

A MIXED METHODS APPROACH TO INVESTIGATE RISK PERCEPTION OF
DEVELOPING DIABETES IN VIETNAMESE AMERICANS WITH PREDIABETES

by

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DEDICATION

This is dedicated to my family, friends,
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ABSTRACT

Background: Vietnamese Americans (VnA) are at high risk of prediabetes and type 2 diabetes mellitus (T2DM). VnA are initially diagnosed at an earlier mean age and have higher T2DM prevalence compared to Non-Hispanic Whites, despite having lower mean body mass index. VnA may not perceive their risk of T2DM, which may affect their risk-reducing behaviors. There is a paucity of literature regarding the risk perception of developing T2DM in general and even more so for VnA, supporting the need for this study.

Purpose: A fixed complementarity (QUAL+quant) mixed method design with a data transformation variant was used to comprehensively describe the perceived risk of developing T2DM among VnA adults with prediabetes.

Methods: A non-random, multiple purposive sampling scheme was used to obtain a sample size of 10 VnA adults with prediabetes in the southwestern United States. Data collection techniques included individual, semi-structured interviews and quantitative questionnaires. Qualitative descriptive, quantitative descriptive, and data transformation techniques were used for data analyses.

Findings: The two risk perception domains emerging from the qualitative data were risk factors and disease severity. The main risk factors of T2DM noted by participants were eating habits (including the cultural influences on eating habits), sedentary lifestyle, and family history of T2DM. The mean composite *Risk Perception Survey for Developing Diabetes* score was 2.15 (SD=0.31) with mean scores of 3.30 and 3.10, respectively for the personal control and worry subscales. The meta-inference concluded that most VnA in this sample have a low perceived T2DM risk with divergence noted only with one participant.

Conclusions: VnA with prediabetes perceive they are at low risk for T2DM. Strategies to promote accurate risk perception for T2DM risk that is more congruent to actual risk may be needed to supplement T2DM prevention efforts. With high levels of perceived personal control and worry, this population that may be amenable to T2DM prevention interventions.

CHAPTER I: INTRODUCTION

This study examined the perception of risk for developing type 2 diabetes mellitus (T2DM) in Vietnamese American (VnA) adults diagnosed with prediabetes. No previous publications have addressed risk perception of developing T2DM in VnA. Chapter one includes an introduction to two papers (a concept analysis and systematic review regarding risk perception of developing T2DM) that were written by the dissertation author and provide background information on the health implications and prevalence rates of prediabetes and T2DM, along with factors contributing to T2DM health disparities among VnA adults. Chapter one also includes the purpose and aims of the study, as well as the significance to nursing. The metatheoretical underpinnings, theoretical models, and operational definitions applied in this study are also discussed. The systematic review supports the need for and factors to consider when conducting research about the risk perception of developing T2DM in VnA. Factors contributing to vulnerability are discussed.

Statement of the Problem

T2DM is a potentially crippling, chronic disease that may be prevented through health-promoting behaviors such as healthy eating and exercise (American Diabetes Association [ADA], 2017). Despite strategies proven to effectively prevent T2DM, there is still a growing T2DM prevalence especially noted in the VnA population who have higher T2DM prevalence rates despite a lower mean body mass index (BMI) compared to Non-Hispanic Whites (NHW) (Karter et al., 2014; Shih, Du, Lightstone, Simon, & Wang, 2014; Sorkin, Tan, Hays, Mangione, & Ngo-Metzger, 2008). In 2021, the prevalence of T2DM in VnA is expected to increase at a faster rate than in other racial and ethnic groups.

Lifestyle modification interventions that consider the Asian American culture have significantly improved glycemic control and glycosylated hemoglobin (A1C) in this population (Joo, 2014). Yet, there is a gap in the literature of T2DM prevention studies specific for VnA with prediabetes. Researching risk perception, which is one of the most distal antecedents of health behavior change (Schwarzer & Luszczynska, 2015), is the initial step in reducing risk. Risk perception is the perceived risk of developing a disease; however, this perception may not be congruent with the actual risk. For example, Pinelli, Berlie, Slaughter, and Jaber (2009) reported only a slight to moderate risk perception for developing T2DM among pharmacists (predominately NHW) in a cross-sectional study, regardless of presence of actual T2DM risk.

The anticipated spike in T2DM prevalence in VnA creates an opportune time to begin this research. Exploring risk perception of developing T2DM in VnA with prediabetes will allow health care professionals a better understanding of effective strategies that will alter risk perception with the end effect of motivation, intention, and then the adoption of T2DM prevention behaviors.

Purpose and Aims

Purpose

The purpose of this study is to comprehensively describe the perceived risk of developing T2DM among VnA adults with prediabetes using a mixed methods approach.

Aims

Aim 1. Ascertain the perceived risk of developing T2DM for Vietnamese Americans with prediabetes.

Aim 2. Determine the level of perceived risk for developing T2DM among VnA adults with prediabetes as measured by the *Risk Perception Survey-Developing Diabetes* (RPS-DD) instrument, noting similarities and differences of the sample characteristics in the group with a high level of perceived risk and the group with a low level of perceived risk.

Aim 3. Use fixed complementarity (QUAL+quant) mixed method design with a data transformation variant to enrich the current understanding of perceived risk for developing T2DM among VnA adults with prediabetes.

Background

Over 30 million people in America have diabetes and about seven million of them are unaware of their diagnosis (Centers for Disease Control and Prevention [CDC], 2017). The number of Americans diagnosed with diabetes has quadrupled over the past 30 years (CDC, 2015). Additionally, there are 86 million American people living with prediabetes, and nearly one-third will develop T2DM within five years without lifestyle changes (CDC, 2016). A1C is a measure for diagnosing prediabetes and T2DM. The normal A1C level is less than 5.7%; A1C levels of 5.7 to 6.4% constitute a diagnosis of prediabetes, and levels greater than 6.4% indicate T2DM (ADA, 2017).

Presence of prediabetes and being of Asian descent are risk factors of T2DM (ADA, 2019). Prediabetes prevalence rates are higher among Asian Americans (35.7%) when compared with NHW (31.5%) (CDC, 2017). The national prevalence rates for T2DM are also higher among Asian Americans compared to NHW (10.3% versus 7.3%, respectively) (CDC, 2017). Culturally-tailored lifestyle modification interventions for T2DM prevention in Asian Americans significantly improved outcomes (Joo, 2014). The literature is replete of interventions targeting

the prevention of T2DM specifically in VnA who have prediabetes. An essential preliminary step for developing and implementing a culturally adapted T2DM prevention intervention for VnA with prediabetes is by determining their perception of risk for developing T2DM.

Risk Perception

Theoretically, risk perception is an antecedent of health-promoting behaviors in theories such as the Health Belief Model, Protection Motivation Theory, Common-Sense Model of Self-Regulation, and Health Action Process Approach (HAPA) Model (Conner & Norman, 2015; Janz & Becker, 1984; Leventhal, Phillips, & Burns, 2016; Rogers, 1975). The dissertation author wrote a manuscript that focused on a concept analysis of risk perception of developing T2DM (Appendix A). Following Walker and Avant's (2011) method for a concept analysis, the dissertation author accomplished the following tasks:

- Reviewed many sources for definitions, synonyms, antonyms, and uses of the term risk perception- including theoretical sources and seminal work.
- Conducted electronic data base searching to determine how researchers applied the concept of risk perception for developing T2DM.
- Extrapolated defining attributes, antecedents, consequences, and empirical referents of perceived T2DM risk from the literature.
- Developed a model case and other cases to further clarify the concept.

All sections of the concept analysis paper were written by the dissertation author with only editorial remarks from the dissertation committee. The dimensions of risk perception that were identified through this concept analysis included components of cognitive and affective risk perception: (1) general risk perception or perceived severity; (2) personal, noncomparative risk

perception (perceived susceptibility or vulnerability); (3) comparative risk perception; (4) optimistic bias; (5) perceived likelihood, conditional risk perception, or personal control; and (6) affective dimensions of risk perception. The dimensions of risk perception can be deliberative or experiential perceptions of risk.

Some personal determinants of health include health-related beliefs, attitudes, knowledge, and behaviors (Braveman, Egerter, & Williams, 2011). Two meta-analyses support the correlational and causal relationship between risk perception and health behavior changes, which are needed to prevent T2DM (Brewer et al., 2007; CDC, 2017; Sheeran, Harris, & Epton, 2014). Theory and research support the need to further explore T2DM risk perception of VnA with prediabetes to inform future interventions that will ultimately encourage health-promoting behaviors in this population. The theoretical framework and findings from a systematic review will be further discussed.

Significance of Prediabetes and T2DM in Asian Americans

Prediabetes is a serious diagnosis that causes moderately impaired fasting glucose and/or impaired glucose tolerance (as relative to higher levels of impairment with T2DM) and has been associated with cancer, cognitive dysfunction, depression, fatty liver disease, periodontal disease, nephropathy (including chronic kidney disease), neuropathy, retinopathy, and increased risk of macrovascular disease such as cardiovascular disease (Buysschaert, Medina, Bergman, Shah, & Lonier, 2015; Chen et al., 2016; Echouffo-Tcheugui, Narayan, Weisman, Golden, & Jaar, 2016; Tabák, Herder, Rathmann, Brunner, & Kivimäki, 2012). Persons with prediabetes are also at higher risk of developing T2DM (CDC, 2018). T2DM can result in: (1) acute complications such as hypoglycemia, diabetic ketoacidosis, and hyperosmolar hyperglycemic state; and (2) chronic

complications such as atherosclerotic cardiovascular disease (including acute coronary syndromes, myocardial infarction, stroke, transient ischemic attack, and peripheral arterial disease), kidney disease, diabetic retinopathy, peripheral neuropathy, and dementia (ADA, 2017). These acute and chronic complications may ultimately lead to severe debility or even death.

General risk factors for T2DM, which are also related to prediabetes, include: being overweight, age 45 years or older, family history of T2DM, sedentary lifestyle, history of gestational diabetes or giving birth to a baby who weighs more than nine pounds; these risk factors are compounded in certain races or ethnicities (African Americans, Hispanic/Latino Americans, Native Americans, and Asian American/Pacific Islanders) (ADA, 2019). Some specific risk factors noted for T2DM in Asian Americans include increased BMI at lower thresholds than the general population, increased central adiposity (waist circumference), and foreign-born living in the U.S. for greater than 10 years (Shih et al., 2014; Stewart, Dang, & Chen, 2016). Despite reports of lacking English proficiency as a barrier to care, two sources found that those with English proficiency were more likely to have T2DM (Huang & Zheng, 2015; Tran, Allen, Nguyen, Lee, & Chan, 2014). Tran et al. (2014) lists English proficiency and living in the U.S. for at least 15 years as associated factors for T2DM. This could indicate an acculturation level, as it was noted previously that T2DM has the greatest association with second generational Asian Americans (Huang & Zheng, 2015).

Significance of Prediabetes and T2DM in Vietnamese Americans

Vietnamese Americans (VnA), a subgroup of Asian Americans, were the population of interest for this study. VnA are the fourth largest ethnic group among Asian Americans with a

population size of 1.98 million (Lopez & Ruiz, 2017). There is no national prevalence rate for prediabetes or T2DM in VnA due to data aggregation into Asian Americans data sets.

There is currently no source that compares prediabetes prevalence rates of VnA with NHW. Only one study reported the prevalence rate of prediabetes (28.6%) in VnA (Stewart et al., 2016). The prevalence rate of T2DM among VnA is not consistently reported (Table 1 - T2DM prevalence rates). A higher prevalence rate of T2DM in VnA, when compared to NHW, is most commonly reported (Karter et al., 2013; Shih et al., 2014; Sorkin et al., 2008). Karter et al. (2013) found the prevalence rate of T2DM is higher in VnA compared to NHW (9.9% versus 7.3%, respectively) despite VnA having a lower mean BMI (23.9 versus 28.3 kg/m², respectively). This finding was supported by Shih et al. (2009) also found that the prevalence of T2DM was 9.6 in Asian Americans versus 6.7% ($p<.05$) in NHW despite a lower BMI of 24.5 versus 25.6 kg/m² ($p<.001$), respectively. Additionally, Karter et al. determined that VnA have a significantly higher relative risk for T2DM prevalence (RR=1.42, $p<.05$)

VnA, compared to NHW, also receive an initial diagnosis of T2DM at a younger mean age. The average age of diagnosis for T2DM in VnA is 46.7 years, which is 5.2 years earlier than in NHW (Becerra & Becerra, 2015). If adjusting for gender, education level, country of birth, and the survey year, the age of diagnosis in VnA is 8.7 years earlier than in NHW (Becerra & Becerra, 2015).

It should also be noted that only 15% of U.S. born VnA were at least 30 years of age compared with 83% of foreign-born VnA in 2015 (Lopez, Cilluffo, & Patten, 2017). The odds ratio of T2DM in Asian Americans versus NHW was lowest with the first-generation (born in their native country and migrated to America) Asian Americans (odds ratio=1.2) and greatest

with the second-generation Asian Americans (individuals born in America, but one or more of their parents were born in their native country) (odds ratio=5.2) (Huang & Zheng, 2015). This suggests that there is a large percentage of younger, second-generation VnA who are likely to be diagnosed with T2DM. Based on the first wave of Vietnamese immigrants to the U.S. in 1975 (Appel, 2013) and the mean age of initial T2DM diagnosis calculated for VnA at age 46.7 years (Becerra & Becerra, 2015), the first group of second-generation VnA will turn 46 years old as early as 2021 and there will likely be a resulting increased T2DM prevalence in this population. It is concerning that the odds ratio for the second-generation VnA will likely be just as high as that of second-generation Asian Americans, which indicates an anticipated disproportionate rise in T2DM prevalence among VnA.

TABLE 1. *Diabetes prevalence rates in Vietnamese Americans.*

Study: Author (Year)	Non-Hispanic Whites	Vietnamese Americans	Adjustments in Prevalence Rate	Data Source
Choi et al. (2013)	Male: 9.7 % Female: 7.0 %	Male: 8.8 % Female: 5.0 %	Specific for gender	2009 CHIS
Karter et al. (2013)	7.3 %	9.9 %	Adjusted for age and gender	2010 Northern California prospective cohort analysis
Shih, Du, Lightstone, Simon, and Wang (2014)	5.7 %	5.9%	Adjusted for age	1997 to 2011 LACHS
Nguyen et al. (2009)	7.3 %	5.3 %	Adjusted for age	2010 REACH with data collection from 2002 to 2005 for VA in Santa Clara County, CA
Sorkin et al. (2008)	11.1 %	15.6 %	None	2001 and 2003 CHIS
Stewart et al. (2016)	Not measured	8.5 %	None	2012 to 2013 in Sacramento County, California
Tendulkar et al. (2012)	Not measured	7.0 %	None	2008 to 2009 in Boston, Massachusetts

Note. Results in bold are prevalence rates that are higher when comparing Non-Hispanic White and Vietnamese American populations within each study. *= studies initially found in a literature review by Staimez, Weber, Narayan, and Oza-Frank (2013); CHIS= California Health Interview Survey; LACHS= Los Angeles County Health Survey; REACH= Racial and Ethnic Approaches to Community Health; NHW= Non-Hispanic White

Metatheoretical and Theoretical Framework

Metatheoretical Underpinnings

The meta-theoretical influences on this dissertation study come from the reciprocal-interaction (RI) worldview and intermodernism. Key characteristics of the RI worldview are: people are holistic, change is probabilistic as a result of multiple antecedent factors, and both subjective and objective phenomena are studied through qualitative and quantitative methods (Fawcett, 1993). RI views the person as a complex organism with bio-psycho-social-spiritual elements similar to the totality paradigm (Fawcett, 1993). This view of the person is in line with the need to further explore risk perception, understanding that risk perception is one of the antecedent factors of change in health promoting behaviors. While this was not an interventional study, the findings will provide an understanding of a construct that may be used to devise future T2DM prevention interventions that will be effective for VnA with prediabetes.

The tenets of intermodernism that most influence this study are: truth, empiricism, reality, methods, openness, discovery, romanticism, and Nightingale (Reed, 2011). Discovery of knowledge comes from abductive reasoning or making an educated guess, followed by both deductive and inductive reasoning. Multiple theoretical ideas should be used as a guiding framework or truth, and evidence comes from various sources through various methodologies (empiricism and methods). Intermodernism proposes that the reality of truth is not entirely independent of the thinker nor is it completely within. Openness requires an ongoing reflection of self. Scientific inquiry requires epistemic (related to knowledge) and non-epistemic (cultural, emotional, and social) values. The non-epistemic values comprise the tenet of romanticism. The

tenet named after the mother of modern nursing, Nightingale, is a reminder to consider a holistic focus on the person and the environment (Reed, 2011), which is in line with the RI worldview.

Health Action Process Approach (HAPA) Model

HAPA is a hybrid model deductively developed by a health psychologist, that incorporates constructs from the social cognitive theory, transtheoretical model (TTM), and theory of planned behavior (Conner & Norman, 2015; Prochaska, Redding, & Evers, 2015; Schwarzer & Luszczynska, 2015). The HAPA Model (Figure 1 - model diagram) provides an appropriate framework for this study because it focuses on the qualitative and quantitative processes of health behavior change (Schwarzer & Luszczynska, 2015). This focus on qualitative and quantitative processes of health behavior change is congruent with RI worldview and intermodernism (Fawcett, 1993; Reed, 2011). Risk perception, an antecedent of health behavior change, will be examined in this study with a future intent to use the new knowledge to culturally tailor health-promoting activities.

The two stages of health behavior change are the motivation and volition stages (Prochaska et al., 2015). In the *motivation stage*, the individual develops the intention to change. In the *volition stage*, the individual may or may not have translated the motivation into action. HAPA also categorizes the individual as either a pre-intender, intender, or actor (Conner & Norman, 2015). A pre-intender has not yet developed the intention to adopt the health-promoting behavior. As the individual develops the intention to change in the motivation stage, the individual transitions to the intender category. Finally, as the individual translates the intention into action, the individual progresses to the actor category.

Risk perceptions are pertinent in the motivation stage, especially with pre-intenders. Pre-intenders are influenced by risk perceptions, outcomes expectancies, and self-efficacy to develop intentions in the motivation stage (Schwarzer & Luszczynska, 2015). *Outcome expectancies* are the links an individual makes between actions and subsequent outcomes. *Self-efficacy* is the perceived ability for action, maintenance, and recovery.

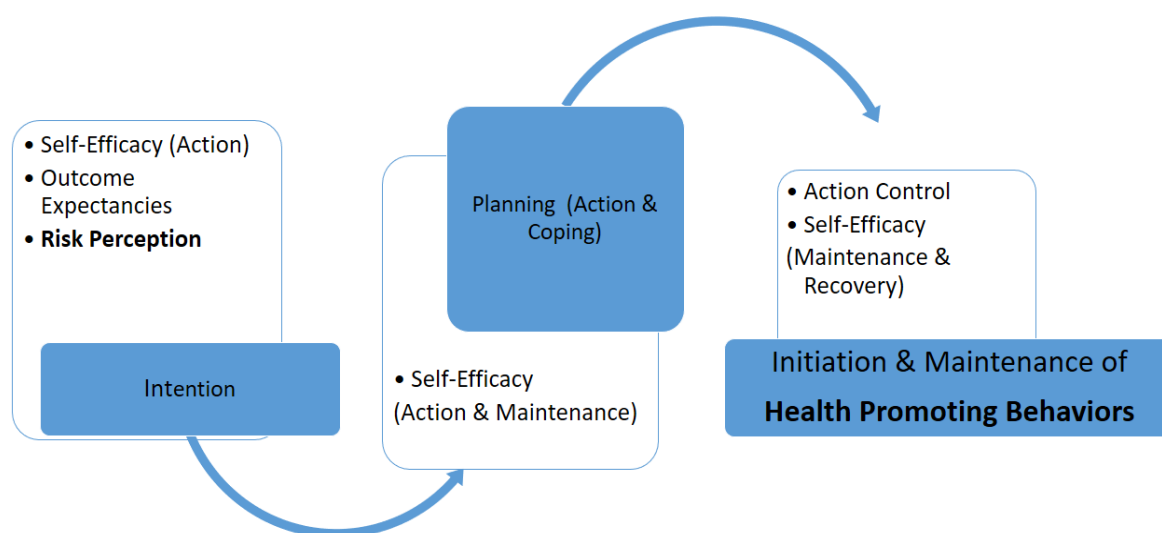


FIGURE 1. Health action process approach model. (Adapted from “Health Action Process Approach” by R. Schwarzer & A. Luszczynska, 2015, M. Conner, & P. Norman (Eds.), *Predicting and Changing Health Behavior: Research and Practice with Social Cognition Models* (3rd ed., pp. 252-2787). New York: McGraw Hill Education.)

Pre-intenders transition to *intenders* as they enter the volition stage by translating the intention into action, with the influences of self-efficacy and planning (Schwarzer & Luszczynska, 2015). Planning is the key strategy to get from the motivation stage to a successful volition stage. *Action planning* details the steps, timing, and setting of the intended action. *Coping planning* requires anticipating barriers and designing ways to overcome the barriers to achieve the goal. Intenders finally transition to become *actors* by using self-efficacy and action control to distinguish between action initiation and maintenance.

Most of the HAPA constructs are more abstract but remain measurable. The definitions provided in the theory are descriptive, rather than theoretical or operational. Relational statements are congruent with the model. The constructs of the model are a continuum of the process for behavior change. The model is a sequential mediator structure which may be used to predict, describe, and explain health behaviors (Schwarzer & Luszczynska, 2015). For the purposes of this proposed study, the HAPA model construct of risk perception was further explored in this population. Future research will aim to influence risk perception and predict the adoption of health-promoting behaviors.

Operational Definitions

TABLE 2. *Operational definitions*

Term	Operational Definitions
Vietnamese Americans	Asian Americans who self-identify as Vietnamese. These individuals and/or their ancestors originate from Vietnam, which is located in Southeastern Asia (Central Intelligence Agency, 2017).
Diabetes	Although self-report of T2DM will be used in this study, it is understood that the diagnosis of T2DM requires meeting one of the following criteria per ADA (2017) guidelines: <ul style="list-style-type: none"> - FPG \geq 126 mg/dL - Two-hour PG \geq 200 mg/dL during an OGTT - A1C \geq 6.5% - Random PG \geq 200 mg/dL in a person with classic symptoms of hyperglycemia or hyperglycemic crisis
Prediabetes	Although self-report of prediabetes will be used in this study, it is understood that the diagnosis of prediabetes requires meeting one of the following criteria per ADA (2017) guidelines: <ul style="list-style-type: none"> - FPG 100 to 125 mg/dL - Two-hour PG 140 to 199 mg/dL during an OGTT - A1C 5.7 % to 6.4%
Risk Perception	A multi-dimensional construct with cognitive/deliberative, affective/emotional, and instinctual/experiential components. Risk perceptions are the general and personal thoughts and feelings that may include worry, anxiety, or even optimism about the susceptibility, vulnerability, and likelihood of developing a disease and the disease's severity that are both instinctually and systematically comprised.

Notes. ADA= American Diabetes Association; FPG= fasting plasma glucose; PG=plasma glucose; OGTT= oral glucose tolerance test; A1C= glycosylated hemoglobin

Literature Review

A manuscript for a systematic review on risk perception of developing T2DM in the general population with foci on Asian Americans and persons with prediabetes was submitted to the *Journal of Transcultural Nursing* (Appendix B). The dissertation author conducted all literature searches. The dissertation author and a committee co-chair reviewed articles to determine if inclusion and exclusion criteria were met, and then independently extrapolated all pertinent findings to reach consensus on the results through weekly meetings. The other dissertation committee co-chair contributed background information regarding Diabetes Prevention Program (DPP). The dissertation author and committee co-chairs found that there was an overall low level of perceived T2DM and a low percentage of persons reporting a moderate to high level of perceived T2DM risk.

Key findings from this systematic review that support the need for this dissertation study include: Asian Americans have comparable low perceived T2DM risk levels as the general population; high levels of worry and perceived control have been reported in the general population; significantly increased levels of perceived T2DM risk and worry in participants with family history of T2DM; incongruent actual T2DM risk and perceived T2DM risk in the general population; and significant predictors of perceived T2DM risk (e.g., being told by the healthcare provider of prediabetes diagnosis or risk factors of developing T2DM). This systematic review identified the need for consistency in measures used to calculate perceived T2DM risk and effective strategies to alter perceived T2DM risk to better match actual T2DM risk. This systematic review also noted the limited representation of Asian Americans in these studies, and the need for more studies in this population.

Summary

This chapter, along with the appended manuscripts, has provided evidence from the literature that highlights the T2DM health disparity that threatens the health of the VnA population. This is a vulnerable population who has a higher prevalence of T2DM, with T2DM risk at a younger age and lower BMI than NHW. The numerous health implications for persons with prediabetes and T2DM, as well as the importance of studying the risk perception of VnA adults with prediabetes, were presented. The T2DM disparity among VnA and the gaps in our understanding of their perception of T2DM risk affirm the critical urgency to study this phenomenon.

The results from this study are expected to contribute culturally relevant nursing knowledge that will guide future interventions by nurses and other health care professionals, for facilitating the adoption of health-promoting behaviors. The results of this study hold promise of informing culturally appropriate T2DM prevention interventions that effectively engage VnA in health-promoting behaviors. The carefully considered meta-theoretical underpinnings and theoretical background have guided the research purpose, aims, and research process.

CHAPTER II: PRESENT STUDY

Chapter two summarizes methods, results, and conclusions for this dissertation study of risk perception of developing T2DM in Vietnamese American adults diagnosed with prediabetes. The methods, results, and conclusions of this study are presented in the results manuscript appended to this dissertation (Appendix C). The dissertation author was the principal investigator for this mixed methods study and performed all data collection. The dissertation committee members served as resources to confirm analyses of both qualitative, quantitative, and transformed data. All portions of the manuscript were originally drafted by the dissertation author with minimal contributions from the dissertation committee in the refinement of the manuscript which included editorial contributions.

Purpose and Aims

Purpose

The purpose of this study is to comprehensively describe the perceived risk of developing T2DM among VnA adults with prediabetes using a mixed methods approach.

Aims

Aim 1. Ascertain the perceived risk of developing T2DM for Vietnamese Americans with prediabetes.

Aim 2. Determine the level of perceived risk for developing T2DM among VnA adults with prediabetes as measured by the *Risk Perception Survey-Developing Diabetes* (RPS-DD) instrument, noting similarities and differences of the sample characteristics in the group with a high level of perceived risk and the group with a low level of perceived risk.

Aim 3. Use fixed complementarity (QUAL+quant) mixed method design with a data transformation variant to enrich the current understanding of perceived risk for developing T2DM among VnA adults with prediabetes.

Mixed Methods Design

To better inform both theory and practice, a mixed methods research design was used and allowed greater understanding of risk perception than would have been discovered by the sole use of either qualitative or quantitative methods (Johnson & Onwuegbuzie, 2004). The risk perception of developing T2DM in VnA adults with prediabetes was explored through a fixed, convergent or complementarity mixed methods design with a data-transformation variant through interviews and questionnaires (Creswell, Klassen, Plano Clark, & Smith, 2011; Creswell & Plano Clark, 2018). Although both qualitative and quantitative research methods may be used for descriptive and exploratory purposes, qualitative methods are better for reflecting the emic perspective and are especially beneficial when there is a paucity of literature regarding the topic (Johnson & Onwuegbuzie, 2004); therefore the qualitative method was the dominant methodology used for this dissertation study (Morgan, 1998).

A descriptive design was used for the overall study. Qualitative description enabled the dissertation author to describe the risk perception of developing T2DM using the native terminology of VnA (Sandelowski, 2000). A comparative descriptive design was planned to compare the means of the demographic and background statistics among prediabetic VnA adults with high versus low levels of perceived risk of developing T2DM as measured with the RPS-DD. However, this analysis was not completed due to having only one participant who received a high RPS-DD composite score.

Sample

This sample was obtained using a multiple purposive sampling scheme- including both snowball sampling and maximum variation techniques (Creswell & Plano Clark, 2018). The inclusion and exclusion criteria were listed in the results paper (Appendix C). Variations in the key individual characteristics for gender and family history of T2DM were considered to achieve maximum variation sampling. To increase available participants, snowball sampling was used to increase the number of available participants by asking all participants if they could refer other potential participants (Teddlie & Tashakkori, 2009). Two participants were referred by previous participants. The final sample size was 10 participants. Participants were compensated for their time.

Setting

The settings for this study were Clark County of Nevada and Los Angeles and Orange Counties of California. There are approximately 9,461 VnA living in Clark County (United States Census Bureau, n.d.). There are approximately 92,059 VnA living in Los Angeles County and 195,351 VnA living in Orange County (United States Census Bureau, n.d.).

Participant Recruitment

There are multiple gatekeepers of the VnA community in Clark County, including the priest at local VnA Catholic church, a monk from a local VnA Buddhist temple and community leaders from the Vietnamese Community Association of Southern Nevada, Las Vegas Vietnamese American Lions Club, Vietnamese American Community of Las Vegas (VACLV), and American Vietnamese Chamber of Commerce Las Vegas (AVCCLV). Recruitment flyers were given to gatekeepers who agreed to collaborate in participant recruitment for the study

(Appendix D). Recruitment flyers were also placed with permission at various medical offices of VnA health care providers, Asian supermarkets, Vietnamese restaurants, and nail salons. The recruitment flyers had the dissertation author's contact information for questions or interest in study participation. For those organizations that had a website or social media account, permission was requested to post the flyer on these sites.

Procedures

Ethical considerations in this study included Institutional Review Board (IRB) approval, informed consent, confidentiality, anonymity, and risks to participants (physical, financial, or legal). The dissertation author obtained ethical approval for this mixed methods research from the University of Arizona IRB (Approval #1807760846) (Appendix E). Following the interview and completion of questionnaires, participants were given the prediabetes infographic (<https://www.cdc.gov/diabetes/pdfs/library/socialmedia/prediabetes-infographic.pdf>) as well as contact information for the local T2DM prevention program. Potential individual benefits include heightened awareness of risk perceptions of developing T2DM and subsequent adoption of health-promoting behaviors.

Data Collection

Qualitative data were collected prior to quantitative data. The RPS-DD was used to guide the development of the interview questions (Appendix G). Using parallel data collection questions is recommended with the complementarity mixed methods design (Creswell & Plano Clark, 2018). Additional face-to-face interviews with two participants were used for member checking. A self-administered pen and paper set of questionnaires comprised of both investigator-developed (demographic) and items from an established risk perception tool was

completed by participants. Included items assessed demographic and background characteristics, and level of risk perception for developing T2DM.

Sample Characteristics

Demographic characteristics collected include age range, gender, educational level, income, insurance status, and marital status. Other background characteristics collected include BMI (calculated from self-reported height and weight), length of time since first diagnosed with prediabetes, history of gestational diabetes (for women), and family history of T2DM (Appendix G). There was one question on the demographic questionnaire that was used to determine the immigrant generational status (first generation, second generation, or third generation VnA) and served as a proxy for acculturation level (Erber Oakkar et al., 2015; Huang & Zheng, 2015) (see Appendix G).

Risk Perception of Developing Diabetes

The RPS-DD is a reliable and validated tool (Cronbach's $\alpha = .84$) that consists of 43 items (E. A. Walker, 2009). There are 32 items scored using a four-point Likert scale with five subscales that examine the concepts of personal control, worry, optimistic bias, personal disease risk, and comparative environment risk (subscale Cronbach's α ranged from .50 to .81) (Table 4 - items included in each subscale and the internal consistency of the subscales).

A mean of each subscale was calculated allowing an indicator of low versus high perceptions of each subscale concept (e.g. high versus low perception of personal control) (E. A. Walker, 2009). Generally, the higher the mean subscale score, the higher the perception of that risk perception dimension and the higher the general risk perception. When calculating scores for each subscale, reverse scoring was used for items number three through eight. Items requiring

reverse scoring included all items from the worry and optimistic bias subscales and two of the four items from the personal control subscale. For example, a lower optimistic bias score (indicating higher comparative risk perception) indicated a higher T2DM risk perception. Additionally, one point was added to each Likert score for items numbered nine through 23 if reports of the participant and/or a family member had the disease specified for each item. Finally, the composite score was comprised of the mean of all subscale scores with reverse scoring as specified previously for items number three to eight. The higher the composite score, the higher the perceived risk. There are an additional 11 items that also use a four-point Likert scale to measure T2DM risk knowledge. One point is awarded for each correct T2DM risk knowledge item, but this score was not included in the composite risk perception score. The RPS-DD took approximately 12 minutes to complete (Walker, Mertz, Kalten, & Flynn, 2003).

TABLE 3. *Reliability of risk perception survey – Developing diabetes.* (Walker et al., 2003)

Dimension of Risk Perception	Subscale	Total Items	Item Numbers	E. A. Walker et al. (2003) Cronbach's α	Kim et al., (2007) Cronbach's α	E. A. Walker (2009) Cronbach's α
Conditional Risk	Personal Control	4	Item 1 – Item 4	.67	.72	.68
Affective	Worry	2	Item 5 and Item 8	Not applicable ¹	Not applicable	.50
Comparative Risk	Optimistic Bias	2	Item 6 and Item 7	.64	.65	.71
Personal Risk and General Risk ²	Personal Disease Risk	15	Item 9 – Item 23	.86	Not applicable	.80
Personal Risk	Comparative Environmental Risk	9	Item 24 – Item 32	.86	Not applicable	.81
General Risk ²	Diabetes Risk Knowledge	11	Item 33 – Item 43	Not applicable	.70	Not applicable

Note. ¹ Not initially regarded as a subscale in this first study; ² Indirectly measures general risk perceptions

Supplementary Data Analysis

The results manuscript outlined all data analysis procedures using parallel mixed method data analysis technique and conversion data transformation techniques (Appendix C). Additional quantitative analysis for this dissertation included tables created for frequency, percentages, ranges of scores, and measures of central tendency (i.e., mode, mean, & median scores) for the RPS-DD subscales and composite score.

Results

Key findings reported in the results manuscript included the domains of qualitative data related to risk perception of developing T2DM among VnA with prediabetes (Appendix C). The two domains for risk perception of developing T2DM were (1) risk factors for prediabetes and/or T2DM and (2) disease severity. A domain for preventing T2DM also emerged from the qualitative data (Figure 2). The domain for preventing T2DM consisted of two categories: health behavior changes and factors influencing health behavior changes. The health behavior changes category was further subcategorized to modifying health behaviors and results of behavior changes. The factors influencing health behavior changes was subcategorized to become aware, “I Do the Best I Can,” “It Hit Home Hard,” and barriers to preventing T2DM. The barriers to preventing T2DM mentioned by participants included limited time and feeling tired, convenient foods are not healthy, eating healthy is expensive, difficult to break habits or mindsets, cravings/temptations are hard to resist or lacking self-discipline, wanting quality of life (spending time with friends and family), or not seeing importance of needed changes due to increased age and life expectancy.

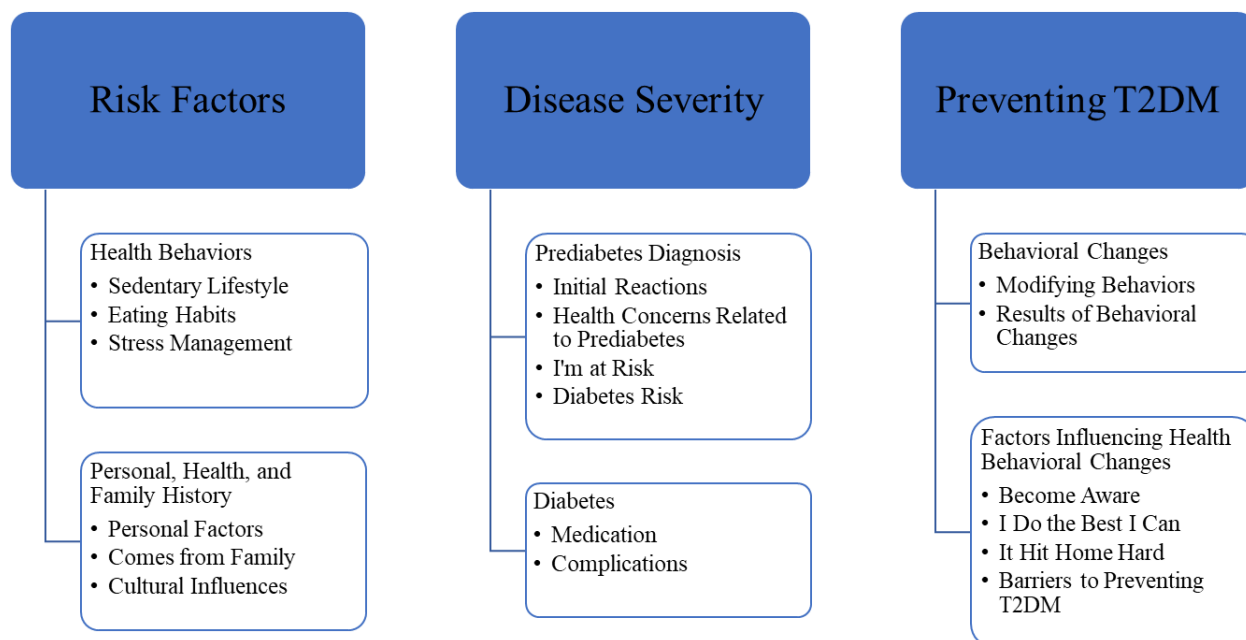


FIGURE 2. Coding themes, categories and subcategories.

Sample characteristics, RPS-DD scores, qualitative themes, verbal counting, and narrative profile were presented in the results manuscript (Appendix C). Key findings and additional findings were included in this dissertation paper. Key findings reported in the results manuscript include an overall low risk perception of developing T2DM but an overall high level of personal control for delaying or preventing T2DM and worry for developing T2DM in this sample. These key findings were supported by convergence of qualitative data and the mean RPS-DD composite score, mean RPS-DD personal control subscale score, and mean RPS-DD worry subscale (Table 5). The frequency, percentage, range of scores, and measures of central

tendency (i.e., mode, mean, and median scores) from the RPS-DD are presented in Table 5 (a condensed version of this table was included in the results manuscript).

TABLE 4. *Measures of central tendency for diabetes risk perception tool.*

RPS-DD (Cronbach's alpha)	Range of Scores	Mean Scores (SD)	Median Scores	Mode (Frequency & Percentages)
Composite RPS-DD ^a ($\alpha=.64$)	1.47-2.59	2.15 (0.31)	2.22	2.22 (2 & 20%) 2.31 (2 & 20%)
Personal Control Subscale ^b ($\alpha=.65$)	2.25-4.00	3.30 (0.59)	3.38	3.25 (2 & 20%) 3.50 (2 & 20%) 4.00 (2 & 20%)
Worry Subscale ^b ($\alpha=.83$)	2.00-4.00	3.10 (0.81)	3.25	4.00 (3 & 30%)
Optimistic Bias Subscale ^c ($\alpha=.70$)	1.50-4.00	2.75 (0.89)	2.75	2.00 (3 & 30%)
Personal Disease Risk Subscale ^d ($\alpha=.52$)	1.53-2.80	2.06 (0.40)	2.10	2.33 (2 & 20%)
Comparative Environmental Risk Subscale ^b ($\alpha=.86$)	1.00-3.44	2.27 (0.78)	2.50	1.56 (2 & 20%)
Knowledge ^e	36.36%-81.82%	60.91% (14.88%)	59.09%	54.55% (2 & 20%)

Note. RPS-DD= *Risk Perception Survey- Developing Diabetes* (Walker et al., 2003)

^a composite RPS-DD score is an average of 32 items comprising the five subscales with reversed scoring of four items to conform with the conceptual direction of composite score; 1= low overall perceived diabetes risk and 4.47= high overall perceived diabetes risk with the midpoint score equal to 2.23

^b 1=low perceived personal control/worry/comparative environmental risk and 4= high perceived personal control/worry/comparative environmental risk with midpoint score equal to 2.5

^c subscale is labelled as measurement of optimistic bias but the two items of this subscale measure comparative risk with a 1= strongly agree that perceived risk for T2DM and serious disease is decreased compared to other people with same age and gender and 4= strongly disagree that perceived risk for T2DM and serious disease is decreased compared to other people with same age and gender, with midpoint score equal to 2.5

^d 1= lower perceived comparative personal disease risk and 4= high perceived comparative personal risk with midpoint score equal to 3

^e= percentage of items correct

Discussion

The themes, categories, and subcategories of the qualitative data described various dimensions of the VnA adults' perceived risk of developing T2DM, which included their perceived risk factors for T2DM and general risk perceptions of T2DM severity. This is the first study to explore the perceived T2DM risk in VnA. The scores of the RPS-DD helped to discern mean levels of perceived T2DM risk and various dimensions of perceived risk (e.g., the high worry subscale scores measuring the affective dimension of perceived risk and all other

subscales measuring cognitive dimensions of perceived risk). Finally, the narrative profile and verbal counting further enriched understanding of perceived risk for developing T2DM among VnA adults with prediabetes.

Strategies to maintain trustworthiness and limitations for transferability and generalizability were discussed in the results manuscript (Appendix C). The similarity and uniqueness of findings for risk factors of T2DM in this study compared to previous studies was also discussed in the results manuscript. Overall, there was convergence of qualitative and quantitative data (i.e., qualitative data supported low perceived T2DM risk) noted in eight of the ten participants. While the results manuscript notes only one case of divergence and one case of ambiguity between qualitative and quantitative data (Appendix C), an in-depth discussion is warranted in this dissertation paper as it supports the validity of the data transformations and meta-inference. In the one incidence of high composite RPS-DD score, the qualitative data demonstrated an indecisive level of perceived risk for Anh. She discussed the need to follow-up with her health care provider as she was only diagnosed with prediabetes one week prior to this interview. She stated that she did not know what her blood sugar level was, and therefore did not know “what level, from there, to get to actual being a diabetic.”

The only case of divergence of qualitative and quantitative data was noted for Huy, who had the lowest composite RPS-DD score of 1.5, but the qualitative data indicated possible a medium to high perceived risk of developing T2DM. Huy noted all of the complications (including the need for medications) as he discussed the disease severity of T2DM. He said that he is “at risk to be a frank diabetic” because of his prediabetes diagnosis. Although he perceived a high personal risk and high general risk of T2DM, he did not perceive as much worry or

concern regarding the diagnosis as he stated that “what [is] gonna happen’s gonna happen” but that he was “not gonna go down without a fight.” Huy also noted a high level of personal control and self-efficacy for self-management of T2DM once developed.

Summary

This dissertation study is an essential preliminary step for developing and implementing a culturally adapted T2DM prevention intervention for VnA with prediabetes. Through an increased awareness of how this population views prediabetes and their risk of developing T2DM, the dissertation author will be able to culturally-tailor future T2DM prevention efforts with potential increased effects. A manuscript of a systematic review of risk perception of prediabetes has been submitted to the *Journal of Transcultural Nursing* (Manuscript # JTN-19-055) (Appendix A). The dissertation author has presented this systematic review at the first inaugural Asian American Pacific Islander Nurses Association of Nevada conference. Manuscripts for concept analysis of risk perception for developing T2DM (Appendix B) and the dissertation study results (Appendix C) will be submitted to refereed journals. A manuscript to further disseminate the qualitative data for preventing T2DM from this study is planned. Future manuscripts reporting post-hoc analyses of quantitative data may include examining significant correlational relationships between RPS-DD composite and subscale scores and sample characteristics (such as immigrant generational status or family history of T2DM). Scaffolding on this dissertation, the next step in building a program of research will be a behavioral intervention study to combat T2DM disparity in this vulnerable population.

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APPENDIX A:

MANUSCRIPT #1: RISK PERCEPTION OF DEVELOPING DIABETES: A CONCEPT
ANALYSIS

(Authored by A. P. Nguyen with plans for submission to *Nursing Forum*)

Risk Perception of Developing Diabetes: A Concept Analysis

Diabetes is a costly disease with a total direct and indirect estimated cost of \$327 billion (American Diabetes Association [ADA], 2018). Type 2 diabetes mellitus (T2DM) accounts for 90% to 95% of all diabetes cases (Centers for Disease Control and Prevention [CDC], 2017). T2DM can result in many acute and chronic complications that may ultimately lead to severe debility or even death (ADA, 2017). Risk factors for T2DM include: family history of diabetes, high risk race/ethnicity, history of cardiovascular disease, hypertension, hyperlipidemia, polycystic ovary syndrome, physical inactivity, severe obesity, prediabetes, gestational diabetes, age 45 years or older (ADA, 2019). Perceptions of risk for developing diabetes is not always congruent with the actual risk of developing diabetes (Nguyen, Loescher, & McEwen, 2019). The purpose of this manuscript is to conduct a concept analysis of perceived risk of developing diabetes.

Cognitive risk perception has been linked to health behavior changes (e.g. changes to diet and exercise), and lifestyle interventions that focus on diet and exercise have resulted in improved health outcomes in persons with prediabetes as evidenced in the Diabetes Prevention Program (DPP) (DPP Research Group, 2009; Sheeran, Harris, & Epton, 2014). Results from the DPP study include: 6% loss of weight in the DPP group compared to a loss of 2% in the control group ($p < 0.001$) at six months post-intervention; maintenance of their weight loss at 6% in the DPP group compared to only 1.8% weight loss in the control group ($p = 0.008$) at 12 months post-intervention; and a 58% reduced incidence of diabetes in 2.8 years, which was maintained at 34% after ten years in the DPP group. These findings indicate that these interventions can prevent or delay T2DM for at least ten years (DPP Research Group, 2009).

The Risk Perception Survey for Developing Diabetes (RPS-DD) was used in the DPP to measure perceived risk of developing diabetes with only one published abstract reporting minimal results for this outcome (Kramer, Walker, Miller, Siminerio, & Orchard, 2007). The RPS-DD is a multi-dimensional tool includes the following dimensions of risk perception for developing diabetes: personal control, affective dimension (i.e. worry), optimistic bias, personal risk perception, and comparative environmental risk perception (Walker, Mertz, Kalten, & Flynn, 2003). More participants who met their weight loss goal at three months had a high perceived diabetes risk compared to those who did not meet their goal (63% versus 28%, $p=.06$) (Kramer et al., 2007). Additionally, there was a positive correlation between personal control and meeting the weight loss goal after completion of the DPP program ($r=0.35$, $p<.05$) (Kramer et al., 2007) further supporting the importance of perceived diabetes risk research.

Methodology

The steps for concept analysis are to identify and/or create the: (1) concept; (2) purpose of analysis; (3) uses of the concept; (4) defining attributes; (5) model case; (6) other cases used to test the model case such as borderline, contrary, and related cases (6) antecedents; (7) consequences; and (8) empirical referents (Walker & Avant, 2011; Chinn & Kramer, 2015). A concept analysis is a challenging activity that requires insight from all angles of the concept to develop knowledge about the researcher's phenomenon of concern (i.e. how perceived risk may affect diabetes prevention efforts) (Walker & Avant, 2011). Dictionary definitions, thesaurus synonyms and antonyms, theoretical sources, and a few seminal works related generally to risk perception were reviewed to determine the uses and defining attributes of risk perception. Electronic searches were also conducted in PubMed, Embase, and Cumulative Index of Nursing

and Allied Health Literature (CINAHL) using the Medical Subject Headings (MeSH), Emtree terms, CINAHL headings, and key terms listed in Table 1. Inclusion criteria were studies conducted in the U.S. that measured perceived risk of developing diabetes. Excluded were articles pertaining to type 1 diabetes mellitus, published abstracts, and articles that neither defined risk perception nor included measures of the concept. No date limitations were set. The titles and abstracts were reviewed for 67 publications to determine eligibility for inclusion. The author reviewed 39 full-text publications and three additional publications found through scanning reference lists, with a final selection of 23 publications (including two publications from a single study).

INSERT TABLE 1 ABOUT HERE

Results

Identification of the Concept and Aim for Analysis

The identified concept for analysis is risk perception of developing diabetes. A recent systematic review of this concept concluded that there is a disconnect between actual and perceived diabetes risk and inconsistency of the measures used to calculate perceived diabetes risk among the studies (Nguyen et al., 2019). A previous meta-narrative of prediabetes supports the disconnect between actual and perceived diabetes risk in a population of persons with prediabetes (Barry, Greenhalgh, & Fahy, 2018). It is important to increase risk perception and knowledge to promote lifestyle changes that may prevent diabetes (Barry et al., 2018). The aim of this concept analysis is to explore perceived diabetes risk.

Uses of the Concept

The definition of risk is “something that that creates or suggests a hazard” (Risk, n.d., para 2). Synonyms for risk include danger, exposure, hazard, liability, peril, possibility, prospect, and uncertainty; antonyms for risk include certainty, safety, and security (Philip Lief Group, 2013b). The definition given for perception is awareness and sensations that result from experiences and observations (Perception, n.d.). Synonyms for perception include awareness, consciousness, feeling, impression, judgment, knowledge, opinion, sense, thought, and viewpoint; antonyms for perception include ignorance, unconsciousness, misconception, and misunderstanding (Philip Lief Group, 2013a).

Health risk perception has been defined as the “perception of the subjective likelihood of the occurrence of a negative event related to health for a person or group of people over a specified time period” (Menon, Raghubir, & Agrawal, n.d., p. 2). Risk perception in the context of employee health safety has been defined as “the ability of an individual to discern a certain amount of risk” (The Campbell Institute, n.d., p. 2). In public health, risk perception has been defined as “subjective perceptions of risk for developing a disease” (Amuta, Barry, & McKeyer, 2015, p. 787).

Defining Attributes

The defining attributes or dimensions of risk perception vary among the various theories and studies (Tables 2 and 3). As presented in the Health Belief Model, risk perception is comprised of perceived susceptibility and severity of the disease (Janz & Becker, 1984). Based on the Protection Motivation Theory, risk perception is comprised of perceptions of severity of the disease and vulnerability to the disease (Rogers, 1975). From the viewpoint of the Common-

Sense Model of Self-Regulation, risk perception is comprised of cognitive and emotional illness representations of the disease (Leventhal et al., 2016). The cognitive illness representation includes the individual's perception of the identity, cause, timeline, controllability, and consequences of the illness; the emotional illness representation includes feelings towards the illness (Leventhal et al., 2016). Risk perception is defined in the Health Action Process Approach (HAPA) Model as both the general perceptions and personal perceptions of risk (Schwarzer & Luszczynska, 2015). For example, there may be the general perception that prediabetes is an indicator of suboptimal health but there may not be the personal perception that the individual with prediabetes is at risk for developing diabetes. This personal risk may be measured as one's perceived risk over a specified time frame (e.g. throughout their lifetime), which refers to the absolute perceived risk (Persoskie et al., 2014).

Three dimensions of risk perception: perceived likelihood, perceived susceptibility, and perceived severity have been described by Brewer et al., (2007). An example of perceived likelihood is the perception that continuing to regularly eat excess calories will increase the likelihood of developing diabetes. An example of perceived susceptibility is the perception that the individual is more likely to develop diabetes compared to other people. An example of perceived severity is the perception that diabetes is a serious disease with many serious health complications.

Perceived likelihood, perceived susceptibility, and perceived severity are relatively more common terms used in theory to describe various dimensions of risk perception; however, there are many other terms used to describe other dimensions. Ferrer, Klein, Persoskie, Avishai-Yitshak, and Sheeran (2016) described three dimensions (experiential, deliberative, and

affective) of risk perception that are named according to how the perception is formed.

Experiential risk perceptions are a result of instinct or intuition (Ferrer et al., 2016). Deliberative risk perception is the result of systematically and logically deciding the likelihood of developing a disease like diabetes (Ferrer et al., 2016). Affective risk perception is the resulting emotions such as worry or anxiety about developing diabetes (Ferrer et al., 2016; Ferrer, Portnoy, & Klein, 2013).

Risk perception has been refined as specific only to the cognitive component of what they call a “risk appraisal” (Sheeran, Harris, & Epton, 2014) p. 511). While other references have defined perceived severity and affective risk perception as dimensions of risk perception, Sheeran et al. (2014) stated that perceived severity, anticipatory emotions of the risk of developing the disease, and anticipated emotions once the individual has the disease are conceptually distinct from risk perception and components of a risk appraisal. These authors identified the following dimensions of risk perception: general risk perception, personal risk perception, noncomparative risk perception, comparative risk perception, and conditional risk perception. General risk perception refers to knowledge of diabetes risk factors, and is a component of risk perception as identified in the HAPA Model. Personal risk perception is the other component of risk perception in the HAPA Model. However, the authors note there is not a clear distinction between personal risk perception and noncomparative risk perception. The concept of comparative risk perception is similar to perceived susceptibility as defined by Brewer et al. (2007). Conditional risk perception is similar to perceived likelihood as described by Brewer et al. (2007).

Despite the diverse description of risk perception, the common characteristic of risk perception from the discussed theories and research is that risk perception is multi-dimensional. Sheeran et al. (2014) offered one of the most comprehensive sources of identified dimensions or defining attributes for risk perception of developing diabetes with cognitive (deliberative or experiential perceptions) encompassing the dimensions of: general risk perception (perceived severity); personal risk perception (perceived susceptibility or vulnerability)- noncomparative versus comparative risk perception; and conditional risk perception (perceived likelihood). Although Sheeran et al. (2014) identified emotional representation or affective perception of risk as a separate component of a risk appraisal, this concept is an important dimension of risk perception in the Common Sense-Model of Self-Regulation (Schwarzer & Luszczynska, 2015) and Ferrer et al. (2016).

Additionally, Shepperd, Waters, Weinstein, and Klein (2015) highlighted another term referred to as “unrealistic optimism” (p. 232). Two types of unrealistic optimism are: (1) “unrealistic comparative optimism” (Shepperd et al., 2015, p. 233) which refers to the belief that the individual’s personal risk of developing diabetes is lower than that of their peers and (2) “unrealistic absolute optimism” (p. 232) which refers to lower risk perceptions than would be expected compared to some objective standard (e.g. family history of diabetes). Unrealistic comparative optimism is no more than what Sheeran et al. (2014) referred to as the comparative risk perception. Unrealistic absolute optimism refers to an optimistic bias. For example, while comparative risk perception reflects the perceptions of diabetes risk as compared to other people, optimistic bias reflects the decreased perceptions of diabetes risk as compared to some known factor that increases actual risk (i.e. obesity) (Shepperd et al., 2015).

Most publications reviewed for risk perception of developing diabetes did not provide a formal definition for risk perception or reference any theories (Table 3). Studies providing meager definitions for perceived diabetes risk used terminology previously presented in other uses of risk perception but added descriptions of attitudes or beliefs towards diabetes, a ‘mental model’ (Pinelli, Berlie, Slaughter, & Jaber, 2009) or self-assessed diabetes risk (Cho et al., 2012; Hariri, Yoon, Qureshi, Valdez, Scheuner, & Khoury, 2006; Johnson, Manjunath, Mansfield, Clayton, Hoerger, & Zhang, 2006; Rosal, Borg, Bodenloss, Tellez, & Ockene, 2011; Seaborn et al., 2016; Shaak et al., 2018; Wu et al., 2017; Zera, Nickals, Levkoff, & Seely, 2013). Only one study provided a robust definition of risk perception as “a complex term with multiple dimensions” (Walker et al., 2003, p. 2543) including the vulnerability to (probability of) diabetes, severity of diabetes, level of personal control, comparative risk perceptions of other diseases and environmental factors. Studies referring to theories cited all theories discussed previously, with the addition of the Risk Perception Attitude Framework and Theory of Planned Behavior (Cho et al., 2012; Jones, Appel, Eaves, Moneybam, Oster, & Ovalle, 2012; Seaborn et al., 2016; Simonds, Ominpanah, & Buchwald, 2017; Wu et al., 2017).

INSERT TABLES 2 AND 3 ABOUT HERE

Empirical Referents

While reviewing empirical referents is typically the last step of a concept analysis, the terms optimistic bias and personal control have appeared as constructs in three of the articles reviewed, that are conceptually similar to self-efficacy and modifiers of risk perception (Jones et al., 2012; Kim et al., 2007; Seaborn et al., 2016). These concepts need to be clarified prior to moving on developing the model case. To determine if optimistic bias is truly a dimension of

risk perception as suggested by both Sheeran et al. (2014) and Walker et al. (2003), a definition of the term is needed. Optimistic bias was defined as “one’s assessment of their [diabetes] risk compared with others like them” (Kim et al., 2007, p. 2281) in one study. Based on this definition, Kim et al. (2007) were using the term “optimistic bias” (p. 2281) in lieu of “comparative risk” perception as defined by Sheeran et al. (2014, p. 524). Understanding the varying terminology, the use of optimistic bias in this case is clearly a dimension of, rather than a modifier for risk perception of developing diabetes.

Perceived personal control was defined as “the degree to which one believes that risk is modified by one’s actions” (Kim et al., 2007, p. 2281). The concept of self-efficacy was further explored to determine if personal control is truly a dimension of risk perception as suggested by both Sheeran et al. (2014) and Walker et al. (2003). Self-efficacy was defined as an individual’s “perceived ability to behave in such a manner to exert a desired effect” (Jones et al., 2012, p. 247). The self-efficacy construct was first introduced in the Social Cognitive Theory to explain and predict behavioral change (Bandura, 1977; Bandura, 1994). The sources of self-efficacy are: mastery (self-success) experiences, vicarious (seeing success by social models) experiences, social persuasion, and a combination of decreased individual stress reactions and improved negative emotional inclinations or corrected misinterpretations of their physical conditions (emotional arousal) (Bandura, 1977; Bandura, 1994). While there is a close relationship between personal control and self-efficacy when reviewing the definitions of the two terms, it is important to examine how personal control has been operationalized and measured.

The only specific sources of measures for personal control are through the *Brief Illness Perception Questionnaire* (IPQ) and the RPS-DD (as used in the Kramer et al., 2007,

publication). One study with two publications used the Brief IPQ, which included one question regarding personal control asking the level of control an individual feels they have over their illness (Broadbent, Petrie, Main, & Weinman, 2006; Cho et al., 2012; Wu et al., 2017). The RPS-DD was the most commonly used tool to measure risk perception (Brown, Grijalva, & Ferrera, 2017; Joiner, Sternberg, Kennedy, Fukuoka, Chen, & Janson, 2016; Pinelli et al., 2009; Pinelli, Herman, Brown, & Jaber, 2010). Four questions of the RPS-DD are used to measure personal control, asking about the perceived control over risks to general health, perceived control over diabetes risk, perceived effectiveness of personal efforts to prevent diabetes, and general thoughts on whether people who try to control their diabetes risk are less likely to develop diabetes (Walker, 2009). None of the measures for personal control ask about the individual's perceived ability to perform the skills necessary to prevent diabetes, which leads to the conclusion that personal control is a distinct construct from self-efficacy. Additionally, based on the questions from both the Brief IPQ and the RPS-DD used to measure personal control, this construct is the same as the conditional risk dimension or perceived likelihood as defined previously by Sheeran et al. (2014) and Brewer et al. (2007).

Other methods used to study risk perception of developing diabetes include singular questions using Likert scales in cross-sectional, prospective, and longitudinal studies. There have also been a number of qualitative and mixed methods studies using open-ended questions. The most commonly addressed dimension of risk perception was personal risk- measured in 20 studies (Table 3).

Model Case

The purpose of developing a model case is to provide an example containing all the concept's defining attributes (Walker and Avant, 2011). Risk perception is the perceived likelihood, susceptibility, and severity of illness or disease for the individual. Using myself as an example, risk perception of developing diabetes includes the belief that if I do not improve my diet and exercise regimen, I will have a high risk of developing diabetes in the future (perceived likelihood or conditional risk). As I am getting older, I believe that my risk of developing diabetes is moderately high (personal risk or noncomparative risk). With my family history of diabetes, I think that I am more likely to develop diabetes compared to other people my age (perceived susceptibility or comparative risk). Despite this higher diabetes based on my family history, I believe that my overall diabetes risk right now is low because my body mass index (BMI) is 23.5 kg/m^2 without acknowledging that Vietnamese Americans are at higher risk of developing T2DM even at a lower BMI (optimistic bias) (Karter et al., 2014). I understand that diabetes can lead to many acute and chronic complications, including death (perceived severity and general risk). I also understand that with my diagnosis of prediabetes that there are already health implications such as increased cardiovascular risk (perceived severity and personal risk). All of those factors demonstrate the cognitive dimensions of my perceived risk; some of which were derived experientially but most of which were derived deliberately through discussing my condition with my health care providers and exploring the literature. I find myself worrying about my diabetes risk a few times a week (affective dimension).

Borderline Case

The construction of a borderline case allows readers to make subtle distinguishing judgements on the defining attributes of risk perception of developing diabetes (Walker and Avant, 2011). The borderline case presents Jane, a middle-aged female who has history of gestational diabetes and understands that history of gestational diabetes is a risk factor for T2DM (knowledge and general risk perception). Despite this knowledge, Jane does not believe that she is at risk for developing diabetes (optimistic bias). This borderline case demonstrates general risk perception and optimistic bias. However, it is borderline case in that this individual does not actually perceive the risk of diabetes in the future and as such does not make any lifestyle changes or do any routine screening.

Related Case

Related cases are developed with similar attributes to the risk perception of developing diabetes, but the concepts behind them are actually different (Walker & Avant, 2011). The constructed case presents Joe who is 50 years old and recently diagnosed with prediabetes, hypertension, and dyslipidemia. The health care provider provides education about risks for heart attack, stroke, and diabetes. Joe is extremely worried about his risk for heart attack and stroke (affective dimension regarding perceived risk of other diseases). With his family history of heart disease, he believes that his risk of suffering from a heart attack in the future is not only high but that the risk is even higher than most people his age (personal risk perception of other disease-noncomparative and comparative). Joe is so preoccupied with his risk for heart attack and stroke that he ignores his risk of developing diabetes.

The health care provider also educates Joe regarding self-management of his conditions to prevent complications- including necessary medications and lifestyle modifications. Joe verbalizes understanding and states that he believes the prescribed medications and lifestyle modifications will significantly reduce his risk of heart attack and stroke (conditional risk perception or increased level of personal control related to another disease). However, he is unsure how to read food labels and does not know how he can incorporate exercise into her already busy schedule (lack of self-efficacy).

While this case has many defining attributes of the concept risk perception, this risk perception is not actually related to the risk of developing diabetes. This person is mainly concerned with his diagnosis of hypertension and dyslipidemia, and he is only concerned with his risk for heart attack and stroke. Finally, while the conditional risk perception or level of personal control over the disease is present, he currently lacks the self-efficacy in order to perform the necessary skills. This constructed case is related to the risk perception of developing diabetes but does not portray actual risk perception of developing diabetes despite the actual risk being present.

Contrary Case

A pre-nursing student is in her early twenties with a mass index (BMI) within normal limits. She eats a well-balanced diet and exercises regularly. There is no family history of diabetes. She has no risk factors for developing diabetes. She has not yet learned anything about T2DM. With this lack of knowledge and awareness of the disorder, she has no perceived risk (including cognitive or affective dimensions) of diabetes nor actual risk for developing diabetes at this time.

Antecedents and Consequences

Antecedents are factors that come before and must exist prior to risk perception of developing diabetes (Walker and Avant, 2011). Knowledge and experience must exist prior to the formation of deliberative and experiential risk perceptions (Ferrer et al., 2016). Some other antecedents of risk perception for developing diabetes are motivational, cognitive, affective, contextual, and individual differences (Menon, Raghubir, & Agrawal, n.d.; The Campbell Institute, n.d.). Motivational factors may include an individual's general needs for social desirability or self-control, such as making adopting a healthy lifestyle due to the person's sense of social desirability from the healthcare provider's viewpoint (Menon et al., n.d.). The cognitive and affective ability must be present before the cognitive and affective dimensions can form. For example, an individual who has severe mental disability may be unable to process the information received regarding diabetes risk and is therefore unable to develop any perceptions of that risk. Contextual factors may include response alternatives, framing of the situation, and proxy information (Menon et al., n.d.). Individual differences may include differences due to gender, personality, or culture (Menon et al., n.d.).

Consequences are the outcomes of the risk perception of developing diabetes (Avant & Walker, 2011). Health-promoting behaviors result from risk perception in theories such as the Health Belief Model, Protection Motivation Theory, Common-Sense Model of Self-Regulation, and Health Action Process Approach (HAPA) Model (Conner & Norman, 2015; Janz & Becker, 1984; Leventhal, Phillips, & Burns, 2016; Rogers, 1975). The consequences of health risk perception are its direct or indirect effect on behaviors and/or intention for behaviors (Brewer, et

al., 2007; Menon, Raghurir, & Agrawal, n.d.). These health-promoting behaviors may prevent or delay the onset of T2DM as seen in the DPP (DPP Research Group, 2009).

Upon further examination of the model case, antecedents of my health risk perception include my desire to have others view me as responsible (motivational factor), Vietnamese cultural influences (individual difference), and how these responses are elicited from me (contextual factor). The presence of my cognitive and affective abilities leads to my frequent awareness of my health risk (cognitive factor) and my generally positive outlook (affective factor). The consequences of my health risk perception are its direct and indirect effects on my behaviors and intention for behaviors. I am moderately motivated to make the necessary lifestyle changes and intend to incorporate more exercise in my everyday routine to delay the onset of T2DM for at least another five years.

Conclusion

An analysis of the concept of risk perception of developing diabetes, increases clarity of this multi-dimensional concept and optimal ways to ensure sufficient measurement of the concept. Two randomized control trials in a recent systematic review for perceived diabetes risk found that the diabetic counseling did not have any effects on changing the level of perceived diabetes risk (Nguyen et al., 2019; Wu et al., 2015; Wu et al., 2017). However, one study only used two items to measure the dimension of personal risk perception (Voils et al., 2015) and the other study used two items to measure the dimension of personal risk perception and six items from the IPQ to measure perceived control (Wu et al., 2017). While it is important to test for reliability or consistency of a measure, it is also pertinent to check the measure's validity for its ability to assess the construct of interest (Kazdin, 2017). Perhaps the outcome of the

interventional studies would show a positive effect had more comprehensive measures of risk perception been used.

The results of this concept analysis may assist clinicians and researchers in understanding risk perception of developing diabetes and the antecedents of this concept. As presented in the borderline and related cases, increasing knowledge alone may not be sufficient to raise perceived diabetes risk and elicit desired health behaviors and outcomes. Because there were more persons with high perceived diabetes risk who met their weight loss goal in the DPP, it will be important to find strategies to increase the level of perceived diabetes risk for increased achievement of health-promotion goals (Kramer et al., 2007). Understanding perceived diabetes risk is an important step in decreasing diabetes disparity.

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Table 1. Strategy for Database Searches

Database	Search Terms
PubMed	((("Prediabetic State"[Mesh]) OR ("Diabetes Mellitus, Type 2/prevention and control"[Mesh]) OR "diabetes prevention")) AND ("risk perception" or "perceived risk")
Embase	((“risk perception” OR “perceived risk”) AND (“impaired glucose tolerance”/exp OR “diabetes prevention”))
CINAHL	((MH "Diabetes Mellitus, Type 2/PC") OR (MH "Prediabetic State")) AND (MH "Attitude to Risk"))

Table 2. Dimensions of Risk Perception from Theoretical Sources and Seminal Risk Perception Literature

Dimension of Risk Perception	HBM (Janz & Becker, 1984)	PMT (Rogers, 1975)	CSM (Leventhal et al., 2016)	HAPA (Schwarzer & Luszczynska, 2015)	Brewer et al. (2007)	Ferrer et al. (2016)	Sheeran et al. (2014)	Shepperd et al. (2015)
Perceived Likelihood, Conditional Risk, or Personal Control					X		X	
Personal Risk (Perceived Susceptibility or Vulnerability) or Noncomparative Risk	X	X		X	X		X	
General Risk or Perceived Severity	X	X		X	X		X*	
Cognitive- Deliberative or Experiential Perceptions			X			X		
Emotional or Affective Perception			X			X	X*	
Comparative Risk							X	
Unrealistic Optimism- absolute (optimistic bias) versus comparative								X

Note. HBM= Health Belief Model; PMT= Protection Motivation Theory; CSM= Common Sense Model of Self-Regulation; HAPA= Health Action Process Model; X= this concept is identified by the source as a dimension of risk perception; *= this concept is identified as a separate dimension of risk appraisal rather than as a dimension of risk perception by this source

Table 3. Measures for Risk Perception of Developing Diabetes in the Literature

Studies	Definition of PR and/or Theories Referenced	Dimension(s) of PR Measured (Number of Items to Measure)
Brown, Grijalva, and Ferrara (2017)	No formal definition and no theoretical references were made.	- Personal Risk (1 item) - Personal Control (4 items from the RPS-DD)
Cho et al. (2012) and Wu et al. (2017)	Using the Common Sense Model (CSM), PR is defined as both cognitive and emotional representations of the disease.	- Affective Dimension (items from the Consequences subscale of the Brief IPQ) ¹ - Perceived Control (6 items from the Brief IPQ) - Personal Risk (2 items)
Cullen and Buzek (2009)	No formal definition and no theoretical references were made.	- Personal risk ²
Dorman et al. (2012)	No formal definition. References to the Health Belief Model (HBM) and the Theory of Planned Behavior (TPB) that PR is adaptable and the basis for health behaviors.	- Affective Dimension (1 item) - Comparative Risk (1 item) - General Risk (1 item) - Perceived Control (1 item)
Hariri, Yoon, Qureshi, Valdez, Scheuner, and Khoury (2006)	PR are attitudes towards diabetes. No theoretical references were made.	- General Risk (including Disease Severity) ¹ - Personal Risk ¹
Johnson, Manjunath, Mansfield, Clayton, Hoerger, and Zhang (2006)	PR is a self-assessed diabetes risk. No theoretical references were made.	- Personal Risk (2 items)

Studies	Definition of PR and/or Theories Referenced	Dimension(s) of PR Measured (Number of Items to Measure)
Joiner, Sternberg, Kennedy, Fukuoka, Chen, and Janson (2016)	No formal definition and no theoretical references were made.	Spanish-translated RPS-DD: <ul style="list-style-type: none"> - Comparative Environmental Risk¹ - Comparative Personal Disease Risk¹ - Optimistic Bias¹ - Personal Control¹ - Affective Dimension (Worry)¹
Jones, Appel, Eaves, Moneyham, Oster, and Ovalle (2012)	No formal definition. Reference to the Risk Perception Attitude (RPA) framework that PR is a motivator affecting health behavior.	<ul style="list-style-type: none"> - Conditional Risk and Personal Control (5 items) - Personal Risk (1 item) - Optimistic Bias (2 items)
Kemple, Zlot, and Leman (2005)	No formal definition and no theoretical references were made.	<ul style="list-style-type: none"> - Affective Dimension¹
Kim, McEwen, Piette, Goewey, Ferrara, and Walker (2007)	No formal definition and no theoretical references were made.	<ul style="list-style-type: none"> - Personal Risk (1 item) - Conditional Risk (1 item) - RPS-DD subscales¹: optimistic bias, personal control, knowledge, and beliefs of benefits and barriers to lifestyle modification
Kullgren, Knaus, Jenkins, and Heisler (2016)	No formal definition and no theoretical references were made.	<ul style="list-style-type: none"> - Affection Dimension² - Personal Risk (1 item)
Markowitz, Park, Delahanty,	No formal definition and no theoretical references were made.	<ul style="list-style-type: none"> - Affective Dimension² - Personal Control²

Studies	Definition of PR and/or Theories Referenced	Dimension(s) of PR Measured (Number of Items to Measure)
O'Brien, and Grant (2011)		- Personal Risk ²
Pinelli, Berlie, Slaughter, and Jaber (2009)	PR is a "part of an individual's beliefs or 'mental model'" (Pinelli et al., 2009, p. 1051) that is based upon many factors including culture, previous experiences, and possibly even misconceptions.	RPS-DD: - Comparative Disease Risk (14 items) - Comparative Environmental Risk (9 items) - Optimistic Bias ¹ - Personal Control ¹ - Affective Dimension (Worry) ¹
Pinelli, Herman, Brown, and Jaber (2010)	No formal definition and no theoretical references were made.	RPS-DD: - Comparative Disease Risk ¹ - Comparative Environmental Risk ¹ - Optimistic Bias ¹ - Personal Control ¹ - Affective Dimension (Worry) ¹
Rosal, Borg, Bodenlos, Tellez, and Ockene (2011)	Risk perception is a judgement of risk which includes the severity and likelihood of negative health resulting from disease, factors, and methods that improve susceptibility. No theoretical references were made.	- Conditional Risk ² - Personal Risk ²
Seaborn et al. (2016)	Reference to the TPB without formal definition for risk perception. Attitudes and beliefs	- Conditional Risk (3 items) - Perceived Control (3 items)

Studies	Definition of PR and/or Theories Referenced	Dimension(s) of PR Measured (Number of Items to Measure)
	that the behavior has specific results are similar to the conditional risk dimension. Perceived control is a separate concept.	
Shaak et al. (2018)	Risk perceptions are part of the health beliefs. No theoretical references were made.	<ul style="list-style-type: none"> - Affective Dimension (Worry) (2 items) - Comparative Risk (Optimistic Bias) (2 items) - Perceived Control (Personal Control) (4 items)
Simonds, Omidpanah, and Buchwald (2017)	Reference to the RPA framework which states that the combination of levels for risk perception and self-efficacy have effects on behavior. No formal definition made.	<ul style="list-style-type: none"> - Personal Risk (2 items)
Voils et al. (2015)	No formal definition and no theoretical references were made.	<ul style="list-style-type: none"> - Personal Risk (2 items)
Walker, Mertz, Kalten, and Flynn (2003)	Risk perception is “a complex term with multiple dimensions” (Walker et al., 2003, p. 2543) including the vulnerability to (probability of) a disease, severity of a disease, level of personal control, comparative risk perceptions of other disease and environmental factors. No theoretical references were made.	<ul style="list-style-type: none"> RPS-DD survey (53 items) - Comparative Disease Risk (15 items) - Comparative Environmental Risk (15 items) - Optimistic Bias (2 items) - Personal Control (4 items) - Diabetes Knowledge (11 items)

Studies	Definition of PR and/or Theories Referenced	Dimension(s) of PR Measured (Number of Items to Measure)
Yang, Baniak, Imes, Choi, and Chasens (2018)	No formal definition and no theoretical references were made.	- Personal Risk (1 item)
Zera, Nickals, Levkoff, and Seely (2013)	Risk perceptions is the “degree of perceived vulnerability to a particular disease state” (Zera et al., 2013, p. 691). No theoretical references were made.	RPS-DD survey (11 items) - Conditional Risk or Personal Control ¹ - Personal Risk ¹ - Optimistic Bias ¹

Note. ¹= number of item(s) not specified in publication; ²= open-ended question(s); CSM= Common Sense Model; HBM= Health Belief Model; IPQ= Illness Perception Questionnaire; RPA= Risk Perception Attitude; RPS-DD= Risk Perception Survey- Developing Diabetes; T2DM= type 2 diabetes mellitus; TPB= Theory of Planned Behavior

APPENDIX B:

MANUSCRIPT #2: SYSTEMATIC REVIEW: PERCEIVED RISK OF DEVELOPING

DIABETES IN THE GENERAL POPULATION AND ASIAN AMERICANS

(Authored by A. P. Nguyen, L. Loescher, and M. McEwen and in review for *Journal of
Transcultural Nursing*)

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March 4, 2019

Norma Graciela Cuellar, PhD, RN, FAAN
Editor-in-Chief
Journal of Transcultural Nursing

Dear Dr. Cuellar,

I am pleased to submit an original research article entitled “Systematic Review: Perceived Risk of Developing Diabetes in the General Population and Asian Americans” by Angelina Nguyen, Lois Loescher, and Marylyn McEwen for consideration for publication in the *Journal of Transcultural Nursing*. Key findings of this systematic review were: (1) inconsistency in measures for calculating perceived diabetes risk; (2) overall low level of perceived diabetes risk, including noncomparative (short-term and lifetime) risk and comparative risk; (3) low percentage of persons in the general population with moderate to high perceived diabetes risk; (4) no interventions that have effectively altered perceived diabetes risk (5) no reports for perceived risk of diabetes in persons with prediabetes; (6) lack of congruency between actual and perceived diabetes risk in the general population; and (7) subgroups including Asian Americans were limited.

We believe that this manuscript is appropriate for publication by the *Journal of Transcultural Nursing* because it promotes culturally congruent health care delivery, especially with considerations for diabetes prevention efforts in Asian Americans. Being informed of a prediabetes diagnosis increased the likelihood of reporting perceived diabetes risk, suggesting that discussions of risk with patients in the clinical setting or as part of diabetes prevention interventions may decrease the gap between actual and perceived risk of diabetes. The decreased congruency between actual and perceived diabetes risk in Asian Americans as well as the increased prevalence of prediabetes/diabetes, further underscores the importance of the provider discussing diabetes risk when applicable in this population.

This manuscript has not been published and is not under consideration for publication elsewhere. We have no conflicts of interest to disclose. We would also like to suggest Drs. Eun-Ok Im and Leilani Siaki as potential reviewers of this manuscript.

Thank you for your consideration!

Sincerely,

Angelina Phuong-Uyen Nguyen, MSN, RN, CNE
PhD Candidate, The University of Arizona College of Nursing

Abstract

Introduction: The purpose of this systematic review was to explore the perceived diabetes risk with foci on prediabetic persons and Asian-Americans. Theory and research support the need to further explore perceived risk of diabetes to inform future diabetes prevention.

Methodology: The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guided this systematic review. Electronic searches were conducted in PubMed, Embase, and Cumulative Index of Nursing and Allied Health Literature (CINAHL). The authors conducted eligibility determination, data extraction, synthesis, and evaluation. Twelve articles were selected.

Results: Key findings include: (1) a low percentage of persons in the general population with moderate to high levels of perceived diabetes risk, (2) a lack of congruency between actual and perceived diabetes risk in the general population, and (3) no interventions effectively changing the level of perceived diabetes risk.

Discussion: More studies regarding perceived diabetes risk are needed, especially with a focus on Asian-Americans.

Background

Eighty-four million adults have prediabetes, a metabolic condition that significantly increases risk for developing type 2 diabetes mellitus (T2DM) within 5 years, with concomitant risk for developing heart disease and stroke (Centers for Disease Control and Prevention [CDC], 2016; CDC, 2019). Prevention of diabetes is a critical public health priority. The U.S. Diabetes Prevention Program (DPP) demonstrated the effectiveness of resource-intensive lifestyle interventions that target daily physical activity and modest weight loss, which in turn can decrease the rate of developing T2DM in half (Knowler, Barret-Connor, Fowler, Hamman, Lachin, & Walker, 2002).

Racial and ethnic minority populations are disproportionately affected by prediabetes and diabetes (Chow, Foster, Gonzalez, & McIver, 2012). Asian Americans have higher prevalence rates of diabetes (10.3%) and prediabetes (35.7%) than non-Hispanic whites (NHW) (7.3% and 31.5%, respectively) (CDC, 2017). Risk factors for diabetes in Asian Americans include increased body mass index (BMI) at lower thresholds than the general population; increased central adiposity (waist circumference); and foreign-born living in the U.S. for more than 10 years (Shih, Du, Lightstone, Simon, & Wang, 2014; Stewart, Dang, & Chen, 2016). Little is known about the perceived risk of developing diabetes. This systematic review focuses on perceived risk of developing diabetes among the general population, with foci on Asian Americans and persons with prediabetes.

Risk perception is a multi-dimensional concept that is an antecedent of health-promoting behaviors in many health behavior change theories (Conner & Norman, 2015; Janz & Becker, 1984; Rogers, 1975). The conceptual definition of risk perception for this systematic review

includes both thoughts and feelings related to general and personal perspectives of risk (Table 1 for defined dimensions of risk perception). Alterations of perceived risk through psychological, social, and cultural processes may affect behavior change (Young, 2004). This effect is supported by two meta-analyses. One meta-analysis of over 200 randomized controlled trials (RCTs) showed small effects of the cognitive dimension of risk perception on behavioral intention ($d= 0.36$) and behavior ($d=0.25$) (Sheeran et al., 2014). Another meta-analysis of prospective and cross-sectional studies supported the relationship of perceived noncomparative, comparative, and general risk on vaccination behavior (pooled correlations all significant at $p < .001$) (Brewer et al., 2007). Although there is only a small-to-moderate pooled correlation between risk perception and health behavior, Brewer et al. (2007) noted larger effects in longitudinal versus cross-sectional studies that indicate a potentially higher correlation between risk perception and health behavior.

[INSERT TABLE 1 ABOUT HERE]

The purpose of this systematic review was to explore the perceived risk of diabetes in persons in the U.S., with secondary foci on persons with prediabetes and the Asian American population. The research questions were:

1. What is the actual risk for diabetes?
2. How is perceived risk of diabetes measured?
3. What is the perceived risk of diabetes in persons with prediabetes or established diabetes risk factors?
4. Is there congruency between perceived risk and actual risk of diabetes?
5. What factors are associated with perceived risk of diabetes?
6. Have interventions effectively changed perceived risk of diabetes?

Methodology

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guided this systematic review (Moher, Liberati, Tetzlaff, Altman, & The Prisma Group, 2009). Article retrieval and eligibility determination, data extraction, synthesis, and evaluation occurred from February 2018 to December 2018. Eligibility determination, data extraction, synthesis, and evaluation were conducted by the authors.

Electronic searches were conducted in PubMed, Embase, and Cumulative Index of Nursing and Allied Health Literature (CINAHL) using Medical Subject Headings (MeSH), Emtree terms, CINAHL headings, and key terms listed in Table 2. The main categories of key terms were: diabetes prevention, risk perception, and Asian Americans. A combination of all categories yielded only one publication, therefore two separate searches were conducted using only two categories of terms in each search. The limit for each search was literature published from 2012 to 2018 to maintain currency and relevance of findings.

[INSERT TABLE 2 ABOUT HERE]

Eligible for this review were primary research articles that were: (1) conducted in the U.S., (2) focused on adults with prediabetes or impaired glucose tolerance, and (3) included information on perceived risk of diabetes. Excluded were abstracts, editorials, position statements, protocol papers without findings, literature reviews, and articles specifying gestational diabetes or risk perception associated with non-health-promoting behaviors for T2DM (e.g. effect of risk perception on genetic testing). Database searching yielded 196 results with five additional resources from a Google Scholar search and reviewing reference lists of selected articles (Figure 1). After removing duplicates, the authors reviewed 166 article titles

and/or abstracts for potentially relevant articles, then reviewed 68 full-text publications, selecting 12 for data extraction.

The authors independently extracted data items from the 12 articles that addressed the research questions and PRISMA checklist. Measures of actual diabetes risk were examined for calculated risk when available, and for actual risk factors (BMI, hemoglobin A1C, and family history of diabetes). Data were extracted for levels and measures of perceived risk and for factors correlated with levels of perceived diabetes risk. The authors met weekly to discuss new data extraction and reached consensus on the results (Tables 3 and 4).

[INSERT FIGURE 1 AND TABLES 3 AND 4 ABOUT HERE]

Synthesis of Results

The 12 studies incorporated a variety of designs (Table 3). There were eleven quantitative studies and one mixed-method study (Kullgren, Knaus, Jenkins, & Heisler, 2016). There were three RCTs (Dorman et al., 2012; Voils et al., 2015; Wu et al., 2017), and eight cross-sectional descriptive studies (Fukuoka, Choi, Bender, Gonzalez, & Arai, 2015; Joiner, Sternberg, Kennedy, Chen, et al., 2016; Joiner, Sternberg, Kennedy, Fukuoka, et al., 2016; Piccinino, Griffey, Gallivan, Lotenberg, & Tuncer, 2015; Seaborn et al., 2016; Shaak et al., 2016; Simonds, Omidpanah, & Buchwald, 2017; Yang, Baniak, Imes, Choi, & Chasens, 2018).

Most studies reporting a sample with diverse racial and ethnic backgrounds had samples that were predominantly NHW (between 58% and 89%) (Dorman et al., 2012; Kullgren et al., 2016; Wu et al., 2017; Yang et al., 2018). Four studies had samples of one racial or ethnic background- none of which were Asian (Joiner, Sternberg, Kennedy, Chen, et al., 2016; Joiner, Sternberg, Kennedy, Fukuoka, et al., 2016; Seaborn et al., 2016; Simonds et al., 2017). Asian

participants comprised approximately 5% of the sample of two studies (Wu et al., 2017; Yang et al., 2018) and over 50% of another study (Fukuoka et al., 2015).

Studies also varied according to mean age and gender of participants. Mean ages reported ranged from 39.5 to 50.9 years (Fukuoka et al., 2015; Joiner, Sternberg, Kennedy, Chen, et al., 2016; Joiner, Sternberg, Kennedy, Fukuoka, et al., 2016; Kullgren et al., 2016; Simonds et al., 2017; Voils et al., 2015; Wu et al., 2017). Most studies reporting gender had samples comprised of approximately 70% -84% females (Dorman et al., 2012; Fukuoka et al., 2015; Joiner, Sternberg, Kennedy, Chen, et al., 2016; Joiner, Sternberg, Kennedy, Fukuoka, et al., 2016; Kullgren et al., 2016; Seaborn et al., 2016; Shaak et al., 2016; Simonds et al., 2017). Yang et al. (2018) had a fairly gender-balanced sample and another study (Voils et al., 2015) had a predominantly male sample (80%).

Actual Risk

Measures used to assess actual diabetes risk were inconsistent. In six studies, the authors based actual risk on a scored tool (Dorman et al., 2012; Fukuoka et al., 2015; Joiner, Sternberg, Kennedy, Fukuoka, et al., 2016; Seaborn et al., 2016; Simonds et al., 2017; Voils et al., 2015). The most common tool was the American Diabetes Association (ADA) Diabetes Risk Test; 23.3% to 29.4% of scores indicated an increased actual risk for T2DM (Joiner, Sternberg, Kennedy, Fukuoka, et al., 2016; Seaborn et al., 2016). One study used a modified version of the ADA Risk Test (no results reported) (Fukuoka et al., 2015). Other tools were the Family Healthcare Risk algorithm (Dorman et al., 2012), an unspecified algorithm (Voils et al., 2015), and a “validated objective risk score” (Simonds et al., 2017, p. 4). Of the six studies that did not report using a specific tool to assess actual diabetes risk, two had samples diagnosed with

prediabetes (Kullgren et al., 2016; Shaak et al., 2016). Assessment of prediabetes included A1C levels, noting mild hyperglycemia (A1C 5.7% to 6.0%) and intermediate hyperglycemia (A1C 6.1% to 6.4%) as risk factors (Shaak et al., 2016), or A1C levels noting prediabetes (Joiner, Sternberg, Kennedy, Chen, et al., 2016; Yang et al., 2018).

Other risk factors reported were BMI and family history of diabetes. Eight studies reported proportions of BMI greater than or equal to 25 kg/m² in the majority (59.5%) if not all participants (Dorman et al., 2012; Joiner, Sternberg, Kennedy, Chen, et al., 2016; Seaborn et al., 2016; Shaak et al., 2016; Simonds et al., 2017; Voils et al., 2015; Yang et al., 2018) or mean BMI between 25.5 and 30.9 kg/m² (Fukuoka et al., 2015; Wu et al., 2017). One study reported on a subsample for which 52.7% had a BMI greater than or equal to 25 kg/m² (Piccinino et al., 2015). Family history of diabetes as a risk factor was variable with less than half (Fukuoka et al., 2015; Seaborn et al., 2016) versus more than half of participants reporting this risk factor (Voils et al., 2015; Wu et al., 2017). One study differentiated between any family history of diabetes (27.7 %) versus immediate family members having diabetes (32.9 %) (Piccinino et al., 2015).

Measures of Perceived Risk

The translated Spanish version of the *Risk Perception Survey- Developing Diabetes* (RPS-DD), a reliable and validated tool (Cronbach alphas ranged from .54 to .88) (Joiner, Sternberg, Kennedy, Chen, et al., 2016; Joiner, Sternberg, Kennedy, Fukuoka, et al., 2016), was used in several studies and one study used other investigator-generated questions (Shaak et al., 2016). Both versions of the RPS-DD (original and translated Spanish) consists of 43 items with a diabetes risk knowledge test and five subscales that examine the concepts of personal control (measures conditional risk), worry (affective dimension of risk perception), optimistic bias,

personal disease risk, and comparative environment risk (measures general risk) scored on a 4-point Likert scale (Walker et al., 2002; Joiner, Sternberg, Kennedy, Chen, et al., 2016). However, only two studies used the complete RPS-DD to measure perceived risk (Joiner, Sternberg, Kennedy, Chen, et al., 2016; Joiner, Sternberg, Kennedy, Fukuoka, et al., 2016). These studies used the translated Spanish version of the *Risk Perception Survey- Developing Diabetes* (RPS-DD), which is a reliable and validated tool (Cronbach alphas ranged from .54 to .88) (Joiner, Sternberg, Kennedy, Chen, et al., 2016; Joiner, Sternberg, Kennedy, Fukuoka, et al., 2016). Other studies used four of the RPS-DD subscales or between one to ten items to measure perceived diabetes risk (Dorman et al., 2012; Fukuoka et al., 2015; Kullgren et al., 2016; Piccinino et al., 2015; Seaborn et al., 2016; Voils et al., 2015; Wu et al., 2017; Yang et al., 2018).

Levels of Perceived Risk

Perceived diabetes risk in the general population. In samples from the general population (i.e. diabetes risk or having prediabetes was not specified), less than one third of the samples indicated a moderate or high perceived risk of developing diabetes (Joiner, Sternberg, Kennedy, Fukuoka, et al., 2016; Piccinino et al., 2015; Voils et al., 2015; Yang et al., 2018). Only one study reported data from the Asian subsample; a perceived diabetes risk level that was comparable to the mixed samples in other studies (Yang et al., 2018).

A lower percentage of persons in the general population reported moderate to high perceived diabetes risk; additionally, mean scores for both one-year and lifetime perceived diabetes risk were low in two studies (Simonds et al., 2017; Voils et al., 2015) and more than half of the sample believed they had a lower diabetes risk compared to persons with similar age and gender (Fukuoka et al., 2015). However, three studies reported low scores for the optimistic

bias subscales from the RPS-DD (Joiner, Sternberg, Kennedy, Chen, et al., 2016; Joiner, Sternberg, Kennedy, Fukuoka, et al., 2016; Shaak et al., 2016). Only one study reported a mean score indicating average to moderately high levels of perceived diabetes risk and perceived a high severity of diabetes (Dorman et al., 2012). One study reported that more than half of the sample perceived their diabetes risk to be serious (Wu et al., 2017). Three studies reported higher levels for worry about developing diabetes (Joiner, Sternberg, Kennedy, Chen, et al., 2016; Joiner, Sternberg, Kennedy, Fukuoka, et al., 2016; Shaak et al., 2016) with one study reporting low levels of worry about developing diabetes (Dorman et al., 2012).

All studies measuring the perceived control or perceived conditional diabetes risk reported participants with high levels of perceived control over their diabetes risk (Dorman et al., 2012; Joiner, Sternberg, Kennedy, Chen, et al., 2016; Joiner, Sternberg, Kennedy, Fukuoka, et al., 2016; Seaborn et al., 2016; Shaak et al., 2016; Wu et al., 2017). In one study 80.9% of the sample believed they could prevent or delay developing T2DM (Seaborn et al., 2016).

One study reported varying levels of perceived diabetes risk between participants who had family history of diabetes and participants who did not have family history of diabetes (Dorman et al., 2012). There was a significantly increased level of perceived diabetes risk and worry reported in participants with family history of diabetes compared to participants without a family history. Another study reported the percentage of participants who estimated risk of developing T2DM within three years comparing groups that either engaged or did not engage in recommended preventive behaviors (Kullgren et al., 2016). This study found a significantly lower percentage estimating diabetes risk within three years in the group that engaged in preventive behaviors.

Only one study compared high versus low perceived diabetes risk and a significant difference between RPS-DD subscale scores (Joiner, Sternberg, Kennedy, Fukuoka, et al., 2016). Findings from this study included: (1) sample characteristics of the group with high perceived risk had history of prediabetes, history of gestational diabetes, family history of diabetes, and being a high school graduate; (2) the group with high perceived diabetes risk also had significantly higher mean scores on the personal disease risk, environmental health risk, and diabetes risk factor knowledge RPS-DD subscales; and (3) the group with low perceived diabetes risk had higher mean scores for the RPS-DD optimistic bias subscale.

Only two studies measured the effects of different types of diabetic counseling (using genetic testing and individualized health risk calculators) on risk perception, but neither study found any significant change in perceived diabetes risk (Voils et al., 2015; Wu et al., 2017). Actual risk related to genetic testing correlated with increased “serious” risk perception for persons with moderate (positive changes noted at three months with $p_{\text{Kendall's}}=.04$) and average actual risk due to family history (positive changes noted at three months and 12 months with $p_{\text{Kendall's}}=.01$ and $p_{\text{Kendall's}}=.04$) (Wu et al., 2017). There was no correlation between actual risk related to genetic testing or of increased risk perception for persons with high actual risk due to family history (Wu et al., 2017).

Perceived diabetes risk in persons with prediabetes. Some studies only reported presence or absence of perceived diabetes risk. There was a significant difference in reported perceived diabetes risk among participants who were informed of this diagnosis by a healthcare professional, compared to those who were not diagnosed with prediabetes (82.3% versus 26.3%, $p<.0001$) (Yang et al., 2018). A similar finding from another study found that two-thirds of the

subsample informed of a prediabetes diagnosis by a healthcare professional reported perceived diabetes risk (Piccinino et al., 2015).

Congruency of Actual Risk and Perceived Risk

Only one study looked at congruency of actual and perceived diabetes risk, noting no correlation between the two concepts (Simonds et al., 2017). Three studies reported perceived diabetes risk for participants with actual diabetes risk (Joiner, Sternberg, Kennedy, Fukuoka, et al., 2016; Piccinino et al., 2015; Yang et al., 2018). Joiner, Sternberg, Kennedy, Fukuoka, et al. (2016) reported no significant difference between groups with actual diabetes risk who had lower versus higher perceived risk. Fukuoka et al. (2015) reported that over one-quarter of participants with actual diabetes risk had perceived risk of diabetes.

Yang et al. (2018) reported actual diabetes risk factors, the percentage of participants with actual diabetes risk who reported perceived diabetes risk, and the percentage of participants with actual diabetes risk who correctly perceived a diabetes risk factor. The actual diabetes risk factors most commonly present in participants reporting perceived risk of developing diabetes were having previously received a doctor's warning of diabetes risk (74.8%) and a family history of diabetes (52.3%). These two actual diabetes risk factors were also the most common in Asian Americans reporting perceived diabetes risk (82.3% and 57.3%, respectively).

Overall, the agreement of actual risk factors and the perception of diabetes risk based on these factors varied between racial groups (Yang et al., 2018). For example, only 1.2% of Asian Americans with prediabetes correctly perceived the prediabetes diagnosis as a risk for developing diabetes compared to 2.7% of NHW ($p = .033$). Only 2.2% of overweight Asian Americans correctly perceived overweight as a risk factor for developing diabetes compared to

5.1% of NHW ($p < .001$). There was a significantly larger difference between correctly perceiving obesity as a risk factor for developing diabetes between Asian Americans (12.2%) and NHW (20.8%) ($p = .015$).

Factors Associated with Perceived Diabetes Risk

Only one study reported correlations of perceived diabetes risk with other factors (Seaborn et al., 2016). Perceived diabetes risk had significantly weak, but positively linear relationships with behavioral intention and perceived behavioral control. The likelihood of adopting preventive behaviors had a significantly weak, but positive linear relationship with both perceptions of (1) controllable risk factors and (2) behavioral control.

Significant Predictors of Perceived Risk. Some of the significant predictors of perceived diabetes risk included: being told by a healthcare professional of prediabetes diagnosis or risk factors of developing diabetes; history of gestational diabetes; family history of diabetes; Asian ethnicity (i.e. Filipino or Korean); having a high school diploma; female gender; high cholesterol; higher BMI; and the RPS-DD scores for the optimistic bias, worry, and personal disease risk subscales (Fukuoka et al., 2015; Joiner, Sternberg, Kennedy, Fukuoka, et al., 2016; Piccinino et al., 2015). Being informed of a prediabetes diagnosis by the health care provider increased likelihood of perceived diabetes risk by up to five times (Piccinino et al., 2015).

Summary of Findings

Key findings of this systematic review were: (1) inconsistency in measures for calculating perceived diabetes risk; (2) overall low level of perceived diabetes risk, including noncomparative (short-term and lifetime) risk and comparative risk; (3) low percentage of persons in the general population with moderate to high perceived diabetes risk; (4) no

interventions that have effectively altered perceived diabetes risk (5) no reports for perceived risk of diabetes in persons with prediabetes; (6) lack of congruency between actual and perceived diabetes risk in the general population; and (7) samples including Asian Americans were limited. Some factors associated with perceived diabetes risk that also matched the characteristics of the groups with a high perceived diabetes risk included prediabetes diagnosis, history of gestational diabetes, family history of diabetes, Asian race, and having a high school diploma.

Discussion

Each of the studies in this systematic review had a relatively unique research purpose. As such, there was a broader range of outcomes measured, allowing for exploration of various factors associated with diabetes risk perception. However, the lack of consistency across studies made it difficult to draw conclusions from the findings. The studies lacked sufficient statistical data (Portney & Watkins, 2009). Overall, the studies lacked inclusion of statistics supporting the reliability and validity of tools used to calculate actual and perceived risk, consistency in measures for perceived diabetes risk across studies, and sample diversity in terms of actual diabetes risk, race/ethnicity, gender, and age.

Few studies reported using a previously validated tool to estimate actual risk or perceived risk of diabetes or prediabetes, and even so many studies failed to report the psychometrics for these tools. Psychometric estimates should be reported to ensure that scales and subscales consistently and accurately measure the construct (Trochim, Donnelly, & Arora, 2016). The absence of psychometric estimates for instruments may limit the validity of reported findings (Kazdin, 2017). No psychometric estimates were reported for tools measuring actual diabetes risk. Nevertheless, persons at high risk for developing diabetes based on scored actual risk

questionnaires or A1C levels in a prediabetic range comprised approximately 25% of the samples (excluding studies that used increased BMI and prediabetes in its inclusion criteria). The percentage of persons at actual high risk for diabetes in most studies was similar to the national prediabetes prevalence of 33.9% (95% CI 31.5 – 36.5) (CDC, 2017). Also, the percentage of adults who are overweight or obese (defined by BMI greater than or equal to 25 kg/m²) is 87.5% nationally (CDC, 2017), which aligns with the at least 70% of overweight or obese persons in the articles reviewed. The congruency of these numbers may help to support the validity of the tools.

For tools used to measure perceived diabetes risk, only one study reported reliability of its newly developed and previously tested RPS-DD Spanish-translated version. The Cronbach alpha for subscales in this new survey ranged from .60 (low and unacceptable with three items) for the perceived behavioral control subscale to .87 (acceptable with four items) for the subscale on moderating variables (i.e. family history, weight, physical activity, and dietary habits) increasing perceived diabetes risk (Field, 2013; Seaborn et al., 2016). The variations in tools used to measure perceived diabetes risk and lack of composite RPS-DD scores makes it more difficult to compare levels of perceived risk across studies.

Despite the low percentage of participants with moderate to high perceived diabetes risk in the general population, some of these samples consisted exclusively of persons with high diabetes risk. For example, overall lifetime perceived diabetes risk was low in all participants in a sample with inclusion criteria of minimum BMI of 27 kg/m² (Voils et al., 2015). This example further supports the lack of congruency between actual risk of diabetes and perceived diabetes risk, further indicating that a large percentage of persons have optimistic bias. The level of optimistic bias may be higher than reported considering the studies that did not correlate actual

diabetes risk with perceived diabetes risk. Optimistic bias is common in various studies ranging from unrealistic optimism with regards to not only diseases, but also events such as natural disasters (Shepperd et al., 2015).

Generalizability of findings is contingent upon obtaining a representative sample of the broader population (Trochim et al., 2016). Because most samples for these studies had predominantly female participants, the external validity of findings is limited. An example of the effect of sampling on the validity of findings surfaces in a study with Korean immigrants in which women experienced more negative emotions (e.g. stress or hopelessness) compared to men (Choi, Rush, & Henry, 2013). Few studies discussed possible variations in risk perception based on racial/ethnic backgrounds. Only Yang et al. (2018) explored the level of perceived diabetes risk in Asian Americans that reflected reports from studies for all other racial/ethnic groups. The absence of studies with an exclusively Asian American sample and the under sampling of Asian Americans in most studies indicate the need for further studies of perceived risk in this population that has a high prevalence of prediabetes. The use of nonproportional quota sampling or stratified random sampling, for example, would allow findings to be more representative of this population (Trochim et al., 2016).

The strength of the evidence generated from this systematic review is limited. Only three studies were RCTs, which are considered the gold standard for experimental designs (Portney & Watkins, 2009). The RCTs had varying risk of bias (Table 5). Two RCTs did not clearly report methodology to determine many aspects of potential bias (Dorman et al., 2012; Voils et al., 2015). In one of the two RCTs not clearly reporting methodology, the only two aspects of bias that could be determined were high (Voils et al., 2015). Overall, the risk of bias was low for the

third RCT (Wu et al., 2017). The intervention effect on perceived diabetes risk was not reported in one RCT (Dorman et al., 2012) and had no significant effect in two other RCTs with small or unspecified Asian American sample percentages (Voils et al., 2015; Wu et al., 2017). Yet there is still publication bias as there may be results from unpublished papers owing to the authors' reluctance to submit for publication or the publisher's reluctance to print (Portney & Watkins, 2009). The other studies in this systematic review focused on descriptive statistics rather than correlations that could show the relationship between risk perception and other variables (Portney & Watkins, 2009). Limitations of this systematic review include the exclusion of dimensions of risk perception such as optimistic bias as search terms. However, studies that examined only one dimension of risk perception would have added limited value to the overall knowledge of perceived diabetes risk.

The findings from this systematic review have several implications for nursing clinicians and researchers. Being informed of a prediabetes diagnosis increased the likelihood of reporting perceived diabetes risk, suggesting that discussions of risk with patients in the clinical setting or as part of diabetes prevention interventions may decrease the gap between actual and perceived risk of diabetes. The decreased congruency between actual and perceived diabetes risk in Asian Americans (Yang et al., 2018), further underscores the importance of the provider discussing diabetes risk when applicable in this population. The incongruency between actual diabetes risk and perceived diabetes risk in the general population, creates an opportunity for education to enhance accurate risk perceptions. The overall higher levels of worry and perceived control over the diabetes risk could indicate a readiness to learn (Shaak et al., 2016). Additionally, the Filipino and Korean ethnic groups had an increased odds ratio for reporting perceived diabetes

risk (adjusted odds ratio 1.7 and 2.4, respectively, with $p < .05$) (Fukuoka et al., 2015) which may indicate target groups for future diabetes prevention efforts.

[INSERT TABLE 5 ABOUT HERE]

Conclusion

The limited data available regarding perceived diabetes risk indicates a further need for studies regarding this multi-dimensional concept using rigorous methods, including reliable and valid measures. These studies should report the results for the groups with known high actual risk for diabetes (e.g. diagnosis of prediabetes or increased BMI) compared to groups with low actual risk for diabetes. More studies to explore the risk perceptions of Asian Americans are needed as they have been underrepresented in the published studies.

With a better understanding of perceived risk, diabetes prevention interventions can be developed or modified accordingly. These interventions should begin with increased screening for prediabetes and diabetes followed with proper education for those with high actual diabetes risk. Interventions targeting family units with history of diabetes may also be beneficial as they are more likely to perceive the disease risk. Diabetes prevention interventions, such as the DPP, could incorporate popular activities such as exercise, healthy eating, and use of technology (e.g. wearable activity monitoring devices and internet-based tools) (Knowler et al., 2002; Shaak et al., 2016).

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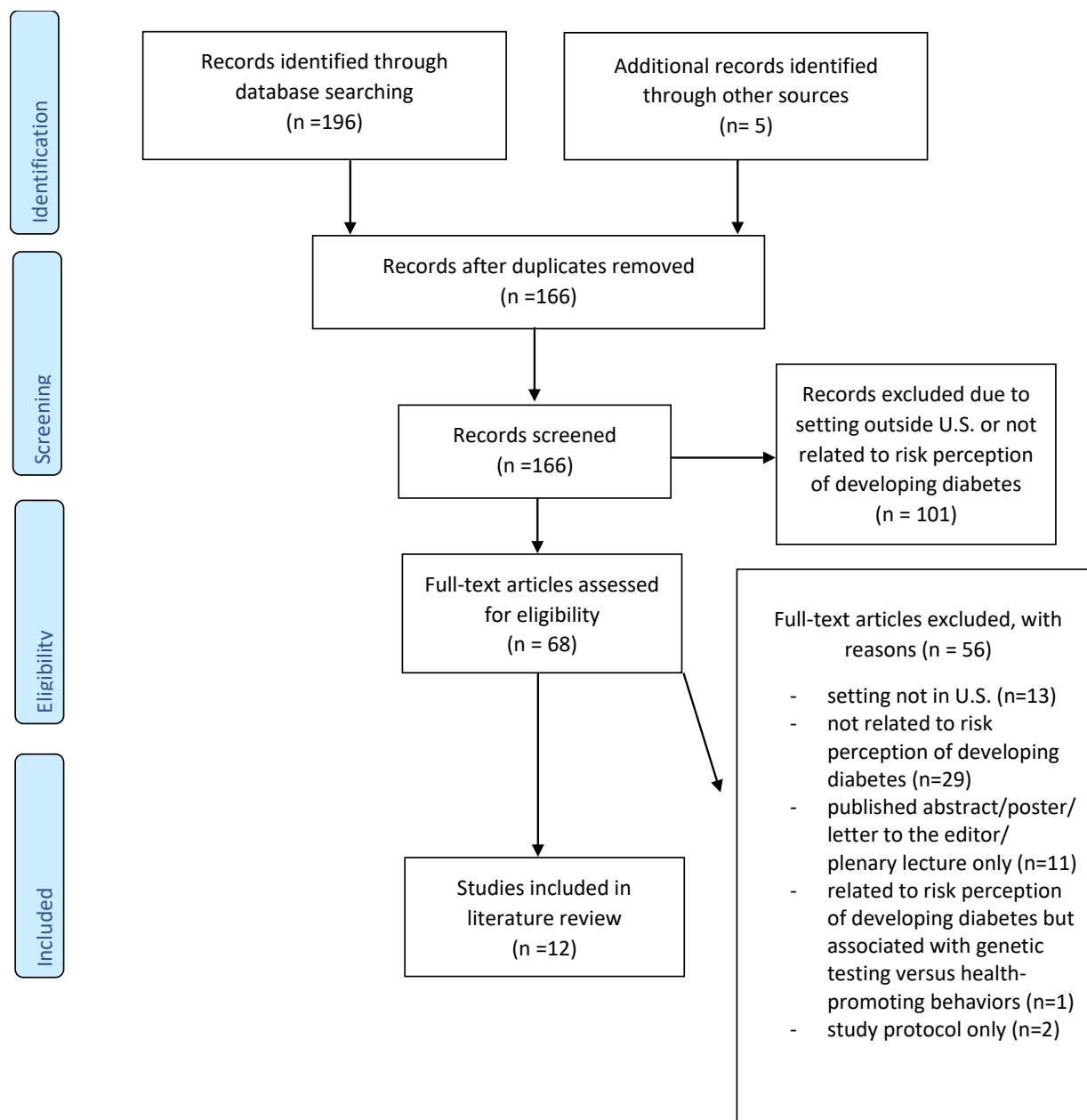


Figure 1. Prisma Flow Diagram for Risk Perception Literature Search. Adapted from “Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement” by D. Moher, A. Liberati, J. Tetzlaff, D. G. Altman, & the PRISMA Group (2009). *PLoS Med* 6(7): e1000097. doi:10.1371/journal.pmed1000097

Table 1. Dimensions of Risk Perception as Defined for this Systematic Review

Dimension	Type	Definition
General Risk	Cognitive	perceived risk of diabetes (e.g. severity of disease) ^{1,3}
Personal/ Noncomparative Risk	Cognitive	perceived risk of disease for self ³
Comparative Risk	Cognitive	perceived susceptibility or perceived risk compared to general population or to a person of similar age or gender ^{1,3}
Optimistic Bias	Cognitive	perceived risk that is lower compared to actual risk ⁴
Conditional Risk	Cognitive	perceived risk or likelihood in relation to certain behaviors ^{1,3}
Anticipatory Emotions of Disease Risk	Affective	feelings related to perceived risk (e.g. worry or anxiety) ^{2,3}

Note. ¹ Brewer et al. (2007); ² Ferrer, Klein, Persoskie, Avishai-Yitshak, and Sheeran (2016); ³ Sheeran, Harris, and Epton (2014); ⁴ Shepperd, Waters, Weinstein, and Klein (2015)

Table 2. Database Search Strategy

PubMed	Embase	CINAHL
"Prediabetic State"[MeSH] OR "Diabetes Mellitus, Type 2/prevention and control" [MeSH] OR "diabetes prevention" AND "Asian Americans"[MeSH] or "Vietnamese" OR "Prediabetic State"[MeSH] OR "Diabetes Mellitus, Type 2/prevention and control"[MeSH] OR "diabetes prevention" AND "risk perception" OR "perceived risk"	“risk perception” OR “perceived risk” AND “impaired glucose tolerance”/exp OR “diabetes prevention” OR “impaired glucose tolerance”/exp OR “diabetes prevention” AND “Vietnamese”/exp OR “asian American”/exp	MH "Diabetes Mellitus, Type 2/PC" OR MH "Prediabetic State" AND MH "Attitude to Risk" OR MH "Diabetes Mellitus, Type 2/PC" AND MH "Vietnamese" OR MH "Asians"

Note. CINAHL= Cumulative Index of Nursing and Allied Health Literature; exp= explosion of Emtree term; MeSH= Medical Subject Headings; MH= major/minor heading

Table 3. Studies Assessing Perceived Diabetes Risk, Actual Diabetes Risk, and Factors Associated with Diabetes Risk in Adults

Author (Year)	Study Design and Purpose	Sample/Sample Characteristics	Actual Risk	Risk Perception Measurement	Comparison of Perceived Risk Between Groups	Factors Associated with Perceived Risk
Dorman et al. (2012)	RCT to evaluate PR, control, worry, and severity about diabetes, coronary heart disease (CHD) and stroke among individuals at increased familial risk of diabetes Research groups: 1. no family history of diabetes, stroke, or CHD (n= 836) 2. family history of diabetes	n= 2,081 with varying risk levels for diabetes Mean age 50.8 (SE 0.14) years Gender (%): - Male 30.9 - Female 69.1 Race (%): - NHW 88.6 - Black 3.7 - Hispanic 2.4 - Other 5.4	Risk factors only. - family history of diabetes, CHD and stroke based on moderate and strong risk categories as calculated by the Family Healthware risk algorithm indicating increased familial risk - BMI \geq 25 comprised 59.5% of sample	Four health belief items using 5-point Likert scale, with 1 = low to 5 = high: - PR: “Compared to most people your age and sex, what chances are for developing _____ (disease)?” (Dorman et al., 2012, p. 4) - Perceived control - Perceived worry - Perceived severity	- Significantly*** higher diabetes PR scores (with adjusting for age, race, gender, education, and BMI) between groups with scores increasing from 2.58, 3.22, and 3.26 for each group respectively - Significantly*** lower adjusted scores for worry about diabetes between groups with scores increasing from 1.53, 1.91, and 1.94 for each group respectively	Not conducted

Author (Year)	Study Design and Purpose	Sample/Sample Characteristics	Actual Risk	Risk Perception Measurement	Comparison of Perceived Risk Between Groups	Factors Associated with Perceived Risk
	alone (n=267) 3. family history of diabetes and CHD and/or stroke (n=978)					
Fukuoka, Choi, Bender, Gonzalez, & Arai (2015)	Cross-sectional study to explore PR for diabetes and myocardial infarction in various ethnic groups without diabetes	N=904 urban adults without history of diabetes Mean age 44.3 (SD 16.1) years Gender (%): - Male 35.7 - Female 64.3 Ethnicity/race: - Caucasian 19.0% - Latino 27.4% - Filipino 27.7% - Korean 25.9%	- 35.3% with family history of diabetes - Mean BMI 25.5 (± 5.3) kg/m ² - modified version of the ADA Diabetic Risk Test used without analysis of total score	- Item from the RPS-DD asking comparative RP: “Compared to other people of my same age and sex (gender), I am less likely than they are to get diabetes using 4-point Likert scale that was ultimately dichotomized into yes/no that equates to “agree/strongly agree” versus “disagree/strongly disagree”	No comparison of groups.	Significant factors predicted diabetes PR: - female gender (AOR=1.4, 95% CI 1.04-1.96)* - family history of diabetes (AOR=1.4, 1.00-1.84)* - ethnicity Filipino (AOR=1.7, 1.04-2.86)* and Korean (AOR=2.4, 1.33-4.48)** - high cholesterol (AOR= 1.6, 1.09-2.37)* - higher BMI (AOR=1.1, 1.08-1.15)***
Joiner, Sternberg, Kennedy,	Cross-sectional survey for tool	n=146 All Hispanics without history of diabetes	- BMI ≥ 25 comprised 80.8% of sample	Spanish-translated version of the RPS-DD using items with 4-point Likert scale (1= lower	No comparison of groups	No analysis of factors.

Author (Year)	Study Design and Purpose	Sample/Sample Characteristics	Actual Risk	Risk Perception Measurement	Comparison of Perceived Risk Between Groups	Factors Associated with Perceived Risk
Chen, et al., (2016)	validation of the Spanish-translated version of the RPS-DD	(except history of gestational diabetes) and not currently pregnant Mean age 39.5 (SD 9.9) years Gender (%): - Male 26.0 - Female 74.0	- 13.7% of sample with A1C level greater than or equal to 5.7%	perception of concept; 4= higher perception of concept) - Cronbach alphas for translated RPS-DD subscales: a. personal control .67 b. optimistic bias .72 c. worry .54 d. personal disease risk .88 e. environmental health risk .88		
Joiner, Sternberg, Kennedy, Fukuoka, et al. (2016)	Cross-sectional survey to describe PR of developing diabetes among immigrant Spanish-speaking Latinos	n=146 All Hispanics without history of diabetes (except history of gestational diabetes) and not currently pregnant Mean age 39.5 (SD 9.9) years Gender (%): - Male 26.0 - Female 74.0	- ADA Diabetes Risk Test score indicating increased risk for type 2 diabetes for 23.3% of sample - ADA Diabetes Risk test score indicating increased risk for type 2 diabetes in participants with lower versus higher PR of developing diabetes (20.4% versus 31%, $p=.186$)	Spanish-translated version of the RPS-DD using items with 4-point Likert scale (1= lower perception of concept; 4= higher perception of concept) - Cronbach alphas for translated RPS-DD subscales ranged from 0.54 to 0.88: a. personal control b. optimistic bias c. worry d. personal disease risk e. environmental health risk	Significant differences between low and high PR of developing diabetes: - history of prediabetes (2.2% versus 26.2%)** - history of gestational diabetes (7.5% versus 26.2%)* - family history of diabetes (25.8% versus 50%)* - high school graduate (30.1% versus 57.1%)* - mean optimistic bias subscale	Significant* predictors PR of diabetes: - history of gestational diabetes (OR 10.95, [CI 95% (2.18-53.99)]) - high school graduate or more= (OR 4.2, [CI 95% (1.20-14.66)]) - optimistic bias subscale score (OR 0.40, [CI 95% (0.20-0.82)]) - worry subscale score (OR 2.86, [CI 95% (1.16-7.04)])

Author (Year)	Study Design and Purpose	Sample/Sample Characteristics	Actual Risk	Risk Perception Measurement	Comparison of Perceived Risk Between Groups	Factors Associated with Perceived Risk
					<ul style="list-style-type: none"> - score (2.67 versus 2.23)* - mean personal disease risk subscale score (1.29 versus 2.04)** - mean environmental health risk score (1.76 versus 2.18,* - mean diabetes risk factor knowledge score (3.82 versus 5.36)** 	<ul style="list-style-type: none"> - personal disease risk subscale score (OR 60.56, [CI 95% (10.71-342.58)])
Kullgren, Knaus, Jenkins, and Heisler (2016)	Mixed methods (cross-sectional and modified grounded theory) to examine facilitators and barriers to engagement in T2DM prevention behaviors	<ul style="list-style-type: none"> - n= 82 persons with prediabetes were given two surveys - subsample n=40 for semi-structured telephone interviews <p>Mean age 50.5 (IQR 40 to 56.5) years</p>	All participants found to have prediabetes during previous workplace screening	<ul style="list-style-type: none"> - One question asking about PR of developing T2DM in the next 3 years, presumably yes/no 	<ul style="list-style-type: none"> - Significant* difference between the group who engaged in recommended preventive behaviors compared to those who did not: estimated risk of developing T2DM within three years (40% versus 60%) 	No associated factors reported.

Author (Year)	Study Design and Purpose	Sample/Sample Characteristics	Actual Risk	Risk Perception Measurement	Comparison of Perceived Risk Between Groups	Factors Associated with Perceived Risk
	Research groups: (1) engaged in physical activity recommend ations since screening for prediabetes (2) not engaged in recommend ed physical activity	Gender (%): - Male 28.0 - Female 72.0 Race (%) - NHW 73.2 - Minority races 26.8				
Piccinino, Griffey, Gallivan, Lotenberg, and Tuncer (2015)	Cross-sectional study to examine trends in knowledge, perception, and behaviors related to diabetes through the 2006, 2008, and 2011 NDEP telephone surveys	n= 6,075 persons with/without diabetes diagnosis & subpopulations at risk Characteristics not specified for entire sample Characteristics for sub-sample who answered question about PR (number in this group is unclear ranging	- 26% to 27% of participants at actual risk (i.e. BMI \geq 25, history of gestational diabetes, or told by a clinican that they have high diabetes risk) perceived their risk of diabetes - BMI \geq 25 comprised 52.7% of sub-sample - Participants with “family history” of diabetes comprised 27.7% of sub-sample - Participants with anyone in immediate family having diabetes	The NNDS measured personal PR by asking whether participants felt at risk for diabetes or prediabetes and, if so, why they felt at risk, and what they could do to reduce their risk. PR was a dichotomy: participants either felt or did not feel at risk for diabetes/prediabetes	Not applicable	- Being told of prediabetes diagnosis increases likelihood of diabetes PR (OR 5.74 to 9.47 between 2006 to 2011) Significant predictors (p < .05) PR for diabetes for 2011 that maintained statistical significance in 2006 and 2008: - BMI \geq 30 vs. BMI <25.0 (OR 7.38, [CI 95% (2.51- 21.72)])

Author (Year)	Study Design and Purpose	Sample/Sample Characteristics	Actual Risk	Risk Perception Measurement	Comparison of Perceived Risk Between Groups	Factors Associated with Perceived Risk
Seaborn et al. (2016)	Cross-sectional study to determine the association between diabetes knowledge, family history of diabetes, and other diabetes risk factors	n= 394 All African American participants Age: - 18 to 29 years 43.4% - 30 to 49 years 24.9% - 50 to 69 years 28.4% - >70 years 3.3% Gender (%):	- 29.4% participants had a high diabetes risk per the ADA Diabetes Risk Test - 48.5% participants reported family history of diabetes - 71.3% participants were overweight or obese	All scales 5-point Likert scales with 1 = low score and 5 = high score Perceptions of controllable risk factors (attitude towards behavior)- 3 questions (Cronbach's alpha- 0.85) Perceived behavioral control- 3 questions (Cronbach's alpha 0.60)	- 47.3% had increased T2DM PR due to family history	- immediate family history of diabetes (OR 3.26, [95% CI 1.43-7.46]) - being told by a healthcare professional that they had prediabetes or risk factors (OR 6.84, [95% CI 1.75-26.69]) - Pearson correlation between likelihood of adopting preventive behaviors and (1) attitude towards behavior (0.187) ** and (2) perceived behavioral control (0.308) ** - PR was associated with behavioral intention

Author (Year)	Study Design and Purpose	Sample/Sample Characteristics	Actual Risk	Risk Perception Measurement	Comparison of Perceived Risk Between Groups	Factors Associated with Perceived Risk
	with likelihood to adopt health-promoting behaviors	- Male 28.2 - Female 71.8		Moderating variables (i.e. family history, weight, physical activity, and dietary habits) for increased PR- 4 questions (Cronbach's alpha 0.87) using 5-point Likert scale		($r=0.19$)*, perceived behavioral control ($r=0.20$)*, and attitude towards behavior (-0.10)*
Shaak et al. (2018)	Cross-sectional study to explore health beliefs of Hispanic adults with prediabetes (i.e. A1C between 5.7 and 6.4%)	n= 414 Ages per inclusion criteria: 18 to 65 years (actual age range and mean not reported) Gender (%) - Male 30.0 - Female 70.0 Race (%) - NHW 29.2 - Black 2.5 - American Indian or Alaskan Native 1.7 - Other 53.3 - Missing 14.2	- 81.7% participants had mild hyperglycemia (i.e. A1C between 5.7 and 6.0%) - 18.3% participants had intermediate hyperglycemia (i.e. A1C between 6.1 and 6.4%)	- 19 questions extracted from the RPS-DD (subscales for personal control, worry, optimistic bias, and diabetes knowledge) and 15 questions created by study team - Subscales for personal control, worry, and optimistic bias range from 1 to 4 (1=lower perception of concept; 4=higher perception of concept) - Diabetes risk knowledge score ranges 0 to 11 indicating number	No comparison between groups.	No associated factors reported.

Author (Year)	Study Design and Purpose	Sample/Sample Characteristics	Actual Risk	Risk Perception Measurement	Comparison of Perceived Risk Between Groups	Factors Associated with Perceived Risk
Simonds, Omidpanah, and Buchwald (2017)	Cross-sectional study to explore perceptions of diabetes risk, actual diabetes risk, self-efficacy, knowledge of diabetes, and engagement in healthy behaviors	N=143 All American Indians without previous diagnosis of diabetes Mean age 41.4 years Gender (%): - Male 14 - Female 86	- 15% were at actual risk of developing diabetes based on validated objective risk score - Spearman correlation of .12 ($p=.18$) between actual and PR - 75% participants were overweight or obese	of items answered correctly Visual analog scale ranging from 0 to 100% - “What do you think your risk or chance is for developing diabetes in your lifetime?” - “What do you think your risk or chance is for developing diabetes in the next 10 years?”	No comparison between groups.	Persons with increased diabetes knowledge had increased association between actual and PR ($\rho=0.290$)* compared to persons with less diabetes knowledge ($\rho=0.144$, $p=.281$) No relationship found between cultural identity and RP
Voils et al. (2015)	RCT to determine effects of supplementing T2DM risk counseling with genetic test results and counseling	n= 601 non-diabetic patients who had $BMI \geq 27$ kg/m ² Mean age 54.1 (SD 8.7) years Gender (%) - Male 80.4 - Female 19.6 Race (%) - Black 52.9 - Other 47.1	- 97.6% had moderate or high lifetime diabetes risk based on a validated algorithm - 51.9% had moderate or high family history diabetes risk - 100% of participants had ≥ 27 kg/m ² based on inclusion criteria - 30% of participants had $BMI \geq 35$ kg/m ²	- Lifetime PR item based on 7-point Likert scale (higher scores indicate higher PR): “What are your chances of getting type 2 diabetes in your lifetime” (Voils et al., 2015, p. 1594)	No comparison between groups.	No significant difference or changes in lifetime PR of T2DM between groups or between time points (baseline, post-counseling, 3 months, or 6 months), indicating no effect of the intervention on this factor

Author (Year)	Study Design and Purpose	Sample/Sample Characteristics	Actual Risk	Risk Perception Measurement	Comparison of Perceived Risk Between Groups	Factors Associated with Perceived Risk
Wu et al. (2017)	RCT to determine the effect of genetic testing and family history on T2DM on behavior and its cognitive precursors	n=312 Mean Age (Years) - Group 1: 50.9 (SD 12.8) - Group 2: 49.3 (13.6) Gender (%) - Group 1: Male 31.3; Female 68.2 - Group 2: Male 29.5; Female 70.5 Race (%) - NHW 57.6 - Black 30.3 - Asian 5.0 - American Indian/Alaskan 1.0 - Mixed racial 5.6	- 68.8% of participants have moderate or high family history diabetes risk - Mean BMI for both groups: 30.6 (SD 7.1) and 30.9 (SD 7.4)	- PR (2 items): “My risk for diabetes is serious” and “What do you think is your chance of getting diabetes in your lifetime?” (Wu et al., 2017, p. 136) - Perceived control over disease risk using personal control subscale of the IPQ (6 items using 1-5 scale with maximum score of 30)	No comparison between groups.	- Higher family history risk was significantly** associated with stronger PR and “serious” risk - Genetic risk was only significantly* associated with stronger perception of “serious” risk for moderate and average family history risk participants (not for the high family history risk participants). - Genetic risk did not influence RP.
Yang, Baniak, Imes, Choi, & Chasens (2018)	Cross-sectional study to examine associations between PR and actual risk	Adults from the 2011 to 2014 NHANES (n = 10,999; n = 9496 answered question on PR for diabetes)	- Among the subsample of participants answering the PR question with valid A1C data (n = 2520), 983 (39.0%) were identified as having an	- Closed-ended question: “Do you feel you could be at risk for diabetes or prediabetes?” (Yang et al., 2018, p. 3)	- Only significant* difference between racial groups for agreement between actual risk and general PR was for the	No associated factors reported.

Author (Year)	Study Design and Purpose	Sample/Sample Characteristics	Actual Risk	Risk Perception Measurement	Comparison of Perceived Risk Between Groups	Factors Associated with Perceived Risk
	of developing diabetes by race and/or ethnicity	<p>Age</p> <ul style="list-style-type: none"> - 20 to 39 years: 36.0% - 40 to 49 years: 18.6% - 50-59 years: 18.9% - ≥ 60 years: 26.5% <p>Gender (%):</p> <ul style="list-style-type: none"> - Male 47.9% - Female 52.1% <p>Race (%)</p> <ul style="list-style-type: none"> - NHW 67.9 - Black 11.8 - Hispanic 14.9 - Asian 5.4 	<p>actual risk for prediabetes or diabetes according to the ADA guideline (an A1C of 5.7% or above)</p> <ul style="list-style-type: none"> - 23.2% of all participants versus 24.1% of Asian participants had A1C in the prediabetic range ** - 71.7% of all participants versus 62.0% of Asian participants were in the overweight or obese BMI categories ** - 37.0% of all participants versus 36.1% of Asian participants reported family history of diabetes ** 	<ul style="list-style-type: none"> - If yes, participants were asked, “Why do you think you are at risk for diabetes or prediabetes?” - PR question was categorical (yes/no), so no data on the degree of PR was available 	<ul style="list-style-type: none"> - actual risk of poor to fair diet habit: 31.7% Asians compared to 33.3% NHW - Significantly* fewer Asians correctly perceived weight status (14.4% compared to 25.9% in NHW) and physical activity (2.1% compared to 3.4% in NHW) as a risk factor for diabetes in contrast to all other racial/ethnic groups - Only 1.2% of Asian Americans with prediabetes correctly perceived prediabetes as a risk factor for developing diabetes (significantly* lower percentages than NHW) 	
		<p>Of those who responded to PR question, only 28.4% (n = 2693) responded to risk factors that they believe to be at risk. Those who answered the RP questions for diabetes were significantly*</p>				

Author (Year)	Study Design and Purpose	Sample/Sample Characteristics	Actual Risk	Risk Perception Measurement	Comparison of Perceived Risk Between Groups	Factors Associated with Perceived Risk
		more likely to deny having a family history of diabetes (2.5 times), have a normal BMI (1.8 times), and have a normal A1C (5.1 times)				

Note. ADA= American Diabetes Association; AOR= adjusted odds ratio; BMI= Body Mass Index; BRFSS= Behavioral Risk Factor Surveillance System; CHD= coronary heart disease; F= Fisher test statistic; IPQ= Illness Perception Questionnaire; n=number; NHANES = National Health and Nutrition Examination Survey; NHW= Non-Hispanic White; NDEP= National Diabetes Education Program; NNDS= NDEP National Diabetes Survey; OR= odds ratio; PR = perceived risk; RCT= randomized control trial; RPS-DD= Risk Perception Survey- Developing Diabetes; T2DM= Type 2 Diabetes Mellitus

* $p < .05$

** $p \leq .001$

*** $p < .0001$

Table 4. Perceived Risk (PR) Level of Diabetes by Dimension

PR of developing diabetes (including personal, noncomparative, or absolute)	Comparative Risk (including optimistic bias)	Perceived Control and Perceived Conditional Risk	Affective	General Risk
<ul style="list-style-type: none"> - 31.5% of sample indicated a moderate or high PR of developing diabetes (one RPS-DD item) on personal disease risk subscale⁴ - PR of developing diabetes in next three years between 40% to 60% of prediabetics⁵ - Among those with prediabetes, nearly two-thirds PR of developing diabetes (ranging 60% to 62% between 2006 to 2011)⁶ - PR levels were low except among persons with prediabetes (see above 	<ul style="list-style-type: none"> - Comparative PR of developing diabetes mean scores ranged between 2.58 and 3.26 for the three groups using a five-point Likert scale¹ - 53.5% agreed or strongly agreed that they had a lower 	<ul style="list-style-type: none"> - Perceived control of developing diabetes was high and mean scores ranged between 4.01 and 4.09 (no significant difference between the three groups)¹ - Greater perceived personal control for personal control subscale (mean score 3.34, SD 0.76)^{3,4} 	<ul style="list-style-type: none"> - Worry about developing diabetes was low and mean scores ranged from 1.53 to 1.94 out of 5¹ - Slight to moderate concern for 	<ul style="list-style-type: none"> - Perceived severity of diabetes was high and mean scores ranged from 4.44 to 4.55 using a five-point Likert scale (no significant difference between the three groups)¹

PR of developing diabetes (including personal, noncomparative, or absolute)	Comparative Risk (including optimistic bias)	Perceived Control and Perceived Conditional Risk	Affective	General Risk
<p>for statistics) and unchanged over 5 years⁶</p> <ul style="list-style-type: none"> - Mean score for lifetime PR of diabetes was 34.8/100 (SD=26.2) and the mean score for one-year PR was 28.6 (SD=27.9)⁹ - Overall lifetime PR of T2DM of all participants ranged from 3.0 to 3.3/7¹⁰ - Larger percentage of baseline overall lifetime PR of T2DM for persons perceiving definitely not getting diabetes versus definitely getting diabetes (13.5% vs. 3.9%)¹¹ 	<p>comparative diabetes risk²</p> <ul style="list-style-type: none"> - Moderately low score for the optimistic bias subscale (mean score 2.55, SD 0.92)³ - Moderately low score for the optimistic bias subscale (mean score 2.96, SD 0.92)⁴ 	<ul style="list-style-type: none"> - Overall, they perceived that they can prevent or delay developing T2DM (mean score 4.01, SD 1.04) but were neutral when it came to the ease of losing weight (mean score 3.14, SD 1.23) and ease of being physically active (mean score 3.58, SD 1.14)⁷ - high scores in personal control 	<p>developing diabetes based on the worry subscale (mean score 2.96 out of 4, SD 0.80)^{3,4}</p> <ul style="list-style-type: none"> - High score in worry (mean score 3.21 out of 4, 	<ul style="list-style-type: none"> - Slight PR of developing diabetes on personal disease risk subscale (mean score 1.73 on a weighted 4-point Likert scale)^{3,4} - Slight perceived environmental health risk subscale score

PR of developing diabetes (including personal, noncomparative, or absolute)	Comparative Risk (including optimistic bias)	Perceived Control and Perceived Conditional Risk	Affective	General Risk
<ul style="list-style-type: none"> - 53% of participants “agreed” or “strongly agreed” that their diabetes risk was serious at baseline, with an increase to 64% at the 12-month follow-up¹¹ - Among those who were told having prediabetes, 82.3% perceived diabetes risk while 26.3% of people who were not told perceived diabetes risk ($p<.0001$)¹² - 28.6% indicated having a high PR for diabetes¹² - 31.5% of Asian Americans with prediabetes reported PR of developing diabetes¹² 	<ul style="list-style-type: none"> - low score in optimistic bias subscale (mean score 2.1, SD 0.78)⁸ 	<ul style="list-style-type: none"> (mean score 3.05, SD 0.53) subscale⁸ - High perceived control over diabetes risk (mean 24.08 out of 30, SD 3.43)¹¹ 	<ul style="list-style-type: none"> SD 0.73) subscale⁸ 	<ul style="list-style-type: none"> (mean score 1.88, SD 0.79)^{3,4} - Highest ranked perceived risk factors were: (1) family history of diabetes, (2) being overweight, and (3) having poor dietary habits¹²

Notes. ¹=Dorman et al. (2012); ²= Fukuoka et al. (2015); ³= Joiner, Sternberg, Kennedy, Chen, et al. (2016); ⁴= Joiner, Sternberg, Kennedy, Fukuoka, et al. (2016); ⁵=Kullgren et al. (2016); ⁶=Piccinino et al. (2015); ⁷=Seaborn et al. (2018); ⁸= Shaak et al. (2018); ⁹= Simonds et al. (2017); ¹⁰= Voils et al. (2015); ¹¹=Wu et al. (2017); ¹²= Yang et al. (2018); PR=perceived risk; RPS-DD= *Risk Perception Survey-Developing Diabetes*; T2DM=type 2 diabetes mellitus

Table 5. Bias Evaluation for Randomized Trials (n=3)

Reference	Dorman et al. (2012)	Voils et al. (2015)	Wu et al. (2017)
Random Sequence Generation (Selection Bias)	U	U	L
Allocation Concealment (Selection Bias)	U	U	L
Blinding of Participants and Personnel (Performance Bias)	U	U	H
Blinding of Outcome Assessment (Detection Bias)	U	U	L
Incomplete Outcome Data (Attrition Bias)	L	H	L
Selective Reporting (Reporting Bias)	H	H	L

Reference	Dorman et al. (2012)	Voils et al. (2015)	Wu et al. (2017)
Comments	<p>This is secondary analysis from RCT data with limited reporting of methodology. Only baseline reporting of perceived risks. No reports on changes of perceived risks after intervention.</p>	<p>Convenience sampling. Full details of protocol were published in separate article. Analysis of data was restricted to participants who completed all stages of the study. Missing data for 3-month and 12-month surveys varied by age, race, BMI, and clinic location.</p>	<p>Genetic counselor and participants blinded up until start of intervention. Research assistants were blinded throughout study.</p>

Note. “-” = no other bias noted; H= high risk of bias; L= low risk of bias; U= unclear bias

APPENDIX C:

MANUSCRIPT #3: MIXED METHODS: PERCEIVED RISK OF DIABETES AMONG
VIETNAMESE AMERICANS WITH PREDIABETES

(Authored by A. P. Nguyen, M. McEwen, L. Loescher, & B. Brewer with plans for submission
to the *Journal of Nursing Scholarship*)

Abstract

Purpose: The purpose of this study was to comprehensively describe the perceived risk of developing diabetes among Vietnamese American adults with prediabetes.

Design: A fixed, convergent mixed method design using a data-transformation variant with qualitative descriptive dominant methodology and quantitative descriptive supplement methodology.

Methods: Purposive and snowball sampling schemes were used to obtain a sample of 10 Vietnamese American adults with prediabetes in the southwestern United States. Qualitative descriptive, quantitative descriptive, and data transformation techniques (i.e. verbal counting qualitative data and using narrative qualitzing for quantitative data) were used to analyze data from face-to-face individual, semi-structured interviews and questionnaires.

Findings: The two risk perception domains emerging from the qualitative data were risk factors of prediabetes and diabetes and disease severity of prediabetes and diabetes. The main diabetes risk factors perceived by participants were eating habits, cultural influences on eating habits, sedentary lifestyle, and family history of diabetes. The mean composite *Risk Perception Survey for Developing Diabetes* score was low at 2.15 (SD=0.31) with high levels of personal control and worry noted (mean subscale scores 3.30 and 3.10, respectively).

Conclusions: The low perceived diabetes risk noted in most participants indicates a need for strategies to increase perceived diabetes risk that are more congruent to actual risk. The high levels of personal control and worry indicate a population that may be amenable to diabetes prevention interventions.

Clinical Relevance: Understanding the perceived diabetes risk in Vietnamese Americans with prediabetes will allow for development of more effective diabetes prevention interventions that consider possible cultural influences on diet and exercise.

Key Words: risk perception, perceived risk, diabetes, prediabetes, Vietnamese, Asian Americans

Perceived Risk of Diabetes among Vietnamese Americans with Prediabetes: A Mixed Methods
Study

Diagnosis with prediabetes increases the risk of developing type 2 diabetes mellitus (T2DM) (Centers for Disease Control and Prevention [CDC], 2018). Prediabetes is a metabolic defect that results in intermediately impaired fasting glucose and/or impaired glucose tolerance, as relative to higher levels of impairment with diabetes. Prediabetes has been associated with multiple chronic conditions including depression, periodontal disease, neuropathy, diabetic retinopathy, fatty liver disease, nephropathy (including chronic kidney disease), cognitive dysfunction, cancer, and increased risk of macrovascular disease such as cardiovascular disease (Buysschaert, Medina, Bergman, Shah, & Lonier, 2015; Chen et al., 2016; Echouffo-Tcheugui, Narayan, Weisman, Golden, & Jaar, 2016; Tabák, Herder, Rathmann, Brunner, & Kivimäki, 2012). Vietnamese Americans (VnA) are a vulnerable population with higher prevalence rates of diabetes despite having a lower mean body mass index (BMI) compared to Non-Hispanic Whites (NHW) (Karter et al., 2014; Shih, Du, Lightstone, Simon, & Wang, 2014; Sorkin, Tan, Hays, Mangione, & Ngo-Metzger, 2008). The average age of diagnosis for T2DM in VnA is 46.7 years, which is 5.2 years earlier than for NHW (Becerra & Becerra, 2015). Despite these risk factors, little is known about how VnA with prediabetes perceive their risk of T2DM.

Exploring risk perception of developing diabetes in VnA with prediabetes provides a foundation for developing effective strategies to accurately alter risk perception, which ultimately could lead toward adopting and sustaining T2DM prevention behaviors. Risk perceptions include cognitive and affective dimensions related to perspectives of general and personal risk (Table 1) (A. P. Nguyen, Loescher, & McEwen, 2019). The *Risk Perception Survey*

for Developing Diabetes (RPS-DD) is the most widely used survey to measure this perceived risk (A. P. Nguyen et al., 2019; Walker, Mertz, Kalten, & Flynn, 2003). Perceived T2DM risk has been associated with behavioral intention and perceived behavioral control; behavioral intention is associated with the likelihood of adopting preventive behaviors (Seaborn et al., 2016). Perceived risk of T2DM was significantly higher in individuals who were informed of the prediabetes diagnosis by a healthcare professional compared to those who had not been diagnosed with prediabetes (Yang, Baniak, Imes, Choi, & Chasens, 2018).

[INSERT TABLE 1 ABOUT HERE]

The purpose of this study was to comprehensively describe the perceived risk of developing T2DM among VnA adults with prediabetes using a fixed complementarity (QUAL+quant) mixed methods approach (see Supplemental Table A). In a sample of VnA adults, the specific aims were to: (1) ascertain perceived risk of developing T2DM; (2) determine level of perceived risk as measured by the RPS-DD; and (3) understand the VnA adults' perceived risk of developing T2DM through elaboration of findings using data transformation.

Methods

A fixed, convergent or complementarity (QUAL+quant) mixed methods design using a data-transformation variant guided the interviews and questionnaires (Caracelli & Greene, 1993; Creswell & Plano Clark, 2018). The method for Aim 1 was qualitative description. The quantitative method for Aim 2 was complementary or supplemental to the qualitative method, adding objective quantitative data to enrich understanding of risk perception. The fixed complementarity mixed method design enabled generation of a meta-inference from both the

qualitative and quantitative data for Aim 3. All study procedures were approved by the institutional review board at the University of [REDACTED].

Sample

The sampling technique for this study was a non-random, multiple purposive sampling technique (including both maximum variation and snowball sampling) (Creswell & Plano Clark, 2018). Participants were asked to refer other potential participants. Maximum variation sampling involved choosing both the settings and the individuals to allow exploration of a broad range of perspectives that were closely representative of VnA with prediabetes (Onwuegbuzie & Collins, 2007; Teddlie & Tashakkori, 2009). To achieve maximum variation in the family history of diabetes and gender, a minimum of four participants was required to meet all variations of these factors. Recommended sample size in qualitative studies is dependent upon the number of participants needed to achieve saturation. Saturation typically occurs when no new categories emerge from the data, usually with small to medium sample sizes requiring 30 or fewer participants (Sandelowski, 1995; Teddlie & Tashakkori, 2009). Inclusion criteria were: (1) self-identify as having Vietnamese ethnic background, (2) self-report of initial diagnosis for prediabetes within the last 6 years, (3) age 18 years or older, (4) speak and read English proficiently, and (5) able to consent. The exclusion criterion was self-reported diagnosis of type 1 or type 2 diabetes.

Setting and Participant Recruitment

Various gatekeepers of the Vietnamese communities from Clark County in Nevada and Los Angeles and Orange counties in California distributed recruitment flyers. Gatekeepers were

religious and community Vietnamese leaders: a Catholic priest, Buddhist monk, and multiple physicians, business owners, and organization leaders. Potential participants contacted the principal investigator (PI) directly. The PI established eligibility via phone or e-mail and scheduled a date to sign consent and participate in the first interview. As part of the compensation for the participants' time, each participant received a \$10 gift card and had the option to enter a raffle for one \$50 gift card.

Measures

Two self-report questionnaires were used to obtain sample characteristics and level of perceived diabetes risk. Sample characteristics assessed were demographics (age range, gender, educational level, income, insurance status, marital status, and immigrant generational status), BMI (calculated from self-reported height and weight and categorized using lower BMI cutoffs as recommended by the American Diabetes Association for Asian Americans) (American Diabetes Association [ADA], 2019) and diabetes disease history (length of time since first diagnosed with prediabetes, history of gestational diabetes, and family history of diabetes). The 43-item RPS-DD was used to measure the level of perceived diabetes risk (Cronbach alpha=.84) (Walker, 2009). Eleven items measure diabetes risk knowledge and were not used for this study. The composite RPS-DD score was calculated using the average of only 32 items (scored using a four-point Likert scale, with 1 = low attribute and 4 = high attribute, and reverse scoring for some items to conform with the conceptual direction of composite score). The five subscales are labelled for the risk perception dimensions of personal control, worry, optimistic bias (subscale items measure the dimensions of comparative risk perception and in this case 1= high attribute and 4= low attribute), personal disease risk, and comparative environment risk (subscale

Cronbach alphas ranged from .50 to .81) (Walker, 2009). An average of each risk perception subscale was calculated allowing an indicator of low versus high perception of each subscale concept (e.g. high versus low perception of personal control) (Walker, 2009) (Table 1).

Data Collection

The PI collected data using individual, semi-structured face-to-face interviews (Neergaard, Olesen, Andersen, & Sondergaard, 2009; Sandelowski, 2000) and questionnaires. The audio-recorded interview began with an introduction of the purpose of the research and the overall structure of the interview (see Supplemental Table B). The interviews were transcribed verbatim, and *Atlas.ti* was used to organize interview transcriptions, coding, memos, and initial analyses (Atlas.Ti Scientific Software Development, n.d.). Other data sources included field notes recorded by the PI. Following the interview, participants completed the RPS-DD. Participants received a prediabetes infographic and information for the local diabetes prevention program(s) after completing data collection.

Data Analysis Procedures

Data analysis began with a separate analysis of qualitative and quantitative data using the parallel mixed method data analysis technique recommended with the complementarity mixed methods design (Creswell & Plano Clark, 2018). Further data analysis occurred using conversion mixed data analysis which consisted of quantizing qualitative data and qualitzing RPS-DD data (see Supplemental Table A). Meta-inferences were derived from the syntheses of the qualitative and quantitative results (Teddlie & Tashakkori, 2009).

Preliminary qualitative data analysis began with the first interview, with analytic notes taken as a part of the field notes (Glesne, 2011). Data analysis was an iterative process in which ongoing, alternating and simultaneous process of data collection and data analysis occurred (Teddlie & Tashakkori, 2009). This involved reading and re-reading the interview transcripts and writing memos that led to coding (or categorization) of the data (Creswell & Poth, 2017). Both deductive and inductive approaches were used for content analysis (Sandelowski, 2000). Deductive coding was based on the defined dimensions of risk perception. To maintain rigor of qualitative description analysis, *in vivo* or using the participants own words was used when possible (Creswell & Poth, 2017). Open coding of the data was completed inductively through line-by-line reading and comparing codes with previous interviews. The PI and a co-author conducted open coding of three interviews independently and compared codes for congruency. The co-author also reviewed all transcripts and had weekly meetings to further discuss analyses. The PI created a codebook of codes and their descriptions (Creswell & Poth, 2017), as well as exemplary quotes from which the codes were derived. The codes were first classified into sub-categories (Creswell & Poth, 2017). Comparing the codes and generating sub-categories and categories from like codes aided in the classification of domains. The PI and a second co-author reviewed the classification and exemplary data supporting the coding system.

For the quantitative method, descriptive statistics were used to analyze the data from the background information and the RPS-DD subscales and composite score. The PI and third co-author reviewed all SPSS output. Correlations and comparisons to determine convergence and divergence of qualitative and quantitative findings were the basis of a meta-inference. The procedure for transforming data from qualitative to quantitative (and vice versa) was to (1)

numerically code (quantitize) qualitative data through verbal counting and (2) convert quantitative data into a narrative (Caracelli & Greene, 1993). Mean RPS-DD scores were transformed into a qualitative narrative profile (Teddlie & Tashakkori, 2009).

Strategies to Maintain Trustworthiness

Considerations for transferability, credibility, dependability, and confirmability were needed to maintain trustworthiness of qualitative findings (Lincoln & Guba, 1985). Participants were selected to optimize variation using a maximum variation sampling technique to allow for increased transferability of results (Wolf, 2012). Strategies used to strengthen credibility were the triangulation of data (e.g. audio-recorded interviews, transcriptions, and field notes), debriefing (weekly meetings with co-authors), and member checking (i.e. sharing the transcribed interview and final report with two participants for verification of accurate representation of risk perception and assurance that data saturation had been achieved) (Glesne, 2011; Lincoln & Guba, 1985). Finally, an audit trail was conducted by the co-authors to review the process of inquiry and the product of inquiry (Lincoln & Guba, 1985).

Results

Ten participants were interviewed and completed questionnaires (see Supplemental Table B). Half of the participants were male. The majority of the participants were married or had a domestic partner (60%), had a household income greater than \$75,000 (60%), and were first generation immigrants (80%). Ninety percent were overweight/obese. Regarding disease history, 50% of the participants had family history of diabetes, none had history of gestational diabetes, and 80% were initially diagnosed with prediabetes over a year ago.

Risk Perception Domains

The two risk perception domains emerging from the qualitative data were risk factors of prediabetes and diabetes and disease severity of prediabetes and diabetes (See Supplemental Table B). Participant names are pseudonyms to protect their identity.

Risk factors of prediabetes and diabetes. This domain consisted of two categories: health behaviors and personal, health, and family factors. The health behaviors perceived by participants as risk factors were sedentary lifestyle, eating habits, and stress management. Other risk factor subcategories included personal factors (e.g. increased age, race, and obesity), “coming from family” (indicating hereditary linkage), and cultural influences (including geographical, Vietnamese, and American influences). The risk factors with the richest data were eating habits and cultural influences, supported by the higher frequency of these subcategories (n=9 for eating habits and n=8 from cultural influences) presented in the sample (Figure 1).

[INSERT FIGURE 1 ABOUT HERE]

Most participants talked about eating large amounts of carbohydrates (including food and beverages high in sugar), sodium-rich foods and fish sauce, and fatty foods. Several participants mentioned that the main source of carbohydrates was rice and rice products. When considering influences on dietary habits, John talked about how overeating and unhealthy food choices were engrained early in life and that those habits were difficult to break. Chinh, Huy, and Lan talked about the social influences on their eating. Chinh referred to how he now limits socializing with his friends because of the associated drinking of alcohol which leads to excessive eating. Huy says that when “my friends coming to town, or my poor health father, or my mom, and we

decide to go for *pho* [Vietnamese rice noodle soup]...I will eat that pho.” Lan talked about how she makes healthier food choices when she eats alone, but that most of her meals are with her family and her husband (who cooks the meals) will get upset if she does not eat those foods.

When talking about cultural influences as a risk factor, most of that discussion was also linked to unhealthy diets. The main cultural influence discussed was the Vietnamese culture. The participants reiterated how Vietnamese “eat a lot of rice-based dishes”. Jane mentioned how Vietnamese “love their tropical fruit and that’s probably packed with sugar like jackfruit and...lychee definitely.” Jane also talked about traditional foods served during holidays such as *banh chung* and *banh tet* (Vietnamese dishes made primarily of glutinous sweet rice and mung bean) which are “in your childhood and it comes up as tradition...and takes you back to that feel-good moment.” While Chinh, Mai, and Quan all denied that there was a cultural influence on their risk, Quan later changed his mind when he talked about how Vietnamese “get arguably the worst of both worlds [Vietnamese and American] because you get more holidays...[which means] more of the celebratory meals.”

Other than the Vietnamese cultural influence, Huy talked about the regional influence of living in Las Vegas. He described how “you get free coupon, two-for-one, five-for-one, for seniors [at the buffet].” He went on to say that many Vietnamese “are gamblers, so they have tons of comps [free compensated meals given by the casinos].” Furthermore, Huy noted that “a lot of Vietnamese here in this region are [casino] dealers, so they got comped from that, so they bring their friends and their family...”

Disease severity. This domain consisted of two categories: prediabetes diagnosis and diabetes. The subcategories for their prediabetes diagnosis included their initial reactions to their prediabetes diagnosis, health concerns related to prediabetes, “I’m at risk”, and diabetes risk. The subcategories for diabetes were medication and complications.

The subcategory with the richest data and highest frequency of participant reporting (n=10; see Figure 1) was the initial reactions to the prediabetes diagnosis, which ranged from “not worried”, questioning the diagnosis, “slightly surprised”, “caught me off-guard”, “frightened”, and “freaked out”. Yen was not worried by her diagnosis saying that she is “too old right now...and can live around 10 more years.” Jane mentioned that she “was just glad that it was prediabetes and not actual diabetes” as she notes not being very surprised by the diagnosis given her family history of diabetes. Chinh instead reflected on his initial diagnosis of prediabetes by the health care provider stating how shocked he was, how he began questioning the diagnosis, and even stating that he may have overreacted to the diagnosis:

In my head, he’s givin’ me all this bad news, and I think I kinda tuned out a lot of things that he was saying. I was thinkin’, ‘how did I get this far?’ Because I was at that state. To me, it just sounded worse when I was sitting there.

Finally, Mai and Quan mentioned being “frightened” or “a little bit freaked out” as they considered their current experiences or knowledge regarding diabetes related to the need for medications (e.g. insulin) and/or the complications of diabetes (e.g. amputations and death).

The perception of diabetes risk was the main focus of this study, and therefore the related subcategories for “I’m at risk” (n=8) and diabetes risk (n=6) are pertinent. In these subcategories,

the participants acknowledged their diabetes risk due to their diagnosis of prediabetes and/or may discuss the level of perceived personal risk. Between the two related subcategories, nine of the ten participants discussed either having risk for diabetes or their level of diabetes risk. Only Yen did not mention this, but rather stated that she did not think that she was at risk for developing diabetes.

Most of the participants believed that they were at least some level of risk of developing diabetes. One of the most profound statements that came from Huy is how much he hated the term “prediabetes” as he equates it to the idiosyncrasy of using a term such as pre-pregnant because “either you’re pregnant or you’re not pregnant”. Huy goes on to say that he believes that having prediabetes indicates that “60 to 70 percent of your beta cells have already been gone...which means [that he is] at risk to be a frank diabetic”. Chinh and Mai did not feel that their diabetes risk was high as they considered the strategies they have implemented to prevent diabetes. John did feel that his diabetes risk would be high if he did not begin to adopt the necessary health-promoting behaviors.

Level of Perceived Diabetes Risk

The mean composite RPS-DD score was 2.15 indicating an overall low perceived risk of developing diabetes (Table 3). Participants had high levels of perceived personal control (mean score= 3.30), worry (mean score=3.10), and optimistic bias (mean score=2.75; this higher score indicates a lower comparative personal risk). Participants had low levels of perceived comparative personal disease risk (mean score=2.06) and perceived comparative environmental

risk (mean score=2.27), relating to low perceived personal risk of diabetes, diabetes-related health complications, other diseases, and potential environmental hazards.

[INSERT TABLE 3 ABOUT HERE]

Meta-Inference

Overall, the qualitative and quantitative data indicated a low level of perceived diabetes risk in VnA with prediabetes with a consideration of risk factors, disease severity, and preventing T2DM. Convergence resulted from similarities between the qualitative and quantitative data of most participants. Divergence resulted from difference between the qualitative and quantitative data of only one participant. The qualitative data regarding level of perceived risk from an additional participant was too ambiguous to determine convergence or divergence of data. Despite the two cases of divergence and ambiguity, these were not deemed to weaken the meta-inference that is best discussed via a narrative profile that was developed based on the nine participants with a low RPS-DD composite score (Table 4). This group had moderately high levels of personal control and worry, but slightly low levels of comparative risk, personal disease risk, and comparative environmental risk. The narrative profile depicts a group that perceives their overall diabetes risk is low because: (1) they believe that by developing a healthier lifestyle (i.e. “eat better” and “exercise more”) they are almost eliminating their diabetes risk and (2) the risk is never nonexistent. They also believe that they have a lower diabetes risk than the general population citing the increased rates of obesity in Americans. Despite having low perceived diabetes risk, the severity of diabetes is a “big concern”. Pertaining to the comparative

environment risk dimension from the RPS-DD, only Huy made one related statement that acknowledged the risk of getting into a car accident from driving on the freeway.

[INSERT TABLE 4 ABOUT HERE]

Discussion

The key findings from this study were the domains of risk factors, disease severity, and preventing T2DM. The risk factors of prediabetes and diabetes that emerged from this study were similar to the top three perceived causes of T2DM (diet, heredity, and stress) identified in an ethnography of VnA diagnosed with diabetes (A. T. Nguyen, 2014). Participants in this study reported the following perceived risk factors: sedentary lifestyle, eating habits, stress management, personal factors, heredity, and various cultural influences. Stress and the need for its management were mentioned by participants Jane, Anh, and Yen. As Jane explained this, “stress breaks down a body...it could cause you to have diabetes...if you don’t feel stressed, your heart feels lighter...and you don’t reach out for those comfort foods.” Perceived risk factors such as race/ethnicity, hypertension, and sedentary lifestyle have not been previously reported in other studies (Mull, Nghia, & Mull, 2001; A. T. Nguyen, 2014; A. T. Nguyen & Edwards, 2014). The cultural perceived cause of diabetes being “heat” (Mull et al., 2001, p. 309) as *am* and *duong* are a belief in the metaphysical causes of illness to be cold versus hot (Appel, 2013) was not found in this study despite the majority of participants being first generation immigrants.

A previous study found that the overall perceptions of VnA with T2DM were not congruent with professional knowledge (A. T. Nguyen, 2014). VnA label diabetes as a *benh tieu duong* or “disease with sugar in the urine” (A. T. Nguyen, 2014, p. 359), which is a literal

translation of the Vietnamese words to identify T2DM. Along with this literal translation of the disease, some participants perceived a less severe condition if sugar is not present in the urine. This finding did not emerge in this study, but this could be related to this sample's proficiency in English compared to the other study (A. T. Nguyen, 2014). Complications indicating severity of diabetes mentioned by participants were also noted in the A. T. Nguyen (2014) study.

Looking at the reliability of the RPS-DD in this study, the reliability coefficient of the personal control, optimistic bias, and comparative environmental subscales were similar to those in other publications (Kim et al., 2007; Walker et al., 2003; Walker, 2009). The worry subscale demonstrated a higher estimated reliability in this study compared to the Kim et al. (2007) study (Cronbach alpha .83 versus .50, respectively). The personal disease risk subscale performed with reduced estimate reliability in this study compared to the Walker et al. (2003) and Walker (2009) study (Cronbach alpha .52 versus at least .80). However, the qualitative data demonstrated congruency with this quantitative data supporting the conclusion of this sample's lower personal disease risk perception of comparative diseases.

A mixed method design was needed to explore the perceived risk of developing diabetes in VnA, as the sole use of qualitative versus quantitative designs would not have sufficiently revealed both the influences of the Vietnamese and American cultures on eating habits or the level of perceived diabetes risk. The analyses for convergence and divergence of data, the verbal counting of qualitative subcategories, and the rich descriptions added to quantitative data from the interviews in the narrative profile increased the current understanding of perceived diabetes risk in VnA through elaboration (Creswell & Plano Clark, 2018; Rossman & Wilson, 1985; Teddlie & Tashakkori, 2009). Awareness of the frequency of subcategories allows proper focus

for future diabetes prevention interventions. For example, the most predominant sub-category in the risk factors domain was eating habits. This combined with the awareness of the cultural influences on eating habits would allow researchers to place more emphasis on these factors for the diabetes prevention efforts.

Similar to this study, the mean composites RPS-DD scores were low (2.3 ± 0.5 , 1.97 ± 0.32 , 1.90 ± 0.40 , respectively) in other studies from the United States and the United Kingdom with sample sizes ranging from 59 to 208; no range of scores were reported (Guess, Caengprasath, Dornhorth, & Frost, 2015; Pinelli, Berlie, Slaughter, & Jaber, 2009; Pinelli, Herman, Brown, & Jaber, 2010). Only one participant in this study had a high composite RPS-DD score, but the qualitative data was ambiguous for level of perceived diabetes risk as she had been recently diagnosed and was awaiting a follow-up visit with her primary health care provider.

While there was an overall low perceived diabetes risk in this sample, they had a moderately high level of personal control. A single study reported a positive correlation with a medium effect between the likelihood of adopting preventive behaviors and perceived behavioral control ($r=.308$, $p\leq .001$) in a sample of African American participants (Seaborn et al., 2016). Given the associated increase in likelihood of adopting health-promoting behaviors to prevent diabetes in the African American population, this may translate to VnA who also have a high level of personal control and therefore may be more amenable to lifestyle intervention programs.

The transferability and generalizability of findings was limited due to the inclusion criteria requiring English proficiency and the low number of participants and geographic area sampled. However, the small sample size was appropriate given the qualitative dominant study.

Overall, the sample was diverse in terms of age, gender, marital status, and family history for diabetes. All participants in this study had some form of healthcare coverage, which is similar to other studies in which more than 90% of the participants were insured through Medicare, Medicaid, or both (Ngo-Metzger, Sorkin, Billimek, Greenfield, & Kaplan, 2012; Kaplan, Billimek, Sorkin, Ngo-Metzger, & Greenfield, 2013). The lack of participants with history of gestational diabetes was not surprising, given that the prevalence rate of gestational diabetes in Vietnam is approximately 5%. This rate likely has increased, paralleling the increasing diabetes prevalence rates in Vietnam since the 1990s shift in economic advancements (Khue, 2015).

Conclusions and Implications for Healthcare

The VnA population experiences a disproportionate burden of diabetes, and yet there are no interventions targeted to overcome this health disparity. The overall benefit of this study relates to increased awareness of risk perceptions of developing diabetes in VnA with prediabetes and potential readiness for participation in future interventions that target adoption of health-promoting behaviors. The use of a mixed methods research design allowed greater understanding of risk perception than the sole use of either qualitative or quantitative methods, greater capacity to inform both theory and practice (Johnson & Onwuegbuzie, 2004). The awareness that high levels of personal control and worry, as found in this sample, will help identify optimal candidates for diabetes prevention (Shaak et al., 2016). Diabetes prevention efforts in VnA should focus on increased screening for prediabetes and diabetes and increasing knowledge of risk factors and complications of diabetes. It will be important for healthcare providers to target dietary changes, incorporating exercise into daily routines, and acknowledge the need for stress management in this population.

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Table 1. Dimensions of Risk Perception as Defined for this Mixed Methods Study

Dimension	Type	Definition	RPS-DD Subscale Measuring Perceived Risk Dimension
General Risk	Cognitive	perceived risk of diabetes (e.g. severity of disease) ^{1,3}	Indirectly measured by Personal Disease Risk
Personal/ Noncomparative Risk	Cognitive	perceived risk of disease for self ³	Personal Disease Risk and Comparative Environmental Risk
Comparative Risk	Cognitive	perceived susceptibility or perceived risk compared to general population or to a person of similar age or gender ^{1,3}	Optimistic Bias
Optimistic Bias	Cognitive	perceived risk that is lower compared to actual risk ⁴	Not measured
Conditional Risk	Cognitive	perceived risk or likelihood in relation to certain behaviors ^{1,3}	Personal Control
Anticipatory Emotions of Disease Risk	Affective	feelings related to perceived risk (e.g. worry or anxiety) ^{2,3}	Worry

Note. ¹ Brewer et al. (2007); ² Ferrer, Klein, Persoskie, Avishai-Yitshak, and Sheeran (2016); ³ Sheeran, Harris, and Epton (2014); ⁴ Shepperd, Waters, Weinstein, and Klein (2015). Adapted from “Systematic Review: Risk perception of developing diabetes in the general population and Asian Americans,” by A. P. Nguyen, L. J. Loescher, and M. M. McEwen, 2019, *Journal of Transcultural Nursing*. (Manuscript # JTN-19-055).

Table 2. Domains, Categories, and Subcategories (including Definitions)

Domain	Category	Subcategory	Definition of Subcategory
Risk Factors for Prediabetes and/or Diabetes	Health Behaviors	Sedentary Lifestyle	Lack of exercise as a risk factor for diabetes.
		Eating Habits	Poor eating routines as a risk factor for diabetes. Eating foods that are considered unhealthy. Diets consisting of high carbohydrates (including foods with added sugar) or high sodium. Also overeating.
		Stress Management	The effects of stress on dietary choices as a risk factor for diabetes.
	Personal, Health, and Family History	Personal Factors	Characteristics of the individual that increases risk of developing diabetes (e.g. increased age, race, and obesity)
		Comes from Family	Family history of diabetes as a risk factor for diabetes.
		Cultural Influences	Cultural influences on eating or exercise that increase risk of diabetes. Cultural influences include geographic influences and ethnic influences.
Disease Severity	Prediabetes Diagnosis	Initial Reactions	Initial thoughts and feelings to being diagnosed with prediabetes.
		Health Concerns Related to Prediabetes	Concerns regarding physical well-being (e.g. cardiovascular risks, light-headedness, and ingrown toenails) related to being prediabetes diagnosis.
		I'm at Risk	Presence of perceived risk of developing diabetes.
		Diabetes Risk	Level of risk for developing diabetes.
	Diabetes	Medication	Taking medication(s) (e.g. insulin injections).
		Complications	Health complications of diabetes.
Preventing T2DM	Behavioral Changes	Modifying Behaviors	Examples of behavioral changes implemented in efforts to prevent diabetes.
		Results of Behavioral Changes	The resulting sense of physical well-being after making changes in health behaviors in efforts to prevent diabetes.
	Factors Influencing Health Behavioral Changes	Become Aware	Having awareness of the need for changes in health behaviors in order to prevent diabetes.
		I Do the Best I Can	Personal efforts to make health behavior changes to prevent diabetes.
		It Hit Home Hard	Factors that provided "motivation" to implement behavioral changes in efforts to prevent diabetes.
		Barriers to Preventing T2DM	Factors that impede health behavior changes that will aid in preventing T2DM.

Table 3. Results of Risk Perception Survey- Developing Diabetes (RPS-DD)

RPS-DD	Reliability (Cronbach's alpha)	Range of Scores	Mean Scores (SD)
Composite RPS-DD ^a	$\alpha=.64$	1.47-2.59	2.15 (0.31)
Personal Control Subscale ^b	$\alpha=.65$	2.25-4.00	3.30 (0.59)
Worry Subscale ^b	$\alpha=.83$	2.00-4.00	3.10 (0.81)
Optimistic Bias Subscale ^c	$\alpha=.70$	1.50-4.00	2.75 (0.89)
Personal Disease Risk Subscale ^d	$\alpha=.52$	1.53-2.80	2.06 (0.40)
Comparative Environmental Risk Subscale ^b	$\alpha=.86$	1.00-3.44	2.27 (0.78)
Knowledge	not applicable	36.36%-81.82%	60.91% (14.88%)

Note.

^a composite RPS-DD score is an average of 32 items comprising the five subscales with reversed scoring of four items to conform with the conceptual direction of composite score; 1= low overall perceived diabetes risk and 4.47= high overall perceived diabetes risk with the midpoint score equal to 2.23

^b 1=low perceived personal control/worry/comparative environmental risk and 4= high perceived personal control/worry/comparative environmental risk with midpoint score equal to 2.5

^c subscale is labelled as measurement of optimistic bias but the two items of this subscale measure comparative risk with a 1= strongly agree that perceived risk for T2DM and serious disease is decreased compared to other people with same age and gender and 4= strongly disagree that perceived risk for T2DM and serious disease is decreased compared to other people with same age and gender, with midpoint score equal to 2.5

^d 1= lower perceived comparative personal disease risk and 4= high perceived comparative personal risk with midpoint score equal to 3

Table 4. Descriptive Profile for Low Perceived Diabetes Risk Scores on the Risk Perception Survey for Developing Diabetes (RPS-DD) (n=9)¹

Level of Mean Scores for RPS-DD Subscales	Mean Scores (Standard Deviation)	Exemplary Qualitative Data
Moderately High Personal Control	3.31 (.62)	Quan ² : “I would say [there is a 0 to 10% chance of my developing diabetes] because I’m gonna try to definitely develop healthier lifestyle, and eat better, and exercise more.”
Moderately High Level of Worry	3.06 (.85)	John ² : “I know that there are people that are diabetic that have to be amputated, which [is]... a big concern. There's also people that I know that die early because of that.”
Slightly Low Level of Comparative Risk ³	2.89 (.82)	Chinh ² : “[I think others have a higher risk of diabetes than me because I think of] Americans as just being obese, or overweight, or not having a healthy lifestyle.”
Slightly Low Level of Personal Disease Risk	2.03 (.41)	Chinh ² : “Well, the reason why is I say my risk [for developing diabetes] is low is because I don’t think anybody’s risk is nonexistent.”
Slightly Low Level of Comparative Environmental Risk	2.19 (.78)	Huy ² : “Just like you driving here today on the freeway, knowing the risk [of getting into a car accident].”

Note. ¹= mean composite score for low perceived diabetes risk 2.10 with minimum score 1.47 and maximum score 2.34; ²= names are pseudonyms; ³=subscale is labelled as measurement of optimistic bias but the two items of this subscale actually measure comparative risk with a higher score indicating decreased perceived risk for diabetes and serious disease compared to other people with same age and gender

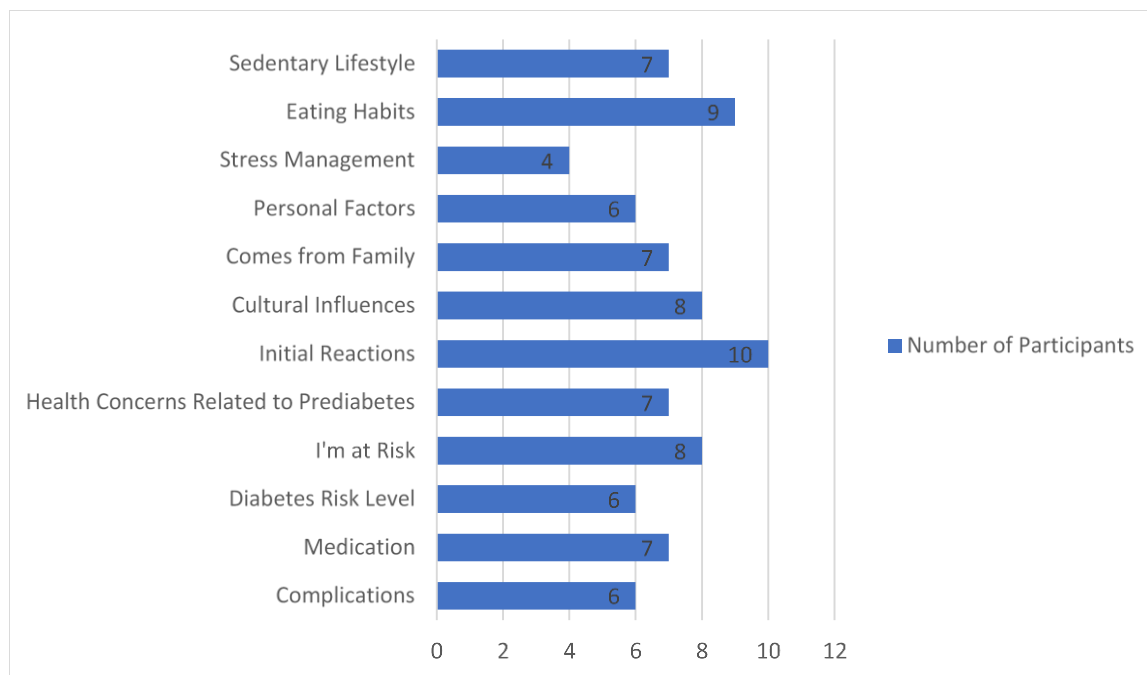


Figure 1. Verbal Counting for Qualitative Subcategories

Supplemental Table A. Terminology for Mixed Methods Study Design

Term	Definition
Convergence	This occurs when the qualitative and quantitative data for each participant is similar ¹
Data Transformation	The process in which quantitative data is converted into a description or narration and/or qualitative data is converted into numbers ²
Divergence	This occurs when the qualitative and quantitative data for each participant is dissimilar ¹
Meta-inference	The conclusion derived from the synthesis of qualitative and quantitative data analyses ²
Narrative profile	This is an example of qualitzing data, in which quantitative data is converted into a description or narration of a subsample ²
QUAL+quant	The uppercase “QUAL” (p. 143) indicates the priority of the methodological approach lies on the qualitative methodology and the plus sign indicates that the qualitative and quantitative methods are conducted concurrently ²
Qualitizing data	The process in which quantitative data is converted into a description or narration ²
Quantitizing data	The process in which qualitative data is converted into numbers ²
Verbal counting	Counting the percentage of people that the themes, categories, or subcategories occur ¹

Note. ¹ Creswell and Plano Clark (2018); ² Teddlie and Tashakkori (2009)

Supplemental Table B. Interview Questions and Resulting Themes

Interview Questions	Predominant Theme from Data
What were your thoughts and/or feelings when you were first told by your health care provider that you had prediabetes?	Disease Severity
What is your understanding of prediabetes?	Disease Severity
What is your understanding of diabetes?	Disease Severity
Now that you know you have prediabetes, how likely do you think it is that you will develop diabetes?	Disease Severity
What are some of the factors that could put you at risk for developing diabetes?	Risk Factors
What are some of the ways that you think you can prevent yourself from developing diabetes?	Preventing T2DM
How does being Vietnamese impact your perception of risk for developing diabetes in the future?	Risk Factors
Is there anything else you would like to tell me about what you believe to be your risk of developing diabetes in the future?	Risk Factors and Preventing T2DM

Note. T2DM= type 2 diabetes mellitus

Supplemental Table C. Sample Characteristics (n=10)

Sample Characteristic	% sample (n)
Family History of Diabetes	50 (5)
Age (years)	
- 30 to 39	30 (3)
- 40 to 49	20 (2)
- 50 to 59	20 (2)
- 60 or older	30 (3)
Male	50 (5)
Initial Prediabetes Diagnosis (years)	
- Less than 1	20 (2)
- 1 to 5	70 (7)
- Greater than 5	10 (1)
Marital Status	
- Married/Domestic Partner	60 (6)
- Divorced/Separated/Widowed	20 (2)
- Never Married/No Domestic Partner	20 (2)
Household Annual Income	
- Less than 25,000	10 (1)
- 25,000 to 49,999	10 (1)
- 50,000 to 74,999	20 (2)
- Greater than 75,000	60 (6)
Education level	
- Some college	50 (5)
- Bachelor's degree	30 (3)
- Postgraduate degree	20 (3)
First Generation Immigrant	80 (8)
BMI category	
- Normal (< 23 kg/m ²)	10 (1)
- Overweight (23 to 24.9 kg/m ²)	40 (4)
- Obese (≥ 25 kg/m ²)	50 (5)
BMI (mean)	27.70 (SD= 6.44)

Note. BMI= body mass index

APPENDIX D:
PARTICIPANT RECRUITMENT FLYER

APPENDIX E:
THE UNIVERSITY OF ARIZONA INSTITUTIONAL REVIEW BOARD APPROVAL
LETTER



Human Subjects
Protection Program

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Date: July 24, 2018
Principal Investigator: Angelina Phuong-Uyen Nguyen
Protocol Number: 1807760846
Protocol Title: A Mixed Methods Approach to Investigate Risk Perception of Developing Diabetes in Vietnamese Americans with Prediabetes

Determination: Approved
Expiration Date: July 22, 2023

Documents Reviewed Concurrently:

Data Collection Tools: *Background Information - Demographics.docx*
Data Collection Tools: *interview guide_7_17_18.docx*
Data Collection Tools: *Local Diabetes Prevention Program Referral.docx*
Data Collection Tools: *rpsdd_survey.docx*
HSPP Forms/Correspondence: *Advisor Confirmation email.pdf*
HSPP Forms/Correspondence: *Nguyen List of Research Personnel.pdf*
HSPP Forms/Correspondence: *Scientific Review and Department Review Confirmation Email.pdf*
HSPP Forms/Correspondence: *UA IRB application-7_17_18.pdf*
Informed Consent/PHI Forms: *Lina_informed consent form_2018_7_12.doc*
Informed Consent/PHI Forms: *Lina_informed consent form_2018_7_12.pdf*
Other: *COI Certification Complete for 1807760846.msg*
Other: *IRB_References.docx*
Other Approvals and Authorizations: *Site Authorization Letters_2018_June.pdf*
Participant Material: *educational handout.pdf*
Recruitment Material: *Eligibility Screening.docx*
Recruitment Material: *Recruitment Flyer 1.docx*
Recruitment Material: *Recruitment Flyer 2.docx*
Recruitment Material: *Recruitment Flyer 3.docx*

Regulatory Determinations/Comments:

- The project is not federally funded or supported and has been deemed to be no more than minimal risk.
- The project listed is required to update the HSPP on the status of the research in 5 years. A reminder notice will be sent 60 days prior to the expiration noted to submit a 'Project Update' form.

This project has been reviewed and approved by an IRB Chair or designee.

- The University of Arizona maintains a Federalwide Assurance with the Office for Human Research Protections (FWA #00004218).
- All research procedures should be conducted according to the approved protocol and the policies and guidance of the IRB.

- The Principal Investigator should notify the IRB immediately of any proposed changes that affect the protocol and report any unanticipated problems involving risks to participants or others. Please refer to Guidance Investigators Responsibility after IRB Approval, Reporting Local Information and Minimal Risk or Exempt Research.
- All documents referenced in this submission have been reviewed and approved. Documents are filed with the HSPP Office.

APPENDIX F:
INTERVIEW GUIDE

Risk Perception of Developing Diabetes in Vietnamese Americans with Prediabetes
Interview Guide

1. *Think back to when you were first told by your health care provider that you had prediabetes. What were your thoughts and/or feelings when you were first told you had prediabetes?*
2. *What is your understanding of prediabetes?*
3. *What is your understanding of diabetes?*

Script to clarify for all participants, especially those who are unaware of the difference between prediabetes and diabetes or the link between the two:

“Having prediabetes means your blood glucose (sugar) levels are higher than normal—but not high enough to be diagnosed as diabetes” (Centers for Disease Control and Prevention [CDC], 2018, para 10). Prediabetes may lead to type 2 diabetes, heart disease, and stroke.

“With type 2 diabetes, your body cannot properly use insulin (a hormone that helps glucose get into the cells of the body)” (CDC, 2018, para 11).

4. *Now that you know you have prediabetes, how likely do you think it is that you will develop diabetes?*

Prompting Statement/Question: *Tell me more about why you answered the way you did.*

5. *What are some of that factors that could put you at risk for developing diabetes?*
6. *What are some of the ways that you think you can prevent yourself from developing T2DM? Prompting Question: How likely are you to engage in these activities or behaviors?*
7. *How does being Vietnamese impact your perception of risk for developing diabetes in the future?*

Prompting Questions: *For example, how does being Vietnamese affect your diet or what you eat? How does being Vietnamese affect your physical activity? How do traditional holidays affect your diet or physical activity?*

8. *Is there anything else you would like to tell me about what you believe to be your risk of developing diabetes in the future?*

Participant ID _____ | Angelina Nguyen

Reference

Centers for Disease Control and Prevention. (2018). *National Diabetes Prevention Program:*

About prediabetes & type 2 diabetes. Retrieved from

<https://www.cdc.gov/diabetes/prevention/prediabetes-type2/index.html>

APPENDIX G:
BACKGROUND INFORMATION

Risk Perception of Developing Diabetes in Vietnamese Americans with Prediabetes
Background Information

Instructions for Item 1:

Please circle the letter(s) corresponding to all answers that apply to you.

1. Have any immediate family members been diagnosed with diabetes?
- A. Father B. Mother C. Sibling D. Son or daughter
(brother or sister)
- E. None of the
Above

Instructions for Items 2-10:

Please circle the letter corresponding to the answer that best applies to you.

2. Which age range applies to you?
- A. Less than 30 years B. 30-39 years C. 40-49 years D. 50-59 years E. 60 years or older
3. Gender
- A. Male B. Female
4. When did you first receive the prediabetes diagnosis?
- A. Less than 1 year B. 1 to 5 years C. Greater than 5 years
5. If you are a woman who has ever been pregnant, have you been diagnosed with gestational diabetes?
- A. Yes B. No C. Not Applicable
6. What is your marital status?
- A. Married/Domestic Partner B. Divorced/Separated/Widowed C. Never Married, No Domestic Partner

Participant ID _____ | Angelina Nguyen

7. What is your household income in this past year?

- A. Less than \$25,000 B. \$25,000 to \$49,999 C. \$50,000 to \$74,999 D. Greater than \$75,000

8. What is your health insurance status?

- A. No insurance B. Medicaid C. Medicare D. Private Insurance

9. What is your highest education level?

- A. Less than or equal to high school diploma B. Some college C. Bachelor's Degree D. Postgraduate Degree

10. Which of the following best applies to you?

- A. Born in Vietnam B. Born in U.S. and at least one parent born in Vietnam C. Born in U.S. and both parents born in U.S.

D. Other

Instructions for Items 11-12: Please write your answer on the line provided below the item.

11. Height

_____feet

_____inches

12. Weight

_____pounds