventions.

7. The reasoning for this question goes back to question 5 (country of birth). Length of time spent in the U.S. is a frequently-used measure of acculturation. Analysis of responses to this question, in combination with responses to other questions, could determine a possible association between acculturation and beverage nutrition knowledge, beverage consumption behavior, and/or diabetes diagnosis.

8. This question is crucial in analyzing responses to the other questions. If my hypothesis is correct, respondents who are of Mexican origin (as opposed to non-Mexican origin) will have higher rates of type 2 diabetes *and* higher rates of sugary beverage consumption than non-Hispanic whites (the typical comparison group). If this survey is to be applied in a clinical setting to both people of Mexican origin and to non-Hispanic whites, it would be important to control for socioeconomic status. This survey does not consider socioeconomic status, which could be a confounding factor in examining beverage consumption habits. Additionally, this question, when analyzed with responses to other questions, will gauge whether or not a type 2 diabetes diagnosis affects beverage consumption attitudes and behavior. While I have evidence that people of Mexican origin drink more sugary beverages and have higher rates of

type 2 diabetes, this question could help determine if these two groups have a significant amount of overlap.

9. This question seeks to determine if familiarity with type 2 diabetes affects one's behavior. According to several of my collaborators at Latina Community Health Services, people in the Mexican community are not likely to modify beverage consumption behavior unless they receive a type 2 diabetes diagnosis. However, this measure of familiarity with the condition distinguishes those who may know about type 2 diabetes first-hand from those who have only vaguely heard of it. It could also be useful for providers to use the results from this question to find out if those people who do have a family member with diabetes are more aware of their beverage consumption and sugar intake. If this is not the case, and given the fact that having a family member with type 2 diabetes is one of the risks for developing the condition, it might be advisable to consider a family diabetes education plan when one family member is diagnosed.

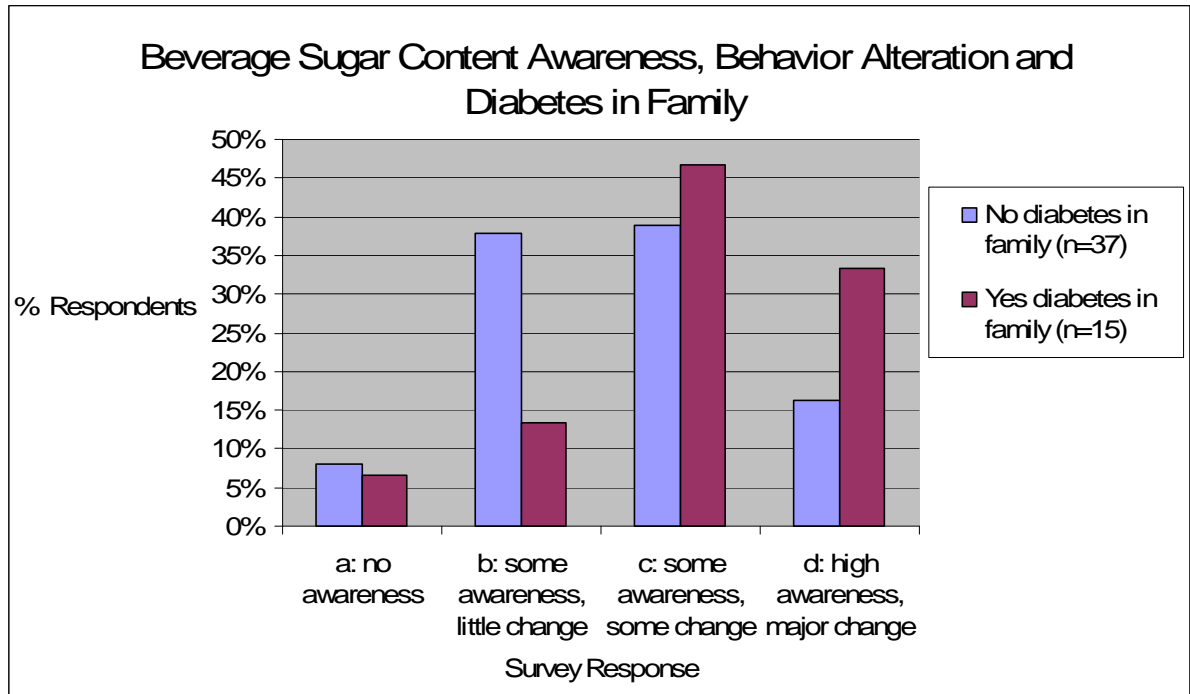
Pilot Survey Analysis and Revision

I administered the pilot version of my beverage consumption survey to Haverford students primarily to determine whether the questions were clear and the responses were amenable for my analysis. During one two-hour lunch period on April 21, 2009, I distributed the surveys to students in the Haverford College Dining Center, and 53 students responded. Although Haverford students are not the targeted demographic group for the survey, I do think their responses are valuable for both considering how to re-frame or address certain issues in the survey and for analyzing beverage consumption habits and attitudes. Thus I will

briefly examine several aspects of the students' responses as well as describe some of the uncertainties that students expressed in filling out the survey.

Analysis of Haverford Students' Responses

While not all responses from Haverford students were relevant for analysis in this study, several patterns arose that could be relevant to this research. Analysis of these factors has helped to inform my suggestions for future research with this survey and the value of each question. While none of the 53 students who responded to the survey had been diagnosed with diabetes, 15 had family members who had. The relationship between having a family member with diabetes and response to question 4, which was meant to determine beverage sugar content awareness, is important in determining if there is a link between familiarity with diabetes and beverage consumption behavior. An "a" response implied a complete lack of awareness of beverage sugar content, a "b" response implied some awareness but little behavior alteration, a "c" response some awareness and some behavior alteration, and a "d" response high awareness with behavior alteration. The results of this analysis are displayed below, with one student eliminated who did not answer question 4.



As shown above, more respondents who had knowledge of a family member with diabetes diagnoses demonstrated high awareness of beverage sugar content than those who did not; they also were much more likely to give a “c” or “d” response, indicating an alteration of behavior based on beverage sugar content. This has important implications for considering recommendations for use of my survey and even for diabetes care and prevention; for instance, a type 2 diabetes prevention intervention could be applied to the immediate family of newly diagnosed patients in order to increase awareness of the condition and of behavioral risk factors such as consuming sugary beverages. Additionally, immediate family members of a type 2 diabetic are already at a higher risk for developing the condition, so intervening with this group is especially important.

Another relevant statistic from the survey relates migration status to beverage sugar content awareness. Of the six students not born in the U.S. who responded to the survey, two selected “a” on question 4, indicating a lack of awareness of beverage sugar content. Of the

remaining 46 students (U.S.-born), only two also selected “a”. Additionally, the two respondents who each reported consuming the most soda and diet soda in the full survey were of the six students born outside the United States. While the sample sizes for both “a” respondents and non U.S.-born students were quite small and the results are therefore not generalizable, I think these responses are noteworthy. Although my hypothesis focuses specifically on people of Mexican origin, and none of the non U.S.-born survey respondents were from Latin America, these data are supportive of the overarching theme that those not born in the U.S. may consume more sugary beverages and be less cognizant of beverage sugar content.

Uncertainties and Reasons for Changes to Pilot Survey

Several issues arose during the course of the pilot survey that revealed flaws which will be improved in the final survey that follows this section. Various students asked for clarification about certain survey questions, and I noticed other problems with the survey based on a few consistently unclear responses to questions.

Question 1 posed the most difficulty for respondents, who wondered what constitutes a serving. After discussing this question with my advisers, I decided that for the purposes of this survey, actual serving size was less important than relative quantities of various beverages; however, I have altered the survey to also ask what the respondent considers a serving to be.

Secondly, I noticed from responses to question 2 that some respondents seemed to be confused about the 1-5 ranking system. While I had assumed that each quality would be ranked differently, some students assigned the same importance ranking to various qualities.

In order to fix this problem, I decided to allow respondents to rank qualities on a visual scale rather than a numeric one. With this design, qualities may be ranked similarly or distinctly, depending on the respondent's preference.

From a conversation with a Hispanic respondent, I realized that I did not include a question to determine Hispanic ethnicity or parental migration status. Because part of the research and analysis for which I intend this survey to be used involves generation in the U.S., I have added questions regarding the country of birth for both parents and grandparents.

Finally, some students were confused about whether the definition of "family" in question 9 included extended or immediate family. While I decided not to change the wording on that question, I did add a space for respondents to affirm which family member had been diagnosed with diabetes, thereby allowing for an analysis of extended vs. immediate familial diabetes.

Final Survey with Revisions Based on Pilot Responses

*Please note that question numbers referenced above apply to the pilot, not to the final survey.

1. What amount of liquid do you consider to be a "serving" of a beverage? (e.g.: 0.5 liters, 8 ounces, one soda can, etc.) _____
2. How many servings of each of the following types of beverage do you drink per day?
 - a. Water _____
 - b. Milk _____
 - c. Non-diet soda _____
 - d. Diet soda _____
 - e. Sweetened juice _____
 - f. Other _____ (please specify type of beverage)

other beverage:

3. Please indicate the importance of each of the following qualities when choosing a beverage to drink on the scales shown.

a. Thirst-quenching

Unimportant somewhat important extremely important
+ _____ + _____ + _____ + _____ +

b. Healthy _____

Unimportant somewhat important extremely important
+ _____ + _____ + _____ + _____ +

c. Tastes good _____

Unimportant somewhat important extremely important
+ _____ + _____ + _____ + _____ +

d. Convenient- it is readily available _____

Unimportant somewhat important extremely important
+ _____ + _____ + _____ + _____ +

e. Cheap- it is the least expensive option _____

Unimportant somewhat important extremely important
+ _____ + _____ + _____ + _____ +

4.. When you drink soda or sugar-sweetened juice beverages, where are you more often?

Please check all that apply.

- a. Home _____
- b. School _____
- c. Work _____
- d. At a restaurant _____
- e. At a party _____
- f. Other _____ (please specify)

other location:

5. Which of the following statements most applies to you?

- a. I never think about the sugar content of the beverages I am drinking.
- b. I sometimes think about sugar content, but it rarely influences which beverages I drink.
- c. I sometimes think about sugar content, and it sometimes influences which beverages I drink.
- d. I am highly aware of beverage sugar content; I choose certain beverages and avoid

others based on their sugar content.

6. In what country were you born? _____

7. What is your age? _____

8. If you were not born here, for how many years have you lived in the United States? _____

9. In what country(ies) were your parents born? _____

10. In what country(ies) were your grandparents born? _____

11. Have you ever been diagnosed with diabetes? _____

12. Has anyone in your family ever been diagnosed with diabetes? _____

If so, what is that family member's relationship to you? _____

Having carefully analyzed responses to the pilot survey, I believe that the above survey is ready to begin trial stages in its administration in a Mexican immigrant/Mexican-origin population. It is possible that upon translation of the survey to Spanish, some adjustments to questions will be necessary, changes which could be made after the survey's initial administration.

An Educational Sugary Beverage Information Sheet as an Intervention Tool

An additional piece of practical literature that I plan to develop based on my hypothesis is a health information sheet about the nutrition of various beverages geared specifically toward people of Mexican origin. The literature would be available in both English and Spanish, and Bixby also described this information as a potentially very useful patient education tool. At a women's health clinic, gestational diabetes, which is a form of type 2 diabetes, is one of the common health risks that patients present, and an information sheet about beverage intake, both in general and during pregnancy, could be utilized by the clinic (Rebecca Bixby, personal communication, February 17, 2009).

In my previous experience designing health information sheets at the Windsor Street Clinic in Cambridge, MA (summer 2007), I confronted the issue of making sure that the information I presented, both in English and Spanish, was clear and easy to understand. In working with populations that have low education levels, I learned that presenting health information in a direct, simple manner is important to patient understanding. If I am able to

clearly present information about beverage consumption to the Mexican community, especially after an initial administration of my survey to the Mexican community to determine sugary beverage consumption trends and cultural factors that influence them, I should be able to develop an informational and effective tool for both patients and providers.

Conclusion

Having reviewed many studies on people of Mexican origin, sugary beverage consumption, and type 2 diabetes rates, several observations have become clear. The first is that within the context of the “epidemiologic paradox”, type 2 diabetes patterns in people of Mexican origin not only present a contradiction to the paradox, but also show the complexity of the concept of acculturation. The greatly varying rates of type 2 diabetes among people of Mexican origin with different birth countries and acculturation levels show one way in which various factors may interact to produce better or worse health in a population.

Secondly, increased sugary beverage consumption is indirectly related to an increased risk for type 2 diabetes. Caloric intake from sugary liquids causes more weight gain than from sugary solids (Chen, et al., 2009), and thus puts those who drink sugary beverages at a particularly high risk for obesity. Because of the strong association between obesity and insulin resistance, these people are also at a higher risk for type 2 diabetes.

A third observation regarding type 2 diabetes and sugary beverage consumption is that, according to the pilot survey, people aware of a family member who has been diagnosed with diabetes are more likely to be aware of sugar content of the beverages they drink and to change their behavior based on this awareness. This observation may be useful for designing interventions among family members of diabetics. It is also an indication that people may associate sugary beverage consumption, perhaps more so than sugary food consumption, with type 2 diabetes—a promising starting point given the association determined by Chen, et al. (2009).

Finally, evidence from various studies and from my shelf measurements suggests that sugary beverages are indeed more popular among people of Mexican origin than among the

general population. Examinations of NHANES and studies examining school children both indicate a higher rate of sugary beverage consumption in people of Mexican origin than in the general population. Increased sugary beverage consumption in Mexico may also contribute to this pattern. While it has been argued that one reason for the “epidemiologic paradox” may be that immigrants maintain healthy habits and behaviors from their home country after arriving in the U.S., sugary beverage consumption proves to be an unhealthy habit common in Mexico that immigrants may be likely to maintain as well.

These factors interact to provide solid support for my hypothesis that the high rates of type 2 diabetes in people of Mexican origin are related to sugary beverage consumption. The high rate of sugary beverage consumption among people of Mexican origin combined with the fact that sugary beverage consumption increases risk for obesity and therefore risk for type 2 diabetes in this group presents a strong connection that has not yet been explored in public health research. A practical next step for further research would be to administer the proposed survey and analyze its results. To be true to the discipline of public health, the survey results should not only be analyzed but also applied to design interventions in beverage consumption behaviors, especially among high risk groups such as people of Mexican origin.

Acknowledgements

I would like to thank my thesis advisors, Professor Kaye Edwards and Professor Jenni Punt, for the time and energy they have expended in working with me on this thesis. Their insight and support have been invaluable to me throughout the research and writing processes. I would also like to thank Haverford College librarians Dora Wong and Laurie Allen for suggesting many helpful resources and research methods and Professor Mariana Chilton for allowing me to access the PHMC database. I am indebted to Professor Judy Owens for taking the time to help me understand the molecular mechanisms of type 2 diabetes, and to Rebecca Bixby, who allowed me to shadow her at Latina Community Health Services and talk with patients at the clinic. I also want to thank Alex Simmons for his assistance in my shelf measurement project, and my fellow public health majors: Ali O'Donnell, Darian Lunne, Jennifer Atlas, and Kernika Gupta for their continued support and advice throughout the thesis process.

References

Abraído-Lanza, A.F., Chao, M.T., & Flórez, K.R. (2005). Do healthy behaviors decline with greater acculturation? Implications for the Latino mortality paradox. *Social Science and Medicine* 61(6),1243-1255.

Acevedo-García, D., Soobader, M., & Berkman, L.F. (2007). Low birthweight among US Hispanic/Latino subgroups: The effect of maternal foreign-born status and education. *Social Science and Medicine* 64(12), 2503-2516.

Akresh, I.R. (2007). Dietary assimilation and health among Hispanic immigrants to the United States. *Journal of Health and Social Behavior* 48(4), 404-417.

“All About Diabetes.” American Diabetes Association. Accessed online: <http://www.diabetes.org/about-diabetes.jsp> Accessed May 6, 2009.

The American Community- Hispanics: 2004. American Community Survey Reports. U.S. Census Bureau, 2007.

American Community Survey Reports, U.S. Census Bureau, 2007.

Barquera, S., Hernandez-Barrera, L., Tolentino, M.L., Espinosa, J., Ng, S.W., & Rivera, J.A., et al. (2008). Energy intake from beverages is increasing among Mexican adolescents and adults. *Journal of Nutrition* 138-12, 2454-61.

Bleich, S.N., Wang, Y.C., Want, Y., & Gortmaker, S.L. (2009). “Increasing consumption of sugar-sweetened beverages among US Adults: 1988-1994 to 1999-2004. *American Journal of Clinical Nutrition* 89(1), 372-81.

Brookings Institution: Recent Immigration to Philadelphia: Regional Change in a Re-emerging Gateway. November 2008.

Brown, David. (2008, June 12). Life expectancy hits record high in United States. *Washington Post*.

CDC, 2007. Health United States, 2007. Table 55.

Centers for Disease Control and Prevention: National Diabetes Surveillance System. Available online at: <http://www.cdc.gov/diabetes/statistics/index.htm>. Retrieved 2/26/2009.

Chen, L., Appel, L., Loria, C., Lin, P., Champagne, C.M., & Elmer, P., et al. (2009). “Reduction in consumption of sugar-sweetened beverages is associated with weight loss: the PREMIER trial.” *American Journal of Clinical Nutrition* 89: 1299-1306.

Coca Cola Company Nutrition Information. (www.thecoca-colacompany.com) Accessed 27 Feb 09.

Crude and Age-Adjusted Percentage of Civilian, Noninstitutionalized Population with Diagnosed Diabetes, United States, 1980–2006. CDC National Center for Health Statistics.

Cullen, KW, Ash, DM, Warneke, C, and de Moor, C. “Intake of Soft Drinks, Fruit-Flavored Beverages, and Fruits and Vegetables by Children in Grades 4 Through 6.” *Am J Pub Hlth* 92-9: 1475-1478 (Sept. 2002).

Dean, L and McEntyre, J. *The Genetic Landscape of Diabetes*. written 2004. Available online: <http://www.ncbi.nlm.nih.gov/books/bv.fcgi?rid=diabetes>. Accessed 29 March 2009.

“Diabetes and Hispanics”, Office of Minority Health, Department of Health and Human Services, 2006.

Diabetes Prevalence Among Adults In Southeastern Pennsylvania. Philadelphia Health Management Corporation. December, 2006. PHMC’s Community Health Database 2004 Southeastern Pennsylvania Household Health Survey.

Diabetes Statistics, American Diabetes Association. Available at www.diabetes.org.

Farley, Tillman; Galves, Al; Dickinson, L. Miriam; and Diaz Perez, Maria de Jesus. “Stress, Coping, and Health: A Comparison of Mexican Immigrants, Mexican-Americans, and Non-Hispanic Whites.” *Journal of Immigrant Health* 7-3 (July 2005): 213- 220.

Hayes-Bautista, D.E. “The Latino Health Research Agenda for the 21st Century” in *Latinos: Remaking America*. Suárez-Orozco, M.M. and Pérez, M.M., ed. University of California Press: Berkeley, 2002.

Hispanics at Mid-Decade. Pew Hispanic Center, 2005.

Ho, A., Shih, M., Simon, P., Smith, D.P., & Bradshaw, B.S. (2007). Hispanic paradox/Smith and Bradshaw respond. *American Journal of Public Health* 97-3, 392-393.

Hummer, R.A., Powers, D.A., Pullum, S.G., Gossman, G.L., & Frisbie, W.P. (2007). Paradox found (Again): Infant Mortality among the Mexican-Origin Population in the United States. *Demography* 44-3 (2007):441-4457.

Kahn, S, Hull, R, and Utzschneider, K. (2006). Mechanisms linking obesity to insulin resistance and type 2 diabetes. *Nature* 444-14.

Klein, B & Klein, R. (1995). Vision Disorders in Diabetes. In *Diabetes in America* chapter 14. Retrieved May 6, 2009, <http://diabetes.niddk.nih.gov/dm/pubs/america/pdf/chapter14.pdf>

Malik, V., Schulze, M, and Hu, B. (2006). Intake of sugar-sweetened beverages and weight gain: A systematic review. *Am J Clin Nutr.* 84, 274-88.

Markides, K.S., and Coreil, J. "The Health of Hispanics in the Southwestern United States: an Epidemiologic Paradox." *Public Health Reports* 101-3 (1986): 253-265.

Montonen, J., Jarvinen, R., Knekt, P., Heliovaara, M. and Reunane, A. (2007). Consumption of sweetened beverages and intakes of fructose and glucose predict type 2 diabetes occurrence. *Journal of Nutrition*, 137,1447-1454.

National Diabetes Fact Sheet, Centers for Disease Control, 2007.

Perez-Escamilla, R., & Putnik, P. (2007). "The role of acculturation in nutrition, lifestyle, and incidence of type 2 diabetes in Latinos." *Journal of Nutrition*, 137(4), 860-870.

Pérez-Stable, E., Juarbe, T., & Moreno-John, G. (2001). Cardiovascular disease. In M. Aguirre-Molina, C. Molina, & R.E. Zambrana (Eds.), *Health Issues in the Latino Community* (246). San Francisco: Jossey-Bass.

Philadelphia Department of Health. "Taking Philadelphia's Temperature, 2008." Available online: http://www.phila.gov/Health/pdfs/TPT2008_7318c_N.pdf Accessed 28 February 2009.

Public Health Management Corporation. Community Health Data Base, 2006. Southeastern Pennsylvania Household Health Survey. Accessed online (password protected).

Hartman, P. & Brown, T. (producers). *Latina Salud: Body, Mind and Spirit*. WHY?, Philadelphia, 2002.

Low Income, Not Race or Lifestyle is the Greatest Threat to Health. Robert Wood Johnson Foundation, 2001

Rewers, M. & Hamman, R.F. (1995). Risk Factors for Non-Insulin Dependent Diabetes. In *Diabetes in America* chapter 9. Retrieved May 6, 2009, <http://diabetes.niddk.nih.gov/dm/pubs/america/pdf/chapter9.pdf>

Smith, D. P. & Bradshaw, B.S. (2006). Rethinking the Hispanic paradox: Death rates and life expectancy for US non-Hispanic white and Hispanic populations. *American Journal of Public Health*, 96(6),1686-1692.

Sundquist, J. & Winkleby, M.A. (1999). "Cardiovascular risk factors in Mexican American adults: A transcultural analysis of NHANES III 1988-1994." *American Journal of Public Health*, 89-5, 723-730.

Palumbo, P.J. & Melton, J. (1995). Peripheral Vascular Disease and Diabetes. In *Diabetes in America* chapter 17. Retrieved May 6, 2009, <http://diabetes.niddk.nih.gov/dm/pubs/america/pdf/chapter17.pdf>

Projected Life Expectancy at Birth by Race and Hispanic Origin, 1999-2100. U.S. Census Bureau, 2000.

Wang C., Bleich, S.N., and Gormaker, S.L. (2008). "Increasing caloric consumption from sugar-sweetened beverages and 100% fruit juices among US children and adolescents, 1988-2004. *Pediatrics*, 121-6, e1604-e1614.