An Examination of Intervention Components that Influence Engagement in Latino Community-Based Diabetes Prevention Program

by

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ABSTRACT

This study examined the responses of Latino community residents diagnosed with pre-diabetes using a complex convergent mixed methods design nested within a three-factor factorial design (age, language, and gender) to understand the intervention contents and activities that are most important to study participants for helping them to prevent the development and onset of type 2 diabetes (T2D). Chapter 1 introduces the topic and provides background literature. Chapter 2 systematically synthesized findings from diabetes prevention studies to identify efficacious intervention components and social contextual resources that have been used to support diabetes prevention in Latinos who are prediabetic or at risk of developing diabetes. Chapter 3 analyzed the qualitative portion of one section within the Latino Lifestyles study protocol. Based on the Integrative Mixed Methods (IMM) methodology, we conducted a thematic analysis to identify emergent themes for each of the three focus questions, as administered in individual interviews with 28 Latino and Latina participants. Chapter 4 utilized the findings from Chapter 3 to examine the levels and associations of three potential moderator variables: (a) health motivation, (b) diabetes awareness, and (c) diabetes concern among Latinos diagnosed with prediabetes. A 2x2 cross-tabulation analysis tested group differences in the mention of response phrases as examined by two levels (high versus low) of the potential moderator variables. The study results offered meaningful intervention components such as healthy cooking classes and assistance with lifestyle changes related to diet and exercise for themselves and their families,, as expressed by the participants. These findings provide informative intervention components for developing a Latino community-based diabetes prevention program

designed to enhance engagement and lifestyle changes for individuals diagnosed with prediabetes.

Keywords: community-based interventions, lifestyle prevention, social-ecological model

DEDICATION

I dedicate this dissertation to my parents, my husband, and my children. Thank you for your support throughout my doctoral program journey. You allowed me to pursue my dreams with unwavering love and belief in me. For this, I will always be grateful.

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CHAPTER 1

INTRODUCTION

A Lifestyle Intervention to Prevent T2D

A major problem exists in the Latino communities related to lifestyle and diabetes prevention. A systematic review of real-world DPP learning over a 15-year period revealed that adherence to guidelines on content and delivery was significantly associated with weight loss (Aziz et al., 2015). However, findings also suggested low participation in most research and clinical studies due to a focus on developing intervention content. Conversely, less attention has been given to intervention fit within the program delivery setting and the needs, preferences, and engagement of the individuals and families receiving that intervention (Aziz et al., 2015). The design of lifestyle intervention programs requires strategies that focus on optimizing engagement and program retention for long-term adherence and effective healthful behavior change (Aziz et al., 2015). Lifestyle interventions such as maintaining a balanced diet and engaging in regular physical activity or exercise are considered the first line of prevention and treatment in diabetes prevention (DiBenedetto et al., 2016).

Lifestyle behaviors involving positive self-management strategies and healthful choices can develop into healthy habits over time. Lifestyle intervention programs such as the Diabetes Prevention Program (DPP) demonstrate the effectiveness of organized diabetes prevention intervention strategies (Albright & Gregg, 2013; Gruss et al., 2019; Venditti, 2016). The DPP has been translated to meet the needs of various communities at a higher risk for developing diabetes, including Latino communities (Aziz et al., 2015; Ruggiero et al., 2011; Soltero et al., 2018). Nonetheless, the adoption of DPP by a given organization, its effective delivery with relevant fidelity and needed adaptations, and

planning for program sustainability persist as issues in DPP delivery at sufficient scale and responsiveness to diverse cultural settings to produce lasting changes in the incidence and prevalence of T2D. Additional implementation science research is needed to design and deliver more effective and lasting diabetes prevention programs across diverse community settings.

Diabetes Among Latinos

Type 2 Diabetes (T2D) prevention has been a primary research focus for many years. This preventable disease is accompanied by significant costs and health complications. T2D is the primary risk factor for developing cardiovascular disease (CVD) (Gomez et al., 2022), and CVD is one of the leading causes of death in communities of color, such as diverse Latino communities (Virani et al., 2021). Although the prevalence rate for developing TD2 within the US Latino population has improved from 12.5% in 2020 to 11.8% in 2022, this is significantly higher when compared to the T2D prevalence rate among non-Hispanic whites of 7.4% and the prevalence rate among non-Hispanic Asians of 9.5% (CDC Report, 2020; CDC Report, 2022).

The Latino population is one of the fastest-growing racial/ethnic groups in the US and is projected to consist of 30% of the population by 2050 (CDC Report, 2021). Researchers have shown over the years that lifestyle behavior modifications and early recognition and management of prediabetes may decrease the risk of T2D in this population (O'Brien et al., 2015; Vitolins et al., 2019; Wagner et al., 2020). The American Diabetes Association describes prediabetes as a blood glucose level higher than normal but not yet high enough to be diagnosed as type 2 diabetes. Pre-diabetes is a precursor to

developing the diagnosis of T2D. Prediabetes is defined as having a Hemoglobin A1C level of 5.7% to 6.4% (ADA, 2023). A diagnosis of prediabetes represents a critical decision-making point in a person's life. When faced with this daunting challenge, one must decide to take charge of one's health and make positive changes in lifestyle behaviors and attitudes to reduce one's risks of developing the sequelae associated with T2D.

Social Context and Culture

From the perspective of a Social Ecologic Model (SEM), context describes the ways in which social variables, whether situational or environmental, influence personal health behaviors and outcomes (Castro et al., 2009; de Wit et al., 2020; Fleury & Lee, 2006). These variables include neighborhood, occupation, situations, gender, family dynamics (Castro et al., 2009; de Wit et al., 2020), and an individual's social needs. For example, information obtained about food insecurities may lead to a referral for nutritional counseling or a social worker for assistance from a food pantry (Hessler et al., 2019). Culturally relevant interventions require careful planning inclusive of social contexts to attain healthy targeted outcomes. For example, a therapist must consider cultural and familial conditions when developing a culturally relevant intervention for a Latino family, as this intervention protocol can guide and produce significant changes in targeted outcome measures (Castro et al., 2009).

Cultural adaptation is a planful approach that can enhance intervention outcomes by increasing participant engagement and effectiveness in changing targeted outcomes (Castro et al., 2009; Castro et al., 2023). Collaborative partnerships between community-

based programs, academia, and health professionals are essential for incorporating local social contexts into a health promotion intervention, thus tailoring the core intervention with culturally relevant intervention modifications that adequately meet the needs of the individuals and the local community. This collective partnership affords stakeholders with opportunities to propose and apply community-based participatory research (CBPR) principles to improve the dissemination and implantation of that evidence-based intervention (EBI) (Castro et al., 2023).

The Social Ecological Model

The Social Ecological Model (SEM) used as a framework for the present study consists of a multilevel hierarchical framework developed by McLeroy et al., 1988. The SEM is used to conceptualize the complexity of interacting factors involving the individual, interpersonal relationships, community, and social factors (CDC, 2022). The SEM is commonly used in the health promotion field to conceptualize and understand the systemic, real-world, multi-level effects that often influence health behaviors (Fleury & Lee, 2006; Golden et al., 2015; Stokols, 1996). The SEM consists of five interactive levels that are influential in reinforcing sustainable health improvements (Golden & Earp 2012: Stokols, 1996). These levels are described as: (a) *the intrapersonal* – promotes knowledge, attitudes, behavior, and personal awareness; (b) *the interpersonal* – emphasizes relationships and social interaction as well as formal and informal networks; (c) *the institutional* – social institutions that establishes rules and regulations, (d) *the community* – networks of organizations and institutions and (e) *public policy* – local, state and national laws and policies (McLeroy et al., 1988). The institutional and community

levels also include neighborhood outreach and community health programs (Golden & Earp, 2012; Stokols, 1996). The present study focuses on three levels of the SEM (see Figure 1). These are the intrapersonal level, the interpersonal level, and the community level. Chapter 2 offers an in-depth description of the SEM framework.

Summary of this Study and Its Chapters

This dissertation study seeks to fill the gap in knowledge related to diabetes intervention prevention by using empirical data to identify specific approaches in intervention content and intervention implementation that will make a diabetes prevention intervention more culturally relevant, acceptable, and engaging among various sectors of the local Latino community. The aim is to enhance diabetes prevention intervention for delivery with diverse Latinos and Latinas who are prediabetic and are at risk of developing T2D.

The Latino Lifestyles Study

The Latino Lifestyles study is the parent study of this dissertation. The protocol included three types of data-gathering instruments (parts). Part one consists of a structured interview called the *Platica* (a chat). This instrument consists of an interviewer-administered series of "focus questions" that produce qualitative text narratives that can yield a greater depth of understanding of the perspectives offered by study participants. Part two consists of a *Lifestyles Questionnaire* that contains quantitative scales and individual items. For each participant, this instrument examines several personal, interpersonal, and sociocultural aspects of the participant's lifestyle. Part three is an eight-item *Post-Interviewer Behavioral Assessment* that consists of

interviewer ratings conducted after the completion of an interview. It captures key participant features as observed and rated by the interviewer. The present study used two scaled items from this post-interview rating. These two interviewer-rated items are the one-item scale of Diabetes Awareness and Diabetes Concern. Additional details about the Latino Lifestyles Study are presented in Chapters 3 and 4.

Participants were selected from individuals enrolled in the Arizona Insulin Resistance Registry, where participants were phenotyped for T2D risk factors (Shaibi et al., 2013). A purposeful, balanced sampling of eligible cases was utilized, which consisted of the following inclusionary criteria: (a) adult Latino males and females who were at least 18 years of age, (b) who were assessed to have pre-diabetes, and, therefore at risk of developing T2D. The criteria for assessing pre-diabetes were: (a) a fasting blood glucose of 110mg/dl or higher; (b) a 2-hour, post-challenge glucose of 140mg/dl - 199mg/dl; and/ or (c) a HbA1c of 5.7-6.4% (American Diabetes Association, 2021). Twenty-eight participants were selected using a balanced three-factor (2x2x2) factorial design: (a) *gender* (male, female), (b) *primary language* (English, Spanish), (c) *age groups* (less than 40, 40 or greater) to ensure equal or almost equal cases.

Overall Research Question

For this study conducted in the greater Phoenix, Arizona area, the overarching focus question is, "What are Latino community residents' preferred intervention components in a diabetes prevention intervention that is responsive to their interests and may result in increased program engagement?"

Chapter 2

Chapter 2 presents a systematic review of the SEM as a conceptual framework to identify the major social-ecological factors associated with effective diabetes prevention for diverse Latino communities. The purpose of Chapter 2 was to examine which SEM levels of influence are commonly found in research studies for Hispanics with prediabetes and at risk of developing diabetes. We then identified within these studies which intervention components and social contextual resources are associated with effective outcomes.

Findings from Chapter 2 suggest that interventions such as education, exercise, and introducing lifestyle enhancement skills to improve food choices or meal preparation were designed to intervene at the intrapersonal and interpersonal levels of the SEM. Social interaction activities were encouraged with family and friends at the interpersonal level. This approach is known to positively impact health outcomes (Castro et al., 2009; Hessler et al., 2019).

Additional findings from this systematic review suggest that effective outcomes are associated with participant engagement in nutrition and exercise-based intervention components. All studies included in this literature analysis integrated a form of physical activity as an intervention component and cultural considerations such as the inclusion of bilingual (English and Spanish) instructors, Spanish language workshops, and culturally appropriate curriculums. The overall community-level engagement was addressed collaboratively. Each study promoted a partnership with various stakeholders such as community members, health practitioners, and academic institutions, encouraging

interprofessional collaborations to promote diabetes prevention education and awareness effectively. These findings were used to inform the analyses in chapters 3 and 4.

Chapter 3

Chapter 3 presents the findings of a qualitative study designed to identify meaningful intervention components (content and activities) for the design and adaptation of a Latino community-based diabetes prevention program. This study assessed participants' desired resources, important program features, and ways to make the experience interesting for participants and their families using three specific focus questions: (a) *community needs for a diabetes prevention program*, "What are the most important needs for diabetes prevention within the local Latino/Hispanic community of Phoenix?"; (b) *desired resources*, "What resources do you want that could help prevent diabetes for you and your family?"; and (c) *interesting features*, "What would make a diabetes prevention program interesting to you?" These focus questions elicited insights into resources and intervention components from a local Latino community perspective to inform the development of enhanced interventions that are more effective and culturally acceptable for promoting diabetes awareness, increasing prevention knowledge, and for designing, disseminating, and implementing more culturally relevant community-based preventive interventions and programs.

Findings from focus question one: "What are the most important needs for diabetes prevention within the local Latino/Hispanic community of Phoenix?**"** revealed four major themes: (a) *community-level resources to raise awareness about diabetes disease process,* (b) *prevention education about the disease of T2D,* (c) *importance of*

Dieting and Healthy Foods and (d) *financial assistance and resources for diabetes-related needs.* These themes suggest that participants desire a diabetes prevention intervention program that can address the structural barriers in their communities that prevent them from accessing meaningful resources such as educational resources, safe places to exercise, and healthy foods available within the community. These structural barriers are antecedent factors in the development of health disparities.

The findings from focus question two: "What resources do you want that could help prevent diabetes for you and your family?" revealed three major themes: (a) s*implified prevention resources for lifestyle balance,* (b) *access to affordable care, healthy food options and exercise,* and (c) *information about healthy food choices*. These themes suggest that participants seek cultural intervention components such as a *personalismo,* a trusted professional that provides education and advice about ways to prevent diabetes. Participants seek affordable care for diabetes screening and resources to promote self-management.

The findings from focus question three: "What would make a diabetes prevention program interesting to you?" revealed four major themes: (a) *an organized activity for self-directed change,* (b) *individually tailored diet and exercise programs,* (c) i*ndividually tailored education on diabetes disease process* and (d) *hands-on healthy cooking classes.* These themes suggest a significant need for individualized intervention components such as cooking and exercise classes and interaction with professionals or educators who understand Latino culture. The overarching theme throughout the thematic analysis centers on the need for culturally appropriate interventions for the local Latino

community as well as access to diabetes prevention education, screening for diabetes, and access to key resources such as healthy food options within the community that are essential for diabetes prevention management.

Chapter 4

Chapter 4 used the thematic analysis established in Chapter 3 to inform this study's Integrative Mixed Method (IMM) approach. Participants were asked to self-rate their general health motivation to add depth and deeper insight. By contrast, the interviewers who completed a *Post-Interview Behavioral Assessment* were asked to respond to scale items that assess levels of important health-related issues. Two of these items used in the present study are interviewer ratings of study participants in terms of their Diabetes Awareness and Diabetes Concerns. Mixed methods integration commonly occurs by merging, connecting, or embedding qualitative and quantitative information to allow the joint analysis of these two forms of data in a manner that provides a greater yield than can be obtained by using either the qualitative or quantitative data approaches independently (Creamer, 2018; Creswell & Creswell, 2018). This approach allows a more in-depth analysis of selected narratives, thus offering a more rigorous identification of measurable co-variation among the quantitative and qualitative data, as this can identify significant associations between qualitative thematic variables (that are temporarily encoded into numeric form) and the measured variables, which consist of the original quantitative (numeric) scales and items.

This mixed methods study consists of two aims. The first aim was to examine the levels and associations of three *potential moderator variables*: (a) Health Motivation, (b)

Diabetes Awareness, (c) Diabetes Concern, as expressed by participating adult Latinos and Latinas who have prediabetes. In a thematic analysis, textual data from the open-ended interview focus questions described in Chapter 3 were used to identify important themes that served as key components for a culturally responsive diabetes prevention intervention as reported by these local Latino community residents. Given the relatively small-sized sample and to conduct simple yet robust cross-tabulation analyses involving these themes, we dichotomized these into two levels (high versus low). We also conducted this dichotomization for each of these three potential moderator variables.

The second aim of this IMM study involved exploring these three potential moderator variables as effect modifiers of the mention and non-mention of each identified theme. That is, we examined this potential moderator effect for the three variables of (a) greater *health motivation* that would indicate a greater desire to live a healthy lifestyle, (b) greater *diabetes awareness* (a measure of diabetes health literacy), and (c) greater *diabetes concern* a measure of preparedness to take action to protect themselves in preventing the onset of T2D.

For example, for the variable of Diabetes Awareness, we conducted a 2 x 2 cross-tabulation analysis to examine casewise differences (that reveal an interaction effect) in the distribution of cases among participants high and low in Diabetes Awareness (an indicator of diabetes-specific health literacy). The rationale for this analysis is that Latinos and Latinas having more heightened diabetes awareness (higher diabetes-related health literacy) are expected to provide more informed and thoughtful comments and recommendations to aid in the design of diabetes prevention interventions when

compared with comments provided by participants exhibiting low diabetes awareness (low diabetes-related health literacy). In addition, we examined these response phrases by levels of a research design factor, for example (male vs. female; $\geq$ 40 years old vs. < 40 years old; Spanish vs. English).

When comparing cases of high versus low diabetes awareness, a significant finding for the potential moderator variable language (English and Spanish) and the theme Healthy Cooking Classes was observed, and a noteworthy trend was observed on the potential moderator variable of language (English and Spanish) and the theme Organized Activities, as well as the potential moderator variable diabetes awareness as observed for two themes: (a) Diet and Exercise Programs, and (b) Healthy Cooking Classes (see Chapter 3).

The outcome from this study is consistent with all chapters as this involves the participant's desire to maintain a healthy and balanced lifestyle that includes diet and exercise. Intervention components that provide access to education about healthful dietary options and resources to promote engagement in exercise and physical activities are associated with diabetes prevention (Magkos et al., 2020) and contribute to maintaining a balanced lifestyle. The high diabetes awareness group mentioned education and resources promoting healthy eating habits, such as hands-on cooking classes, access to local healthy foods, and access to nutritional consulting or nutritionist-led group sessions.

From a community-based participatory perspective, our findings highlight the need for cultural and local intervention adaptations focusing on the local Latino

community residents' needs and preferences. Participants with high diabetes awareness expressed a desire for family-oriented interventions, such as physical activities to promote being "active as a family," and cooking fairs that offer meal preparation. These forms of group activities draw the community together while encouraging engagement.

Chapter 5

Chapter 5 is the final chapter of this dissertation study. It presents an integrated discussion of the major findings from Chapters 2 to 4 and recommendations for future research. Intervention adaptation and fit is essential given the considerable variations found across the US in diverse Latino communities, as influenced in part based on the extent to which their lifestyle is embedded within their Latino culture. Local community members' participation in the design and development of community-based programs can help enhance the cultural relevance of science-based evidence interventions (EBIs) as these are developed to facilitate dissemination and implementation within diverse communities and by removing social and community structures that produce inequities and health disparities. These intervention design and implementation strategies are important to ultimately produce changes at various levels of the Social Ecological Model, as these changes can improve the quality of life of Latinos and Latinas who are residents of diverse communities nationwide.

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CHAPTER 2

MANUSCRIPT 1

The Social Ecological Model and Latino Diabetes Prevention: A Descriptive Review

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Abstract

Purpose

This review synthesizes findings from studies to identify efficacious intervention components and social contextual resources that have been used to support diabetes prevention in Latinos who are prediabetic or at risk of developing diabetes.

Methods

A social-ecological model (SEM) was used as a conceptual framework to identify the major social-ecological factors associated with effective diabetes prevention for Latino communities. We conducted a systematic review of peer-reviewed literature published from January 2015 through June 2022 that described community-based diabetes prevention intervention components for Latinos diagnosed with prediabetes or at risk of developing diabetes. The study quality was assessed using the EPPH Quality Assessment criteria.

Results

Nine studies met the inclusion criteria and examined a range of community-based diabetes prevention intervention components and related outcomes. The quality assessment resulted in two studies rated as having moderate quality and seven studies rated as having strong quality. According to the SEM, findings suggest: (a) all studies mention intrapersonal intervention components. Emphasis was placed on intervention components that impact behavioral changes and self-management using classroom-style education directed at nutrition and weight management, (b) eight of the studies reviewed

contained intervention components or resources that influenced the interpersonal level. Social engagement and peer interaction were found to be culturally fundamental, and (c) all studies integrated community-based lifestyle intervention components such as physical activity. Participants were offered access to safe places (e.g., facilities, and open fields) to exercise within the community. All studies included cultural considerations in the design of lifestyle intervention components, and six studies integrated aspects of the Diabetes Prevention Program (DPP).

Conclusion

This information is useful to community outreach practitioners and public health researchers when developing or adapting future diabetes prevention programs. A comprehensive, interdisciplinary diabetes prevention program with social contextual intervention and resources directed at multiple levels of the SEM will likely have the greatest impact on improving health behavior outcomes in prediabetic Latinos.

Keywords: community-based interventions, cultural approach, prediabetes, health behavior outcomes

The Social Ecological Model and Latino Diabetes Prevention

Ninety-six million adults in the United States (US) are affected by prediabetes, which constitutes 38% of the population and a total of 14.3% of the Hispanic population (Center for Disease Control [CDC] Report, 2022). The Hispanic population is the largest minority group in the United States (U.S.), having grown by 23% over the last decade compared to 4.3% of other ethnic groups (U.S. Census, 2021). The Hispanic population is projected to constitute 30% of the U.S. population by 2050 (U.S. Census, 2021) and is expected to double in size by 2060 (Vespa et al., 2020). The prevalence of diabetes in Hispanics is 12.5% compared to non-Hispanic Whites 7.5% (CDC, 2020). Hereafter, we will refer to this racial/ethnic group as "Latinos."

Prediabetes is diagnosed with a Hemoglobin A1C (HbA1c) of 5.7% to 6.4% or a fasting blood sugar of 100mg/dl to 125mg/dl (American Diabetes Association (ADA), 2021, CDC Report, 2022). Prediabetes is a precursor, if left unmanaged, for diabetes: those with prediabetes have up to 70% risk of developing T2D (Kleinherebrink et al., 2018), compared to 2% of those without prediabetes (Iranfar & Smith, 2018). The progression from prediabetes to T2D in the U.S. is projected to increase by 198% between 2005 and 2050 among non-Hispanic whites and 481% among Hispanics (Perez et al., 2015).

The American Diabetes Association reported that 1.5 million people will be diagnosed with diabetes this year (ADA, 2021). This is alarming given that the prevalence of T2D in the Latino population is 11.8% (CDC Report, 2022). T2D, characterized by HbA1c of $\geq$ 6.5%, is a primary risk factor for cardiovascular disease

(CVD) (Gomez et al., 2022). CVD remains the leading cause of death in Hispanics, affecting 42.7% of Hispanic women and 52.3% of Hispanic men (Virani et al., 2021). T2D is accompanied by significant cost, health complications, and decline in quality-of-life (CDC, 2022; Shaak et al., 2018; Hessler et al., 2019; de Wit et al., 2020).

With the steady increase in T2D and its complications researchers have spent the past decade trying to identify meaningful ways to reduce the risk of developing T2D (Gruss et al., 2019; O'Brien et. al., 2015; Shaak et al., 2018; Wagner et al., 2021). Although studies show that lifestyle modification and dietary changes can reduce the risk of developing T2D in the Latino population (Bowe et al., 2016; Kriska et al., 2021) there still exists a strong need for community-based prevention intervention and the provision of resources especially for those who are diagnosed as having prediabetes (Hessler, 2019).

The risk of developing diabetes can be costly and result in significant health and quality-of-life complications (CDC Report, 2022; Shaak et al., 2018; Hessler et al., 2019; de Wit et al., 2020). There is still limited research on how best to guide or empower individuals about the complexity of diabetes and on ways to cope effectively with challenging environments. These challenging environments include, (a) the stressors and social support present in family relationships, (b) education that includes knowledge about dietary, exercise and self-management for a healthful lifestyle, and (c) workplace conditions that promote healthful lifestyles (de Wit et al., 2020). Accordingly, culturally relevant research is needed to develop preventive interventions that help residents in Latino communities to reduce their risk of developing T2D. This can be accomplished by

a greater understanding of the influences of social and familial contexts that need to be incorporated into preventive intervention components, and the inclusion of resources that are culturally and personally relevant for engaging consumers' participation in these interventions. In principle, preventive interventions that are well developed should contribute to the important outcome of reducing diabetes progression among persons with prediabetes.

Social Ecological Model

Effectively responding to the complex challenges experienced in public health and community-oriented health promotion requires a multilevel system analysis. A multilevel system analysis aids in the understanding of the multiple factors, and their interactions, to design efficacious and culturally relevant interventions that will promote healthful changes in specific health-related behaviors (Burke et al., 2009; Fleury & Lee, 2006; Golden & Earp, 2012). The *Social Ecological Model* (SEM) McLeroy et al., 1988 is a meaningful framework widely employed in public health research and practice (Burke et al., 2009; Fleury & Lee, 2006; Stokols, 1996). As shown in Figure 1, the SEM multilevel framework describes five principal levels of influence: (a) intrapersonal, (b) interpersonal, (c) institutional, (d) community, and (e) public policy (Stokols, 1996). This systems analysis allows researchers to effectively conceptualize the ways in which individuals, their social networks, and organized groups produce community context that can inform the development of programs, policies and environmental structures to produce healthful behavioral changes (Sallis et al., 2006; Stokols, 2018). These SEM levels are interactive and influential in reinforcing sustainable health improvements

(Golden & Earp, 2012; Stokols 1996). They offer researchers and practitioners a framework that can contribute to producing health outcomes based on the application of a multilevel approach.

This review focuses on three levels within the SEM, the intrapersonal, the interpersonal, and the community/environment (see figure 1). Each level offers interventions directed towards specific behavioral changes: (a) the intrapersonal level interventions are directed towards personal education and skills development are used to promote personal awareness (Stokols 1996), (b) the interpersonal level is driven by relationships and influenced by social interactions within the family system and the social environment (Golden & Earp, 2012; de Wit et al., 2020). Interactions at this level can influence an individual's attitude, self-concepts, and knowledge (Stokols 1996). Interventions at the interpersonal level include engagement in activities that are culturally relevant. Culture is described as "*life ways*" that includes customs and traditions, it promotes a sense of identification and belonging (Castro & Alarcon, 2002). For Latino populations, this typically includes integrating values and traditions such as *familismo* (family), *respeto* (respect), and *confianza* (trust) at the interpersonal level (Castro et al., 2023; Castro et al., 2009; Soltero et al., 2019), and (c) the community level includes neighborhood, healthcare systems (clinics) and community outreach programs designed to empower disadvantaged groups. Some cultural adaptation strategies at the community level are engaging community health workers, *promotoras* (trained community members), and *navegantes* (peer educators) to promote outreach and facilitate activities

that promote diabetes awareness and prevention (Golden & Earp, 2012; Castro et al., 2009; Stokols 1996).

The SEM provides a framework for understanding correlates of intervention components and resources used within a social context to support diabetes prevention for Latinos who are prediabetic or at risk of developing diabetes. The SEM provides a systems analysis that can be used to organize and evaluate health promotive interventions in a community-based environment. This allows for an inherently interdisciplinary approach to health research and the development of health promotion programs. Developing community-based programs that focus on interventions and resources that impact the structure and function of the Latino community may add depth and knowledge into the development of meaningful diabetes prevention programs.

Social Context

Social context refers to our understanding of the ways in which social variables influence personal health management (de Wit et al., 2020). Social contextual variables include neighborhood, occupation, situations, gender, environments of support, family dynamics, system characteristics, education, and individual cultural contextual variables such as *acculturation*, *familism*, and *traditionalism*. (Castro et al., 2009; de Wit et al., 2020). Social contextual factors can also influence inequality and disparities within a given community. For example, an individual's neighborhood of residence can have a considerable impact on physical activity (Heredia et al., 2022; Lee et al., 2021; LeBrón et al., 2019; Silfee et al., 2016) as a significant lifestyle modification in diabetes prevention. Individuals who perceive their neighborhoods as safe and walkable are likelier to engage

in physical activities (Silfee et al., 2016). By contrast, individuals exposed to discrimination in their neighborhoods are more likely to experience diabetes-related disparities such as low health literacy (Hill-Briggs et al., 2021), depressive symptoms (LeBrón et al., 2019) and are also less likely to do physical activity (Lee et al., 2021).

Culture is influenced by context, Culture is not random, bounded, or static; instead, it is dynamic and fluid and an integral part of the world around us (Burke et al., 2009). Culture and cultural norms are constantly shaped and reshaped by the people in our social circles and by existing surrounding community structures. Cultural beliefs, attitudes, and practices, individually and in combination, contribute to a person's worldview, which, in turn, influences that person's health-related motivations and behavioral efforts toward personal health management.

Research and health programs in diabetes prevention require health system collaboration and community-oriented health promotion for designing and developing health promotion interventions that are relevant and acceptable to diverse residents of a local neighborhood or community (Wallerstein et al., 2018). Community-based participatory research (CBPR) is a collaborative approach to research that equally involves the community to promote social change and community health (Wallerstein & Duran, 2006; Wallerstein et al., 2018). The CBPR research design harnesses the strength of both the researcher and the community members who are engaged (Campbell et al., 2020; Wallerstein & Duran, 2006; Wallerstein et al., 2018). Accordingly, designing and developing diabetes prevention interventions that motivate and guide more effective diabetes preventive behaviors can be informed by feedback received from various local

community residents. Capturing the needs and preferences of residents within a local community is more likely to engage these residents, and to be more effective in producing healthful behavioral and other forms of change that effectively improve identified health outcomes that reduce the likelihood of developing T2D (Hessler et al., 2019).

C*ultural tailoring or adaptation* of an existing evidence-based intervention (EBI) to render it more culturally relevant for individuals such as Latinos and Latinas having pre-diabetes can improve its acceptability and effectiveness. At higher ecological levels, such adapted EBIs that are broadly disseminated and implemented within Latino communities can contribute to reducing social and health inequities existing within that local community. Culturally relevant tailoring or adaptation has clinical implications and impacts the way in which the interventions are prescribed. Examples are, the adaptation of T2D EBPI from its origin with Spanish translation and attention to other cultural factors (Barrera et al., 2017), such as having T2D EBPI intervention delivered by *Navegantes* (peer educators) (Buckley et al., 2015; McCurley et al., 2016).

For example, cultural tailoring to promote self-management education has been effective in improving health outcomes in Latino communities (Joachim-Célestin et al., 2021).

In summary, the SEM would serve as a framework to examine the interaction of individual and environmental factors at multiple levels of influence that can lead to improved physical wellness and related diabetes risk reduction consistent with T2D prevention (Hessler, 2019; de Wit et al., 2020). Individuals and their environments have

reciprocal interactions (dewitt et al., 2020). An analysis of the social contextual elements serving as a preventive intervention *core component* can aid in understanding and describing the "mechanisms of effect" that would make a diabetes preventive intervention effective in activating changes on major outcomes associated with diabetes risk reduction. Including relevant cultural and other adaptations to core intervention components and resources can enhance the cultural relevance, acceptability, and effectiveness of the original evidence-based preventive interventions (EBPI). Thus, introducing cultural adaptations /tailoring that make the T2D EBPI more compatible with the cultural lifestyles and values of local Latino and Latina community residents, and increase these residents' engagement in that culturally enhanced EBPI.

Purpose

The purpose of this paper is to review recent literature to identify efficacious intervention components and social contextual resources that have been used to support diabetes prevention in Latinos who are prediabetic or at risk of developing diabetes. Toward this purpose we will summarize these findings using the SEM as a conceptual framework to identify the major social ecological factors that are associated with effective diabetes prevention for Latino communities. The results of our findings may be useful to community outreach practitioners and public health researchers when developing or adapting future diabetes prevention programs. A comprehensive, interdisciplinary diabetes prevention program with social contextual intervention and resources directed at multiple levels of the SEM will likely have the greatest impact in

improving health behavior outcomes in prediabetic Latinos. This review was guided by the following research questions.

Research Questions

1. Which SEM levels of influence are most commonly found in research studies for Hispanics with prediabetes or at risk of developing diabetes and
2. Within these studies, which intervention components and social contextual resources are associated with effective outcomes?

Methods

Search Strategy

The aim of this review was to identify research studies that utilized diabetes prevention intervention and resources as implemented with Latinos/ Hispanics having prediabetes. This systematic search consisted of English-language literature indexed in four electronic databases (Psych-info, Medline, PubMed, and CINAHL). Articles searched (January 1, 2015- June 30, 2022) included the following key search terms: "Prediabetes*" and "Hispanic* or Latino or Latina or Latinx" and "Social Context" or "Social Support" or "Community" or "Assistance" or "Resources" or "Public Health." These terms were searched in the titles and abstracts of the articles. To gain a broad understanding of culturally relevant interventions for Latinos with prediabetes, the term "Cultural Adaptation" was included in this search. This study was conducted using the PRISMA guidelines by an independent reviewer and senior researcher (Moher et al., 2009). The complete PRISMA search strategies are listed in Figure 2.

Inclusion and Exclusion Criteria

Research articles saved from this search were published in a peer-reviewed journal and written in English. All met the following inclusion criteria: (a) Latino participants diagnosed as prediabetic or at risk of developing diabetes, (b) community health environment/ public health program, (c) social contextual resource strategies, (d) measures of cultural adaptation were assessed but did not result in article elimination if missing. Articles that described prediabetes and included a definition and or theoretical framework were considered, as well as diabetes prevention conducted within a healthcare setting such as clinics or hospitals.

This search retrieved a total of 84 articles, 6 additional articles were identified using Google Scholar key search terms. After duplicates were removed 78 articles title and abstracts were reviewed. Of these articles, 55 were removed for lack of relevance such as editorials and studies not related to diabetes prevention interventions. After these procedures were completed, 23 articles were eligible for a full article review. Following a full review of the articles, 12 additional articles were removed. Finally, a total of 11 articles met the final screening criteria. We then completed a quality assessment of the remaining studies using the Effective Public Healthcare Panacea Project: Quality Assessment Tool (EPPH) (EPPH, n.d.). The quality assessment resulted in the removal of two additional studies. Nine studies in total were selected for inclusion in this systematic review. Two were rated as having moderate quality and seven studies were rated as having strong quality, see Table 1. To aid in transparency and reproducibility a checklist

was created using the established inclusion criteria (Aromataris et al., 2014). Figure 1 illustrates the article selection process (Moher, 2009).

Articles that met inclusion criteria were evaluated in a discussion between the independent reviewer and the senior researcher. During the discussion notes were reviewed and difficult cases were discussed. After a consensus was achieved, the articles were categorically applied to the appropriate SEM levels according to the study's intervention components using the three SEM levels of influence as a framework: (a) intrapersonal level interventions, such as intervention directed towards behavioral changes, self-management and knowledge, (b) interpersonal level interventions, such as intervention directed towards social engagement and peer interaction, and (c) community level interventions, such as intervention setting, neighborhood engagement, health systems interaction)(Golden & Earp, 2012; Castro et al., 2009; de Wit et al., 2020). As presented in Table 2, the following information was extracted from the nine articles that met inclusion criteria: (a) SEM level of influence, (b) intervention components and social contextual resources, (c) study sample, (d) study design, (e) description of the intervention, and (f) cultural adaptations.

Results

Of the nine articles that met the inclusion criteria, five studies (Hingle et al., 2021; Mayer et al., 2019; Obrien et al., 2017; Soltero et al., 2019; Van Name et al., 2016) were random control trials (RCTs) designed to determine the causal relationship between the intervention and the outcomes (Sidani, 2015). Four studies were quasi-experimental, Cohort (Pre + Post) design (Buckley et al., 2015; Frediani et al., 2020; Joachim-celestine

et al., 2021; Soltero et al., 2019). Quasi-experimental designs are used when randomization is not available. Researchers allocate participants to one of the following groups: (a) between-subject (intervention or comparison) groups (b) within-subject (intervention and comparison) groups (Sidani, 2015). Two studies recruited only female participants (O'Brien et al., 2017; Van Name et al., 2016); one study recruited only male participants (Frediani et al., 2020); one study focused on youths 14-16 years (Soltero et al., 2018); and one study included the school-age children of the parent participants (Soltero et al., 2019). Majority of the studies invited friends and family to participate in the educational components of the intervention, however, they were not included in the data collection. The total sample size for the studies in this review ranged between 21 and 343, N= 1,186.

Among all studies, only one study's intervention focused primarily on physical activity (Frediani et al., 2020). The intervention components of the eight other studies focused on a combination of factors impacting self-management using classroom-style education, nutrition, and exercise. All studies incorporated cultural adaptations specific to Latino communities. These included (a) peer-led educational courses offered in Spanish, (b) culturally tailored curriculum and educational material, and (c) modified literacy to assist in comprehension. One study in particular included "*Loteria*" cards, (Mexican "bingo" playing cards) that contain images to convey specific messages (Joachim-Celestin et al., 2021). In all of the studies reviewed, participants self-identified as Latino, with the exception of one study (Mayer et al., 2019) in which 294 of the 343 participants (85%) self-identified as Latino.

All studies in this review were conducted in the United States in collaboration with a community health clinic or health system. Within the SEM, all nine articles contained intervention components impacting the intrapersonal level of influence, seven articles contained intervention components at the interpersonal level of influence, and eight articles connected interventions at the community level of influence. These findings were categorized by logical groupings of similar findings to present a review of the literature, rather than a comprehensive synthesis.

SEM Levels

Intrapersonal

The primary intervention and resources used in all the studies were within the intrapersonal level of the SEM. Emphasis was placed on intervention components that impact behavioral changes and self-management using classroom-style education directed at nutrition and weight management. Four articles included behavior outcome measures using behavioral change questionnaires and/ or intervention components such as waist circumference and weight outcomes post-intervention (Buckley et al., 2015; Frediani et al., 2020; Hingle et al., 2021; Joachim-Célestin et al., 2021). Seven articles included behavior management strategies such as self-monitoring, self-management and/or established individual accountability using goal setting, food journaling, or action plan development (Hingle et al., 2021; Joachim-Célestin et al., 2021; Mayer et al., 2019; O'Brien et al., 2017; Soltero et al., 2018; Soltero et al., 2019; Van Name et al., 2016).

This review identified intrapersonal cultural variables that addressed the needs of participants who were characterized as having low income and considered predominately

Spanish-speaking. Intervention components in all studies were modified to meet the language and literacy needs of low-income Latino participants. For example, the *Vida Sana* (Healthy Life) program used the "Thumbs Up!" metabolic syndrome workbook, and presentation materials was specifically designed for low English-speaking populations (Buckley et, al., 2015). All studies modified the instructional materials (e.g., workbooks, handouts, presentation modules) to meet the competency and literacy needs of the participants. Nutrition education was culturally adapted to include food cooking demonstrations, sampling, and recipes of healthy alternatives (Hingle et al., 2021; Joachim-Célestin et al., 2021; Mayer et al., 2019; Van Name et al., 2016).

Interpersonal. Eight of the studies reviewed contained intervention components or resources that influenced the interpersonal level of the SEM (Buckley et al., 2015; Frediani et al., 2020; Hingle et al., 2021; Joachim-Célestin et al., 2021; Mayer et al., 2019; Soltero et al., 2018; Soltero et al., 2019; Van Name et al., 2016). Social engagement and peer interaction was found to be a fundamental component within these studies. Social intervention components identified in this review consisted of small group activities (Hingle et al., 2021; Mayer et al., 2019), dance class and bingo (Buckley et al., 2015), soccer games (Frediani et al., 2020) exercise with a fitness trainer (Soltero et al., 2018; Soltero et al., 2019; Van Name et al., 2016) and family and friends participation in nutrition education and physical activities (Frediani et al., 2020; Hingle et al., 2021; Joachim-Célestin et al., 2021; Mayer et al., 2019; Soltero et al., 2018; Soltero et al., 2019; Van Name et al., 2016). Although all studies were not designed for the family unit, a few studies encouraged children participation with activities such as parallel play (Van Name

et al., 2016) and age-appropriate exercises (Hingle et al, 2021). The Latino youth study required a parent or guardian to attend the nutrition education classes with their participating child and siblings (Soltero et al., 2018).

Interpersonal cultural variables were identified that addressed program delivery and facilitation. For example, all studies offered intervention sessions in Spanish. The intervention sessions were facilitated by bilingual educators (Frediani et al., 2020; Hingle et al., 2021; Joachim-Celestin et al., 2021; Mayer et al., 2019; Soltero et al., 2018; Soltero et al., 2019; Van Name et al., 2016), *Promotoras* (community members); O'Brien et al., 2017; Soltero et al., 2018; Soltero et al., 2019), or *Navegantes* (peer educators) (Buckley et al., 2015) creating a more traditional learning experience by influencing ethnic social communication. Many of the studies included in this review contained bilingual collaborators such as dietitians (Soltero et al., 2019), nurse practitioners (Van Name et al., 2016), health educators (Soltero et al., 2018), or soccer coaches (Frediani et al., 2020) who contributed to incorporating cultural intervention components creating an experience of *confianza* (trust) and *respeto* (respect).

Community and Environment. Many researchers partnered with Federally Qualified Health Centers (FQHC) (Hingle et al., 2021; Soltero et al., 2019), others engaged local clinics (Buckey et al., 2015; Frediani et al., 2020; Joachim-Celestin et al., 2021; Mayer et al., 2019; O'Brien et al., 2017; Soltero et al., 2018; Van Name et al., 2016). In addition to healthcare partners, some studies also included partnerships with churches (Buckley et al., 2015), and the YMCA (Soltero et al., 2018; Soltero et al., 2019). The intervention setting for all studies occurred in predominantly low-income communities. A few of the

studies were creative in their approach and hosted intervention components at popular areas within the community, such as soccer fields (Frediani et al., 2020) and a neighborhood community center (Joachim-Celestin et al., 2021). This design approach indirectly allowed community members who were not engaged in the studies to benefit from diabetes prevention education, therefore promoting diabetes awareness and social capital. Social capital is a sense of community belonging (Kamimura et al., 2017), it defines values and trust (Field, 2016), and resources and benefits (Rodgers et al., 2019) within a community.

All studies integrated lifestyle intervention components such as physical activity. Participants were offered access to safe places such as facilities or open fields to exercise within the community. All studies included cultural considerations in the design of lifestyle intervention components and several studies (Frediani et al., 2020; Mayer et al., 2019; O'Brien et al., 2017; Soltero et al., 2018; Van Name et al., 2016) integrated aspects of the Diabetes Prevention Program (DPP). A nationally recognized comprehensive diabetes prevention program that successfully demonstrated the positive impact of weight loss on reducing diabetes related indices (Albright & Gregg, 2013). Although the intervention components and social contextual resources of the studies presented in this review did not directly influence the policy-level of the SEM, the outcomes of these studies are meaningful and may inform local, state and national policies impacting the health of Latino communities.

Effective Intervention Components and Social Contextual Resources.

Effective intervention components and social contextual resources were (a) an interactive

group setting that encourages engagement and participation (Frediani et al., 2020; Hingle et al., 2021; Joachim-Célestin et al., 2021; Mayer et al., 2019). Especially studies that included social support systems like friends and family. Joachim-Célestin et al. (2021) reported that 57% of those who attended sessions with family or friends reached clinically significant weight loss as compared to 30%, those who attended with neither, suggesting that including social networks in intervention design is meaningful, and (b) low health literacy curriculum and materials in the participants preferred language (English or Spanish), as mentioned in all studies as an effective intervention component. When interventions such as curriculum materials designed for low health literacy were used to introduce health issues and lifestyle choices, participants showed an increase in their health literacy, and a minimum of 60 % decrease in the primary risk factors associated with metabolic syndrome (Buckley, et al., 2015).

Discussion

In this descriptive review, we aimed to identify which SEM levels of influence are commonly found in research studies that include Latinos who are diagnosed with prediabetes or at risk of developing diabetes and which intervention components and social contextual resources were associated with successful outcomes. The findings of this review revealed many commonalities. For instance, education, exercise, and the introduction of lifestyle enhancement skills to improve food choices or meal preparation were aimed primarily at the intrapersonal level and in some instances interpersonal levels within the SEM. This approach is consistent with other studies aimed to reduce the risk of

diabetes in Latino communities (Ockene et al., 2012; Sorkin et al., 2014; Vincent et al., 2014).

Cultural Considerations

Interpersonal social interactions were contextualized across studies in which family and friends were encouraged to participate in various intervention activities. This culturally influenced approach is known to impact positive health outcomes (Castro et al., 2009; Hessler et al., 2019). For example, statistical significance was noted in weight loss when individuals attended diabetes prevention intervention sessions with friends or family in comparison to those who attend alone (Joachim-Célestin et al. (2021). Social interactions and relationships with family are more proximal and are often more salient or important sources of interpersonal influences. This can include important cultural values that are inculcated by parents and family, as well as others such as relatives and friends living in or near the individual's neighborhood or community (Ni et al., 2021). Low social capital can hinder the development of culture within a community (Weaver, et al., 2014).

Latinas Influence on Interventions

Latinas (Latino women) participated in large numbers as compared with Latinos (Latinos men). This may be associated with gender roles in which Latinas are known to bear the primary responsibility for the wellbeing of the family (*Marianismo)* (D'Alonzo, 2012; O'Brien et al., 2014). In a prior study exploring diabetes risk among Latinas, participants shared a sense of pride and a great responsibility when discussing their influence on family (O'Brien et al., 2014). This level of influence can positively impact

family behavior by promoting healthful habits. For instance, Latinas trained in healthy food selection, are empowered to encourage and model for their family eating various vegetables. This includes communicating a positive attitude towards eating vegetables. In addition to healthy eating, much emphasis is placed on exercise. Whether it is in the form of dancing, walking or active sports, physical activity is mentioned in the studies reviewed as an effective intervention component that complements good nutrition involving a balanced diet. This suggests that effective outcomes are associated with participant engagement in nutrition and exercise-based intervention components. This aligns with previous literature in which Latino adults with prediabetes indicate nutrition and exercise are major areas of preferred activities that are consistent with maintaining a healthy lifestyle (Shaak, et al., 2018).

Environment and Social Capital

Although the intervention environment varied across studies, a meaningful finding is the collaborative approach to engage community members, health practitioners and academic partnership as a group effort within a study, thus building the structures needed for social capital to thrive. For example, a CBPR project assessed the association between physical activity adherence and social capital, the results indicated a higher sense of community (social capital) may increase physical activity adherence (Kamimura, et al., 2017). This level of collaboration is necessary to address diabetes prevention management upstream. A community-level analysis and implementation of the SEM requires the development of partnerships with various community stakeholders to effectively promote diabetes prevention education and awareness across communities and

their diverse residents. From the perspective of intersectionality, several adverse Social Determinants of Health (SDoH) such as food insecurities, limited financial resources and unemployment collectively contribute to the development of T2D (Martinez-Cardoso et al., 2020). Access to health and community resources are fundamental in creating social patterning of health. As diabetes prevention programs emerge intervention components that focus on changing certain structural factors that constitute SDoH should be considered. This said, changing structural factors at the community level to produce health changes will require a coordinated effort among various stakeholders, also requiring a persistent effort implemented across a period of time (Martinez-Cardoso et al., 2020).

Study *Limitations and Future Research*

Limitations of this review must be taken into consideration. Although the intervention components were culturally tailored to meet the various Latino community needs, some studies were noted to be underpowered with small sample sizes resulting in no significant impact outcome measures. The inclusion of small, uncontrolled trials provided minor evidence of outcome effectiveness but validated strategies related recruitment and community-based implementation approaches that are useful for future research. Another limitation is the lack of generalization of these results across heterogeneous Latino communities due to within community variations in factors such as acculturation, background and geography. Although the SEM allows for multilevel ecological analysis, the framework does not allow for the complexity of comprehensive testing and intervention development (Stokol, 1996; Fleury & Lee, 2006).

Future research in diabetes prevention programs should continue to include intervention components and social contextual resources that influence multiple levels of the SEM. Culturally tailored diabetes prevention interventions have been shown to be instrumental in creating engagement and participation. The integration of social support and family participation to improve health outcomes were found to be a meaningful program design strategy which compliments the cultural beliefs within the Latino community (Joachim-Célestin et al., 2021, Mayer et al., 2019)). Assessing the impact or level of influence of family and social supporters in the outcomes evaluation of future studies may inform researchers of the impact these influencers had on the intervention. Additional research on social contextual resources available to address upstream SDoH factors may improve the deployment of diabetes prevention programs to meet specific needs within Latino communities. Within the community, environmental influence such as policies that affect safety are needed to allow individuals of color such as Latinos to participate in physical activities (e.g., walking or exercising in a community park) (Lee et al., 2021). Finally, future studies should address macro-level intervention components that will in turn impact the community. Policies that may positively impact community resources are needed for effective community-based diabetes prevention.

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Tables

Table 2.1

Study Quality of Evidence

Study Quality of Evidence

Quality of Evidence (EPHPP Quality Assessment Tool)							
First Author and Date	Selection Bias	Study Design	Confounders	Blinding	Data Collection	Withdrawal Dropout	Overall Quality Score
Buckley et al., 2015	Moderate	Moderate	Moderate	Weak	Weak	Moderate	Moderate
Frediani et al., 2020	Moderate	Moderate	Moderate	Weak	Strong	Moderate	Moderate
Hingle et al., 2021	Strong	Strong	Strong	Weak	Strong	Strong	Strong
Joachim-Célestin et al., 2021	Strong	Moderate	Strong	Weak	Strong	Strong	Strong
Mayer et al., 2019	Moderate	Strong	Moderate	Strong	Strong	Moderate	Strong
O'Brien et al., 2017	Strong	Strong	Strong	Weak	Strong	Strong	Strong
Soltero et al., 2018	Strong	Strong	Strong	Weak	Strong	Strong	Strong
Soltero et al., 2019	Strong	Moderate	Strong	Weak	Strong	Strong	Strong
Van Name et al., 2016	Strong	Strong	Strong	Weak	Strong	Strong	Strong

- Strong – very likely to be representative of the target population (>80%)
- Moderate – at least somewhat likely to be representative of the target population (60-79%)
- Weak – not likely to be representative of target population (<60%)

*See source for criteria/ definition – Quality Assessment Tool Effective Public Healthcare Panacea Project: EPPH Quality Assessment Too Retrieved from https://www.ephpp.ca/PDF/Quality%20Assessment%20Tool_2010_2.pdf

Table 2.2

Intervention Components and Study Outcomes

Study and SEM Level	Intervention Components/ Social Contextual Resources	Cultural Adaptations	Primary Outcome Measures	Findings (+/-)
Buckley et al., 2015 • Intrapersonal • Community	Peer Educators, Social Activities (e.g., dance class) Education (nutrition, diabetes, CVD) Previous program participants sharing	Workbook/ intervention materials Groups setting Peer educators (*Navegantes*)	Body Weight, BMI, A1c, LDL Cholesterol, Waist Circumference, Blood Pressure	(+) 60 % improved one or more measures 88.9% improved health literacy
Frediani et al., 2020 • Intrapersonal • Interpersonal	Recreational Soccer (RS) NDPP Curriculum Modules Family and friends participate as spectators	Bilingual coaches for program delivery NDPP Modules Group setting	Aerobic Fitness - Yo-Yo Intermittent Recovery Test Level 1 (Yo-Yo IR1)	(+) 1.9% increase over baseline at 12wks and 1.0% at 24wks.
Hingle et al., 2021 • Intrapersonal • Interpersonal • Community	Nutrition Education/ Food Demonstration Family Physical Activity (e.g., parents/children) Small Group Goal Setting Behavioral Health/ Stress Mgt	Bilingual group leaders Groups taught in Spanish Spanish-designated clinic Spanish Questionnaire/ intervention material	Mothers – Body Weight, Waist Circumference, BMI Children – BMI z-scores	(-) No significant difference in any primary outcome measures
Joachim-Célestin et al., 2021 • Intrapersonal • Interpersonal	Classes (e.g., healthy eating with food samples) Physical Activity Family and friends encouraged to participate Handouts with minimal writing	Modifications to the *Vida Vibrante* Program Key concepts were associated with "Loteria" cards to facilitate understanding	A1c, Body Weight, Height, BMI Diabetes Knowledge	(+) Significant improvement in weight loss and diabetes knowledge
Mayer et al., 2019 • Intrapersonal • Interpersonal • Community	Nutrition Education (e.g., portion control, reading labels, budgeting for food, cooking healthy food) Physical Activity/ Stress Reduction Strategies Action Plans with a Buddy System Family and friends encouraged to participate	Bilingual staff Workshops offered in Spanish Culturally appropriate, low literacy curriculum Group led by facilitators with similar backgrounds and health issues	Body Weight	(+) Intervention group lost significantly more weight than the control group
O'Brien et al., 2017 • Intrapersonal • Community	Goal - Setting /Self – Monitoring Stimulus Control/ Feedback on Changes Tracking Dietary Intake and Physical Activity	*Promotora* -led lifestyle intervention Sessions delivered in Spanish	Body Weight	(+) 5% more weight loss compared to 1.1% intervention group
Soltero et al., 2018 • Intrapersonal • Interpersonal • Community	Nutrition w/ Parent Health Education Exercise w/ Fitness Trainer Behavior Change Strategies – weekly goals Siblings encouraged to attend classes	Bilingual/ Bicultural educators Latino cultural values of *familismo* (familism) and *respeto* (respect) are used to honor family, community, traditional roles, and cultural celebrations	Insulin Sensitivity QoL Instrument	(+) Parents significant improvement in Body Fat %, A1c, QoL Children significant improvement in Body Fat %, QoL
Soltero et al., 2019 • Intrapersonal • Interpersonal • Community	Nutrition Education Behavioral Skills Training Physical Activity Classes	Intervention conceptualized by bilingual/ bicultural community dietitians. *Promotora* -led Latino cultural values *familismo* (*familisim*), *confianza* (trust), *respeto* (respect) were used to orient families	BMI, Waist Circumference, Body Fat, A1c, Body Weight	(+) 1.8% weight loss Parents significant improvement in waist circumference Children significant decrease in BMI percentile
Van Name et al., 2016 • Intrapersonal • Interpersonal • Community	Healthy Food Choice Behavior Change Strategies Linked dietary counseling sessions to urban farming Weekly Cooking Demo Trainer-led group exercise Parallel play-based physical activity for children and adolescents	Spanish classes Bilingual handout and presentation material Bilingual Nurse Practitioner Family/ children encouraged to participate	Body Weight	(+) Intervention group lost significantly more weight than the control group 3.8% more weight loss compared to -4.4%

Figures

Figure 2.1

Social Ecological Model

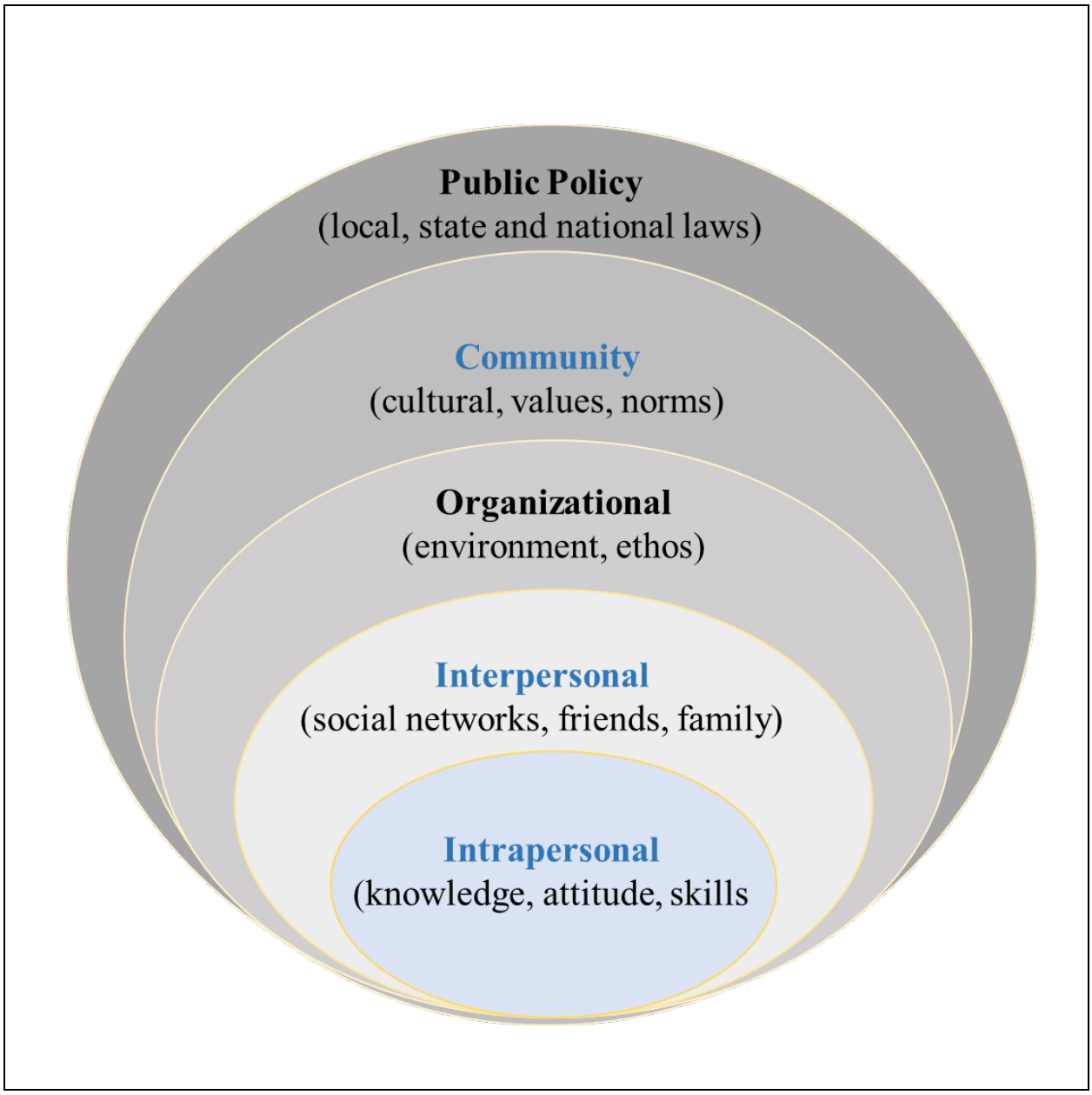

Figure 1: The social ecological model: A framework for prevention. Source: Adapted from the centers for Disease Control and Prevention (CDC, 2021).

Figure 2.2

PRISMA Diagram

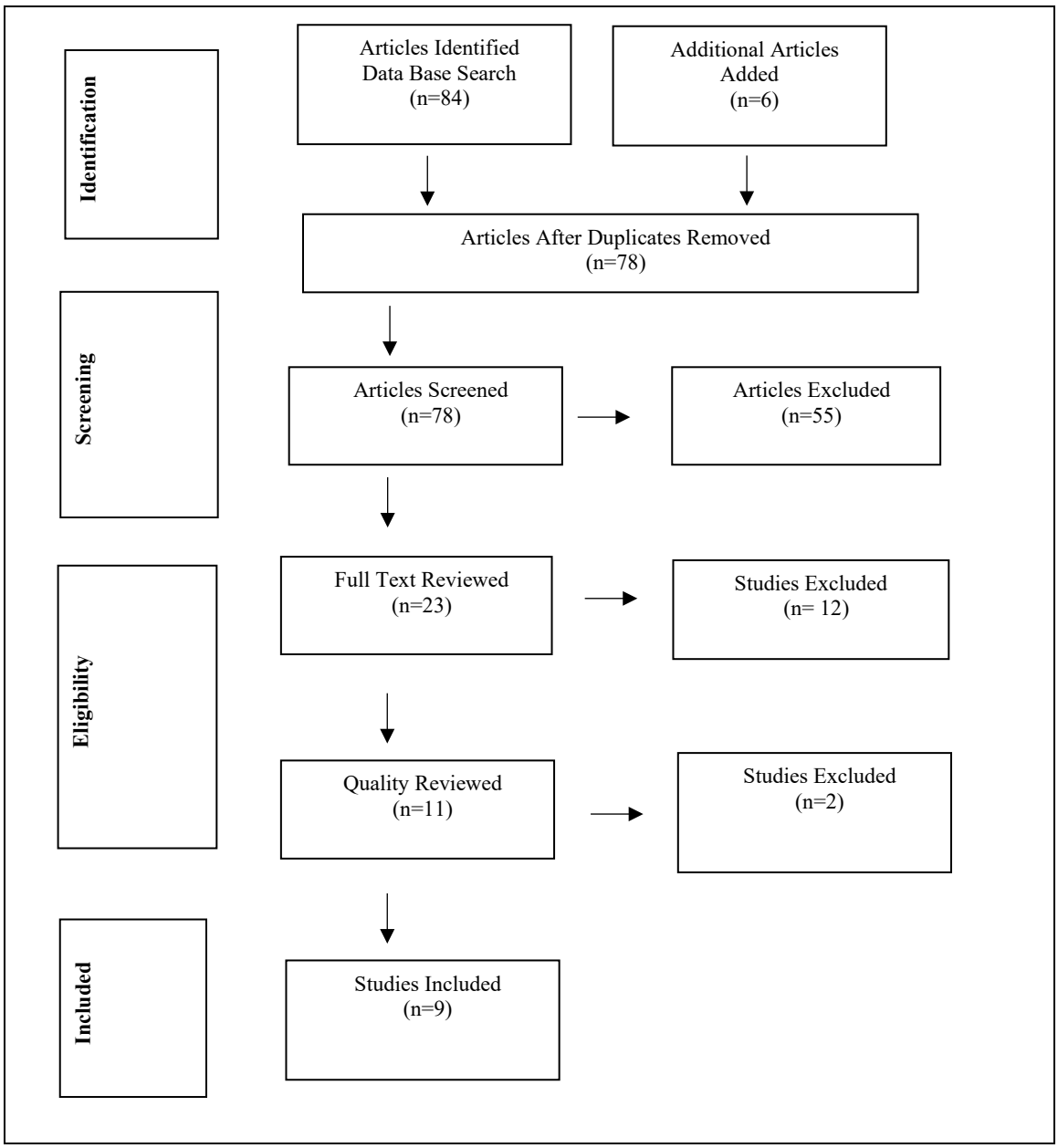

Figure 2.2: PRISMA Diagram, (Moher et al., 2009).

CHAPTER 3

MANUSCRIPT 2

Una Platica: A Qualitative Study to Understand Individual Preference in a Latino Community-Based Diabetes Education and Prevention Program

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Abstract

Purpose

This article presents the findings of a qualitative study conducted to understand the culturally relevant participant views that can be incorporated into a Latino-focused community-based diabetes prevention program. The study assessed participants' desired resources, important program features, and ways to make the experience interesting for participants and their families.

Methods

This study analyzed the qualitative portion of one section of the mixed methods protocol from the Latino Lifestyles Integrative Mixed Methods study. The Latino Lifestyles study used a complex convergent mixed methods design nested within a three-factor factorial design (*age, language, and gender)*. Based on the Integrative Mixed Methods (IMM) methodology we conducted a thematic analysis to identify emergent themes for each of the three focus questions, as administered in individual interviews with 28 Latino and Latina participants.

Results

The participants (N = 28) expressed a strong need for individualized diabetes education regarding diabetes awareness and prevention within the community, as well as tailored education to meet the distinct needs of the participants and their families. Findings suggest participants desire lifestyle behavior changes to improve diet and exercise, and social activities that are culturally engaging such as cooking classes.

Conclusion

To have an impactful Latino community-based diabetes prevention program, the program should include intervention components that consist of desired resources and interesting features that the local Latino community residents believe to be needed and acceptable to them for promoting prevention knowledge, and healthful skills perceived to be useful to them and for their families.

Keywords: community-based interventions, behavior change, cultural approach

Latino Community Diabetes Prevention Program: An Integrative Mixed Methods Study

Type 2 Diabetes (T2D) persists as a major public health issue for Latino populations in the US. It affects approximately 34.2 million persons in the U.S (Centers for Disease Control [CDC], 2020), a significant increase from 26 million almost a decade ago (Albright & Gregg, 2013). Hispanic/ Latinos (hereafter referred to as "Latinos") exhibit a higher prevalence of diabetes in comparison to other racial/ ethnic groups such as Asian Americans and non-Hispanic White Americans. The prevalence of diagnosed diabetes in Latinos is 12.5% in comparison to non-Hispanic Asians 9.2% and non-Hispanic White 7.5% (CDC, 2020). The average cost of medical care for this group is $16,750 annually, about 2.3 times higher than care for nondiabetics (Centers for Disease Control [CDC], 2019).

Lifestyle Interventions

Evidence-based lifestyle preventive interventions (EBPIs) designed for persons with pre-diabetes have been efficacious in reducing the risk of T2D (O'Brien et al., 2014; Vitolins et al., 2019; Wagner et al., 2021). Organizations such as the National Diabetes Prevention Program have provided access to lifestyle prevention programs designed to reduce the incidence of T2D (Albright & Gregg, 2013; Gruss et al., 2019). The results from these lifestyles intervention programs demonstrated favorable outcomes within areas such as weight management and blood glucose management (Albright & Gregg, 2013; Gruss et al., 2019).

To intervene with Latinos at high-risk researchers have introduced culturally adapted contents to improve program engagement and retention (McCurley et al., 2016).

Adapting effective preventive interventions that are culturally relevant for diverse Latino communities requires a careful analysis of the diabetes-related preventive activities, and adapting these when needed, so they may be consistent with the expressed needs and preferences of local Latino community residents. The involvement of Latino community members in expressing the needs of a local Latino community, and in expressing their own needs and preferences is essential to inform cultural adaptations to preventive interventions. Adaptation includes considerations in the dissemination and implementation of the evidence-based intervention (EBI), to address environmental and infrastructure issues. Such adaptations aim to make the intervention culturally relevant in its acceptability and capacity for engagement of diverse Latino community members (Castro et al., 2023) This includes a sensitivity to various cultural factors and the socioeconomical disadvantages that may exist among these residents (Castro et al., 2009; O'Brien et al., 2014; Fagan et al, 2019). The design and development of interventions that are flexible enough to allow local adaptations is important to improve the intervention's fit and function and fit within diverse Latino communities nationwide (Barrera et al., 2017; Castro & Yasui, 2017). Such adaptations can aid in increasing the preventive intervention's efficacy, that contributes to improving targeted health outcomes (McCurley et al., 2016; Shaibi et al., 2015). Furthermore, when evidence-based lifestyle interventions are culturally adapted, a critical need is addressed for facilitating to facilitate the dissemination and implementation of high-quality care to diverse Latino communities. This approach can also contribute to reducing racial and ethnic health disparities and inequities.

Health Disparities

Health disparities are preventable differences in access to health-related resources, negatively impacting health outcomes, thus placing these individuals at a disadvantage (Suarez-Balcazar et al., 2018). Racial and ethnic groups such as Latinos experience greater social and economic barriers to health, and related inequities and patterns of health disparites (Braveman, 2006; Castro et al., 2009). A study by LeBrón et al. (2019) suggests that discrimination significantly contributes to diabetes-related health disparities and poor mental health. These findings reveal high rates of discrimination among Latinos with diabetes in urban communities, leading to exacerbated depressive symptoms and diabetes related distress. Diabetes related disparities are multifactorial and multidimensional which requires a distinct approach to their management (Chin et al., 2014; Fleischer et al., 2016). Detecting and identifying factors such as quality of life that contribute to health disparities in a specific community population constitutes an important approach for understanding the major factors that can be addressed and used for informing interventions that may advance health equity. (Pressman et al., 2019).

Purpose

The purpose of this study was to conduct a thematic analysis of local community participant perspectives that provide further empirical information on the design and adaptation of a Latino community-based diabetes preventive intervention. The specific objectives were to assess the participants' (a) desired resources; (b) important program features; and (c) ways to make the experience interesting for the participants and their families. These considerations offer opportunities to promote an integrative care approach for individuals, families, from a local Latino community perspective, based on new

empirical information for improving the dissemination and implementation of these efficacious diabetes preventive interventions. In summary, the present study aimed to obtain relevant information about Latino community residents' needs and preferences, to inform the development of enhanced interventions that are more effective and culturally acceptable for promoting diabetes awareness, increasing prevention knowledge, and for designing, disseminating, and implementing more culturally relevant community-based preventive interventions and programs. Such programs can be improved for greater effectiveness in promoting diabetes prevention.

Overarching Research Question and Specific Focus Questions

The overarching research question for this study was, "In the greater Phoenix, Arizona area, what are Latino community residents' preferred intervention components in a diabetes prevention intervention that is responsive to their interests, as examined by (a) desired resources, (b) features that promote interest and active engagement, (c) healthful activities?" Three specific focus questions that relate to this overarching research question were

(a) *Community Needs for a Diabetes Prevention Program,* "What are the most important needs for diabetes prevention within the local Latino/Hispanic community of Phoenix?"; (b) *Desired Resources,* "What resources do you want that could help prevent diabetes for you and your family?"; (c) *Interesting Features,* "What would make a diabetes prevention program interesting to you?"

Methodology

A secondary data analysis was conducted using the Latino Lifestyles Study, with permission from the original principal investigator. To conduct a rigorous qualitative data

analysis, and to safeguard the confidentiality of participants, all data were identified by a Case ID number. In conducting a thematic analysis (Ryan & Bernard, 2003), we identified reoccurring patterns of response to a given focus question, as examined across independent participant cases. Independently mentioned responses in the form of response phrases served as the units of analysis used to inductively identify themes that emerged. NVivo 12 (Lumivero, 2021) was used to log, label, and conduct a rigorous analysis of these data (Ryan & Bernard, 2003). The original study along with this secondary qualitative analysis was approved by the Arizona State University Institutional Review Board.

Research Design

This paper examined the qualitative portions of one section from the Latino Lifestyles study. The Latino Lifestyles study used a complex convergent mixed methods design (Creswell & Creswell, 2018), that is nested within a three-factor (2x2x2) factorial design. An Implementation Matrix is presented in Table 1 that describes the methodological steps for conducting this thematic analysis. The first five steps were used to identify emerging themes based on response phrases that constitute an answer to the focus questions under examination.

Participants

The sampling frame consisted of three socio-demographic factors, each with two levels in this (2x2x2) factorial design: (a) *gender* (male, female), (b) *primary language* (English, Spanish), (c) *age group* (less than 40, 40 or greater). This approach afforded a balanced sample to ensure equal or almost equal cases for each level of each of the design factors. This analysis established the pre-condition to allow viable comparisons of the

occurrence of the emerging themes in each of these factors. This allowed an assessment of possible differences that could be examined by gender (male, female), primary language as a proxy for acculturation levels (Spanish for lower acculturation, and English for higher acculturation), and age group (younger, older) (Castro et al., under review). This approach aided in understanding within-group variations or segmentation strata that might be important in adapting future interventions by these specific within-group factors (Castro et.al., 2009).

Participants from the Latino Lifestyles study were selected from individuals enrolled in the Arizona Insulin Resistance Registry, among individuals in a prior study who consented to be recruited for future research opportunities. The Arizona Insulin Resistance Registry database was designed to examine cardiometabolic disease risk within the local Latino community in an effort to connect research and community engagement (Shaibi et al., 2013). Inclusionary criteria for the Latino Lifestyles study allowed a purposeful selection of eligible cases from the Arizona Insulin Resistance Registry. As part of the registry, participants were phenotype for T2D risk factors (Shaibi et al., 2013). The inclusionary criteria are adult Latino males and females who were at least 18 years of age, who were considered pre-diabetic, and therefore at risk of developing T2D. The criteria for assessing pre-diabetes were: (a) a fasting blood glucose of 110mg/dl or higher; (b) a 2-hour, post challenge glucose of 140mg/dl - 199mg/dl; and/ or (c) a HbA1c of 5.7-6.4%.

Participant Selection

As described in the larger Latino Lifestyle Study, eligible individuals were invited to participate using an initial contact via regular mail and email, followed by a

recruitment call conducted by the Project Coordinator. The Principal Investigator engaged in the call when contact was made with a potential participant to provide a brief but detailed description of the study. This approach was used as a brief screening procedure. If the individual expressed interest during the call, a verbal Informed Consent was obtained during this call in the individual's primary language. After consenting to participate, a date and time was established for a one-hour in person interview conducted in a university research center office. On arrival for the interview, the individual was read the same Informed Consent. After signing the Informed Consent, each participant was given a copy and a second copy was archived and stored within the study's research office. Each participant was offered reimbursement for travel, parking cost and a $25 remuneration for their participation.

Data Collection

All eligible participants engaged in a one-hour interview conducted by one of three undergraduate research assistants using an in-depth Integrative Mixed Methods interview protocol. The research assistants participated in interviewer training to enhance their skills in *effective probing* and *reflection of content*. During this training, the interviewers were trained on how to conduct follow-up probes to the participant's initial response. They also learned the technique of reflection of content, to verify their correct understanding of the participant's response to the focus questions. This aided in clarifying and validating the respondent's responses to the focus question. This approach enhanced the credibility of the response, as it ascertained major points in the participant's response and clarified any unclear assertions. (Miles et al. 2014).

For the qualitative part of this interview, the interviewers administered the “Your Health: A Chat (*Una Platica*)” focus questions portion. The *Platica* contained four sections of structured open-ended questions. Among the four sections in the *Platica* the current qualitative study focused on one section titled “A Diabetes Prevention Program” (Latino Lifestyle). Within this section the following focus questions were used for this secondary qualitative data analysis to understand the views on local community preferences, as well as his or her own preferences in a community-based diabetes prevention program: (a) Latino Community Need for Diabetes Prevention, “What are the most important needs for diabetes prevention within the local Latino/Hispanic community of Phoenix?"; (b) Resources you want to Help Prevent Diabetes, “What resources do you want that could help prevent diabetes for you and your family?"; (c) Features for Making a Diabetes Prevention Program more interesting, "What would make a diabetes prevention program interesting to you?"

Data Analysis

All interview sessions were recorded with digital audio recorders. These audio files were securely uploaded to a professional transcription service agency using their encrypted uploading process. The professional transcription service translated the Spanish-language digital audio files to English, and all completed transcription were downloaded into a secure file and labeled in accord with the study’s protocol.

The files were securely uploaded and organized into NVivo 12 (Lumivero, 2021) for thematic analysis of textual data. NVivo coding assists in the identification and labeling of *response phrases* to identify and label emerging thematic categories (Castro et al., 2010). The original IMM methodology used the shorter *response codes* as a unit of

analysis to capture the answers to the focus question (Castro et al., 2010). Given the limitations of original response codes, the present qualitative analysis used *response phrases* that consisted of partial or entire sentences that provided a more complete and contextualized answer to the focus question.

This thematic analysis coding using NVivo 12 (Lumivero, 2021) was conducted by two independent coders who identified response phrases which constituted answers to the focus question. This procedure was then followed by a series of Roundtable discussions by the research team. The research team consisted of a graduate student, three undergraduate honors students and the principal investigator of the parent study. The Roundtable session discussions focused on resolving differences between the coders to attain a consensus on *accuracy* (dependability) in the identification of each emerging theme, as well as ascertaining validity (credibility) in accurately describing the identity or meaning of a theme. (Braun & Clark, 2006; Curry & Nunez-Smith, 2015; Miles et al., 2014; Ryan & Bernard, 2003). Zoom sessions were used to maintain momentum and support the challenges related to collaboration at a distance. This team approach allowed a real-time discussion of the emerging themes, that could also be encoded as thematic categories. A cross-check auditing procedure was used to verify all coding and to reduce the risk of errors during the coding process. Ongoing assessment of progress, a discussion of coded choices and "best-choice modification" were made during these Roundtable. A codebook of final themes and their response phrases was printed for a final review of this solution to this thematic analysis.

Results

Table 2 presents the characteristics of the 28 individuals who participated in the "Platica" interview using the three-factor factorial design (*age, language, and gender*). The participants group consisted of 14 males and 14 females. The age group consisted of 14 participants in the younger group (>40 years) and 14 participants in the older group (≤40 years). A total of 15 participants preferred to respond to this in-depth interview in Spanish as their primary language and 13 participants preferred to respond in English as their primary language.

Focus Question 1. Latino Community Needs for a Diabetes Prevention Program

Focus Question 1 asked the participant to serve as a representative of their local community, in responding at the community level about major local community needs and preferences on contents of culturally relevant components of a diabetes preventive intervention for Latinos and Latinas. This focus question was, "What are the most important needs for diabetes prevention within the local Latino/Hispanic community of Phoenix?**"** This question asked about participants' perceptions of needs at the local Latino community as a whole, needs to make community-wide diabetes prevention more acceptable to them.

Major Theme 1. Community-Level Resources to Raise Awareness about Diabetes Disease Process

Participants expressed that within the community at large, there was a lack of awareness regarding diabetes, and a need for dissemination of this information to create awareness and promote prevention. There was a prevailing sense that diabetes, although common in the Latino community was not discussed enough among family and friends to

create the attention needed to promote awareness. A representative response was, *"we don't have any television commercials or brochures about diabetes" (Case 119).* Participants described the need for effective communication using activities such as campaigns highlighting risks factors and general information about the diabetes disease process to create a sense of concern and engagement. A representative response is, [in our Latino community,] *"we need information people can listen to" (Case 140).*

Major Theme 2. Prevention Education about the Disease of T2D

Many of the participants described a need for community education that provided information about diabetes prevention, symptom identification, and disease management. Some expressed the importance of bringing awareness to the community as conveyed by the statements, "what is diabetes," "the cause of diabetes" and "how to prevent it." A representative response was, *"we [Latino and Latinas] need to know what causes diabetes to prevent it from happening" (Case 136)*. Several participants mentioned the need to engage children by offering diabetes education in schools or in a public forum for the community. Representative responses were, *"education [diabetes information, especially for children]" (Case 137), "[offer] activities where children and parents participate, [discussions] should be discussions in schools" (Case 114)* and another representative response was "*Teach children how to eat healthier, and how to prepare things differently" (Case 122)*. Many commented on the importance of prevention education to promote self-help. Participants want the community to recognize that there was an adverse health consequence if a person does not take preventive action. A representative response was, *"Explain what generates diabetes or [its] consequence" (Case 119).*

Major Theme 3. Importance of Dieting and Healthy Foods

Participants identified a need for community programs to highlight the importance of a good diet and healthy food selection to prevent diabetes. Information on diet and nutrition that is Latino culturally relevant is seen as important for Latino families. Relevant information is needed to provide knowledge about the types of foods to be consumed to improve health. A representative response is, *"we need healthy diets for kids and the family" (Case 114)*. Participants suggested offering community dietary programs that promote building healthy food habits. They recognized the importance of eating healthier as a means for prevention. A representative response is, *"We need a good dietary plan and a program to help [us] create the plan" (Case 125)*.

Major Theme 4. Financial Assistances and Resources for Diabetes-Related Needs

Participants described a need for financial assistance to access resources for diabetes testing and preventative measures. Many shared the challenges encountered in accessing health care and health services. This suggests that some Latinos in the community must make difficult decisions between food and medication. A representative response is, *"you have to choose between food and medication" (Case 126)*. Some expressed not being able to get medical exams or diabetes testing due to a lack of money. A representative response is, *"you don't get the test you need because you don't have the money" (Case 101)*. Overall, a consensus expressed by these participants is that the Latino community at large needs to have resources to support clinical diagnostics and testing to increase awareness and encourage prevention for those who are uninsured or unable to pay for these services.

Focus Question 2. Participant's Desired Resources for a Diabetes Prevention Program (as seen at the Individual and Family-Levels)

This focus question asked for participants to respond about their own personal views on aspects of diabetes preventive intervention that are important to them. That focus question is, "What resources do you want that could help prevent diabetes for you and your family?" This question shifted the focus from the needs of the local Latino community at large, to the participants and his or her own family to understand the resources needed for diabetes prevention.

Major Theme 1. Simplified Prevention Resources for Lifestyle Balance

Participants expressed a desire to have simplified education about diabetes, the implications of having diabetes, and ways to prevent diabetes. Many suggest having a trusted individual who could relate and convey personalized experiences and information about living with diabetes. This point about receiving information from a trusted person highlights the role of the cultural factor, *personalismo*, as an important cultural value among many Latino men and women. A representative response is, I would like to have *"someone you trust who can give you good advice or good ideas about how to take care of yourself" (Case 101)."* Participants spoke about prevention education on various levels. Some of the specific prevention resources that participants requested for themselves, and their families were educational classes about how to prevent diabetes. A representative response is, I would like to have *"diabetes classes to help[us]understand what diabetes is" (Case 121).* They also expressed interest in commercials/videos to promote diabetes prevention. A representative response is, I would like to have *"video information on how diabetes can be prevented, how its treated, and the consequences*

when it's not treated" (Case 114). A diabetes specialist was mentioned that can show them how to change their lifestyle by taking better care of themselves. A representative response about who is best to present diabetes-related health information is, I would prefer *"teachers that are specialized in diabetes education" (Case 109).*

Major Theme 2. Access to Affordable Care, Healthy Food Options and Exercise

The participants collectively expressed the desire to access *preventative care services* and *better food options*. When addressing the resources needed for themselves and their family participants identified these important resources as, (a) access to affordable care, and (b) low-cost healthy foods and exercise to help prevent diabetes. Participants see a need for assistance with the costs of getting a check-up or for testing and screening for diabetes. A representative response is, I would like *"help with the cost of getting screened, like free screening for diabetes" (Case 108)*. Others shared the need to access healthier foods at a low cost. A representative response is, *"stores in my neighborhood don't carry healthy foods" (Case 102)*. Some participants proposed the idea of having access to a local farmers market or health food store. They understand the limitations of access to healthful foods in their neighborhoods and would like resources to support access to the right foods. A representative response is, I would like *"[access to a local] farmer's market [for healthy food] (Case 125).* Another key resource recommended by participants is access to venues for exercising such as a park with a walking trail or fitness center. A representative response is, for my family and I *"we need a place where we could go exercise" (Case 137)*.

Major Theme 3. Information about Healthy Food Choices

Participants requested resources that highlight the importance of healthy foods to prevent diabetes and promote healthy eating habits. Healthy eating habits contribute to having a balanced lifestyle. These participants would like instructions on how to make good food choices and create healthy routines. A representative response is, I would like *"a guide about the best way to keep a diet to prevent diabetes" (Case 124).* Participants are interested in learning how to cook new foods and/ or healthier ways to prepare meals. A representative response is, I would like to have *"information on how to eat healthier and new recipes" (Case 128).* Mothers are often the primary cook and responsible for family meals. Participants recommend educating moms about healthy food options. A representative response is, we need to *"educate moms about the food that kids should eat" (Case 140).*

Focus Question 3. Participant's View of Important Features for a Diabetes Prevention Program (as seen at the Individual and Family-Levels)

This focus question also asked for participants to respond about their personal views on aspects of a diabetes preventive intervention that are important to them, with the addition of looking into increasing participants' engagement in the content because it is made more interesting. "What would make a diabetes prevention program interesting to you?" This question focuses on the participant and his or her own family with an emphasis on diabetes prevention program activities that can generate interest and engagement.

Major Theme 1. An Organized Activity for Self-Directed Change

Participants recommended as an important feature to make diabetes prevention more interesting, the availability of organized classes and workshops that target specific demographics for diabetes self-directed change. These individuals recommended having programs that are attractive for young adults and families that will motivate them to take-action. A representative response is, I would like *"a program for people in their twenties, a family program [that] includes everyone in your family of all age demographics" (Case 122).* They also wanted classes that are led by community leaders who are knowledgeable about diabetes. A representative response is, I would like a program led by *"someone who really knows how to talk to Latinos in this community, talk on a regular person's level" (Case 128).* Participants also prefer classes and workshops offered within their community because of the limited knowledge of diabetes prevention. A representative response is, *"[offer a] class for two- to-three hours for prevention of diabetes" (Case 127).* This suggest a significant need for access to educational resources that are not readily available within the community contributing to poor awareness and knowledge deficit regarding diabetes prevention. Participants want to fully engage and learn more about diabetes and preventative measures by exploring the details of diabetes prevention using graphic examples and visual aids that really connect with them individually. A representative response is [I would like to have presented] *"visuals like diagrams and charts, not just literature" (Case 136).*

Major Theme 2. Individually Tailored Diet and Exercise Programs

Participants shared that diet and exercise programs that are designed according to *individualized preferences* to *promote interest* and *participation* as an important feature

for a diabetes prevention program. That is, these participants identified the need for program activities that are tailored to the needs and preferences of individual consumers. They described a need for programs that promote having a physically active family. A representative response is, I would like *"a program about how to be physically active as a family" (Case 122).* They also requested a place to go that can teach them about general exercising. A few representative responses are *"[I] need to be able to find someplace to go and exercise" (Case 123). [I would like to be] taught more about exercises" (Case 109). [I would like to] learn how to find time to exercise (Case 128).* These comments express a need for available resources to allow exercise activities, learning important information about types of exercises, and learning skills to do them well. This suggests the need to teach community residents to distinguish between stretching, aerobic, and muscle building exercises, the benefits of each, and how to enact them well.

Some participants described interest in programs about dieting that promote the consumption of healthy organic or alternative foods. A representative response is, I would like a program that *"promote[s] healthy foods with organic food stands or alternative foods" (Case 127).* Programs that focus on health promotion education and good eating habits were also expressed. A representative response is, I would like *"a program that offers information about [healthful] dieting" (Case 103).* This suggests their need and preferences for authentic and scientifically based dietary practices, versus any dietary information and practices that are not accepted by reputable dietary agencies.

Major Theme 3. Individually Tailored Education on Diabetes Disease Process

Participants shared an interest in educational programs offered in Spanish using various modes of communication that described what diabetes is, how it progresses, and what individuals can do to prevent it. Participants requested programs that improve medical knowledge about consequences of lack of awareness knowledge, motivation and behavior change efforts that aid in reducing the risks of developing T2D. A representative response is, I would like to know *"how noncompliance can lead to foot amputation" (Case 138)* and how diabetes related complications may impact their health. A representative response is, I prefer *"knowing that having diabetes you can lose your vision, your legs and your arms" (Case.121)*. Participants are interested in having informational content such as brochures that could help them personally understand risk factors impacting them. A representative response is, I would like *"a brochure [about diabetes and risk factors]" (Case.119*).

Major Theme 4. Hands-On Healthy Cooking Classes

Participants prefer programs that offer interactive "hands on" cooking practice to improve food selection, options, and healthier eating to prevent or better manage diabetes. A representative response is, I would like *"a program about how to make your lifestyle better by cooking better" (Case.122).* Participants expressed a desire to participate in real-life healthy eating workshops where they can learn how to cook better using the foods they love. They are interested in a program that will host nutrition classes and show them how to prepare hand-on meals. A representative response is, I would like *"a healthy cooking class that people can take" (Case.124).*

Discussion

Study Purpose and Approach

The purpose of this study was to identify diabetes prevention interventions components (content and activities) identified and reported by local Latino community residents who have pre-diabetes and are at risk of developing T2D. This at-risk status introduces some incentives for the participants to consider and describe their needs and preferences for taking personal actions consistent with improving their health lifestyles for reducing their risks of developing T2D. The diabetes prevention intervention components that were reported constitute desired resources and interesting features that these local Latino community residents believe to be needed and acceptable to them for promoting prevention knowledge, and healthful skills perceived to be useful to them and for their family.

These at-risk participants described various intervention contents that they perceive to be important to them, and that can support diabetes prevention while also meeting their needs and those of their community. Accordingly, in our results section we examined the major themes that emerged inductively for each of three focus questions: (a) a question about each participant's perceptions about local Latino community needs and preferences in a culturally responsive T2D prevention program/intervention, (b) each participant's own preferences in a diabetes prevention program, and (c) and the participant's views of program/intervention contents that can make the intervention interesting and engaging.

Summary of Major Results

This inquiry examined the needs and preferences of local Latino community residents in Arizona in an evidence-based and culturally responsive diabetes prevention intervention yielded a few major results. Table 3 summarizes the themes and draw implications from these results, to inform the design, development, or adaptation of future Latino focused diabetes prevention interventions or programs. In this discussion section we will translate this science into efficacious and engaging prevention information and activities that promote knowledge, preparedness, quality of life and skills to help prevent the development of T2D within Latino families and within their communities.

Implications for the Adaptation, Dissemination and Implementation of these Latino Focused Evidence Based Prevention Interventions

The contents and activities provided within the study can be used to inform the design and development of more acceptable and engaging T2D preventative interventions that are "scale up ready" to improve the health and well-being of the local Latino communities (Fagan et al., 2019). Although the present study participants voiced exposures to general information about diabetes, the consensus expressed a strong need for information that is applicable to their community and personal needs. This theme emerged in both the needs of the community and the individual participant's needs for an effective diabetes prevention program that is tailored to their specific community and family needs. This finding likely reflects to the heterogeneity of the various sectors within Latino sub-communities. The occurrence of diabetes across Latino subgroups has substantial variation (Concha et. al., 2015). A clear understanding of major needs and

preferences of various subgroups or population sectors within a given Latino community can inform necessary adaptations required to effectively promote behavior changes that can reduce T2D risks and improve wellness and quality of life as most relevant for each of these consumer subgroups. For example, health education program information, activities, and skills training must be age and gender appropriate, while also acceptable to them and able to engage and motivate these consumer subgroups to engage in thinking, motivation and health-related behavior changes. This effect can be promoted by using lay-health workers. Promotoras, in a community-based participatory intervention approach that engages individuals and families from these various Latino community consumer subgroups (Coleman et al., 2010). Engaging members of these communities in identifying intervention activities of greatest interest and importance to them can serve as the basis for tailoring intervention strategies that are acceptable and interesting to members of that constituency (Concha et. al., 2015; Shaibi et al., 2015; Smith-Miller et al., 2017).

Diabetes Prevention Program: Community Needs

The first focus question examined the participant's perception of local community needs and preferences for a program/ intervention in response to the question, "What are the most important needs for diabetes prevention within the local Latino/Hispanic community of Phoenix?" At the community level participants expressed the importance of connecting with the community to make diabetes prevention a priority that is coupled with resources that will promote awareness and provide diabetes prevention education that provides tangible consumer resources, support and capabilities for taking preventative actions on their own behalf. These participants described a need for

interventions such as modified literature, Spanish language delivery, and peer guidance to help them take specific actions to improve diabetes awareness and encourage and provide specific instructions and skills development for effective risk-reducing self-management. This is consistent with the findings discussed in a system review of behavioral lifestyle interventions used to reduce the risk for T2D in a Latino population (McCurley et al., 2016).

Community Access for Promote Significant Lifestyle Changes

Over the years multiple studies have been conducted that aimed to address prevention of T2D with diet and exercise intervention components (Ramal et al., 2018; Saslow et al., 2017; Vasconcelos et al., 2019; Murillo et al., 2019). However, access barriers such as time, financial resources and limited transportation exist in underserved areas, thus limiting the Latino consumer ability to participate in hands-on in-person training for meal planning, cooking and healthful exercise activities (Saslow et al., 2017). These limitations were also consistent with participants' needs for access to resources that promote healthy eating, exercise, and provide diabetes assessment and helpful health services in their own community. New research is emerging to explore individual preferences that involve digital modalities to promote engagement (Adu et al., 2018). Nonetheless, there persists a need to encourage technology and to provide access monitoring to guide and achieve healthful outcomes for T2D prevention within diverse Latino communities.

Financial Needs Within the Community

Participants were clear that there is a strong need for financial assistance and community resources for diabetes related preventative interventions such as health

screening and medication assistance. Many were concerned about having to choose between the cost-of-care and having to make difficult financial and other decisions related to managing their health needs and family life-balance. The use of organized systems and community mobilization is a novel approach to address these needs (Castro & Yasui, 2017; Fagan et.al., 2019). Health care systems are examples of organized systems and community mobilization structures. Healthcare systems provide an ecosystem in which both researchers and health care professionals can work together. This integrated environment is needed to address fundamental needs such as employment, healthcare access and transportation which are essential for supporting positive lifestyle behavioral changes (Coleman et al., 2010; White et al., 2015). A major theme evolved from the participants response within this study focused on a need for resources to improve lack of awareness, motivation and behavior change to reduce T2D. These needs can be met using the structures, processes and resources within these health systems and community mobilization structures to reduce noncompliance and increase adherence to efficacious community-based intervention components offered within a well-organized environment.

An integrated and collaborative approach can be used to address a combination of challenges at the policy, system, and individual level and creates opportunity to scale-up interventions by serving as a conduit between research and intervention (Fagan et al., 2019). Health care safety-net systems are designed to deliver health- related services to individuals that are primarily low-income, with no health insurance or those that are underinsured (Mehta et. al., 2021). Safety net systems are designed to care for individuals who experience disproportionate access to health and social resources and exposed to a

wide range of disparities within their communities. For example, one study shows how researchers collaborated with an academic medical center and a regional health department to address the high prevalence of diabetes within their state. They used strategies to improve communication and health literacy. These strategies included: motivational interviewing, teach back, goal setting, reduction in jargon (White, et al., 2015). These strategies coupled with an evidence-based diabetes toolkit designed for individuals with limited literacy and numeracy, in randomized controlled trials were shown to be efficacious in improving the quality of communication and diabetes outcomes among individuals cared for within the public health setting, as well as, addressing disparities for vulnerable patients within these system structures (White et al., 2015). The community needs described by the participants in this study align with common vulnerabilities found in safety-net communities such as access to healthy foods and social resources to support access to care (Mehta et. al., 2021). Access to these resources in a structured system is likely to have a favorable impact on T2D in Latino communities. Collaborative relationships between researchers, practitioners and policy makers are needed to support the implementation of meaningful interventions and promote positive healthful outcomes within these communities (Fagan et al., 2019).

Diabetes Prevention Program: Individual Desired Resources and Interesting Features

The second focus question examined the individual's own needs and preferences for a program intervention in response to the question, "What resources do you want that could help prevent diabetes for you and your family?" The third focus question

examined the individual's needs and preferences regarding the question "What would make a diabetes prevention program interesting to you?"

Given the close association between these questions we examined the emergent themes from both questions in this one section. Significant themes emerged supporting interventions centered on (a). the *helpfulness* of intervention activities for diabetes prevention and (b) features that are *interesting* and *engaging.* Participants expressed a need for educational materials that are simple and understandable, and that provide clear information about the development of T2D, and with specific information on ways to prevent diabetes that are applicable to the individual and his or her family. Participants expressed a desire for health information that is easy to understand and translatable into daily activities.

Health and General Literacy Issues

Regarding this, the health literacy of each Latino participant, and their literacy for comprehending information must be considered in developing and administering intervention components that intended to provide the knowledge and skills needed to perform basic lifestyle tasks necessary to achieve personal goals (Nutbeam & Lloyd, 2021). Literacy skills enable knowledge development and improved potential. Accordingly, having low literacy often leads to low seeking, utilization, and low participation in prevention services (Nutbeam & Lloyd, 2021; White et al., 2015). Health literacy motivates participants to actively seek information to improve their understanding of diabetes, whereas limited health literacy may lead participants to seek information from friends and family that may be inaccurate (Abdullah et al., 2020). Attention to health literacy issues and responding to these is essential for diabetes

prevention in many Latino/ Hispanic communities as it may promote self-care and the ability to understand basic health information and get the services needed to make good health decisions (ADA, 2021; White et al., 2015). Among community residents having low health literacy, effective communication is needed. This is essential in self-management education where simple instructions are essential (White et.al., 2015).

Healthful Dietary Practices

Another noteworthy theme is the importance of eating healthier as a means for prevention. Study participants request classes that promote engagement and self-management. Diabetes prevention starts with self-management. Diabetes self-management is complex and requires individualized education and support (Conner et al, 2019). Some areas of interest that participants would find helpful promoting self-management are, (a) having a good dietary plan, (b) access to programs that provide information about organic and healthy foods, and (c) cooking classes to learn meal preparation and meal planning. These participants indicated that these program activities should be individualized and provided in a format that is acceptable for the participants within the focused community. As community-based programs are well implemented and delivered using a person-center approach, they produce significant changes in communication, health literacy (Conner et al., 2019; White, et al., 2015) personal engagement in knowledge about themselves and their health, as well as personal growth (Heggdal et al., 2021).

In summary, the participants' responses provide insights into the answers to our focus questions by providing examples of meaningful intervention components that would enhance interest and engagement in a Latino community-based diabetes

prevention program. Our findings demonstrate that there is still a vital need for individualized prevention resources to establish lifestyle balance, support access to affordable care, and access to healthy food options and exercise. Participants want tailored activities that are not scripted and generalized to all Latinos and Latinas. Implementation science research continues to direct us towards developing cohesive communities of care consisting of an integrated network of health systems, policy makers and community resources, as a whole, to effectively impact change (Castro et al., 2010; Fagan et al., 2019).

Implications for Improving T2D Diabetes Prevention in Latino Communities

Since the COVID-19 pandemic lifestyle management resources have been created to increase health information and access to services (Kumari et al., 2020). The closure of clinics and health centers has forced health care providers to identify innovative solutions for providing diabetes prevention information and manage care using technology to help community consumers make "real world" changes in their motivation and skills to improve their dietary, exercise and lifestyle behaviors in a manner that significantly reduces their risks of developing T2D.

Remote access has transformed healthcare and now serves as an instrumental resource that connects individuals and clinical providers with the use of various telehealth platforms. Telehealth remotely connects individuals to care providers for healthcare services. It can improve access, cost, and quality using multiple modalities such as internet, phone, SMS, web-based tools, and cloud-based technology (American Telemedicine Association (ATA), 2021). This transformation in care delivery has positioned individuals at risk for developing T2D one step closer to effectively managing

their healthcare needs inside their home. Telehealth enhances communication and connectivity to improve disease management outcomes by assisting in identifying barriers to care (Vaughan et al., 2021). It provides an opportunity to virtually connect individuals with clinicians and specialists such as nutrition consultants for meal planning and weight management which is essential in diabetes prevention.

Many healthcare providers and health systems now offer online access to medical records, online office visits and online access to communicate with members of the care team. Participants of a web based T2D self-management feasibility study asserts that having online access to their medical records allowed them to correct misinformation, and easily connect with a variety of health care disciplines for dietary management and advice for healthy eating (Taloyan et al., 2021).

A systematic review to evaluate the effects of mobile text messaging interventions on health improvement and behavior change reported significant effects on health outcomes when the messaging is specifically focused on diabetes (Hall et.al., 2015). Almost a decade later, this digital platform has grown from simplified text messaging to more innovative ways to promote synchronous and asynchronous engagement communication using cloud-based technology and social media platforms offering practical programs that deliver healthcare, provide education and access to specialist that promote the implementation of a healthful life that is well accepted (Appuswamy & Desimone, 2020).

Telehealth creates a new pathway for care delivery and accountability. It appears to be a major technology-based approach to leverage in many Latino communities who experience limited resources and higher levels of disparities to manage prevention of

T2D. This platform allows for individualized care management and customization to create a personalized virtual care experience that is interesting and meaningful. The cost effectiveness and expanded service reach accessible within the telehealth model allows for rapid scaling of interventions. Considerations such as cost are often overlooked in research reports but considered fundamental to strategic decisions in public health program implementation and ability to scale up (Milat et al., 2015).

In addition, improving T2D diabetes prevention in Latino communities requires policies and research that removes the structural barriers that create disparities within these communities. Collaboration between researchers and community members allows for *"citizen science"* to increase awareness and promote representative engagement related to the issues that are most important within their community (Lee et al., 2021). Polices that support these types of research is fundamental to improve the health and safety within the Latino communities.

Limitations and Future Research Directions

This study is influenced by limitations related to a relatively small sample (N=28) and the participants' experience. The participants indicated their preferences and provided recommendations for the future development of an intervention program that is relevant to their community needs. These limitations prohibit generalization to a larger Latino population. The balancing sample frame involving age group, gender, and primary language contributed to a fair representation of Latino men and women within the local Maricopa County Latino community.

Future research can focus on diabetes prevention with interventions conducted in SafetyNet health systems using telehealth to reach communities with higher levels of

disparities. Health policies are needed that included the allocation of fund for resources to promote diabetes preventive education and access to prevention resources among Latino populations and communities. Such financial support includes funding to expand access for increased use of technology-based care delivery platforms in Latino communities. The recent increase in telehealth to deliver essential healthcare services is leading the way towards building a culture of health and equitable care where common barriers such as transportation and cost would no longer be obstacles to receiving individualized quality diabetes prevention services.

Conclusion

This study advances our understanding of relevant interventions that can be incorporated into various Latino community-based diabetes prevention programs. The information obtained informs current and future diabetes preventive interventions and programs to design these interventions for high acceptability among various Latino consumer groups. This approach could contribute to more culturally relevant and effective diabetes prevention interventions or programs that will effectively promote prevention, increase education, and provide skills and motivations to apply these skills, to enact healthful behavior changes that will reduce the risk of developing T2D within the community and at the individual level. Programs with interventions that are tailored for Latinos appear to be effective in reducing diabetes risk indicators (McCurley et al., 2019). Promoting the scale-up of preventive interventions with strong evidence of effectiveness is an important approach for community development and supportive public health systems that will introduce and sustain specific strategies for cross-system collaborations, awareness, and engagement (Fagan et al., 2019).

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Tables

Table 3.1

Implementation Matrix: Latino Lifestyle Integrated Mixed Methods

Step	Research Task	Description	Specific Details in the Present Study
Study Design			

1	**Research Study Design and Sampling Frame**	Study design and sampling frame developed to obtain data to answers to Focus Questions	• *Sampling frame by three independent variables allows planned comparisons by:*
			  • *Gender* (male, female)
			  • *Age Group* (older, younger)
			  • *Language* Preference (Spanish speaking, English Speaking)
			• Aim to examine, for two separate focus questions, types of social support for diet and exercise

2	**Interview Protocol Development**	Develop and refine (QUAL+QUAN) Mixed Methods Interview Protocol	A two-part QUAL+QUAN structured interview • QUAL: the *Platica* (a chat) • QUAN: the Questionnaire consisting of scales and Likert items
Implementation			
3	**Conduct Interview**	Administer Mixed Methods Interview Protocol	Structured interviews: audio recorded QUAL and QUAN data • QUAL Focus Questions with follow-up probes elicit complete answers each Focus Question • QUAN Questionnaire data yields obtains QUAN data from scales and rated items
4	**Data Management**	• QUAL: Transcriptions and Translations • QUAN: Data entry to SPSS	• Audio recorded data transcribed to verbal texts. Translations conducted if needed. • Numeric data entered into a statistical data analysis program, SPSS
5	**QUAL Thematic Analysis**	Conduct thematic analysis using *NVivo*	Thematic analysis with NVivo includes Roundtable discussions during coding, and Codebook review checks on reliability/dependability of coding

Future articles will address the Qual – Quant integration outlined below			
6	**QUAL→ QUAN Transformation**	*Scale Coding* to allow integrative analysis • Converted QUAL to *Thematic Variables*. • QUAN data are *Measured Variables*	*Scale coding* used to "quantify" emergent themes to create *Thematic Categories* or *Thematic Variables*. Allows mixed methods numeric operations to discover significant associations
Data Analysis			
7	**Quantitative Analyses to Identify Associations**	Conduct integrative data analysis to identify significant QUAL and QUAN associations	Quantification aids in identifying significant associations in robust integrative data analysis for a deep-structure analysis of answer so Focus Questions, within the context of the independent variables, i.e., Gender, Age Group, Language. Types of QUAN analyses: • Cross Tabs for categorical variables • Spearman correlations for interval level-variables
8	**Joint Display of Select QUAN and QUAL Data**	Conduct *Storyline Analyses* (Joint Displays) for a deeper integrative understanding of significant associations	• Return to original QUAL texts within context of QUAN variables • Identifies significant QUAL, QUAN associations for more focused analysis of results • Allows deep-structure interpretations

Mixed Methods Implementation Matrix Adopted from (Castro, et al., under review).

Table 3.2

Three-factor Factorial Design Characteristics (age, language, and gender)

Total Study Participants (N=28)	
Characteristics	No.
Age	
≤ 40	14
>40	14
Gender	

Total Study Participants (N=28)	
Male	14
Female	14
Primary Language	
English	16
Spanish	12

Table 3.3

Emerging Themes from Focus Questions

1. Community Level: LATINO COMMUNITY NEEDS FOR A DIABETES PREVENTION PROGRAM	
"What are the most important needs for diabetes prevention within the local Latino/Hispanic community of Phoenix?"	
Major Themes	**Nodes (Response Phrase)**
Awareness about diabetes disease process	16
Diabetes prevention education	14
Importance of dieting and healthy foods	9
Finance and resources for diabetes-related needs	6

2. Individual and Family Level: DESIRED RESOURCES FOR A DIABETES PREVENTION PROGRAM	
"What resources do you want that could help prevent diabetes for you and your family?"	
Major Themes	**Nodes (Response Phrase)**
Prevention resources for lifestyle balance	17
Access to affordable Care, healthy foods and Exercise	12
Information about healthy food choices	9

3. Individual Level: IMPORTANT FEATURES FOR A DIABETES PREVENTION PROGRAM	
"What would make a diabetes prevention program interesting to you?"	
Major Themes	**Nodes (Response Phrase)**
Organized activity for self-directed change	10
Individually tailored diet and exercise programs	9
Customized education on diabetes disease process	9
Engaging healthy cooking classes	7

CHAPTER 4

MANUSCRIPT 3

Local Latino Community Needs and Preferences for a Culturally Responsive and Engaging Diabetes Prevention Program: An Integrative Mixed Methods Study

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Abstract

Purpose

This study examined the responses of Latino community residents diagnosed with pre-diabetes to the focus question, "What would make a diabetes prevention program interesting to you?" To understand the intervention contents and activities that are most important to study participants for helping them to prevent the development and onset of type 2 diabetes T2D).

Methods

An Integrative Mixed Methods (IMM) approach was used to examine the levels and associations of three potential moderator variables: (a) health motivation, (b) diabetes awareness, and (c) diabetes concern among Latinos diagnosed with prediabetes. Open-ended interviews were conducted with the focus question to identify the most important intervention components for a culturally responsive diabetes prevention program. Lastly, a 2x2 cross-tabulation analysis tested group differences in response phrases by levels of concern (high levels of concern versus low levels of concern), levels of awareness (high levels of awareness versus low levels of awareness), and health motivation (highly motivated versus low motivation). In addition, we examined these response phrases by levels of a research design factor, for example (male vs. female; $\geq$ 40 years old vs. < 40 years old; Spanish vs. English).

Results

Participants (N = 28). When comparing cases of high versus low diabetes awareness, a significant finding for the potential moderator variable language (English

and Spanish) and the theme Healthy Cooking Classes was observed, and a noteworthy trend was observed on the potential moderator variable of language (English and Spanish) and the theme Organized Activities, as well as the potential moderator variable diabetes awareness as observed for two themes: (a) Diet and Exercise Programs, and (b) Healthy Cooking Classes.

Conclusion

These findings provide informative intervention components for developing a Latino community-based diabetes prevention program designed to enhance engagement and lifestyle changes for individuals diagnosed with prediabetes.

Keywords: community-based interventions, prevention lifestyle, social-ecological model

Latino Community Diabetes Prevention Program: An Integrative Mixed Methods Study

Over the past few years, the number of adults diagnosed with prediabetes has increased from 88 million in 2020 to 96 million in 2022 in the United States. (Center for Disease Control [CDC] Report, 2020; CDC, 2022). Prediabetes is an intermediate stage in the progression of Type 2 Diabetes (T2D), representing a critical opportunity for implementing culturally relevant preventive interventions (Gruss et al., 2019; Knowler et al., 2002). Untreated, prediabetes can develop into T2D. According to the CDC, T2D constitutes 90-95% of adults who are later diagnosed with diabetes in the United States. The prevalence of T2D among Latinos is 11.8% of this population (CDC, 2022). A mixed methods analysis of patterns of intervention components can yield insight for designing culture-centered health-related lifestyle changes to reduce the risks of developing diabetes as incorporated into evidence-based preventive interventions (EBPIs) developed for diverse Latino communities.

Lifestyle Behaviors and Diabetes

Latinos are often unaware of their risk for diabetes, causing a delayed response to preventive lifestyle changes. For those aware of their risk for developing diabetes, this awareness is often coupled with worry, i.e., diabetes concern (Shaak et al., 2018). This concern may be attributed to a lack of understanding of the diabetes disease process and the impact of positive self-management. Lifestyle behaviors contributing to being overweight and obesity are closely linked to the development and outcome of diabetes (Venditti, 2016). Although self-management is often viewed as the key to *good medicine practice,* the ultimate challenge is identifying effective interventions that are accessible,

scalable, and affordable (Venditti, 2016). In a study by Smith-Miller et al. (2017), participants were knowledgeable about diabetes, but they experienced difficulty comprehending the complexity of diabetes self-management. The role of healthcare providers was instrumental in guiding participants through self-management strategies and offering resources to help manage obstacles. There are significant barriers related to education, health literacy, and social support when cultivating new self-care behaviors (Venditti, 2017). In particular, diabetes-specific health literacy is also important for greater knowledge and understanding of the best ways to prevent the onset of type 2 diabetes (T2D).

Developing healthful habits alone can be difficult when it requires robust lifestyle and social changes. However, improving *health literacy* when focused on diabetes prevention education paired with health provider support can be effective in engaging community consumers in making more specific behavior changes consistent with diabetes prevention (Buckley et al., 2015; Smith-Miller et al., 2017; Van Name et al., 2016). For instance, the Healthy Living Partnerships to Prevent Diabetes (HELP PD) program, a low-cost, community-based weight loss study consisted of lifestyle interventions led by *Promotoras* (community health workers), This study demonstrated the importance of continued contact in a community-based programs for improving health literacy and diabetes prevention focusing on maintaining long-term weight loss, a critical factor in diabetes prevention and self-management (Vitolins et al., 2019). As researchers look for innovative intervention components for diabetes prevention, new and state-of-the-art lifestyle interventions are emerging that extend beyond the traditional lifestyle management of dietary intake and exercise to behavior change counseling that

promotes important and more personal changes that aid in diabetes sustainable prevention adherence (Venditti, 2016).

Cultural Influences on Program Interventions

Culture-centered refers to the use of a specific cultural approach to develop theory and applications (Concha et al., 2015). It conceptualizes a disease process that is contextualized within a culture and influenced by health communication (Concha, 2018). This approach can be used to improve communication and engagement when creating community-based diabetes prevention programs that incorporate cultural competence. Cultural competence is commonly established by adapting intervention components to align with the culture of a population or cultural group (Uttal, 2006). For instance, researchers may translate program intervention components or resources to Spanish for individuals who identify Spanish as their primary language (Lindberg et al., 2020; O'Brien et al., 2017; Soletro et al., 2018). These adaptative measures can be effective, although additional culturally sensitive methods are important to capture distinct needs within individual Latino communities to produce healthful and culturally congruent preventive interventions (Castro et al., 2009; Obrien et al., 2014; Fagan et al., 2019). *Cultural sensitivity* incorporates a given population's cultural characteristics, experiences, and norms into an intervention's design, delivery, and evaluation phase to produce an effective message that fits the culture (Dutta, 2007). These cultural factors are constructs that capture cultural values, beliefs, and lifeways (Castro & Alarcón, 2002; Castro et al., 2023). Ideally, information collected with an emphasis on cultural factors will incorporate intervention contents that can increase the fidelity and cultural adaptation of developing programs. Castro & Yasui (2017) describes using interviews (*information gathering*) to

understand the influences of ecological and sociocultural factors on a given population, as the first step in developing rigor within the process of cultural adaption. Integrating content from such interviews within the intervention design allows for the development of intervention components that are adapted locally, which are more meaningful to consumers, and can promote their engagement (Castro & Yasui, 2017). For example, obtaining the perspectives of individuals diagnosed with prediabetes within a Latino community is important and can be leveraged to identify distinct intervention components and resources for increasing community residents' engagement, and self-management, towards achieving sustainable health outcomes.

Applying a cultural lens to the development of a diabetes prevention program enables cultural traditions, values, and can address health inequalities commonly associated with Latino communities to be included within the design of the program/ evidence-based intervention. If limitations in health awareness and health management are left unaddressed, Latino communities may continue to experience an increase in the onset of diabetes and its related health complications (Braveman, 2006; McCurley et al., 2016). Accordingly, a well-developed cultural analysis is needed to aid in designing an intervention that promotes participant engagement. This can be done by integrating *cultural factors* into the intervention that can infuse proposed adaptations of original intervention components to develop more culturally responsive versions of the original intervention. This approach can be used to add cultural focus to existing prevention programs such as the original Diabetes Prevention Programs as modified for specific sectors of Latino communities (Boyd et al., 2023; Castro & Yasui, 2017).

The Present Study

Diabetes awareness and preventive education is a complex phenomenon. Multiple individual and cultural factors must be considered regarding fidelity to original intervention components, when they must be adapted to local needs, and as implemented effectively within diverse Latino communities. The present study identifies potential core intervention needs and preferences obtained from independent interviews that elicited the views of Latino community residents from the Phoenix metro area. All of these persons had been diagnosed with prediabetes. To add depth and deeper insights, participants were asked about their thoughts and feelings about health-related lifestyles and related aspects of these lifestyles, by using self-ratings of their general health motivation and other psychosocial constructs.

Interviewer Rated Factors

Post-interview, each interviewer and occasionally a second interviewer rated the participant they interviewed on several items. These included two diabetes-related items: (a) their level of diabetes awareness and (b) their level of diabetes concern. To assess these constructs, single item scales were developed specifically for this research study to obtain the interviewer's behavioral assessment of the participant's diabetes awareness, and diabetes concerns, as these variables may be associated with other health-related outcomes, such as the participant's self-reported levels of health motivation.

Study Aims

Within this context, the present study had two study aims. First, we conducted the *Platica*, a qualitative instrument having a series of focus questions developed to identify the most important components for a culturally responsive diabetes prevention

intervention/program. We later conducted a *thematic analysis* on the transcribed textual narratives. We also examined emergent themes identified from the audio recorded interviews' transcripts. Follow-up analyses were used to examine associations between select quantitative variables, and the numerically encoded themes. These analyses also examined the aforementioned potential moderator effects of select moderator variables: (a) *health motivation*, *diabetes awareness*, and *diabetes concerns* Thus, we sought to identify intervention needs and preferences deemed as most important to participating community residents, as moderated by levels, (lower and higher) levels of (a) *health motivation* that would indicate a greater desire to live a healthy lifestyle, (b) *diabetes awareness* (a measure of diabetes health literacy), and (c) *diabetes concern* (a measure of anxiety and preparedness to take action to protect themselves in preventing the onset of T2D).

Methods

Participants

Twenty-eight (28) participants from the Latino Lifestyles study were purposefully selected from individuals agreeing to participate in the Arizona Insulin Resistance Registry. All individuals consented to be recruited for future research opportunities. The present study consists of 28 of the 35 cases in the final sample of the Latino Lifestyles study. Those 35 cases were selected from this Insulin Resistance Registry based on a balanced sampling frame with identified eligible Latino and Latina participants and sampled for balance by *gender* (male, female), *age group* (under 40, 40 and over), and *language* (Spanish, English). The language variable was the available sampling variable that served as a proxy variable for levels of acculturation.

The Arizona Insulin Resistance Registry database was designed to examine cardiometabolic disease risk within the local Latino community to connect research and community engagement (Shaibi et al., 2013). As noted, this Latino Lifestyles study had inclusionary criteria that allowed for a purposeful selection of eligible cases from the Arizona Insulin Resistance Registry. As part of the registry, participants were phenotype for T2D risk factors (Shaibi et al., 2013). The inclusionary criteria were described as adult Latino males and females who were at least 18 years of age, who were considered pre-diabetic, and at risk of developing T2D. The criteria for assessing pre-diabetes were: (a) a fasting blood glucose of 110mg/dl or higher; (b) a 2-hour, post-challenge glucose of 140mg/dl - 199mg/dl; and/ or (c) an HbA1c of 5.7-6.4% (American Diabetes Association, 2021).

Sample Selection

A balanced three factor (2x2x2) factorial design served as an experimental framework and sampling frame for this Latino Lifestyles study. This approach allowed the researchers to obtain a small yet balanced sample of participants. As noted, we utilized a three-factor (2x2x2) factorial design consisting of (a) *gender* (male, female), (b) *primary language* (English, Spanish), (c) *age groups* (less than 40, 40 or greater) to ensure an equal or almost equal selection of cases from the larger sample of cases in the Diabetes Registry. This approach was designed to allow data analyses by each of these factors, to aid in the understanding of within-group segmentation strata, as this could add within sample insights as examined by these three independent research design factors (Castro et al., 2009).

In an initial contact eligible individuals were invited to participate using an initial contact via regular mail and email, followed by a recruitment call conducted by the Project Coordinator. The Project Coordinator conducted three attempts to reach each provisionally selected participant prior to selecting another potential participant from a given cell that contains several cases having the same demographic characteristics.

This initial contact allowed for the participants to be screened and for the bilingual Principal Investigator (English and Spanish) to engage in the call when contact was made. The potential participant was provided with a brief screening interview conducted in the individual's preferred language. If the individual expressed interest in participating during this screening call, verbal informed consent was obtained in the individual's primary language. After consenting to participate, a date and time were established for a one-hour in-person interview. Upon arrival for the interview, the prospective participant was read the same informed consent in their preferred language. After signing the informed consent, each participant was given a copy of this written consent form, and a second signed copy was archived and stored securely. Each participant was offered reimbursement for travel and parking, and each was offered $25 in remuneration for their participation. The Arizona State University Institutional Review Board approved this study.

Data Collection and Procedures

The total mixed methods interview protocol consisted of three parts: (a) the qualitative *Platica*, "Your Health: A Chat (*Una Platica*)," that consisted of a series of focus questions, (b) the quantitative *Latino Lifestyles Questionnaire* (also administered via interview to address literacy issues), and (c) the *Post-Interview Behavioral*

Assessment form. This mixed methods interview protocol was designed to last about one hour. The interviews were conducted by trained undergraduate research assistants. All interviewers were bilingual and bicultural members of the Latino Lifestyles team. This interactive interview approach created a safe space for participant self-reflexivity and meaningful engagement (Way et al., 2015).

Part 1 – The Qualitative "Platica". The "Your Health: A Chat (Una Platica)" focus questions contains four sections of structured focus questions. The present study focuses on one section of the Platica titled "A Diabetes Prevention Program." Within this section the following focus questions were used to understand the views on local community preferences, as well as his or her own preferences in a community-based diabetes prevention program: (a) Latino Community Need for Diabetes Prevention, "What are the most important needs for diabetes prevention within the local Latino/Hispanic community of Phoenix?"; (b) Resources you want to Help Prevent Diabetes, "What resources do you want that could help prevent diabetes for you and your family?"; and (c) Features for Making a Diabetes Prevention Program more interesting, "What would make a diabetes prevention program interesting to you?"

Part 2 – The Quantitative Lifestyle Questionnaire. Part two, the Lifestyle Questionnaire, consists of six sections that capture important quantitative data about each participant. These sections are (a) You and Your Family (items about participants' family information), (b) Developmental History (early life variables including levels of acculturation assessed across time), (c) Community Life Ways (cultural items that generate two scales – Family Traditionalism and Urban-Rural Preferences, (d) Health and Behavior (scales of Health Motivation and Life Satisfaction) a behavioral frequency data

on Exercise, Rest, Lower Fat Foods (healthful), Higher Fat Foods (unhealthful foods), and scales of Behavioral Intentions to take actions to avoid developing T2D, (e) a Resilience Scale (the Connor-Davidson Scale) and (f) Background Information.

Part 3 – The Post-Interview Ratings. This form consists of an eight-item Post-Interviewer Behavioral Assessment form. These items are completed independently by the interviewer (or interviewers) to capture observable rated aspects of the participant. The present study utilizes two of these single-item scales: the Diabetes Awareness and the Diabetes Concern scales. Persistent observation, such as a focus on the characteristics or aspects of a conversation contributes to high-quality data collection in qualitative inquiries (Polit & Beck, 2017). In addition, the Post-Interviewer Behavioral Assessment provides a level of reflexivity and awareness that the interviewer may have contributed to the inquiry process.

Recorded Interview Procedures

Interview sessions were recorded with digital audio recorders and securely transmitted to a professional transcription service, where the Spanish-language digital audio files were translated into English. All completed transcription were secured according to the study's protocol. The files were securely uploaded, and later, the transcribed case files were downloaded from an outside vendor that uses secured submission and retrieval internet connections.

These transcribed files were uploaded into NVivo 12 (Lumivero, 2021) for conducting the study's thematic analysis of the textual data using an Integrative Mixed Methods protocol. NVivo coding assists in the identification and labeling of *response phrases* to identify and label emerging thematic categories (Castro et al., 2010). Our

current response phrases operates as units of analysis are longer than the original more truncated *response codes* previously used as a unit of analysis (Castro et al., 2010). This study's response phrases can consist of a partial or entire sentence, which provides a more complete and contextualized answer to the focus question as a unit of analysis.

Research Design

A complex convergent mixed-methods research (QUAL+QUAN) design (Curry & Nunez-Smith, 2015) was utilized in the parent study. The present study consists of a secondary data analysis from the Latino Lifestyles Study mixed methods data, obtained with permission from the original Principal Investigator. This complex *convergent mixed methods research design* is embedded within the study's three-factor (2x2x2) factorial design. This approach yielded deeper insights from the thematic analysis of these text narratives to allow a deeper and more nuanced interpretation of study results.

Exploring Potential Moderator Effects

Three factors were used as potential moderator variables (Fleiss et al., 2003) for this study: (a) *Diabetes Concern* (a levels of Concern scale), (b) *Diabetes Awareness* (a levels of Awareness scale), and (c) Health Motivation Scale. These potential *moderator variables* can be conceptualized as "effect modifiers" of the emergent themes drawn from a study's focus question. Statistical differences in the distributions of cases involving the mention or non-mention of a given theme (e.g., Disease Process Education) were examined as influenced by a moderator variable (e.g. Diabetes Awareness). The presence of a significant moderator effect would suggest that the potential moderator variable exerts a significant influence on the identified predictor-outcome effect. That is, (e.g., lower and higher) levels of moderator variable exhibit differential patterns of predictor (a

theme) and its outcome, as assessed by different frequency of mentions. In exploring the influences of effect modification in a given model, Fleiss and collaborators have stated that, "It is always good practice to assess the impact of a potential effect modifiers on important coefficients in the model (Fleiss et al., 2003, p. 298), also noting that, "When screening for interactions, widths at lower confidence levels and conducting tests of less stringent Type I error rages, such as $\alpha = 0.10$ or higher." (Fleiss et al., 2003, p. 298). Thus, we explored the potential effect modifier (moderator) effects of gender, age group, and acculturation (as assessed by interview language) in our analysis of key factors in the design of more effective evidence-based preventive interventions (EBIs) for implementation in diverse Latino communities.

Integrative Mixed Methods (IMM) Approach and Its Implementation

The Integrative Mixed Methods (IMM) approach offers concise methodological steps during thematic analysis by applying rigor with the integration of qualitative and quantitative data analyses (Castro et al., 2010). Table 1 presents a mixed methods Task Implementation Matrix that provides an overarching summary of the implementation of the IMM approach as implemented in eight steps. (1) *Research Study Design and Sampling Frame* (2) *Interview Protocol Development* (3) *Conduct Interview* (4) *Data Management* (5) *QUAL Thematic Analysis* (6) *QUAL → QUAN Transformation* (7) *Quantitative Analyses to Identify Associations* (8) *Joint Display of Select QUAN and QUAL Data.* This concise process allowed researchers to identify and encode participants' *response phrases*, which, under this IMM approach, consist of "answers to a given focus question." Organized sets of identified *response phrases* that contain the

same or similar meaning constitute the “building blocks” for generating *emergent themes* (Castro et al., 2010).

Thematic Analysis

Thematic Analysis is commonly used to identify and report observed patterns within data (Braun & Clark, 2006) by linking constructs to expressions found in text, images, sounds, and objects to affirm a theme (Ryan & Bernard, 2003). Two independent coders conducted the thematic analysis using NVivo 12 (Lumivero, 2021). For this analysis, using NVivo, we constructed a hierarchical node structure using three levels of data: (a) *Parent Nodes*, (b) *Child Nodes,* and (c) *Grandchild Nodes* (see Figure 1)

These data were organized, logged, and labeled in preparation for analysis (Ryan & Bernard, 2003). The two-person coding team met frequently during iterative Zoom sessions (Roundtable Discussions) to review results for *concordance* with emerging themes and to cross-check coding procedures. A lack of agreement among coders served as the occasion for a discussion to reconcile these differences in coding. These group review procedures allowed for consensus building and also reduced instances of coding errors.

To develop the hierarchical thematic analysis, we began with the highest nodes, the *Parent Nodes*, followed by the *Child Nodes* and *Grandchild Nodes*. The *Parent Node* consists of a focus question, which serves as the origin of the textual responses to be generated. For this study, we examined Focus Question 3, which elicited participants’ views on the contents and activities of a preventive intervention/program that would be of great interest to participants as helpful in preventing the onset of type 2 diabetes. Focus question 3 states: "What would make a diabetes prevention program interesting to you?"

The *Child Nodes* are subsumed under the *Parent Node* (focus question). The child nodes consisted of emerging themes that were constructed by grouping response phrases having the same meaning into distinct themes. This approach allowed for various themes to emerge inductively that identify intervention information or activities that would elicit engagement and interest in a Latino community diabetes prevention program.

Last within this hierarchical thematic analysis is the lowest level, the *Grandchild Nodes. Grandchild Nodes* consists of the *identified response phrases* that constitute "an answer to the focus question" also consisting as the "building blocks" of emerging themes. NVivo 12 (Lumivero, 2021) was used to identify and sort these response phrases into coherent themes. Under this coding process, each coder (researcher) created organized and succinct *Grandchild Nodes* (specific response phrases). This iterative analysis of data continued amongst the coding team using "best-choice modification" until the team developed a final codebook of themes that emerged during this process.

Measurement

Latino Lifestyle Focus Question "Platica"

As noted, the Latino Lifestyle study titled "Your Health: A Chat (*Una Platica*)" contains four sections of structured open-ended questions that examine the participants' experience related to (a) "*Healthy Habits*," (b) "*Family Influences*," (c) "*Preventing Diabetes*," and (d) "*Diabetes Prevention Program*." This study focused on the *Diabetes Prevention Program* section, with emphasis on the focus question, "What would make a diabetes prevention program interesting to you?" to examine participants' preferences and recommendations for core components and resources that would contribute to the design

and development of a more engaging diabetes prevention program within the Latino community.

Latino Lifestyle Questionnaire

The Lifestyle Questionnaire (Castro et al., 1987) was used to garner participant feedback in six general sections that define health-related behaviors: (a) social and cultural information, (b) development history, (c) traditional cultural lifeways, (d) psychological and behavioral aspects of a healthy lifestyle, (e) resilience, and (f) background information. For the quantitative portion of this study, we selected the 5-item Health Motivation scale found in the Psychological and Behavioral aspects of a Healthy Lifestyle section of the questionnaire.

Health Motivation Scale. This scale examines participants' thoughts and feelings toward health-related lifestyles, allowing insight into health orientation's cognitive aspects (Castro et al., 1987). This scale measures health motivation by asking the participants, "How motivated were you to improve your health?" The scale ranges from (1) Absent "you were not motivated" to (5) Extreme- "determined to improve your health." For the current sample, Cronbach's alpha for the Health Motivation scale is $\alpha = .83$.

Post-Interviewer Behavioral Assessment

A post-interview behavioral assessment was created by the research team using an iterative approach that consisted of private interviews and interrater reliability to ensure the scales were appropriate for this study (Castro et al., under review). The questions were derived from the Theory of Reasoned Action (TRA), in which factors of behavioral change were assessed to fully understand the different levels of engagement and

motivation (Castro et al., under review; Ajzen & Fishbein, 1980). The assessment comprised of two single item scales: (a) *Diabetes Awareness* scale and (b) *Diabetes Concern* scale. In the context of this study, the theory was employed to examine the participant's behavior with respect to awareness of diabetes and levels of concern as observed by the interviewer. Generally, the participant's behavior (positive attitude) results in a higher intention (motivation) (Ajzen & Fishbein, 1980). Independently, the interviewer rate participants immediately after post-interviews.

Diabetes Awareness Scale. This scale consists of a single item within the Post-Interview Behavioral Assessment form. The 5-point Likert scale allowed the interviewer to rate the participants by answering the following question, "How *aware* and *informed* was this participant about the disease of diabetes and about ways to prevent it?" The scale ranges from (1) "Unaware" to (5) "Professional awareness." Higher scores meant higher levels of awareness.

Diabetes Concern Scale. is a single-item scale within the diabetes questionnaire protocol. The 5-point Likert scale allowed the interviewer to rate the participants by answering the following question, "How *concerned* was this participant about his or her risk of developing diabetes?" The scale ranges from (1) "No concern" to (5) "Excessive concern." Higher scores meant higher levels of concern.

Coding and Data Analysis

Thematic Analysis

As noted, the thematic analysis coding was accomplished using NVivo 12 (Lumivero, 2021). Two independent coders identified text narrative responses (*response phrases)* to the focus question. These were used to create themes that support intervention

components for a Latino community diabetes prevention program to promote engagement. We then identified the emerging theme as a major theme or minor theme according to the number of cases in the study mentioning that theme. For example, our heuristic method for identifying a major theme was "7 or more cases." This constituted 25 percent or more cases mentioning that theme; therefore, it was considered a major theme. Emerging themes with response phrases less than the minimal number of cases are considered a minor theme.

This procedure was followed by a series of round-table discussions by the research team, consisting of a graduate student and a senior faculty member. Zoom online conferencing sessions allowed for interactive discussions and real-time data sharing to maintain momentum and support the challenges related to collaboration at a distance. These discussions focused on resolving differences between the coders to attain a consensus on *accuracy* (dependability) in identifying each emerging theme. This review also involved ascertaining validity (credibility) in describing the identity or meaning of a theme. A codebook of final themes and their response phrases was printed for a final review. NVivo files were shared using a secure Dropbox folder for ease of access.

Integration: Scale Coding for Conversion from QUAL to QUAN Data

Mixed methods integration commonly occurs by merging, connecting, and embedding qualitative and quantitative information to transform data (Creamer, 2018; Creswell & Creswell, 2018). This quantification of data allows for an in-depth analysis of selected narratives, offering a more rigorous identification of measurable co-variation to identify association between thematic and measured variables. *Scale Coding* was applied to each thematic category using an interval-level thematic variable for high

coding reliability by counting the participant's number of distinct mentions of a particular theme (coded as 0, 1, 2, 3). Coding by frequency of mention is identified as follows: (0) = "No Mentions," (1) = "One Mention," (2) = "Two Mentions," and (3) = "Three or More Mentions." Next, we created a series of new quantitative thematic variables. Finally, we conducted a storyline analysis to complete the analysis of association within the selected text, which included the response phrases for joint display of analyses (Fetters et al., 2013; Gutterman et al., 2015). During this process, we contrasted differences in response phrases by levels of concern (high levels of concern versus low levels of concern), levels of awareness (high levels of awareness versus low levels of awareness), and health motivation (highly motivated versus low motivation). In addition, we examined these response phrases by levels of a research design factor, for example (male vs. female; $\geq$ 40 years old vs. < 40 years old; Spanish vs. English).

Results

Summary of Research Approach

This study examined the responses of Latino community residents diagnosed with pre-diabetes to the focus question, "*IMPORTANT FEATURES: What would make a diabetes prevention program interesting to you?"* The aim was to understand what intervention contents and activities are most important to these Latino study participants for helping them to prevent the development and onset of type 2 diabetes (T2D).

Accordingly, using 2x2 cross-tabulation analysis, we tested group differences in the mention of response phrases as examined by two levels (high versus low) for three potential moderator variables: (a) Health Motivation, (b) Diabetes Awareness, and (c) Diabetes Concern. In conducting these analyses, we found significant moderator effects

in four difference analyses involving the moderator effects of: (a) Language (Spanish, English) in the relationship of the theme Organized Activity on being mentioned or not mentioned (see Figure 2); (b) Language (Spanish, English) in the relationship of the theme Healthy Cooking Classes on being mentioned or not mentioned (see Figure 3); (c) Diabetes Awareness (Low, High) in the relationship of the theme Healthy Cooking Classes on being mentioned or not mentioned (see Figure 4); and (d) Diabetes Awareness (Low, High) in the relationship of the theme Diet and Exercise Programs on being mentioned or not mentioned (see Figure 5).

About the Analysis of Significance, Correlations and Effect Sizes

A 2 x 2 contingency table can examine the distribution of case counts occurring between two dichotomous factors. For example, among a sample of participants responding to a Focus Question, participants may reply to an emergent theme, e.g., preference for an *Organized Activity,* by mentioning or not mentioning this theme, with (a Mention = 1,) or ("No Mention" = 0). Furthermore, these responses may be influenced by an *Effect Modifier* variable, otherwise also known as a *Moderator Variable*. In this case, a moderator variable could be the interview *Language* of the research participant (see Figure 2 and Table 3), whereby participants who speak Spanish may be more likely to mention this theme, versus those who speak English.

A significant *moderator effect* would be indicated by significantly different distribution of cases observed across the cells of this 2 x 2 contingency table. This significant distribution can be detected by the chi-square test value (e.g., χ^2 (df = 1) = 9.15, p. = .003). In the special case involving a 2 x 2 contingency table, the correlation coefficient (ϕ) is identical to the effect size coefficient (w). That is, in this special case,

both coefficients have the same value (Cohan, 1988, p. 223), a same "identify." Furthermore, in this special case, Cohen reports that the magnitude of the Effect Size (w) can be classified as: (a) w = .10 being a *small* effect size; (b) w = .30 being a *medium* effect size; and (c) w = .50 being a *large* effect size, (see Cohen, 1988, pp. 224-225).

Sample Characteristics

We collected data and examined 28 individuals who completed the "Platica" interview in addition to a successful English language transcription. Purposeful sampling was used to balance *gender* (male, female) and *age group* (<40 years, ≥40 years), resulting in a participant group that consisted of 14 males and 14 females. Of the total participants, 14 were in the (≥40 years) group, and the remaining 14 participants were in the (<40 years) group. Amongst this group, 12 participants preferred to respond to this in-depth interview in Spanish as their primary language, and 16 participants preferred to respond in English as their primary language. The demographic characteristics using the three-factor factorial design for this sample can be found in Table 2.

Participant Differences in Diabetes-Related Health Literacy and/or Health Motivation

We conducted cross-tabulation analyses with a Chi-Square test to identify themes for which there was a difference between participants rated high versus low on that potential moderator variable. Our selected moderator variables were (a) Health Motivation, (b) Diabetes Awareness, and (c) Diabetes Concerns.

The rationale for these analyses was our observation that some participants appeared to have low diabetes-specific health literacy and thus provided less informed and actionable responses for the design and development or adaptation of a more

effective evidence-based preventive intervention (EBPI) for preventing type 2 diabetes (T2D). That is, in their responses to a focus question, some participants provided a limited understanding of type 2 diabetes (T2D) which was not as informative for improving future preventive interventions for Latino communities. Thus examining instances of high versus low Diabetes Awareness emerged as an important approach for better use of community members expressions of needs and preferences.

Differences in High and Low Diabetes Awareness Groups

We assessed these differences by high and low levels of our three select moderator variables. We found two instances of differences by high versus low levels of diabetes awareness, as examined for two emergent themes: (a) Healthy Cooking Classes and (b) Diet and Exercise Programs.

Differences by Diabetes Awareness for Healthy Cooking Classes

Table 5 revealed that diabetes awareness and the theme of Healthy Cooking Classes displayed a trend worth mentioning. The frequency and types of mentions of diabetes awareness, and the theme Healthy Cooking Classes was observed amongst the high awareness group, six cases mentioned this theme, and 10 cases did not mention this theme. For the low awareness group, 1 case mentioned the theme, and 11 cases did not mention the theme. In this 2x2 cross tabs analysis, the test of significance was also (χ^2 (1) = 3.111, p = .078 (see Figure 4). This outcome indicates that the preference for Cooking Classes is more strongly preferred by participants having a High level of Diabetes Awareness, when compared with those having a low level of Diabetes Awareness.

Differences by Diabetes Awareness for Diet and Exercise Programs

Table 6 shows a trend in the frequency and types of mentions of diabetes awareness, and the theme Diet and Exercise Program was observed among cases who exhibit high diabetes awareness compared to those who are unaware or have low awareness of diabetes. Specifically, among the high-awareness group, six cases mentioned this theme, and 10 cases made no mention of it. By contrast, in the low awareness group, one case mentioned this theme, and 11 cases made no mention. The Chi-Square test of significance for this analysis was (χ^2 (1) = 3.111, p = .078. (see Figure 5). This constitutes a trend that was just above the conventional ($p < .05$) level of significance. Given this, we sought to mention this outcome, which consists of a noteworthy difference in case distributions that indicates a remarkable interaction effect suggestive of a moderator effect.

Joint Display Analysis

Theme Diet and Exercise Intervention Components

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Theme Diet and Exercise Intervention Components

The moderate and high awareness group participants mentioned education about diet and exercise, as presented jointly, would be an important feature for a diabetes prevention program tailored to the needs of Latino communities. Table 6 displays the case narratives for each participant by levels of Diabetes Awareness. The Storyline Analysis revealed patterns of expressions for developing healthy eating habits. For example, participants mentioned straightforward program activities such as food selection

while grocery shopping as a meaningful intervention activity to assist them in making better food choices. One participant pointed out the need for access to organic and alternative food options. They recommended a food stand as a viable option to promote access to these types of healthy food selections. Most participants also mentioned exercise as an important intervention activity or component. They suggested that a meaningful diabetes prevention program should offer a family-oriented environment for exercise. In contrast, only one case from the low diabetes awareness group mentioned the importance of diet and exercise as an intervention component to prevent diabetes. Both groups identified diet and exercise as a critical intervention component of a diabetes prevention program is more strongly preferred by participants having a High level of Diabetes Awareness, when compared with those having a low level of Diabetes Awareness.

Theme Healthy Cooking Classes Intervention Components

Healthy cooking education activities can also include hands-on training on "healthy cooking" to improve lifestyle and prevent diabetes. This was identified as a trend in the high-awareness group. As displayed in the case narratives found in Table 5, participants shared a desire for classes or cooking fairs that provide hands-on activities to learn how to prepare healthy meals they can enjoy. Suggestions were made to have classes led by a nutritionist or group sessions where they can learn how to cook meals that can be integrated into their everyday life. Again, only one case from the low diabetes awareness group mentioned the Healthy Cooking Classes as an intervention component to prevent diabetes. This case mentioned the importance of Healthy Cooking Classes to prevent diabetes as well as how to eat healthier foods. Overall, both groups emphasized

the need for a course in preparing healthy meals as a critical intervention component of a diabetes prevention program.

Discussion

This study identified information and activities recommended by these Latino community residents, as contents that can be incorporated into core intervention components to improve these evidence based preventive interventions (EBPIs) in accord with the views of local Latino community residents. First, we conducted open-ended interviews using focus questions, to identify the most important components for a culturally responsive diabetes prevention intervention. Second, we assessed the levels and associations of three potential moderator variables: (a) Health Motivation, (b) Diabetes Awareness, and (c) Diabetes Concern among Latinos and Latinas who have prediabetes. We also obtained behavioral assessment data from the interviewers using single-item rating scales of participants observable responses and behaviors occurring during this interview session. The two single item scales from this behavioral assessment form that we utilized in this study were the participant's level of Diabetes Awareness and level of Diabetes Concern. We then assessed the potential moderator effects of these variables to explore potential differences in the mention of themes by levels of these potential moderator variables.

Accordingly, we sought to identify intervention program needs that are most important among community residents having (a) greater Health Motivation that would indicate a greater desire to live a healthy lifestyle, (b) greater Diabetes Awareness (a measure of diabetes health literacy), and (c) greater Diabetes Concern (which constitutes a measure of preparedness to take action to protect themselves in preventing the onset of

T2D). In these analyses, we identified two trends that were worth mentioning. The first trend was between the moderator variable of Diabetes Awareness and the theme of the Diet and Exercise program. The second trend was between the moderator variable of Diabetes Awareness and the theme of Healthy Cooking Classes.

Other researchers have examined previous diabetes prevention programs over the past decade to determine if they are applicable to real-world conditions. For example, a systematic review of real-world DPP learning over a 15-year period revealed that adherence to guidelines on content and delivery was significantly associated with weight loss. Low participation in most of the studies was due to the amount of attention placed on the content of the intervention instead of focusing on participant intervention engagement (Aziz et al., 2015). Emerging evidence from our study supports the importance of disseminating and implementing stronger diabetes prevention intervention strategies that are culturally relevant as this can increase participant engagement.

Responsiveness to Needs and Preferences of Community Residents

We examined the views of Latino community residents with pre-diabetes to add depth and deeper insight into intervention components that could help them engage in real-world health-related lifestyle changes to reduce their risk of developing diabetes. Health-related lifestyle changes such as increasing physical activity and choosing healthy meal options can reduce the risk of developing diabetes. Several important findings were discovered during our assessment.

First, we identified a strong desire to develop healthy eating habits. Researchers and healthcare professionals should consider intervention component activities that allow for appropriate food selection, such as “grocery shopping” or a “food stand” with access

to “organic” fruits and vegetables, when designing diabetes prevention programs for Latinos, especially in communities with limit access to healthy food sources. This is consistent with the “*food is medicine”* movement, a movement in which a nutritionally adequate diet supports better health outcomes (Barnidge et al., 2020). Food and nutrition interventions such as medically tailored meals, medically tailored groceries, and prescriptions for produce are administered in concert with a healthcare system at no cost (Downer et al., 2020). Studies have emerged over the past few years that validate *food is medicine* interventions as a practical approach for healthful outcomes. For example, a produce prescription study designed to improve hypertension offered nutritional counseling and produce vouchers to a local farmers market to patients who screened positive for food insecurity and demonstrated significant changes in dietary behaviors, such as an increase in fruit and vegetable consumption, which contributes to positive hypertension outcomes (Trapl et al., 2018). These findings are meaningful for designing and developing more acceptable real-world interventions, that are congruent with food consumption traditions and daily practices which constitute an integral aspect of life within Latino communities.

Culturally Engaging and Interactive Intervention Components

Next, our study highlighted the need for intervention components that are culturally adapted. Our findings suggest that local community residents who have high diabetes awareness seek interventions that are interactive and inclusive of cultural norms, e.g., “engaging family.” This aligns with previous studies that included family members in intervention activities, resulting in improved engagement, weight, and eating habits (Soltero et al., 2018; Soltero et al., 2019; Van Name et al., 2016). Another noteworthy

example of culturally engaging and interactive intervention components are hands-on cooking experiences using culturally appropriate ingredients. An analysis of a hands-on cooking education program for veterans (The Healthy Teaching Kitchen) showed that hands-on cooking and nutrition education positively impacted the participants cooking confidence, dietary quality, and self-management (Dexter et al., 2019). Incorporating cooking demonstrations using healthy food selections into a Latino diabetes prevention program may contribute to healthful dietary practices, better food choices, and knowledge on preparing healthy meals for themselves and their family.

The trends observed in these preferences among participants having high diabetes awareness suggest that many individuals have a willingness to engage in healthful dietary lifestyle management. When designing interventions that have a good "cultural fit," the design and the development of intervention components should fit the needs of the local community residents (Castro & Yasui, 2017). Engaging families in the intervention activity and interactive, hands-on healthy cooking classes using culturally receptive foods constitute useful intervention components that researchers and program designers can consider when designing interventions for Latino community-based diabetes intervention programs.

Intervention Components that Impact the Community

Finally, a major finding in this study is the trending relationship between Diabetes Awareness and the theme of Diet and Exercise. The local Latino community residents with high diabetes awareness who were diagnosed with prediabetes expressed a desire to learn about dietary and exercise intervention components for developing a healthful lifestyle consistent with diabetes prevention. This finding is congruent with prior research

that reported that Latinos diagnosed with prediabetes expressed an interest in interventions to improve diet and exercise (Shaak et al., 2018). A growing body of literature documents that diet and exercise have multiple benefits associated with diabetes prevention (Magkos et al., 2020; McCurley, 2016).

Despite the effectiveness of innovative programs such as the Diabetes Prevention Program (DPP), there is still a need to bridge the gap between evidence-based findings and cost-effective real-world interventions (Venditti et al., 2016). Designing such interventions can increase participant interest and engagement. Local adaptation can consist in making needed modifications of components of an evidence-based intervention (EBI) when implemented in a community setting (e.g., changes to *intervention content* and *procedures*). These modifications must be conducted based on a clear understanding of the intended modification and with actions to document improvements or problems occurring in relation to the modification made. The ideal outcome is to improve *cultural fit* (Barrera et al., 2017). Making culturally relevant adaptations to fit the needs of local communities has remained a challenge (Aziz et al., 2015). For example, a participant in this study expressed a need for "places to walk" within the community. However, Latino communities are often under-resourced or in high-crime neighborhoods, hindering local residents' ability to be physically active (Lee et al., 2021). Community intervention components that reduce ecological and social structural barriers to physical activities are needed to promote improvement in health outcomes (Lee et al., 2021). For example, a community soccer program designed with principals from the DPP improved physical activity and health outcomes in Latino men (Frediani et al., 2020). The alignment of community resources could prevent the development of diabetes in individuals with

prediabetes (Shaak et al., 2018). Lifestyle interventions (e.g., physical activity intervention components) that are culturally adapted are necessary to be responsive to the critical needs that exist within local Latino communities as well as policies to eliminate racial and ethnic health inequities and disparities, as doing so will improve preventive intervention efficacy in attaining targeted health outcomes (McCurley et al., 2016; Shaibi et al., 2015).

Study Limitations

Study limitations include a small sample size obtained from community residents from one geographical area. We recognize that the small sample size limits the generalizability of findings and the transferability of these results to larger Latino populations. Also, the post-interviewer assessments were designed to obtain measured behavioral ratings from the interviewers. Despite the use of measurement scales for diabetes awareness and diabetes concerns, the reported ratings could be influenced by certain forms of observer bias. However, the use of these measures in a previous study confirms the reliability of its subscales (Castro, under review). Given this study's limitations with a smaller sample size, future research could adapt the *Latino Lifestyle Questionnaire* and further explore the relationship between health motivation, diabetes awareness, and diabetes concern with a larger sample size for a larger database for assessing the reliability and validity of the measures contained within the Latino Lifestyle Questionnaire. That larger database may enhance the rigor in assessing culturally adaptive intervention components to aid in promoting community engagement and healthful outcomes within a Latino diabetes prevention program. Further, with a larger sample size, the constructs of health motivation, diabetes awareness, and diabetes

concerns can be formally tested for their actual role as a moderator variable of the effects of identified predictors and targeted outcome variables.

Future Research

Future research should focus on intervention components that may be implemented virtually. For example, the Healthy Teaching Kitchen study was administered using telehealth technology to support access and decrease travel demands (Dexter et al., 2019). Research shows that optimizing the efficiency of diabetes prevention programs using various technologies such as mobile applications, websites, and SMS to increase the program's accessibility and convenience is well received when administering lifestyle intervention programs (Villegas, 2022).

In addition, this information is critically important for policymakers and program implementers to develop diabetes prevention programs that are effective among racial or ethnic communities. Policies are needed to improve the social conditions within communities to address health disparities and health outcomes (Braveman et al., 2010; Lee et al., 2021). Investing in community-based programs that promote access to evidence-based content is needed to increase understanding of existing research and for an appreciation of cultural approaches intended for diverse and marginalized population sectors (Boyd et al., 2023).

Conclusion

These findings provide informative intervention information on components that can improve cultural relevance, participant engagement, and intervention effectiveness in the development and/or adaptation of a Latino community-based diabetes prevention intervention designed to enhance engagement and healthful lifestyle changes among

Latinos/as diagnosed with prediabetes. Despite the effectiveness of innovative evidence-based interventions, such as the DPP, there still exists a need to bridge the gap between evidence-based findings and cost-effective real-world intervention implementation (Venditti et al., 2016), by designing such interventions to Latino community residents as these will increase cultural relevance, interest, and engagement.

Human Subject Statement

All procedures, as well as sample and recruitment for this research study, were approved by an Institution Review Board (IRB). Informed consent was obtained from all subjects prior to data collection.

Conflict of Interest Statement

The authors have no conflicts of interest.

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Tables

Table 4.1

Implementation Matrix: Latino Lifestyle Integrative Mixed Methods Approach

Step	Research Task	Description	Specific Details in the Present Study
Study Design			

1	**Research Study Design and Sampling Frame**	Study design and sampling frame developed to obtain data to answers to Focus Questions	• *Sampling frame by three independent variables allows planned comparisons by:*
			  • *Gender* (male, female)
			  • *Age Group* (older, younger)
			  • *Language* Preference (Spanish speaking, English Speaking)
			• Aim to examine, for two separate focus questions, types of social support for diet and exercise

2	**Interview Protocol Development**	Develop and refine (QUAL+QUAN) Mixed Methods Interview Protocol	A two-part QUAL+QUAN structured interview • QUAL: the *Platica* (a chat) • QUAN: the Questionnaire consisting of scales and Likert items
Implementation			
3	**Conduct Interview**	Administer Mixed Methods Interview Protocol	Structured interviews: audio recorded QUAL and QUAN data • QUAL Focus Questions with follow-up probes elicit complete answers each Focus Question • QUAN Questionnaire data yields obtains QUAN data from scales and rated items
4	**Data Management**	• QUAL: Transcriptions and Translations • QUAN: Data entry to SPSS	• Audio recorded data transcribed to verbal texts. Translations conducted if needed.

			• Numeric data entered into a statistical data analysis program, SPSS
5	**QUAL Thematic Analysis**	Conduct thematic analysis using *NVivo*	Thematic analysis with NVivo includes Roundtable discussions during coding, and Codebook review checks on reliability/dependability of coding
6	**QUAL→ QUAN Transformation**	*Scale Coding* to allow integrative analysis • Converted QUAL to *Thematic Variables*. • QUAN data are *Measured Variables*	*Scale coding* used to "quantify" emergent themes to create *Thematic Categories* or *Thematic Variables*. Allows mixed methods numeric operations to discover significant associations
Data Analysis			
7	**Quantitative Analyses to Identify Associations**	Conduct integrative data analysis to identify significant QUAL and QUAN associations	Quantification aids in identifying significant associations in robust integrative data analysis for a deep-structure analysis of answer so Focus Questions, within the context of the independent variables, i.e., Gender, Age Group, Language. Types of QUAN analyses: • Cross Tabs for categorical variables • Spearman correlations for interval level-variables
8	**Joint Display of Select QUAN and QUAL Data**	Conduct *Storyline Analyses* (Joint Displays) for a deeper integrative understanding of significant associations	• Return to original QUAL texts within context of QUAN variables • Identifies significant QUAL, QUAN associations for more focused analysis of results • Allows deep-structure interpretations

Table 4.2

Three-factor factorial design characteristics (age, language, and gender)

Total Study Participants (N=28)	
Characteristics	No.
Age	
≤ 40	14
>40	14
Gender	
Male	14
Female	14
Primary Language	
English	16
Spanish	12

Table 4.3

Joint Display Analysis - Theme: Organized Activity by Language Preference

Healthy Cooking Classes – Joint Display Analysis		
Spanish Language Preference		
No Mention	Mentions in the form of Response Phrases	Storyline
5 Cases	7 Cases	Spanish and English cases mention a common storyline. The frequency of mention is significantly higher in the Spanish speakers group. The Spanish speakers offered specific and usable content. Participants request organized activities: • Credible messenger • Diverse age groups • Visuals
	108. [a class to] explain to you the [diabetes process] and what the risks are and how to prevent	
	122. a program for people in their twenties [and] for everyone in the family	
	123. classes or workshops	
	124. [a program that] motivates you to do something take action [like run a marathon or do stuff for a cause]	
	127. Class for two- three hours for prevention of diabetes	
	128. Someone knowledgeable about diabetes who could present it in a way that's visual, like a diagrams, charts, not just lecture	
	137. [a speaker that has been affected by diabetes that nobody really knows	
English Language Preference		

No Mention	Mentions in the form of Response Phrases	Storyline
15 Cases	1 Case	Similar content to above, but vague
	103. free classes or seminars	
Note: Total Cases = 28, (χ2 (1) =9.115, p <.003, Phi = 0.571 (Effect Size (ES) = Large)		

Table 4.4

Joint Display Analysis - Theme: Healthy Cooking Classes by Language Preference

Healthy Cooking Classes – Joint Display Analysis		
Spanish Language Preference		
No Mention	Mentions in the form of Response Phrases	Storyline
7 Cases	5 Cases	Spanish and English cases mention a common storyline. The frequency of mentions is higher in the Spanish group. It is not significant but a trend worth mentioning with a Medium Phi (0.333). Participants request cooking activities: • To improve lifestyle • To prevent diabetes • To learn how to cook healthy foods
	102. courses to prevent [diabetes] and how to eat healthier foods	
	122. [a program about] how to make your lifestyle better [by] cooking	
	124. Healthy cooking class that people can take	
	126. [a nutrition class for]… ways to prevent diabetes	
	128. teaching people how to cook	
English Language Preference		
No Mention	Mentions in the form of Response Phrases	Storyline
14 Cases	2 Case	Similar content to above
	101. a program that taught us how to prepare meals that we like	
	107. food cooking fairs	
Note: Total Cases = 28, (χ2 (1) =3.111, p <.078, Phi = 0.333 (Effect Size (ES) = Medium Effect)		

Table 4.5

Joint Display Analysis - Theme: Healthy Cooking Classes by Levels of Diabetes Awareness

<table>
<tr><th colspan="3">Healthy Cooking Classes – Joint Display Analysis</th></tr>
<tr><td colspan="3">High Awareness</td></tr>
<tr><td>No Mention</td><td>Mentions in the form of Response Phrases</td><td>Storyline</td></tr>
<tr><td rowspan="7">10 Cases</td><td>6 Cases</td><td rowspan="7">High and Low-Awareness cases mention a common storyline. However, the frequency of mention is higher in the high-awareness group. It is not significant but a trend worth mentioning with a Medium Phi (0.333).

Participants request cooking activities:
• To help prevent diabetes
• To improve healthy eating habits
• To cook meals, they like to eat</td></tr>
<tr><td>101. a program that taught us how to prepare meals that we like</td></tr>
<tr><td>107. food cooking fairs</td></tr>
<tr><td>122. [a program about] how to make your lifestyle better [by] cooking better</td></tr>
<tr><td>124. healthy cooking class that people can take</td></tr>
<tr><td>126. [a nutrition class for] ways to prevent diabetes</td></tr>
<tr><td>128. teaching people how to cook</td></tr>
<tr><td colspan="3">Low Awareness</td></tr>
<tr><td>No Mention</td><td>Mentions in the form of Response Phrases</td><td>Storyline</td></tr>
<tr><td rowspan="2">11 Cases</td><td>1 Case</td><td rowspan="2">Similar content to above</td></tr>
<tr><td>102. courses to prevent [diabetes] and how to eat healthier foods</td></tr>
<tr><td colspan="3">Note: Total Cases = 28, (χ2 (1) =3.111, p <.078, Phi = 0.333 (Effect Size (ES) = Medium Effect)</td></tr>
</table>

Table 4.6

Joint Display Analysis - Theme: Diet and Exercise by Levels of Diabetes Awareness

<table>
<tr><th colspan="3">Diet and Exercise – Joint Display Analysis</th></tr>
<tr><td colspan="3">High Awareness</td></tr>
<tr><td>No Mention</td><td>Mentions in the form of Response Phrases</td><td>Storyline</td></tr>
<tr><td rowspan="7">10 Cases</td><td>6 Cases</td><td rowspan="7">High and Low-Awareness cases mention a common storyline. However, the frequency of mention is higher in the high-awareness group. It is not significant but a trend worth mentioning with a Medium Phi (0.333).

Participants request diet and exercise activities:
• Family oriented
• About healthy choices
• A place to go exercise</td></tr>
<tr><td>107. health promotion education and publicity for good eating habits and exercise prevent diabetes</td></tr>
<tr><td>114. information [about nutrition] to the public [to make better food choices]</td></tr>
<tr><td>122. [a program about how to be] physically active as a family</td></tr>
<tr><td>123. being able to find some place to go and exercise</td></tr>
<tr><td>127. [promote healthy foods with] organic food [stands] alternative foods</td></tr>
<tr><td>128. teach people how to find time to exercise</td></tr>
<tr><td colspan="3">Low Awareness</td></tr>
<tr><td>No Mention</td><td>Mentions in the form of Response Phrases</td><td>Storyline</td></tr>
<tr><td rowspan="2">11 Cases</td><td>1 Case</td><td rowspan="2">Similar content to above, but vague</td></tr>
<tr><td>104. dieting</td></tr>
<tr><td colspan="3">Note: Total Cases = 28, (χ2 (1) =3.111, p <.078, Phi = 0.333 (Effect Size (ES) = Medium Effect)</td></tr>
</table>

Figures

Figure 4.1

Thematic Analysis – NVivo Hierarchical Node Structure

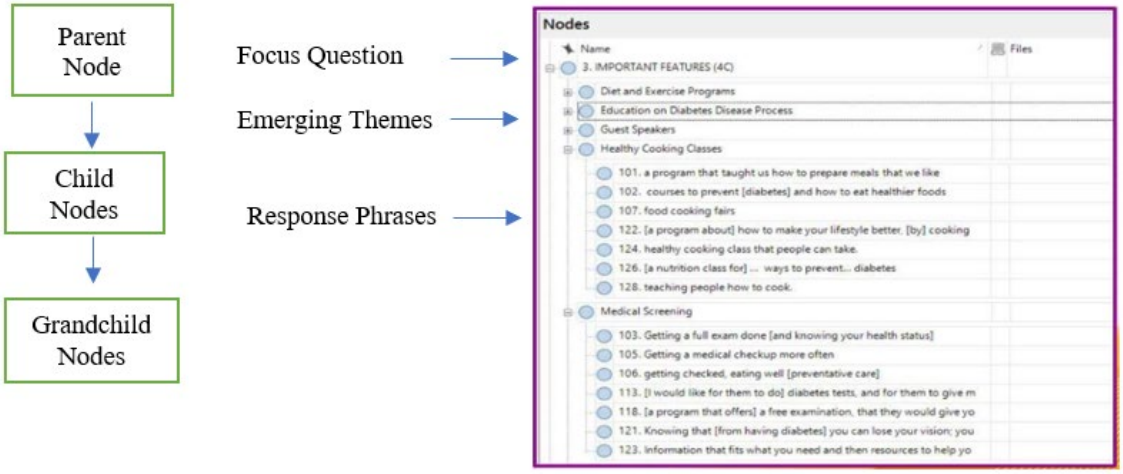
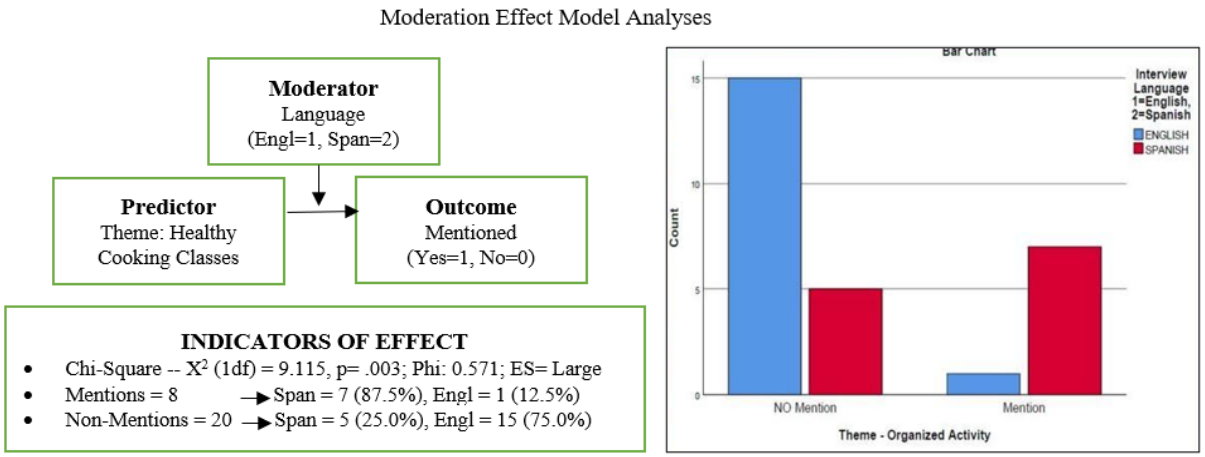


Figure 4.2.

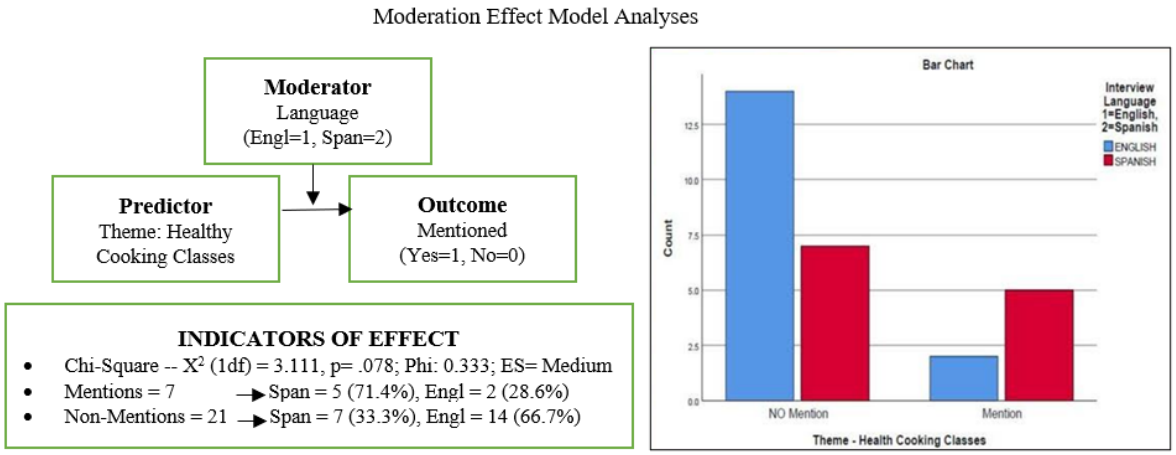
Moderation Effect Model Analyses – Language & Theme: Organized Activity



Note: Significant Effect

Figure 4.3

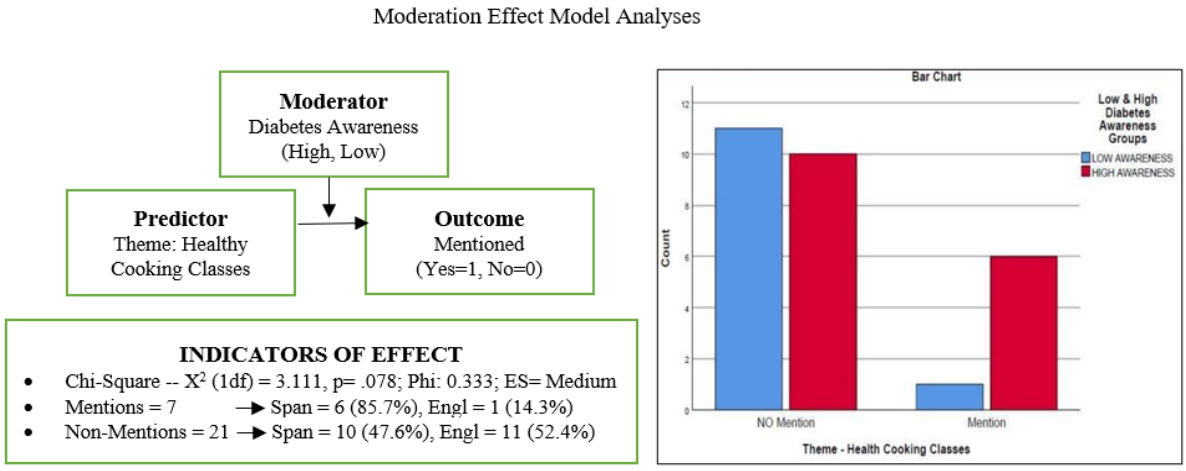
Moderation Effect Model Analyses – Language & Theme: Healthy Cooking Classes



Note: A *Trend Worth Mentioning*

Figure 4.4

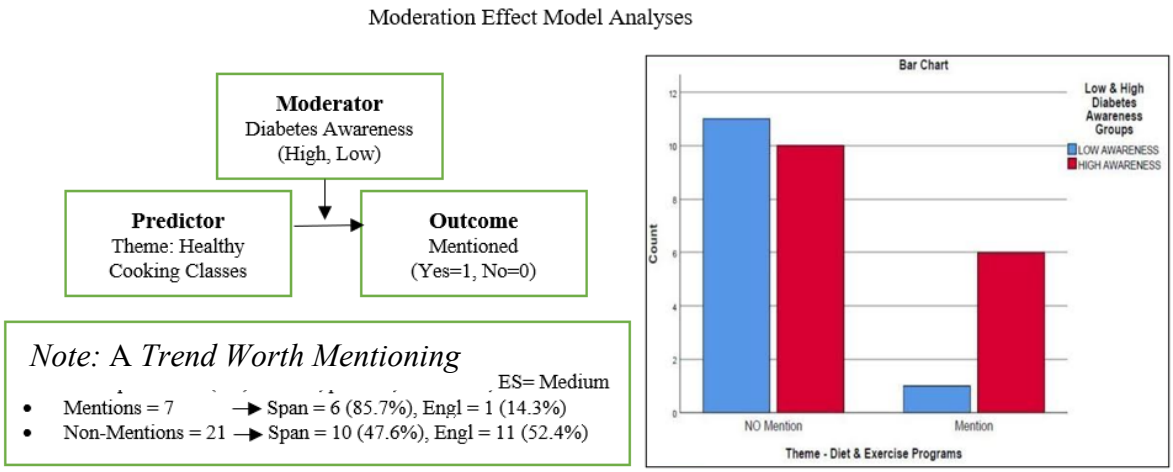
Moderation Effect Model Analyses – Diabetes Awareness & Theme: Healthy Cooking Classes



Note: A *Trend Worth Mentioning*

Figure 4.5

Moderation Effect Model Analyses – Diabetes Awareness & Theme: Diet & Exercise Programs



CHAPTER 5: DISCUSSION

This three-manuscript dissertation assessed the local Maricopa County Latino community residents' needs and preferences for a culturally responsive and engaging community-based diabetes prevention program. The social-ecological model (SEM) was used as a guiding framework for this study. Three levels, (a) intrapersonal level, (b) interpersonal level, and (c) community level, were used to inform the intervention component levels of influence within the SEM. Table 1 displays the intervention components identified within each study using this multilevel framework.

Relationship Between Chapters

Intrapersonal Level

At the intrapersonal level of the SEM, similarities exist across all chapters within this study. Intervention components that direct self-awareness were consistent between studies. For example, local Latino residents seek intervention components that promote healthy eating habits, such as dietary plans and guides for food selection when grocery shopping. Intervention component strategies to promote a healthful lifestyle were mentioned in all Chapters (e.g., assistance with exercise and meal preparation). Local Latino residents mentioned a desire for interventions that demonstrate how to integrate culturally relevant food options. As one example, the person can make healthful cognitive and behavioral changes to introduce healthier food options such as "asparagus" into their daily routines. Still, identifying more healthful food options that taste good and are healthful can be a challenge for some Latino consumers. They also requested diabetes prevention education materials, such as brochures in Spanish. Developing informative items, such as brochures, that will be informative and positively engage consumers is also

a challenge. Such culturally adaptive strategies are consistent with the studies identified in Chapter 2's systematic review. This study highlighted the use of items and activities developed in the participant's preferred language (English and Spanish) and intervention components such as training materials offered in Spanish. The use of behavioral outcome measures (e.g., weight and waist circumference) and behavioral management strategies (e.g., goal setting and action plan development) were mentioned as intervention components within Chapter 2's systematic review. However, these intervention components did not emerge in chapters 3-4.

Interpersonal Level

The interpersonal level of the SEM shared similarities in intervention components that can introduce interpersonal interventions directed toward improving social networks. These local Latino residents desire diabetes education on healthy food options for the family. They expressed a need for interactive activities such as hands-on cooking demonstrations and family-oriented exercise classes that include intervention components for children. These intervention components were consistent across all chapters.

Community Level

At the community level, the SEM intervention components were directed toward resources for community-based diabetes prevention education and for resources to address the disparities within the community. For example, local Latino residents requested a trusted peer such as *Promotora* to provide classes on diabetes disease process and lifestyle changes to prevent developing Type 2 Diabetes. They also requested financial assistance for medication and diabetes preventive screening. Structural barriers were described that hinder engaging in healthful physical activities (e.g., the lack of safe

neighborhood locations that disallow walking within downtown environments). These residents requested interventions such as access to fitness centers and walking trails. These types of intervention components that address structural barriers are mentioned throughout all chapters, and the particular approaches mentioned were more specific to the environments within the local Maricopa County Latino community.

Implications for Practice

Culturally Tailored Intervention Components

Culturally tailored diabetes prevention interventions are instrumental in creating healthful engagement and participation. The findings from this study suggest that cultural adaptations at the intrapersonal level of the SEM, such as education materials in Spanish to improve diabetes awareness and healthful lifestyle activities are important features to consider when designing diabetes prevention interventions. Previous studies have shown that local cultural adaptations improve engagement and targeted health outcomes (Frediani et al., 2020; McCurley et al., 2017; Van Name et al., 2016). Future research in prevention science aimed at identifying principles and guidelines for conducting practical cultural adaptations is needed to guide decision-making during the implementation of strategic adaptations to improve health and well-being (Castro & Yasui, 2017).

Family-oriented Intervention Activities

Our findings support integrating family-oriented activities into diabetes prevention programs as a meaningful intervention component strategy to improve health outcomes. In a previous study, researchers included family members in the diabetes prevention intervention activity but did not include them in the outcome (Van Name et al., 2016). Assessing the impact or level of influence of family and non-family

individuals (e.g., friends, social groups) in the outcomes evaluation of future studies may inform researchers of the impact these influencers have on the intervention utilized. In addition, these participants emphasized the importance of youth intervention components. These local community residents recommended exercise and dietary classes for children and young adults. In this regard, a *family-friendly* (parent and child) diabetes prevention study successfully reduced diabetes-related risk factors (e.g., BMI and fat intake) and quality of life for both the parents and children (Soltero et al., 2019).

Interventions to Promote Access to Community Resources

Access has been identified as a fundamental challenge within this local Latino community. Residents recommend a diabetes prevention program that includes intervention components to address (a) access to prevention education materials in public settings, (b) access to resources that offer financial assistance for medication and health screening, and (c) access provided by ecological community improvements that allow engaging in physical activity in their community (e.g., walking trails). A systematic review that assessed the cost-effectiveness of diabetes prevention interventions reported that investing in diabetes prevention using population-based approaches is an efficient use of healthcare and societal resources (Zhou et al., 2020). A good example of an effective diabetes prevention intervention program is the Diabetes Prevention Program (DPP). The DPP was designed to deliver evidence-based lifestyle interventions directed toward diet and physical activity to prevent the development of type 2 diabetes (T2D) (Gruss et al., 2019).

The DPP interventions have been culturally adapted for communities at risk of developing diabetes including the Latino community (McCurley et al., 2017). A common

cultural adaptation within the Latino community engaged local community members to deliver interventions (e.g., prevention education) (McCurley et al., 2017). This study's local Latino community residents preferred a trusted community member to deliver intervention components within a community-based diabetes prevention program. Previous researchers mentioned the effectiveness of this intervention component in a local Latino community-based diabetes prevention program. They reported that a *Promotora* knowledgeable of local cultural views and behaviors was instrumental in shaping the study's outcome (Millard et al., 2017). Lifestyle programs like the DPP that included trained lay health workers and health professionals were found to be the most cost-effective (Zhou et al., 2020). For this intervention component to be effective, it will require collaboration between healthcare professionals and community leaders using the principles of community-based participatory research (Wallerstein et al, 2018). Future research should include more behavioral lifestyle prevention research conducted with well-sampled Latinos and Latinas, to maximize the effects of formal, cost-effective programs such as the DPP, as informed by the views of local community residents, as this can identify and demonstrate the benefits of culturally adapted intervention components in Latino communities (Venditti, 2016).

Social Determinants of Health (SDoH) such as access to food, healthcare, and neighborhood as described by this study's local community residents collectively contribute to the development of T2D (Martinez-Cardoso et al., 2020). Access to healthful intervention information and activities and access to healthful community resources are fundamental in creating social patterning that promotes health. As diabetes prevention programs emerge intervention components that focus on changing certain

structural factors that constitute SDoH should be conducted, to improve neighborhood environments and eliminate structural barriers that disallow the practice of targeted health-enhancing behaviors.. This said, changing structural factors at the community level to produce health changes will require a coordinated effort among various stakeholders and a persistent effort implemented over time (Martinez-Cardoso et al., 2020).

Implications for Policy

Policymakers are essential in developing more culturally relevant community-based prevention programs, including those for reducing the risks of developing T2D and enhancing healthful lifestyles. For this to happen, policymakers and community leaders must advocate for population-based approaches aimed at public health and environmental change strategies (Zhou et al., 2020). Since lifestyle programs like the DPP were implemented, payor organizations such as the Centers for Medicare and Medicaid Services now recognize these lifestyle change programs for their beneficiaries (Zhou et al., 2020).

Social capital refers to resources and benefits that can be applied to reducing and eliminating various health disparities (Rodgers et al., 2019). Specific, culturally informed, and community-focused health policies are needed at the local and regional levels, that direct funding toward providing needed resources to effectively promote diabetes prevention in Latino communities. Such investments can make changes that will reduce or eliminate specific health disparities among Latino populations. For example, among low-income Latino populations, the health disparity or inequity of systemic injustices such as unequal access to health care can be remedied by the systems that

created these inequalities using system-based solutions to solve these types of complex challenges. (Lee, et al., 2021).

Furthermore, these policies coupled with targeted appropriation of funds can include funds for research and evaluation to support evidence-based interventions that are culturally adapted for specific Latino communities, as these can build local social capital and increase access to critical resources.

Strengths and Limitations

The balanced sampling frame utilized in this study consisted of participant selection for equity based on three factors, age group, gender, and primary language. This approach contributed to a fair representation of Latino men and women within the local Maricopa County Latino community. These participants were provided with the opportunity to express their preferences and offer recommendations on program components needed by the local community and intervention components important to the participant and their families (Buckley et al., 2015; Hingle et al., 2016; Joachim–Celestin et al., 2021). This information can inform researchers and community leaders in designing and developing future and localized Latino community-based diabetes prevention programs.

This study has some limitations. The small study sample size, N= 28, was obtained from community residents from one geographical area. This limits the generalizability of these results across heterogeneous Latino communities. Although the SEM is a common framework used in public health research, it does not allow for the complexity of comprehensive testing and intervention development (Stokol, 1996; Fleury & Lee, 2006). The post-interviewer assessments were designed to obtain measured

behavioral ratings from the interviewers. Despite the use of measurement scales for diabetes awareness and diabetes concerns. Given that ratings of diabetes awareness and diabetes concerns were obtained as behavioral observations provided by the interviewers, these ratings could be influenced by certain forms of observer bias. Nonetheless, extensive interviewer training was used to reduce inaccuracies and any biases that may emerge in conducting these ratings.

Conclusion

This dissertation consisted of a detailed mixed methods study conducted with a small sample, that comprehensively assessed the local Maricopa County Latino community residents' needs and preferences for a culturally responsive and engaging diabetes prevention program. Findings from the three manuscripts presented collectively suggest that intervention components for a Latino community-based diabetes prevention program should include (a) culturally tailored intervention components that are adapted based on participants' preferred language, as an indicator of acculturation status, (b) family-oriented intervention activities that include the participant's social network, and (c) strategies for making community-level structural changes that will eliminate specific structural barriers that will eliminate specific inequities and related health disparities. Continued research in Latino community diabetes prevention that identifies intervention components and social contextual resources that can be taken to scale, i.e., widely disseminated within other Latino communities, can be utilized as a framework, the multiple levels of the SEM. Specific strategies in this approach can contribute towards building social equity and provide a good return on investment (Venditti, 2016).

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Table 5.1

Intervention Components by SEM Level of Influence

SEM Level	Chapter Reference	Intervention Components Described	Cultural Context
Intrapersonal	Chapter 2 Systematic Review	• Behavior outcome measures (e.g., waist circumference and weight) • Behavior management strategies (e.g., self-monitoring, self-management, and individual accountability (e.g., goal setting, food journaling, or action plan development))	• Language preference modification for English and Spanish participants • Literacy needs for low-income Latinos • Modified instructional materials
	Chapter 3 Qualitative Summary	• Diabetes prevention education to promote self-awareness • Resources to promote healthy eating habits (e.g., dietary plan, guides for healthy food selection and preparing meals) • Resources to promote healthful lifestyle changes (e.g., strategies to include exercise and healthy eating into daily routine)	• Language preference modification for English and Spanish participants • Integrate culturally relevant healthful food options into lifestyle behaviors
	Chapter 4 Integrative Mixed Method Approach	• Resources to promote healthy eating habits (e.g., assistance with healthy food selection while grocery shopping) • Resources to promote healthful lifestyle changes (e.g., strategies to include exercise and healthy eating into daily routine)	• Language preference modification for English and Spanish participants • Integrate culturally relevant healthful food options into lifestyle behaviors
Interpersonal	Chapter 2 Systematic Review	• Social engagement and peer interaction (e.g., soccer games) • Small group activities (e.g., dance class, exercise w/fitness trainers) • Family and friends participated in nutrition education and physical activities	• *Latoria* (bingo-like activity) • Family (e.g., parent/children intervention activities)
	Chapter 3 Qualitative Summary	• Family-oriented diabetes prevention education to promote awareness (e.g., education on healthy food options directed at mothers, young adults, and children) • Family-oriented physical activities and education (e.g., exercise classes) • Preparing healthy meals (e.g., hands-on cooking and nutrition classes)	• Family engagement in activities • Social activities (e.g., cooking and exercise classes)
	Chapter 4 Integrative Mixed Method Approach	• Family-oriented physical activities and education (e.g., exercise classes) • Preparing healthy meals (e.g., hands-on cooking and nutrition classes)	• Family engagement in activities • Social activities (e.g., cooking and exercise classes)
Community	Chapter 2 Systematic Review	• Engaged local clinics and health systems (e.g., Federally Qualified Health Centers (FQHC)) • Partnership with churches and community centers (e.g., YMCA) • Intervention settings that build social capital (e.g., soccer fields, open markets, neighborhood community centers)	• Bilingual professionals (e.g., intervention facilitators, dietitians nurse practitioners, coaches, and health educators) • Trusted peer educators (*Navegantes*) and community members (*Promotoras*
	Chapter 3 Qualitative Summary	• Dissemination of diabetes information for awareness and prevention (e.g., television commercials, brochures, and classes on diabetes disease process) • Diabetes prevention education in schools to promote awareness • Financial assistance (e.g., purchasing medication and medication) • Resources for diabetes screening (e.g., diabetes testing) • Access to healthful foods (e.g., local farmers market, stores with healthy food options, organic food stands) • Venues for exercising (e.g., parks, walking trails, fitness centers)	• Trusted community representative (e.g., *Personalismo*) • Programs offered in Spanish • Social activities (e.g., classes on the diabetes disease process)
	Chapter 4 Integrative Mixed Method Approach	• Dissemination of diabetes information for awareness and prevention (e.g., brochures, and classes on the diabetes disease process) • Access to healthful foods (e.g., organic food stands and alternative food options) • Venues for exercising (e.g., parks, walking trails, fitness centers)	• Programs offered in Spanish • Social activities (e.g., classes on the diabetes disease process)

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APPENDIX A

IRB APPROVAL

ASU Knowledge Enterprise Development

APPROVAL: MODIFICATION

Felipe Castro
EDSON: Health Promotion and Disease Prevention, Center for
602/496-1720
Felipe.Castro@asu.edu

Dear Felipe Castro:

On 3/23/2023 the ASU IRB reviewed the following protocol:

Type of Review:	Modification / Update
Title:	Latino Familial Supports for Diabetes Prevention: A Mixed Methods Study.
Investigator:	Felipe Castro
IRB ID:	STUDY00012474
Funding:	None
Grant Title:	None
Grant ID:	None
Documents Reviewed:	None

The IRB approved the modification.

When consent is appropriate, you must use final, watermarked versions available under the "Documents" tab in ERA-IRB.

In conducting this protocol you are required to follow the requirements listed in the INVESTIGATOR MANUAL (HRP-103).

Sincerely,

IRB Administrator

cc: Aliria Rascon
Gabriel Shaibi
Christopher Dilli
Shanna Doucet