THE PENNSYLVANIA STATE UNIVERSITY
SCHREYER HONORS COLLEGE

DEPARTMENT OF HEALTH POLICY & ADMINISTRATION

NATIONAL VARIATIONS IN CONCORDANCE BETWEEN PERCEIVED AND CLINICAL RISK OF TYPE 2 DIABETES

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FALL 2016

A thesis
submitted in partial fulfillment
of the requirements
for a baccalaureate degree
in Health Policy & Administration
with honors in Health Policy & Administration

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ABSTRACT

Despite high prevalence of type 2 diabetes mellitus in the United States, research indicates that individuals tend to inaccurately estimate their susceptibility. This study aims to understand the determinants of adults who are vulnerable to developing type 2 diabetes because they incorrectly perceive they are not at clinical risk.

This study employs data from the 2011-2012 National Health and Nutrition Examination Survey of adult respondents who were examined in the Mobile Examination Center (N=4,877). Stratified by clinical risk, logistic regression models were conducted in Stata/SE 14.1 to regress perceived risk onto health services utilization determinants. Among individuals with a clinical risk of type 2 diabetes, 61% incorrectly perceive themselves at no risk ($p<0.0001$), in unadjusted analyses. There were several findings from adjusted multivariate analyses. Men had 2.6 higher odds (95% CI: 1.91-3.45) of inaccurately perceiving their risk, compared to women. Relative to non-Hispanic Whites, Mexican Americans had 0.42 times the odds (95% CI: 0.27-0.67) of estimating their clinical risk inaccurately. Each additional year of age increased the odds of inaccurate risk assessment by 1.06 times (95% CI: 1.06-1.08), and each 1-unit decrease in self-rated health resulted in 0.79 times the odds (95% CI: 0.68-0.92) of inaccurately perceiving no risk. Overall, results indicate that men, non-Hispanic Whites, older adults, and adults with higher self-rated health were vulnerable to being at clinical risk but incorrectly perceiving no risk. This analysis indicates that awareness of diabetes risk is low, and education could enable individuals to estimate their risk of developing diabetes accurately.

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ACKNOWLEDGEMENTS

I would like to acknowledge a few people who have been instrumental in guiding me during the completion of this manuscript.

I would sincerely like to thank Dr.Miranda for mentorship, countless hours of feedback and instruction, and for exhibiting a work ethic I'll always aspire to. Through working together, my writing has improved tremendously. I know that your help shaping my writing will continue to benefit me in my future career. I would like to thank Will Bleser for technical assistance, and for being a role model, friend, and supporter. I would also like to thank Dr.BeLue for providing conceptual guidance in the early stages of this thesis, feedback on drafts, and for support as an Honors Advisor.

Finally, I would like to express my gratitude to the Health Policy & Administration program for providing continual opportunities for academic and personal growth. The HPA faculty served as mentors, who have shaped this experience into an incredible learning experience for me. My peers have been a source of encouragement and friendship. Pursuing a BS/MS in HPA has been one of the most challenging and rewarding experiences of my life and it will be an honor to represent the department as an alumni.

Chapter 1

Introduction

One in three Americans born in 2000 will develop type 2 diabetes in their lifetime (Maty & Tippens, 2011). Prevalence of type 2 diabetes has grown significantly within the past three decades in every demographic subgroup with larger increases in racial and ethnic minority populations, namely among non-Hispanic black and Mexican Americans (Menke, Casagrande, Geiss, & Cowie, 2015). Despite high prevalence, individuals tend to inaccurately estimate their susceptibility (Li, Geiss, Burrows, Rolka, & Albright, 2013).

Prevention and treatment of type 2 diabetes is largely self-managed. For this reason, it is key that individuals know how and when to prevent diabetes. Perceptions of risk must be accurate and according to clinical risk, in order to motivate preventive behaviors. Beliefs shared among subpopulations may identify systematic group-level differences in how risk is perceived. Individual's perceptions, beliefs, and attitudes about health affect how they perceive their risk for disease, thus influencing health behaviors and clinical risk (Tseng, Halperin, Ritholz, & Hsu, 2013).

As a result, systematic differences in perception within racial and ethnic groups have the potential to affect the prevalence of diabetes within that group. Racial and ethnic minority groups, who are affected disproportionately by type 2 diabetes, must be able to accurately assess and manage their diabetes risk (Shreck, Gonzalez, Cohen, & Walker, 2014).

This study will be guided by the following research question: Among adults in the United States, are there racial/ethnic differences in the concordance between perceived and clinical risk

of type 2 diabetes? The objective of this study is twofold. First, it seeks to identify dimensions of risk perception, particularly those that are unique to specific racial/ethnic groups that impact equity in health care. It also aims to gain a greater understanding of how race/ethnicity amplifies or diminishes the association between perceived risk and clinical risk. These two objectives will also help identify origins of the racial/ethnic disparity in diabetes.

Without investment in exploring factors contributing to the diabetes pandemic, the disparity will persist, and likely grow. Knowledge gained through this study can be used in the creation of new educational programs or preventive interventions.

Chapter 2

Background

In the United States, more than 23 million Americans have been diagnosed with type 2 diabetes mellitus, and prevalence is expected to double by 2050 (Maty & Tippens, 2011). Type 2 diabetes affects minority populations at a higher rate than other Americans: prevalence is 7.1% among non-Hispanic whites, 11.8% among Hispanic, 12.6% of non-Hispanic African Americans (Shreck et al., 2014, p. 89).

A potential barrier to halting the growth of the diabetes epidemic is awareness. Though prevalence is high, past studies have indicated that awareness and knowledge of diabetes risk is low in the US population (Li et al., 2013). The CDC reports that in 2005-2006, only 7% of prediabetic Americans knew that their susceptibility to type 2 diabetes was severe (Li et al., 2013). Empirical studies have also concluded that the public knows little about type 2 diabetes. For example, when a General Diabetes Knowledge Assessment was administered to adults at risk for diabetes, 48.7% of respondents knew that a fasting blood glucose level of 250 mg/dL is too high and 25.3% of respondents knew that eating sweet foods is not a cause of diabetes (Strauss, Rosedale, & Kaur, 2015). Health literacy has also been identified as a barrier to diabetes awareness (Saver, B. G., Mazor, K. M., Hargraves, J. L., & Hayes, M., 2014). Lack of awareness

contributes to the type 2 diabetes epidemic because individuals will not know to engage in prevention if they do not realize they are at risk.

Past studies indicate that differences in perception may be a result of differences in characteristics, experience, and environment. For example, language discordance between a patients and provider may cause confusion and impede the patient's ability to determine their risk (Tseng et al., 2013). The effect of age and risk perception is unclear: lack of knowledge and unrealistic optimism regarding type 2 diabetes risk has been observed among college students (Mongiello, Freudenberg, & Jones, 2015; Reyes-Velázquez & Sealey-Potts, 2015); however, other studies have seen that older adults have low capacity to understand information about their health (Kirk et al., 2012). Local dominance, self-comparison to peers or family members, may also have a role in the development of perceptions of one's risk (Zell & Alicke, 2013). A known family history has been associated with increased self-awareness of diabetes risk and greater concordance between clinical and perceived risk in minority populations. In a study of risk perception in a Hispanic community, individuals who reported a family history of type 2 diabetes were more likely to accurately estimate their likelihood of developing the disease (Diaz et al., 2012). In another study, 60% of participants supported this pattern by identifying family history as a strong influence on their personal perceptions of diabetes risk (Saver, B. G. et al., 2014). Additionally, past and present conditions may also impact perception of other health risks. African Americans with depressive symptoms perceived themselves to be at higher risk for type 2 diabetes than those without depressive symptoms (Rovner, Haller, Casten, Murchison, & Hark, 2014).

There are presently gaps in our understanding of perceptions of risk for developing type 2 diabetes within racial/ethnic groups; however, evidence suggests that awareness is even lower

among racial/ethnic minority groups, when compared to Non-Hispanic White Americans (Graham, 2006). Existing literature is heavily concentrated on some racial/ethnic groups, while little is known about others. Researchers have been able to piece together findings that can speak to one subgroup, or another, but have not yet studied this topic with a nationally representative dataset. Contributing further to this body of literature is a priority because some racial/ethnic minority groups have higher faced higher increases in prevalence over time (Menke, et al., 2015).

Past studies have observed that racial/ethnic minorities are inaccurate in their estimation of personal risk and tend to underestimate, when compared to Non-Hispanic White Americans. For example, in a study of Hispanic adults, 54.8% of respondents underestimated when self-reporting their risk (Diaz, Mainous, Williamson, Johnson, & Knoll, 2012). Another study also observed a disconnect between perception and reality when comparing clinical risk to self-reported perceived risk in a sample of African American adults: "Of those participants who did not believe they were at risk for diabetes, 36% actually were at high risk, whereas an additional 28% were at low risk for getting diabetes, as calculated by their Risk Assessment score" (Graham, 2006, p. 40). Additionally, in a study of Chinese and Hispanic/Latino Americans in Portland, Oregon, participants in both ethnic groups who did exhibit risk factors erroneously reported that they were not at risk for diabetes (Maty & Tippens, 2011). Improving concordance between perception and reality of individual patients' susceptibility to type 2 diabetes is necessary to engage patients in preventing diabetes, particularly in population subgroups that are at higher risk.

Numerous confounding factors impede the understanding of risk perception in racial/ethnic minorities. Conceptually, we can attempt to understand perception as the sum of

various contributing factors. For example, an association has been observed between higher education, higher income levels and a positive self-reported health status (Caballero, 2011). Furthermore, in a study of low-income minority groups, an association was found between low income and a lack of knowledge about type 2 diabetes (Walker et al., 2007). These factors, along with other environmental factors or circumstances, must be considered in totality when attempting to understand why particular perceptions exist.

Nativity and citizenship status may also influence the relationship between perceived risk and clinical risk in ethnic/racial minority groups who are assimilating to a new culture in the United States. The level of assimilation is associated with improved outcomes and access for individuals of minority groups (Tseng et al., 2013). Additionally, language discordance between patients and health care professionals pose a threat to the provider's ability to understand the patients' needs and recommend and relay instructions for appropriate treatment plans (Tseng et al., 2013).

This study hypothesizes that controlling for differences in risk perception between racial/ethnic groups is the first step to closing disproportionate levels of type 2 diabetes prevalence. It will then be possible to translate this knowledge into practice and interventions facilitating the development of healthier behaviors in at-risk individuals. According to the Health Belief Model, motivation for behavioral change is a result of patients' belief that they are susceptible to a serious health risk (Diaz et al., 2012). Behaviors such as prevention, engagement, treatment adherence, and self-management can be achieved by aligning risk perception with clinical risk. This study's output may provide public health officials with information to guide the design of preventive and educational interventions related to diabetes in minority populations. Discordance between perceived and clinical risk in a specific racial/ethnic

population could indicate a need for increased education and awareness of type 2 diabetes. This study's findings will also be useful to providers. By understanding the factors contributing to perceptions of health risks, providers can tailor strategies to communicate with and encourage healthy behaviors in patients of racial/ethnic minorities. Changes in behavior within large groups of at-risk individuals can create change on a larger scale and reduce the prevalence of diabetes among racial and ethnic minorities in the United States.

In order to add to current literature, this inquiry is guided by a fundamental question: Among adults in the United States, are there racial/ethnic differences in the concordance between perceived and clinical risk of type 2 diabetes? The study will use cross-sectional data from the 2011-2012 National Health and Nutrition Examination Survey to quantify how race/ethnicity amplifies, or diminishes, the relationship between clinical and perceived risk of developing type 2 diabetes. No prior study has assessed the effect of race/ethnicity in moderating the relationship between clinical risk and perceived risk of developing type 2 diabetes on a national scale. The following sections include an articulation of the conceptual framework, description of the research design, and analysis of the results.

Chapter 3

Methods

In order to fill a current gap in the literature, this study aims to understand the determinants of adults who incorrectly perceive they are not at clinical risk of diabetes and disparities in the ability to perceive risk correctly. This study's data source, measures, and analysis are described in the following section.

Data Source

The data source of this analysis is the 2011-2012 National Health and Examination Survey (NHANES), conducted by the National Center for Health Statistics (NCHS), which is a two parts survey: interview and physical examination (National Center for Health Statistics, U.S. Department of Health and Human Services, & Center for Disease Control and Prevention, 2012). During the 2011-2012 sampling period, 13,431 adults and children were selected and asked to participate; 72.6% (9,756 persons) responded and were interviewed; 69.5% (9,338 persons) of respondents were physically examined in the Mobile Examination Center (MEC) (Center for Disease Control and Prevention & National Center for Health Statistics, 2013). NHANES oversamples the following groups to achieve representativeness: Hispanic persons, Non-Hispanic black persons, Non-Hispanic black person, Non-Hispanic Asian persons, Non-Hispanic white and Other persons at or below 130 percent of the FPL, and Non-Hispanic white and Other persons aged 80 years and over (Center for Disease Control and Prevention & National Center for Health Statistics, 2013)

Study Population

Within the study population of NHANES respondents, the population of interest in this study is Americans age eighteen and older who were interviewed and physically examined in the MEC. The original demographic component contains responses for a total of 9,756 persons, 9,338 of which were physically examined in the MEC (MEC data was necessary to calculate clinical risk). Of these MEC respondents, we restricted our analyses to the 5,615 respondents who were age eighteen and older, given that our target population is adults. Of these 5,615 eligible sample respondents, we then further restricted analyses to respondents not missing on our outcome and stratifying variables. We then refined our sampling frame to respondents who have not been diagnosed with diabetes or who have been told by a doctor that they are at risk for diabetes. Adjusting the sampling frame to the undiagnosed respondents is critical to construct validity of perceived risk; a diagnosed individual should be able to perceive their risk accurately. The final study population totaled 4,643 adult, MEC respondents, not missing on key variables (82.7% of eligible sample respondents).

Measures

Perceived Risk: Perceived risk of developing diabetes in currently undiagnosed respondents, the primary independent variable of this study, is measured with the dichotomized interview question "do you feel you could be at risk for developing diabetes or prediabetes?" (1=yes). This question was only asked to individuals who reported that they had not been told by a doctor that they had diabetes, in order to make the distinction between respondents who have and have not been diagnosed.

Clinical Risk: Our outcome variable, clinical risk of developing diabetes, is measured with a validated, composite risk score developed by the American Diabetes Association. The

ADA distributes this risk test to Americans in effort to prevent diabetes by raising awareness for its risk factors. Due to the complex etiology of diabetes, there are seven different components of the risk score: age, gender, history of gestational diabetes, history of diabetes in the family, past diagnosis of high blood pressure, physical activity, and weight status (American Diabetes Association [ADA], n.d.). Responses to each component are associated with points. We follow ADA standards to construct a dichotomized variable indicating increased risk of diabetes (1=5+ points on the ADA risk score) (ADA, n.d.). The ADA urges those who score a sum of five or higher to visit their doctor for additional consultation or testing (ADA, n.d.). Figure 1 displays the risk score used in this study.

In construction of this measure, data for age and gender were collected successfully without missingness. Other variables required some manipulation due to missing values because some questions necessary for the measure were not asked to all NHANES participants.

The gestational diabetes question was asked in the reproductive health questionnaire to women ages 20-44 who have been pregnant at some time: "During pregnancy, were you ever told by a doctor or other health professional that you had diabetes, sugar diabetes, or gestational diabetes? Please do not include diabetes that you may have known about before the pregnancy (NHANES, 2013)" This survey question excludes male participants (2,772 persons) and anyone who is eighteen or nineteen years old (NHANES, 2013); in our risk score calculation, men automatically receive a zero (0=no) for this question. There are missing values from 1,046 participants, corresponding to women who have never been pregnant, or who are eighteen or nineteen years old.

Respondents who indicated that they perceived a risk for developing diabetes were asked a follow-up question: "Why do you think you are at risk for diabetes or prediabetes (NHANES,

2013)?" There were 1,048 respondents who said that they perceived this risk due to a family history of diabetes. This was used to construct a dichotomized measure of family history for the risk score. There were no missing values; however, it is worth noting that family history was coded in the risk score only if the respondent indicated that family history as the reason why they perceived risk of diabetes. As a result, this is likely a underestimation because we were unable to capture respondents who have a family history, but do not perceive risk.

We dropped eight respondents missing high blood pressure diagnosis data and one respondent due to missing physical activity data because it was not possible to determine why this data was missing. We dropped 354 individuals missing BMI and 90 individuals missing waist circumference data from the MEC examination because these values were necessary to measure weight status. Values missing from the risk score may have negative implications for this analysis because the reason why they are missing is unknown; however, these 354 samples only account for 6.3% of the overall sample, so it should not introduce too much bias.

Predictors of Perceived Risk: The independent variables of interest in this study are potential predictors of perceived risk. We derived covariates from the theory of behavior in the Anderson model, seen in Appendix A, Figure 2. According to this framework, contextual characteristics influence individual's interactions with the health care system (Andersen, Rice, & Kominski, 2007, p. 5). These characteristics point to circumstances that are predispose, enable, or cause a need for health care. According to Anderson, contextual characteristics influence perception, which then influences health behavior (Andersen et al., 2007). As such, covariates in this study include circumstances that predispose or enable individual to perceive a need to prevent diabetes: age, gender, race/ethnicity, nativity, citizenship, education, language, self-rated

health, usual source of care, number of physician visits in the previous 12 months, current insurance status, family income.

Analysis

Data analysis was performed with Stata/SE 14.1. Survey characteristics are displayed in Table 1 and bivariate statistics are displayed in Table 2. Respondents were stratified by perceived risk, and we used logistic regression models to analyze the binary clinical risk variable in Table 3.

Figure 1: American Diabetes Association Diabetes Risk Test

	Scoring:
1. How old are you?	Less than 40 years (0 points) 40-49 (1 point) 50-59 (2 points) 60 years or older (3 points)
2. Are you a man or woman?	Man (1 point) Woman (0 points)
3. If you are a woman, have you ever been diagnosed with gestational diabetes?	Yes (1 point) No (0 points)
4. Do you have a mother, father, sister, or brother with diabetes?	Yes (1 point) No (0 points)
5. Have you ever been diagnosed with high blood pressure?	Yes (1 point) No (0 points)
6. Are you physically active?	Yes (0 points) No (1 point)
7. What is your weight status?	Not overweight or obese (0 points) Overweight (1 point) Obese (2 points) Extremely obese (3 points) See guidelines*

*Obesity guidelines:
(BMI>=40) or (waist>=50inches for males) or (waist>=49inches for females) then *extremely obese*;
(30<=BMI<=40) or (40<=waist<50inches for males) or (35<=waist<=49inches for females) then *obese*;
(25<=BMI<30) or (37<=waist<40inches for males) or (31.5<=waist<35inches for females) then *overweight*;
(BMI<25) or (waist<37inches for males) or (waist<31.5inches for females) then *not overweight or obese.*

Clinical Risk calculated by the American Diabetes Association's Diabetes Risk Test.
If total score is >=4, the patient is at high risk of having undiagnosed diabetes or prediabetes.
If total score is >=5, the patient is at high risk of having undiagnosed diabetes.

Individuals at clinical risk, scoring 5 points or higher, are at increased risk and should consult their doctor for additional testing.

Chapter 4

Results

Unadjusted, sample summary statistics are found in Table 1. In our sample of 4,643 study sample respondents, 37.2% (n=1,824) individuals were at increased risk for type 2 diabetes, according to the ADA risk score; however, 72.4% (n=3,278) reported that they did not perceive themselves to be at risk for developing diabetes. Our sample was 49.1% male and 50.8% female. Respondents in our sample were largely younger (23.6% 18-29 years), Non-Hispanic White (66.8%), US born (82.1%), US citizens (90%), have completed some college education (33.1%), English speaking (93.1%), and have an income greater than 130% FPL (62%). With regard to their health, respondents were largely of "good" self-rated health (35%), had one or more usual source of care (83.3%), had visited a physician 2-3 times in the previous 12 months (29.4%), and reported currently having health insurance (79.4%).

Table 1: Sample Summary Statistics: NHANES 2011-2012 (Weighted)

Characteristic	N = 4,643
Clinical Risk	
Increased Risk (ADA Risk Score 5+)	37.2% (1,824)
No Increased Risk (ADA Risk Score 0-4)	62.8% (2,819)
Perceived Risk	
Perceived Risk	27.5% (1,309)
No Perceived Risk	72.4% (3,278)
Age Group (Years)	
18-29	23.6% (1173)
30-39	18.4% (858)
40-49	18.6% (748)
50-59	17.9% (709)
60-69	12.1% (638)
70-79	5.8% (316)
80+	3.3% (201)
Gender	
Male	49.1% (2311)
Female	50.8% (2332)
Race/Ethnicity	
Mexican	7.9% (474)
Other Hispanic	6.6% (483)
Non-Hispanic White	66.8% (1701)
Non-Hispanic Black	11.0% (1182)
Non-Hispanic Asian	5.1% (664)
Other (Including Multi-Racial)	2.4% (139)
Nativity	
United States	82.2% (3229)
Other	17.8% (1412)
Citizenship	
Citizen	90.2% (3916)
Noncitizen	9.8% (711)
Education	
Some High School	16.1% (1037)
Completed High School	19.7% (988)
Some College	33.1% (1462)
Completed College	31.0% (1156)
Language Of Interview	
English	93.1% (4153)
Spanish	6.8% (490)
Self-Rated Health	

Excellent	18.1% (721)
Very Good	33.1% (1334)
Good	35.0% (1743)
Fair	11.7% (707)
Poor	1.9% (137)
Usual Source Of Care	
One Or More Source	83.8% (3810)
No Usual Source Of Care	16.1% (833)
Number Of Visits To Physician, Prev. 12 Months	
None	17.5% (875)
1	19.5% (930)
2-3	29.4% (1322)
4-9	21.4% (973)
10-12	5.6% (245)
13+	6.3% (296)
Current Insurance Status	
No	20.5% (1165)
Yes	79.4% (3471)
Family Income As Percentage Of Poverty Line	
Income <= 130% FPL	27.7% (1692)
130% < Income <=185% FPL	10.1% (551)
Income > 130% FPL >185% FPL	62.0% (2144)

Bivariate Statistics

Weighted, bivariate statistics by diabetes clinical risk and perceived risk are displayed in Table 2. Among respondents with clinical risk of diabetes, 61% incorrectly perceive themselves at no risk ($p<0.0001$), compared to 39% who correctly perceive their risk of developing diabetes.

When stratified by perceived risk, there were significant ($p<0.0001$) differences in gender and self-rated health. When comparing respondents who perceive risk to those who do not perceive risk, there were significant differences in within gender, race/ethnicity, nativity, and self-rated health.

Bivariate statistics, stratified by clinical risk, can be found in Appendix A, Table 4.

Table 2: Bivariate Statistics by Diabetes Perceived Risk: NHANES 2011-2012 (Weighted)

Perceived risk (n=4,643)			
Characteristic	No perceived risk	Perceived risk	P-value
Clinical risk			
No increased risk (ADA risk score 0-4)	79.3%	20.7%	
Increased risk (ADA risk score 5+)	60.9%	39.1%	<0.0001
Perceived risk			
No perceived risk	--	--	
Perceived risk	--	--	
Age (years), mean (SE)	44.8 (0.93)	43.9 (0.99)	0.2594
Gender			
Male	76.6%	23.3%	
Female	68.3%	31.6%	<0.0001
Race/ethnicity			
Mexican	63.4%	36.6%	
Other Hispanic	74.2%	25.7%	
Non-Hispanic White	74.4%	25.5%	
Non-Hispanic Black	67.6%	32.3%	
Hon-Hispanic Asian	74.4%	25.5%	
Other (including Multi-Racial)	60.3%	39.6%	0.028
Nativity			
United States	71.7%	28.3%	
Other	76.0%	23.9%	0.0281
Citizenship			
Citizen	71.9%	28.1%	
Noncitizen	77.3%	22.7%	0.0951
Education			
Some High School	74.2%	25.8%	
Completed High School	70.3%	29.6%	
Some College	70.0%	29.9%	
Completed College	75.4%	24.5%	0.1174
Language of interview			
English	72.3%	27.6%	
Spanish	74.2%	25.7%	0.4788
Self-rated health			
Excellent	84.5%	15.4%	
Very good	75.5%	24.4%	
Good	68.1%	31.9%	
Fair	60.6%	39.3%	
Poor	53.6%	46.3%	<0.0001
Usual source of care			
One or more source	72.0%	27.9%	
No usual source of care	74.3%	25.6%	0.5124

Number of visits to physician, prev. 12 mos.			
None	76.1%	23.8%	
1	73.9%	26.0%	
2-3	72.6%	27.3%	
4-9	70.6%	29.3%	
10-12	72.1%	27.8%	
13+	62.5%	37.4%	0.0624
Current insurance status			
No	70.8%	29.1%	
Yes	72.8%	27.1%	0.3961
Family income as percentage of poverty line			
Income <= 130% FPL	70.7%	29.2%	
130% < income <=185% FPL	67.4%	32.5%	
Income > 130% fpl >185% FPL	73.9%	26.0%	0.0948

Multi-variate Logistic Regression

The results of two logistic regression models are found in Table 3. Our sample was stratified by perceived risk. Model 1 exhibits a false negative: respondents who do not perceive risk of diabetes, but do have clinical risk. Model 2 exhibits a true negative: respondents who do not perceive diabetes risk and also do not have clinical risk.

Our sample included 1,688 respondents who did not perceive risk but have clinical risk, according to the ADA Risk Score. Men had 2.6 higher odds (95% CI: 1.91-3.45) of inaccurately perceiving their risk, compared to women. Relative to non-Hispanic Whites, Mexican Americans had 0.42 times the odds (95% CI: 0.27-0.67) of estimating no clinical risk inaccurately. Each additional year of age increased the odds of inaccurate risk assessment by 1.06 times (95% CI: 1.06-1.08), and each 1-unit decrease in self-rated health resulted in 0.79 times the odds (95% CI: 0.68-0.92) of inaccurately perceiving no risk. Overall, results indicate that men, non-Hispanic Whites, older adults, and adults with higher self-rated health were vulnerable to being at clinical risk but incorrectly perceiving no risk.

Our sample included 2,640 respondents who did not perceive risk, but also do not have clinical risk, according to the ADA Risk Score. Results of Model 2 are found in Appendix C, Table 5. These individuals are not of primary interest for our study because since they are more accurate at estimating their risk, they are not as vulnerable as the individuals in Table 3.

Table 3: Adjusted Odds Ratios of Incorrectly Perceiving No Risk for Diabetes among those with Clinical Risk, according to ADA Standards: NHANES 2011-2012 (Weighted Logistic Regression)

	No Perceived risk, clinical risk (type 2 error) N= 1,688	
	Adj. OR *	95% CI
Age group (years)	1.07	(1.06, 1.08)*
Gender (Male)	2.57	(1.91, 3.45)*
Race/ethnicity (ref: Non-Hispanic White)		
Mexican	0.42	(0.27, 0.67)*
Other Hispanic	0.75	(0.51, 1.11)
Non-Hispanic Black	1.09	(0.82, 1.47)
Non-Hispanic Asian	0.72	(0.34, 1.53)
Other (including multi-racial)	0.68	(0.33, 1.39)
Nativity		
Foreign Born	1.56	(0.93, 2.61)
Citizenship		
Not Citizen	1.57	(0.80, 3.10)
Education	0.93	(0.78, 1.12)
Language of interview (English)	1.31	(0.71, 2.43)
Self-rated health	0.79	(0.68, 0.92)*
Usual source of care (ref. One or more.)	1.12	(0.49, 2.59)
Number of visits to physician, prev. 12 months	0.98	(0.85, 1.12)
Current insurance status (Yes)	0.92	(0.63, 1.34)
Family income as percentage of poverty line	1.01	(0.84, 1.20)

Chapter 5

Discussion

Although prevalence of diabetes has steadily increased, reductions in type 2 diabetes through prevention cannot be achieved without acknowledgement of risk, as illustrated by our underlying conceptual framework (Andersen et al., 2007). This study asserts that perception is an important construct to study because it is an element of type 2 diabetes risk that influences future behavior and that we currently know little about (Andersen et al., 2007). Individuals can contribute to public health efforts to prevent diabetes by first learning how to accurately evaluate their own risk for developing diabetes.

This study aimed to determine factors predicting perceived risk of type 2 diabetes because it is necessary in order to prevent further increases in national prevalence of diabetes. Due to the higher prevalence of diabetes in racial/ethnic minority populations, we were specifically interested in associations between race/ethnicity and perceived risk of diabetes. We also tested for other potential predictors of perception: age, gender, race/ethnicity, nativity, citizenship, education, language, self-rated health, usual source of care, number of physician visits in the previous 12 months, current insurance status, family income.

Our results indicated that individuals tend to not be able to accurately estimate their risk. In our study, 60.9% of individuals did not perceive risk, when in fact they were at clinical risk of diabetes. These finding are consistent with other studies' estimates. The CDC reported that in 2009-2010, only 11% of individuals with prediabetes, a measure of increased risk, reported that they knew they were at risk (Li, Geiss, Burrows, Rolka, & Albright, 2013). Similarly, Diaz et al. also found that in their sample of Hispanic and Latino adults, more than half underestimated their likelihood of developing diabetes (2012).

Our study found that compared to non-Hispanic Whites, Mexican Americans had 0.42 times the odds (95% CI: 0.27-0.67) of estimating their clinical risk inaccurately; in other words, Mexican Americans had higher odds of correctly estimating their risk than non-Hispanic White Americans. This finding contradicts the CDC's nonsignificant findings of associations between diabetes awareness and race/ethnicity (Li et al., 2013). It was also interesting that we did not find significant associations detected when comparing non-Hispanic White Americans to individuals that identify as Non-Hispanic Black, Non-Hispanic Asian, Other Hispanic, or with other racial groups. To our knowledge, this is the first study to look at risk perception with nationally representative data. This may explain why our findings seem to contradict some existing studies; many studies have looked at one subpopulation in isolation and have had much smaller sample sizes. Our finding that Mexican Americans at risk for diabetes had higher odds of concordance than non-Hispanic White Americans is, however, consistent with a phenomenon identified in disparities research: the Hispanic Paradox.

The Hispanic paradox is a phenomenon stating that when sociodemographics are held constant, Hispanic Americans exhibit some superior health outcomes, when compared to other racial/ethnic groups (Gallo, Penedo, Espinosa de los Monteros, & Arguelles, 2009; Young &

Hopkins, 2014). This paradox is particularly supported in the literature for individuals who identify being of Mexican American descent (Markides & Eschbach, 2005; Palloni & Arias, 2004). For example, there are lower rates of lung cancer and COPD among Hispanics, when compared to other racial/ethnic groups (American Lung Association, 2010; American Lung Association Epidemiology and Statistics Unit Research and Program Services Division, 2014; Bruse et al., 2011; Howe et al., 2006; Young & Hopkins, 2014). Fewer cases of mental illness have also been observed in Hispanic Americans than non-Hispanic Americans (Alegría et al., 2008; Kessler, 1994; Kessler et al., 2005). Some explanations have been offered for the Hispanic paradox: selective migration to the United States by some Hispanic subgroups (Franzini, Ribble, & Keddie, 2001; Markides & Eschbach, 2005; Palloni & Arias, 2004); diet rich in legumes and fruits (Young & Hopkins, 2014); and lower rates of smoking (Gallo et al., 2009; Young & Hopkins, 2014). Our study provides evidence for an additional health outcome to be part of the Hispanic paradox; however, the origin of the paradox is still unclear.

Our study also found that men at risk for diabetes had significantly higher odds of underestimating their risk, when compared to women who were also at risk. This finding is consistent with other studies of gender differences. Another study of diabetes risk reported higher odds of underestimating diabetes risk for men, when compared to women (Diaz et al., 2012). Additionally, in a study of public health hazards, men tended to underestimate their risk of experiencing any type of public health hazard, when compared to risk reported by women (Flynn, Slovic, & Mertz, 1994). Future studies of risk perception in diabetes should control for marital status.

Additionally, we found that as age increases by one year, individuals become increasingly less likely to accurately estimate their risk. This finding is consistent with Strauss,

Rosedale, & Kaur's finding that younger individuals in their sample had significantly different perceptions of diabetes than older respondents and that the younger group was more likely to report their risk (2015). There also may be skills related to perception that deteriorate with age; health literacy in diabetics has been seen to decline with increasing age (Kirk et al., 2012). Additionally, scores on diabetes knowledge tests showed significantly better results from younger participants (ages 20-52), when compared to older participants (ages 64-85) (Walker et al., 2007). Future studies should aim to study the relationship between age and perception further. A longitudinal study could expand our knowledge of this relationship by examining changes in perception with increasing age.

Several limitations of our study should be acknowledged along with our findings. Many of the variables critical to our analysis, including our outcome variable, are measured by self-report; as a result, respondents were subject to recall bias. We were also limited in the construction of clinical risk instrument. NHANES's questionnaire format prevented us from having family history data from all respondents. Due to this limitation, we can say that our results are conservative. Existing studies indicate that family history plays a role in risk perception, but the intensity of this relationship needs to be explored further in future studies (Saver, B. G. et al., 2014). Additionally, NHANES samples the noninstitutionalized civilian population. It is unknown if there are systematic differences in risk perception among Americans who were not eligible for NHANES. Finally, although our study proposes a relationship between perceived risk and clinical risk, causal relationships should not be assumed from our findings, due to the cross sectional nature of our data.

Despite these considerations, we are confident in our use of NHANES to address our research question, and as it is nationally representative data, our findings are generalizable to the U.S. population.

We have found that the majority of Americans are vulnerable to developing diabetes because they do not perceive their risk accurately. This highlights a need for education on diabetes risk factors. We have also found that men, non-Hispanic Whites, older adults, and adults with higher self-rated health were especially vulnerable due to significant differences in their ability to perceive risk, when they are at risk for diabetes. In order to combat the diabetes epidemic in the United States, public health programs should design their approach around multi-dimensional elements of risk, including perception, and can target interventions for the subpopulations identified in this study as being most vulnerable.

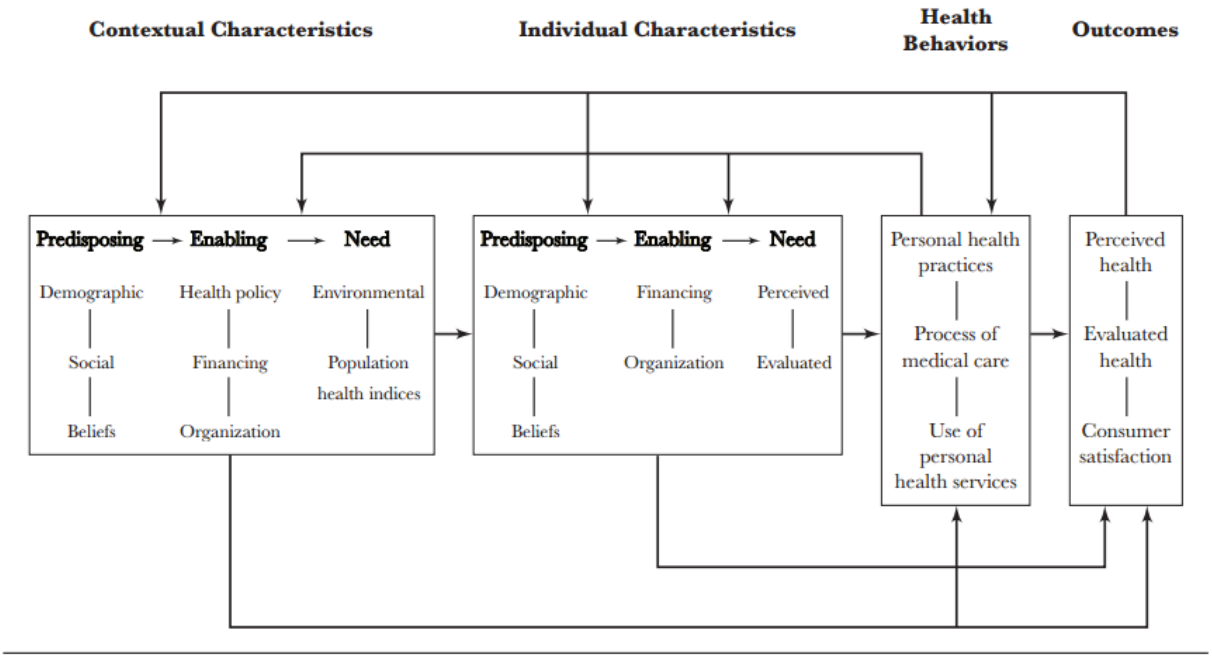
APPENDIX

Appendix A

Figure 2: Andersen's Behavioral Model of Health Services Use

Figure from: Andersen, R., & Davidson, P. (2007). Improving Access to Care in America: Individual and Contextual Indicators. In R. Andersen, T. H. Rice, & G. F. Kominski (Eds.), *Changing the U.S. health care system: key issues in health services policy and management* (3rd ed, pp. 3–32). San Francisco: Jossey-Bass.

FIGURE 1.1. A BEHAVIORAL MODEL OF HEALTH SERVICES USE INCLUDING CONTEXTUAL AND INDIVIDUAL CHARACTERISTICS.



Appendix B

Table 4: Bivariate Statistics by Diabetes Clinical Risk: NHANES 2011-2012 (Weighted)

	Clinical risk (n=4,643)		
Characteristic	No Increased Risk (ADA Risk Score 0-4)	Increased Risk (ADA Risk Score 5+)	P-Value
Clinical Risk			
No Increased Risk (ADA Risk Score 0-4)	--	--	
Increased Risk (ADA Risk Score 5+)	--	--	--
Perceived Risk			
No Perceived Risk	68.8%	31.2%	
Perceived Risk	47.3%	52.7%	<0.0001
Age (years), mean (SE)	35.9 (0.73)	59.4 (0.45)	<0.0001
Gender			
Male	60.7%	39.3%	0.0058
Female	64.8%	35.2%	
Race/Ethnicity			
Mexican	71.7%	28.2%	
Other Hispanic	67.9%	32.0%	
Non-Hispanic White	59.7%	40.2%	
Non-Hispanic Black	62.4%	37.5%	
Non-Hispanic Asian	78.5%	21.5%	
Other (including multi-racial)	70.6%	29.3%	<0.0001
Nativity			
United States	60.6%	39.4%	
Other	72.8%	27.2%	<0.0001
Citizenship			
Citizen	61.1%	38.9%	
Noncitizen	77.5%	22.5%	<0.0001
Education			
Some High School	56.3%	43.7%	
Completed High School	58.8%	41.1%	
Some College	62.9%	37.0%	
Completed College	68.4%	31.5%	0.0143
Language of Interview			
English	62.4%	37.5%	
Spanish	67.5%	32.4%	0.0798
Self-rated health			
Excellent	75.0%	24.9%	
Very Good	66.6%	33.3%	
Good	59.1%	40.9%	
Fair	48.5%	51.4%	
Poor	34.0%	65.9%	<0.0001
Usual Source of Care			

One or more Source	59.7%	40.2%	
No Usual Source of Care	78.3%	21.6%	<0.0001
Number of Visits to Physician, prev. 12 mos.			
None	74%	26%	
1	70.8%	29.1%	
2-3	62.7%	37.2%	
4-9	51.2%	48.7%	
10-12	58.8%	41.1%	
13+	49.5%	50.4%	<0.0001
Current Insurance Status			
No	73.8%	26.1%	
Yes	59.9%	40.0%	0.0001
Family Income as percentage of Poverty Line			
Income <= 130% FPL	67.2%	32.7%	
130% < Income <=185% FPL	62%	38%	
Income > 130% FPL >185% FPL	61.2%	38.7%	0.0787

Appendix C

Table 5: Adjusted Odds Ratios of Correctly Perceiving No Risk for Diabetes among those without Clinical Risk, according to ADA Standards: NHANES 2011-2012 (Weighted Logistic Regression)

	No Perceived risk, no clinical risk (odds of no type 2 error) N= 2,640	
	Adj. OR *	95% CI
Age (years)	1.03	(1.02, 1.04)*
Gender (male)	1.38	(1.11, 1.71)*
Race/ethnicity (ref: Non-Hispanic White)		
Mexican	0.53	(0.32, 0.88)*
Other Hispanic	0.85	(0.50, 1.43)
Non-Hispanic Black	0.77	(0.57, 1.05)
Non-Hispanic Asian	0.61	(0.46, 0.79)*
Other (including multi-racial)	0.44	(0.25, 0.75)*
Nativity		
Foreign Born	1.17	(0.74, 1.85)
Citizenship		
Not Citizen	1.38	(0.76, 2.48)
Education	0.85	(0.76, 0.94)*
Language of interview (English)	1.27	(0.82, 1.96)
Self-rated Health	0.61	(0.50, 0.74)
Usual Source of Care (ref. One or more.)	0.85	(0.61, 1.17)
Number of Visits to Physician, prev. 12 months	0.93	(0.87, 1.11)
Current Insurance Status (yes)	1.13	(0.86, 1.51)
Family Income as percentage of poverty line	0.99	(0.83, 1.20)

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Undergraduate Research Assistant

- Assist the Qualitative Research Manager on the Aligning Forces for Quality (AF4Q) Initiative Evaluation
    - Sponsored by the Robert Wood Johnson Foundation as the largest privately funded community-based quality improvement initiative to date
    - Population includes 16 diverse communities, covering 12.5% of the U.S. population
    - Code entry of qualitative data from key informant interviews using ATLASti software
    - Organize and archive supporting media files for each of the 16 participating sites
    - Create summary materials to track efforts in quality improvement, public reporting of quality measurement, and disparities equity

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- Analyzed individual exchange plans for elements of value based insurance design for diabetes and hypertension management.
    - Systematically collected cost sharing data from official form filings using SERFF.
    - Contributed to Families USA report summarizing study results and policy recommendations.
- Researched and systematically reviewed Medicaid payment and delivery reform programs in all 50 states and created a summary tool of programs to facilitate state level advocacy efforts.
- Analyzed, evaluated, and drafted federal comment letters on regulatory proposals including MACRA and the 2017 Physician Fee Schedule on issues such as: Quality Measurement in Advanced APMs, Advancing Care Information, and Medicare Advantage Data Transparency.

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- Co-led monthly, firm-wide journal club on the topic of drug and companion diagnostic reimbursement in personalized medicine.
- Researched, prepared, and presented an independent research project, "Aligning Incentives in Medicaid Patient Engagement", assessed strategies to align Medicaid beneficiaries' expectations for high value care with the health plan's method of measuring quality and experience.
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- Collected lab and blood pressure data for patients in the BCSMA Alternative Quality Contract.
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