ATTENDANCE BARRIERS AND FACILITATORS TO THE UNIVERSITY OF ARIZONA COOPERATIVE EXTENSION-LED NATIONAL DIABETES PREVENTION PROGRAM

by

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As members of the Master's Committee, we certify that we have read the thesis prepared by Martina Rahim-Sepulveda, titled Attendance Barriers and Facilitators to the University of Arizona Cooperative Extension-led National Diabetes Prevention Program and recommend that it be accepted as fulfilling the dissertation requirement for the Master's Degree.

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Final approval and acceptance of this thesis is contingent upon the candidate's submission of the final copies of the thesis to the Graduate College.

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DEDICATION

This Master's thesis is dedicated to my parents, Martin and Mirta, for making numerous sacrifices to see me succeed; to my sisters Alana, Samantha, and Lyssett who never stopped cheering me up; and my husband Azri for his unconditional love and support. I also thank all of the mentors in my life that have poured their time and energy to shape me into the scholar I am today.

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LIST OF ABBREVIATIONS

NDPP, National Diabetes Prevention Program

T2D, Type 2 Diabetes

University of Arizona, UA

Cooperative Extension, CE

DPS, Finnish Diabetes Prevention Study

CDC, Centers for Disease Control and Prevention

MDPP, Medical Diabetes Prevention Program

USDA, United States Department of Agriculture

MUA, Medically Underserved Area

DPRP, Diabetes Prevention Recognition Program

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ABSTRACT

The National Diabetes Program (NDPP) is a group, lifestyle-change intervention offered over 12 months, which has been shown to prevent or delay the onset of Type 2 Diabetes by 58%. The program promotes healthy eating, physical activity, and modest weight loss. In the NDPP, for every session attended and every 20 minutes of physical activity completed, participants lost 0.3% of their initial body weight. However, a major challenge to program success is attendance given its 12-month duration, with less than 50% of participants making it to the half-way point in the NDPP. Non-attendance and reduced retention rates have been associated with poorer health outcomes in the NDPP, underscoring the importance of maximizing attendance and retention in this long-duration program. This study examined barriers and facilitators to participant attendance in the first 6 months of the University of Arizona Cooperative Extension-led NDPP. Data from qualitative semi-structured interviews with NDPP participants (n=28) and educators shows that the emerging themes influencing program attendance include 1) program implementation; 2) participant-specific factors; 3) external environment; and 4) coach-specific factors. Common barriers and facilitators were interest, program curriculum, flexibility, and clarity; commitments, Cooperative Extension network, motivators, timing, support system, readiness, and cost. The Cooperative Extension infrastructure is well positioned to address the barriers to program attendance in the UA CE-NDPP. While there are some areas it has limited control, such as interest, motivators, and readiness of participants; the Cooperative Extension system has the capacity to address several of the engagement issues reported in this study.

INTRODUCTION

The Burden of Type 2 Diabetes

Diabetes is a chronic health condition considered to be a worldwide epidemic of the 21st century[1-4]. Characterized by elevated blood sugar levels, diabetes was estimated to affect 30.3 million Americans, or 9.4% of the U.S. population[5]. The hallmark of Type 2 Diabetes (T2D) is a decreased delivery of glucose into cells due to insulin resistance. In Arizona, T2D affects an estimated 700,000 individuals, or 10.8% of the population, compared to the national prevalence rate of 10.5%. Furthermore, T2D in Arizona poses a healthcare cost burden of about $8.1 million in 2013 attributable to direct and indirect costs[6].

Type 2 diabetes has a precedent disease state known as prediabetes, which is also characterized by high blood sugar but not high enough to be considered diabetes (Please see **Table 1** for cut-off points). Without an intervention, it often develops into diabetes within five years[7]. Alarmingly, 84.1 million U.S. Americans and 1.8 million people in Arizona are estimated to have prediabetes. However, in Arizona only approximately 500,000 have been diagnosed[6]. Prediabetes has been associated with an increased risk for cardiovascular disease[8]. Once prediabetes develops into diabetes, the risk for developing complications such as stroke, retinopathy, neuropathy, and nephropathy increases[9]. Diabetes comorbidities have also been identified, these include cognitive decline, depression, gastrointestinal, musculoskeletal and respiratory diseases[10]. Diabetes complications have been associated with a low quality of life[11,12]; individuals aged 65 and older with diabetes have an estimated loss of quality-adjusted life years by 5.6 years[13]. Furthermore, diabetes has been associated with a high mortality; diabetes is the 7th cause of death in the US attributing 2.9% of total deaths in 2016[14].

Table 1. Diagnostic criteria for prediabetes and type 2 diabetes.

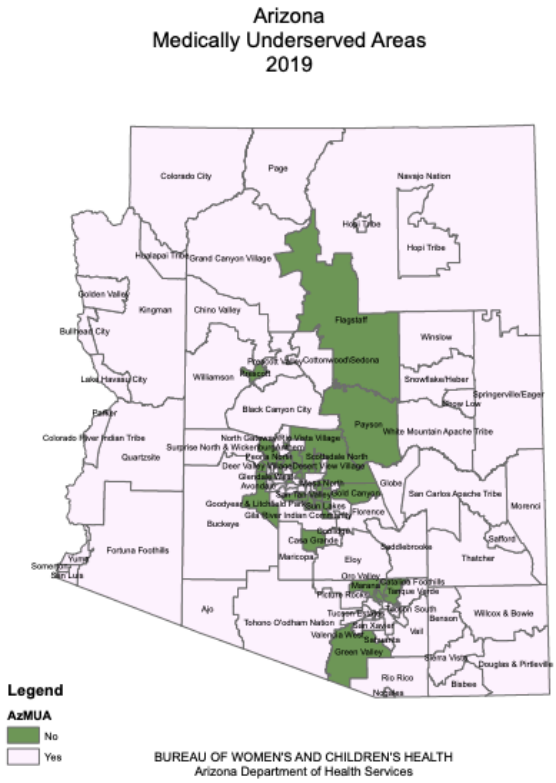
Diagnoses	**Fasting Blood Glucose**	**Hemoglobin A1C**	**Random Blood Glucose**
Normal	60 - 100 mg/dL	Below 5.7%	N/A
Prediabetes	100 - 125 mg/dL	5.7 – 6.4%	N/A
Diabetes	126 mg/dL and up	6.5% or above	Over 200 mg/dL

Affected Populations

T2D is a disease that like many other chronic health conditions, has been shown to affect certain groups of individuals disproportionately. Individuals at risk for T2D and prediabetes are characterized by overweight, family history, a sedentary lifestyle, having had gestational diabetes, being 45 years or older, and being of African American, American Indian, Alaska Native or Hispanic background[5]. Additionally, data from the 2018 Burden Report of Diabetes in Arizona reveals an increase in the percentage of diabetes among Black/African American, Hispanic, and non-Hispanic White in recent years and a slight decrease among American Indian/Alaska Native in 2016 with the highest prevalence among American Indian/Alaska Native followed by Black/African Americans[6]. Furthermore, trends from 2011-2016 show that prevalence of diabetes has been increasing among adults greater than 24 years of age and that males are more likely to obtain a diabetes diagnosis compared to females (prevalence: 10.9% among males vs 9.7% among females)[6]. T2D is disproportionally more prevalent in certain geographical regions, such as medically underserved areas (MUA's) which are known to include

rural areas of low socioeconomic status and few opportunities for educational achievements[15]. The Health Resources and Service Administration (HRSA) defines a MUA as an area or population with too few primary care providers, high infant mortality, high poverty, or a high elderly population[15]. These areas are at high risk for T2D due to the disadvantaged environment that they are exposed to that includes less racial and ethnic diversity, worse health outcomes, and especially a reduced access to healthcare compared to urban areas[16]. Eleven out of fifteen Arizona counties had higher prevalence rates compared to the state and the national prevalence rates. Most of these counties have MUAs (refer to **Figure 1**).

Figure 1. Arizona Medically Underserved Areas 2019.



Prediabetes as Window of Opportunity for Prevention

In 2014, the national prevalence rate for diagnosed prediabetes was 8.6% compared to 9.1% in Arizona[6]. Prediabetes is a high-risk, reversible condition that if left untreated often develops into T2D[17,18]. Thus, prediabetes serves as a window of opportunity for T2D prevention efforts. The first step in preventing T2D is the detection of prediabetes. This is accomplished through a blood test (refer to Table 1). Risk for prediabetes can also be assessed via the CDC Prediabetes Screening Test or the American Diabetes Association Type 2 Diabetes Risk Test[19], which considers known risk factors that predispose to T2D. Once it has been determined an individual has prediabetes or is at risk for T2D, certain lifestyle changes can be undertaken to help lower risk of developing T2D[20], as described below.

Community-based Behavioral Interventions for T2D Prevention

In the past two decades, several lifestyle modification interventions have been shown to reduce the risk for T2D[21-24]. The best known among these studies are the Diabetes Prevention Program (DPP)[25] and the Finnish Diabetes Prevention Study (DPS)[26].

In 2002, a randomized control trial (RCT) sought to compare the impact of three different interventions on the incidence of T2D in people at risk: a lifestyle intervention, metformin, or placebo[25]. Inclusion criteria were to have an age of at least 25 years, a body mass index (kg/m^2) of 24 or higher (22 or higher in Asians), and a clinical diagnosis of prediabetes. Exclusion criteria was taking medicines known to alter glucose tolerance or illnesses that could seriously reduce life expectancy or the ability to participate in the trial.

The intervention consisted of randomly assigning participants to one of the three interventions: standard lifestyle recommendations plus metformin (Glucophage) at a dose of 850 mg twice daily, standard lifestyle recommendations plus placebo twice daily, or an intensive

program of lifestyle modification. Subjects in the standard lifestyle recommendation medication group were encouraged to reduce their body weight and increase their levels of physical activity by following the Food Guide Pyramid and a National Cholesterol Education Program Step 1 diet. Furthermore, subjects in this group received written information and annual sessions emphasizing the importance of a healthy lifestyle. On the other hand, subjects in the intensive lifestyle intervention had the goal of reducing 7% of initial body weight and to engage in 150 minutes of moderate intensity exercise each week. Those in the intensive lifestyle intervention received 16 individual sessions lead by lifestyle coaches on healthy eating and physical activity in order to achieve their specific goals.

This clinical trial had a mean follow-up of 2.8 years and involved a total of 3234 study participants from 27 centers that were at high risk for diabetes (1082 in placebo, 1073 in metformin, and 1079 in the intensive lifestyle intervention). Adherence to the treatment regimen was assessed quarterly on the basis of pill counts and structured interviews.

Outcome of interest was T2D, diagnosed on the basis of an annual oral glucose-tolerance test or a semiannual fasting plasma glucose test performed in the clinics. The diagnosis required confirmation by a second test, usually within six weeks. HbA1c was measured using blood samples in those subjects diagnosed with diabetes throughout the study. Self-reported levels of leisure physical activity were assessed annually with the Modifiable Activity Questionnaire and daily caloric intake was assessed using a modified version of the Block food frequency questionnaire. Baseline characteristics, including all measured risk factors for diabetes, were similar among the three study groups.

The lifestyle intervention reduced the incidence of diabetes by 58% (95% CI l, 48-66%) and metformin by 31%(95% CI, 17-43%), as compared with placebo; the lifestyle intervention

was significantly more effective than metformin and these effects were similar in men and women and in all racial and ethnic groups (P>0.05). The authors concluded that lifestyle changes and treatment with metformin both reduce the incidence of diabetes in persons at high risk, but lifestyle changes are more effective. A subsequent study looked at outcomes in adults over 60 and reported the risk reduction in that age group was even higher, at 71% compared to control[25].

Following the rigorous scientific evidence provided by the publication in 2002, the DPP Research Group completed a ten-year follow-up of diabetes incidence and weight loss in the participants who had completed the original DPP trial[27]. The goal of this study was to investigate the long-term persistence of the observed 58% diabetes incidence reduction in high-risk adults. The study found that over the ten-year follow-up, diabetes incidence was reduced by 34% in the lifestyle group and 18% in the metformin group compared with placebo. In other words, participants completing the lifestyle program were more successful with long-term outcomes compared to the metformin group[27].

Other efforts placed on large-scale diabetes prevention includes the Diabetes Prevention Study (DPS), which was a very similar study to the original DPP[26]. The DPS was a large randomized controlled trial whose purpose was to determine whether T2D can be prevented through lifestyle intervention in high-risk individuals. With a total of 522 middle-aged, overweight participants randomized to either the intervention or control groups, the mean duration of follow-up was 3.2 years. The intervention group received individualized counseling to reach the specific goals of the DPS. These included reducing original body weight by at least 5%, reach 30 minutes or more of daily physical activity, reduce dietary fat to less than 30% of total energy, reduce saturated fat to less than 10% of total energy, and increase fiber intake to a minimum of 15g of daily fiber per 1,000 kcals consumed[26]. Intervention subjects met with a

nutritionist in seven different sessions the first year of the program and one session every three months thereafter. Control subjects received general oral and written information about diet and exercise but no tailored nutrition advice. Endpoints included diabetes (defined as fasting plasma glucose concentration of 140 mg per deciliter or higher or a plasma glucose concentration of 200 mg per deciliter or higher two hours after an oral glucose challenge) measured through an oral glucose-tolerance test and verified through a second test, serum insulin determined with a radioimmunoassay, anthropometric measurements such as waist circumference measured midway between the lowest rib and iliac crest and hip circumference over the great trochanters, with 0.5 cm precision with the subject in a standing position, lean body mass through bioelectrical impedance analysis or near-infrared spectroscopy, serum lipids through blood measurements, blood pressure with the right arm in a sitting position and is measured a second time, after 10 min of rest, using a standard sphygmomanometer, weight with a scale; fat, vegetable, sugar, salt, and alcohol intake measured through food records; exercise through self-report using an exercise diary. Findings of the DPS were similar to that of the DPP in that it was shown to reduce the risk of developing T2D by 58% through lifestyle modifications. The DPS found that lifestyle interventions are effective for at least three years following the intervention[26].

The National Diabetes Prevention Program

In efforts to encourage the dissemination of evidence-based interventions for diabetes prevention, in 2012 Congress authorized the Centers for Disease Control and Prevention (CDC) to launch the National DPP (NDPP), a partnership between public and private organizations[28]. To further support the widespread implementation of this lifestyle change program, Congress authorized insurance reimbursement through Medicare. The new Medicare Diabetes Prevention Program (MDPP) took effect in April of 2018 [29], and is unique in providing insurance coverage

for prevention as opposed to treatment. Previous to the MDPP, only a select few health insurance plans offered limited coverage for the DPP[30]. The goal of the NDPP is to provide low-cost evidence-based programs in communities across the US by bringing together community organizations, private insurers, employers, health care organizations, faith-based organizations, and government agencies to prevent or the delay the onset of T2D. The NDPP efforts include a working force to effectively implement lifestyle change programs in real-world settings, ensure a quality and standardized manner of reporting, disseminate the programs nationwide, and increase physician referrals to the programs[31].

The CDC-supported NDPP is an evidence-based lifestyle change program based on the original DPP trial shown to prevent or delay the onset of T2D through lifestyle modification such as healthy eating, weight loss, and regular physical activity[28,32]. The intervention was adapted into a group-based program and lessons were added to bring the intervention period to 12 months. The NDPP curriculum provided free of charge by the CDC, in English and in Spanish, is called *Prevent T2* (*Prevenga T2*). The program is led by a CDC-trained lifestyle coach and consists of a one-year program with a total maximum of 26 lessons (minimum of 22 lessons required). Participants are encouraged to attend sixteen (16) one-hour lessons during the first six months of the program. Following these six months, participants attend six to ten lessons (6-10) until the termination of the program. The program is offered in-person, in a group setting. The overall goal of the program is to lose at least 5% of initial body weight and perform a minimum of 150 weekly moderate to vigorous physical activity minutes. Currently, organizations offering a lifestyle change program may apply for CDC recognition status. The process of recognition involves meeting a set of standards put forth by the CDC[19,33] (Refer to **Table 2**). Program recognition is required for programs seeking Medicare reimbursement.

Table 2. Standards for CDC recognition.

Standards for CDC Recognition
• CDC-approved curriculum
• 12-month duration
• 16 core sessions (months 1-6) and ≥ 6 (months 7-12)
• Minimum session attendance: ≥ 60% of participants must attend ≥ 9 sessions during months 1-6 and ≥ 3 sessions during months 7-12.
• Physical activity and weight documentation
• Average weight loss ≥ 5% from original body weight
• ≥ 35% of participant eligibility by clinical markers

Real-World Implementation of the NDPP

Despite the rigorous evidence of the NDPP original trial for successful long-term outcomes, examination of the real-world implementation of the NDPP has reported a concern with attendance and retention, metrics that have been used to predict long-term, behavioral-based program's outcomes and success[34-36]. In a systematic review and meta-analysis that assessed 28 studies translating the NDPP to real-world settings, authors found that with every additional session completed, weight loss increased by 0.26%. Authors report varied attrition rates ranging from 0-49%[37]. Similarly, results from an evaluation of the New York State YMCA Diabetes Prevention Program show that 38% of participants attended less than half of the 16 core sessions offered in the first half of the program[38].

A recent study from 2017 reveals a comparable trend. Ely and colleagues published an evaluation of the NDPP at the participant level, encompassing 14,747 eligible participants from 220 CDC recognized organizations delivering in-person classes that had a minimum of 12

months of completed data[39]. The analysis was performed on attendance that took place between February 2012 and January 2016. Outcomes of interest included attendance as defined by the number of sessions attended during the 12-month program duration. Authors set an *a priori* threshold of 4 sessions, the number set forth by the Diabetes Prevention Recognition Program standards as the minimum amount to observe changes in lifestyle behaviors and weight. Authors looked at number of months attended in the NDPP in which they defined it as the number of days from first to last day attended divided by 30.4. Percent weight change was calculated for individuals who had a minimum of two weights recorded. Last but not least, average physical activity minutes provided through self-report were divided by the number of sessions in which minutes were reported. Findings revealed that for every additional session attended and every 20 minutes of activity reported, participants lost 0.3% of their initial body weight. However, retention rates were low: whereas nearly 87% attended at least 4 sessions, only 43% completed 16 sessions[39], compared with 95% in the original DPP trial[25], and nearly all of the sessions attended took place during the first 6 months. Together, this growing body of evidence demonstrate the issues with attrition faced by the NDPP, highlighting the need for understanding the factors that promote and detract from optimal NDPP participant engagement in multiple program settings.

Reported Barriers and Facilitators to Attendance in the NDPP

Attendance and retention are widely recognized problems in the NDPP[37-39], however, published literature addressing barriers and facilitators to attendance and retention in the program across the US is scarce. The available literature provides some insight into the issues that participants face when making time to come to the sessions and factors that facilitate continued engagement, as in a report by Realmuto et al, where authors conducted open-ended telephone

interviews with 26 drop-outs from 11 NDPPs across New York City, exploring the barriers faced during participation[40]. Drop-out participants were defined as attending a minimum of two sessions but no more than eight. Authors found discontinued participation as a struggle faced by all of the study participants due to multiple factors broken down into three categories: (1) conflicting commitments; (2) personal priorities and motivation; and (3) dissatisfaction with the program. Johnson and Melton further examined factors that motivate and deter individuals with pre-diabetes from utilizing the NDPP through qualitative interviews and focus groups[41]. Authors interviewed program implementers, health professionals, and patients from the state of Florida. Reported barriers to program utilization included a general lack of knowledge about the program, cost of the program, and the time commitment needed to engage in the program. Facilitators of program utilization included the existence of a peer support system fostered by the group format and the program curriculum's year-long duration. The impact of pre-sessions, held prior to the first NDPP lesson and aimed at clarifying program expectations, showed promise as a strategy for retention[42]. Participants from the pre-sessions attended 14.3% ($p<.001$) more NDPP sessions on average and remained in the program 99.8 more days ($p<.001$) compared to participants who had not attended a pre-session. In addition, pre-session participants lost 2% ($p<.001$) more weight than controls[42]. This study highlights the importance of clarifying program expectations prior to enrollment to maximize retention and positive outcomes. The limited literature about barriers and facilitators to the NDPP in various settings across the US shows a need for studies that examine factors that act to impede and facilitate participant engagement in the NDPP.

Cooperative Extension as a Model for NDPP Dissemination

Cooperative Extension (CE) is an entity across the fifty states and territories found in every land-grant university responsible for extending scientific research to the community. It was

established by the Smith Lever Act by Congress in 1914, which appropriated federal funds for Cooperative Extension "to aid in diffusing among the people of the United States useful and practical information on subjects relating to agriculture and home economics, and to encourage the application of same."[43] CE is a partnership between federal (United States Department of Agriculture (USDA)), state (land-grant universities, state government), and county (community stakeholders, county government) agencies to reach communities more effectively and efficiently.

Cooperative Extension addresses the need to speed up the adoption of research into practice. Through a network of content-matter experts and strategically placed personnel, CE utilizes research findings to help communities and individuals solve problems, improve lives and the economy[44]. Through local partnerships, CE offers informal educational programs that address critical issues in the areas of agriculture and natural resources, food safety, youth development, as well as nutrition and physical activity.

The Cooperative Extension network is well-positioned to address the goal of the National DPP to "make it easier for people with prediabetes to participate in affordable, high-quality lifestyle change programs to reduce their risk of type 2 diabetes and improve their overall health"[32]. Due to CE's presence in most U.S. counties, its infrastructure provides unprecedented reach into underserved communities, including MUAs. In fact, the medical community identified Extension as a potential key player in the prevention of chronic disease in underserved areas[45]. In addition to reach, Extension can address the issues of reported participant engagement by supplementing the NDPP with complementary programming from its existing network of educational programs. This could be particularly helpful in the maintenance phase of the program, when sessions become less frequent. Thus far, implementation of the NDPP across the

United States through Cooperative Extension is limited to under 20 states[46]. In AZ, CE is delivering the NDPP in seven counties, most of which are rural areas lacking diabetes preventive services.

SPECIFIC AIMS

Behavioral-based interventions aimed to reduce the risk of T2D such as the NDPP have faced challenges with participant attendance, thereby reducing the success of program outcomes. Barriers and facilitators specific to participants of NDPP's across the U.S. are not well understood. The objective of this study is to examine coach and participant perceptions on barriers and facilitators to participant retention and recruitment, which for purposes of this thesis will be referred to as "program attendance", in the University of Arizona Cooperative Extension-led National Diabetes Prevention Program (UA CE-NDPP). To the authors' knowledge, there are no published research studies exploring the perceived barriers and facilitators to attendance in the NDPP led through Cooperative Extension. We believe that due to the unique circumstances that CE presents, CE barriers and facilitators are likely to differ from NDPP barriers and facilitators. For instance, the Cooperative Extension system brings the NDPP to the doors of those in need, thus eliminating barrier of transportation or location. Furthermore, Extension counts with trained lifestyle coaches that live in the community they serve, creating an increased cultural sensitivity and reducing program costs. Extension also has a long-standing history of delivering informal education, therefore individuals and communities are likely to be familiarized with the Extension services, eliminating the barrier of trust. This work will help organizations implementing the NDPP, particularly through Cooperative Extension, understand barriers and facilitators to program attendance. This understanding should help improve program retention rates, thereby improving program outcomes and the overall health of the program

participants.

MATERIALS AND METHODS

National Diabetes Prevention Program (NDPP)

The NDPP is a 12-month lifestyle change program with a group-based approach for individuals at risk for T2D. In order to be determined eligible for the program, participants must meet the following criteria: 1) being at least 18 years of age; 2) being overweight (body mass index ≥25; ≥23 if Asian) ; 3) have no previous diagnosis of type 1 or type 2 diabetes; 4) have a blood test result in the prediabetes range within the past year (hemoglobin A1C: 5.7%–6.4% or fasting plasma glucose 100–125 mg/dL or two-hour plasma glucose 140–199 mg/dL); or 5) high rank at risk for T2D based on an approved risk survey; or 6) be previously diagnosed with gestational diabetes. A trained educator ("lifestyle coach") delivers the 26-lesson *PreventT2* curriculum, developed by the CDC, which focuses on increasing physical activity and healthy eating behaviors. The first 16 "core" sessions are delivered during the first half of the program followed by 6-10 additional maintenance sessions in months 6-12. Program intensity lessens over time: during the first two months, participants meet weekly. In months 3-10, the frequency changes to biweekly meetings, and finally in months 11 and 12, participants meet once per month. The stated goals of the program are associated with a decreased risk for T2D: a loss of at least 5% of initial body weight, and a minimum of 150 weekly minutes of moderate physical activity[25]. At each session, participants' body weight is measured by the lifestyle coach. Additionally, participants are asked to fill out weekly food logs recording their dietary intake and minutes of physical activity.

The UA CE began implementation of the NDPP in June 2018 following the guidelines set forth by the CDC[32]. Extension educators completed CDC-approved training. Institutional

funding subsidized costs to participate in the program; direct costs to participants were limited to their time and transportation-related costs to and from the program.

Diabetes Prevention Recognition Program (DPRP)

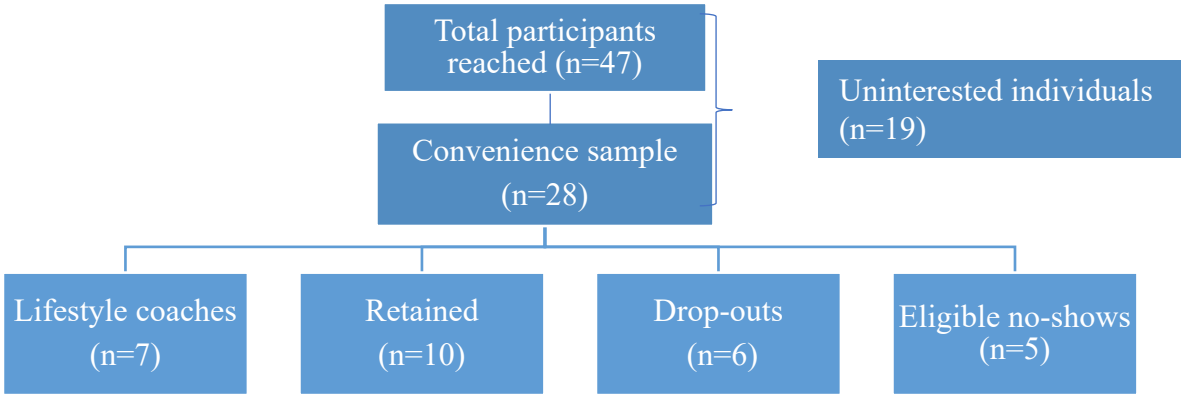
The CDC's Diabetes Prevention Recognition Program requires a series of criteria to be met (see **Table 2**) in order for a program to considered effective per NDPP standards, including specific attendance guidelines during the first and second half of the program. The criteria define adequate program attendance as attendance of a minimum of 9 sessions during months 1-6 and a minimum of 3 sessions during months 7-12 by at least 60% of participants[19].

Study Sample

A convenience sample of key stakeholders from the UA CE-NDPP in AZ (N=28) participated in a short telephone interview to understand perceived barriers and facilitators to program attendance. Four different groups were interviewed in order to obtain a unique perspective from multiple sources: 1) lifestyle coaches (n=7); 2) participants who met the minimum attendance of at least nine classes by the sixth month mark, described as "retained" participants (n=10); 3) participants who completed fewer than nine classes within six months of start of the program, described as "drop-out" participants (n=6); and 4) eligible individuals who were informed about the NDPP but chose not to participate, described as "eligible no-shows" (n=5). Lifestyle coaches have years of experience in delivering informal education and are likely able to provide some insight into specific strategies that worked for their individual DPP groups, especially since all interviewed coaches in this study had at least a few weeks of experience delivering the NDPP. Retained participants, on the other hand, may provide with insightful information about what helped them stay in the program, while drop-outs might have feedback on the barriers they faced in coming to the program. Lastly, eligible no-shows will offer insight into the impediments they

faced in signing up to the program. UA CE-NDPP lifestyle coaches, who have access to participant attendance and recruitment records, helped identify and recruit potential participants to the study. In addition, some participants who had completed 9 classes by the sixth month mark were directly recruited by the author (MS) who attended NDPP classes to invite participants in person and distribute recruitment flyers. A total of 47 individuals associated with the UA CE-NDPP were invited to take part in this study. Of these, 28 individuals participated in the interviews. (See **Figure 2**). Four interviews were completed in Spanish and 24 in English.

Figure 2. Study flow diagram.



NDPP participants were excluded from this study if they did not meet the CDC-NDPP eligibility criteria mentioned above. Eligibility was assessed through confirmation with coach and participants prior to completion of telephone interview. Before the interview, participants were asked a series of questions (e.g. have you ever been told by a doctor you have pre-diabetes, have you ever taken a diabetes risk test) to verify eligibility and based on these answers eligibility was determined. DPRP criteria for program attendance (9 sessions during months 1-6),

were used to determine attendance parameters for groups 2 and 3. Upon conclusion of the study, participants received an electronic or physical $10 Starbucks or Walmart gift card. This study was approved by the University of Arizona Institutional Review Board.

Semi-structured interviews

The author undertook a naturalistic approach[47] to understand perceived barriers and facilitators unique to participant retention in the UA CE-NDPP. The method of data collection was a qualitative semi-structured interview, one per participant. Four total interview scripts with a standard number of questions were elaborated (one interview script per study group) with the help of three researchers (KS, MH, VDS) of which two have extensive background in qualitative research methods (KS, MH) (See **Appendices A** through **D** for interview scripts). Two NDPP lifestyle coaches and one graduate student with qualitative research training helped modify the scripts for further clarification. Interviews took place between September 2018 and February 2019. By November, scripts underwent modifications (i.e. change of question order and addition of a question about the thoughts of launching an online platform for the NDPP). These changes were based on the responses provided by participants to interview questions. For instance, it became apparent that participants felt uncomfortable answering questions in the original order as evidenced by long pauses and repetition of similar information due to the order the questions presented. Also, some participants provided feedback about their conflicting schedules/timing in attending the program and could not provide any suggestions on how to overcome this obstacle, therefore a probing question about an online platform was provided.

Data Collection and Analysis

Once stakeholders were identified, they were contacted by the author through a telephone call, text, or e-mail to be invited to participate in a telephone interview. The author either

arranged a time and date for a 30- to 60-minute telephone interview with interested participants or conducted the interview immediately depending on participant preference. Participants were given the opportunity to provide oral consent to participate in this research before the interview and were given the opportunity to speak in their preferred language (English or Spanish). Once consent was obtained, the author conducted the telephone interview. Interviews took place between September 2018 and February 2019 and lasted 10 to 60 minutes and were audio recorded using a Sony ICDPX370 mono digital voice recorder with built-in USB and a telephone record adapter device VEC TRX-20 3.5MM, the Rev iPhone application for recording telephone calls, and a MacBook Air QuickTime Player. Audio recordings were transcribed using Rev and TranscribeMe! online services for English and Spanish interviews. Data was analyzed by MS and VdS, with the help of NVivo qualitative data analysis software to organize the data analysis (Version 12, QSR International Pty Ltd., Melbourne, Australia, 2018).

Authors undertook an abductive thematic approach to analyze the transcripts, using the linear relationships that exist between a theory and the data and vice versa, such as in induction and deduction[47,48]. MS and VdS were involved with the familiarization of transcript data, which consisted of reading through the transcripts to get a sense of what the data entailed. Furthermore, MS and VdS were involved in the generation of initial codes which were derived from both the literature and the transcripts themselves. This was completed independently by MS and VdS. These authors came together after the identification of initial codes to discuss discrepancies which were ultimately resolved by the senior author. The next step was the identification of themes, which involved the identification of commonalities among the emerging codes to synthesize them into more succinct categories. MS and VdS completed this step together by sharing their own ideas. Next, as the authors reviewed and compared to other transcripts, MS and

VdS were responsible for defining and renaming categories of these themes by comparing and contrasting the transcript data until both authors were in agreement; any discrepancies were resolved by the senior author. MS coded the data using the refined thematic categories by assigning a theme to the various sections of the scripts. KS helped guide authors through the familiarization of transcript data, generation of initial codes, identification of themes, refining of the themes, and coding of the data. MS and VdS produced the written report. KS and MH provided extensive feedback and approved the final report.

RESULTS

UA CE-NDPP Demographics

While we did not collect demographic data from our sample due to the participant burden this step would involve, **Table 3** shows the characteristics of the entire UA CE-NDPP cohort from which our sample was drawn, with 81 total participants enrolled, and a median age of 61.5 years. Most participants were female (81.8 %), similar to our study sample (89.3%). The predominant racial makeup in UA CE-NDPP participants was white (91%), with 33% of participants reporting Hispanic or Latino(a) ethnicity.

Three UA CE-NDPP groups had reached the 6-month mark as of February 2019. Of the 39 participants initially enrolled in these three groups, 29 remained in the program at the halfway point.

Table 3. Participant demographics for statewide cohort currently enrolled in the UA CE-NDPP from which study participants were recruited.

NDPP Participant Demographics	UA CE-NDPP
Sample size, n	81

Age, y (median, (range))	64 (25 – 86)
Sex, %*	
Male	18
Female	82
Race, %*	
White	91
African American/Black	2
Asian	4
Pacific Islander	2
Not reported	2
Ethnicity, %*	
Hispanic or Latino	33
Not Hispanic or Latino(a)	65
Education completed, %*	
College ≥4 years (college graduate)	46
College 1-2 years (some college)	33
Grade 12 or GED (high school graduate)	13
<Grade 12 (no GED)	7
Not reported	2

*Percentages rounded to the nearest whole number.

Emerging Themes Influencing Program Attendance

Emerging themes from semi-structed qualitative interviews are listed in **Table 4**. Emerging themes and their codes are discussed below with illustrative quotes to support the narrative as described below.

Table 4. Emerging themes and respective codes from semi-structed qualitative interviews.

Theme	Influencing recruitment	Influencing retention
1) Program implementation (factors associated with the implementation of the program).		
• Program curriculum	X	X
• Cooperative Extension network	X	X
• Program flexibility	X	X
• Timing	X	X
• Cost	X	X
2) Participant-specific (factors associated with the participants).		
• Motivators	X	X
• Readiness	X	X
• Interest	X	X
3) External environment (factors that were beyond the program, individual, or coach).		
• Commitments	X	X
• Support system	X	X
4) Coach-specific (factors associated with the coach).		
• Tailored recruitment strategies	X	X
• Tailored retention strategies		X
• Program clarity	X	X

Program implementation

Program Curriculum

As far as program curriculum, it represented a facilitator to program attendance when participants felt that the goals of the curriculum were ideal for them, sharing that the accountability portion from the goal setting and the food and activity log together with the frequent weigh-ins was helpful in their progress:

"You know what else I liked? Is the food and activity log. I really feel that gives me credibility in keeping track, the food and activity log." (Retained).

On the other hand, program curriculum deterred some participants from enrolling and continuing their attendance. For instance, some coaches shared that the curriculum can be dull at times and not apply to everyone in the audience:

"I am going to be honest though, the curriculum, some of it is a little bit dry. I think as the educator, …, you have to really be comfortable, not only with the material, but also find ways to make that subject matter more exciting. Or more, you know, relatable sometimes." (Educator).

One participant who dropped out decided not to continue with the program because the content was too basic for her: *"The whole approach and the material that I saw…was a bit basic for me."*

Cooperative Extension Network

A theme acting as a facilitator for program attendance was the Cooperative Extension Network, assisting with the recruitment phase through its wealth of community partners at the reach of educators*: "Part of my luck is that the person who does the public service announcements on the local radio station actually works for extension in my office." (Educator)*. One coach explained that thanks to Extension, she was able to recruit among the Master Gardeners (individuals who teach about gardening) for her class, which was evidenced by a retained participant: *"I am a Master Gardener at the extension service and they notified all the master gardeners."*

Extension network also helped with the retention phase by helping with complementary programming, offering cooking classes and demonstrations to foster participant engagement:

"I think we're lucky because we have another program, and because some people in the diabetes class are eligible for our snack program, I was able to do a snack program class."(Educator). In this case, participants were eligible for a SNAP-Ed benefit of snacks that the coach was able to use in her NDPP class.

Program flexibility

When the educator was willing to go above and beyond in accommodating participant needs during the recruitment and retention phase of the program, flexibility was a facilitator to attendance. A coach shared that she thinks that *"flexibility is also something that's kept them. They feel bad when they're late, but it's like, no, I'm pretty flexible." (Educator).*

An element of flexibly has been the opportunity to join the NDPP later in the program: *"I [joined the NDPP] around the second or third session."(Dropout due to work commitments)* while others were allowed to bring their spouse to the class: *"I didn't even think about this when we made it, but I ended up bringing in a lot of spouses of Master Gardeners who were more qualified for the program than the Master Gardener themselves…" (Educator).* In this case, the Master Gardeners the coach is referring to were actual NDPP participants.

Flexibility was a barrier to program attendance when this element was not available, as evidenced by an eligible individual that was not able to attend to the program due to childcare issues: "*I would have liked to see someone that would have helped take care of the children [near the NDPP class while I learned]….in a different class I attended in the past, they would help me take care of them while the mother learns. This is helpful because you know that your children can be right next to you and you are not worried about them." (Eligible no-show).*

Timing

Participants reported that timing facilitated their ability to attend the program when the day of the NDPP coincided with their schedule: *"...You know, the time that [the NDPP class is offered], because I am retired, I am able to attend." (Retained).*

On the other hand, timing impeded their ability to sign up or stay in the program, most commonly due to having other responsibilities such as work that fell on the same class time that the NDPP was offered. One educator shared: *"And we just started in January. It just didn't seem like a good idea to try and start it over the holidays." (Educator).*

Multiple participants reported scheduling issues related to work: *"I'm a substitute teacher, fortunately they call me a lot. It is good for me, but it's not good because I'm going to stop going to the program." (Dropout due to work commitments).*

Cost

The fact that the NDPP was offered for free was indicated to be a facilitator to sign up and to stay in the program, as evidenced by a participant sharing that *"[the program] was free. I saw it in the newspaper, and I thought you know what, I'm gonna enroll in that one." (Retained).* Hand in hand with this observation, a person felt that *"...a free program is always a little bit easier to get people to attend than if you have a cost involved." (Eligible).*

Coaches specifically perceived that attaching a fee to program participation would have to depend on the demographic of the NDPP participants, and that a potential benefit would be establishing buy-in from participants and making it a deterrent from dropping out of the program given the financial investment. One coach shared, *"I do think that if people have buy-ins, even if it's a small fee, they're likely to attend."*

Some individuals did not mind a program-associated cost because they perceived a value from the program: *"Right now, we don't have to pay, which is awesome…But if they would have to pay, that is okay because the program is good." (Drop-out due to work commitments).*

On the other hand, it was reported that if the program were to have a cost it would not allow some participants from enrolling or continuing in the program: *"I wouldn't have had the money to pay for it." (Eligible); "If there's a slight reason not to come, I think that would be it." (Educator).*

Participant-specific

Motivators

Motivators for behavior change included family history of diabetes, fear of medication or complications, desire to lose weight and be healthy, wake-up calls involving life-threatening conditions, health deterioration, doctor notices, and hospital mail; having a diabetic spouse, and wanting to help the entire family. These factors constituted facilitators to attendance. One lady shared: *"I figured it was worth it because I don't want to be even close to be a diabetic." (Retained).*

Motivators represented barriers when participants lacked a source of these nudges: *"Being a retired Marine, I used to run all the time and be in really good shape, and after I retired I continued that for a while, but then started having difficult issues. Feet problems, I had a knee surgery, and so it's difficult for me to just get myself motivated to anything, because I have pain. So I know I need to do it, so I thought this class would help motivate me." (Dropout due to distance and co-existing health conditions).*

Readiness

Individuals displaying readiness had a "do not quit" personality which would not allow life to get in the way of achieving their goals. Several retained participants had these readiness traits that facilitated their ability to sign up and stay in the program: *"I am a very tenacious person." (Retained); "…when I start something, I finish. That's just my nature." (Retained); "I fully expect to make every class." (Retained).* Additionally, readiness was a facilitator to attendance for individuals that felt the timing of the NDPP was just right: *"And then at that time, good thing I saw the ad in the newspaper, and then I called right away…" (Retained).*

We had some individuals who displayed lack of readiness, characterized by having multiple excuses for not being ready to make a commitment. These individuals had a hard time enrolling and sticking through the program: *"…it was right when my mom had fallen and hurt herself, and so I wasn't sure I could fulfill all the requirements." (Dropout due to distance and caregiver responsibility).* Similarly, other participants described fear of making permanent changes: *"It's always scary, talking about lifestyle changes…" (Dropout due to distance and co-existing health conditions).*

Interest

Interest was a facilitator to program attendance for individuals who shared that they had a strong satisfaction with the program: *"... I am trying to really learn as much as I can on this diabetes thing. And it's helping me too, a lot, and I understand about the sugar even more than I did before, so I've learned so much and I'm just so ... I'm so blessed by all of this knowledge." (Retained).*

A factor deterring individuals from signing up and staying in the NDPP included a lack of interest in hearing about health-based programs or interest in some of the program components, such as the 12-month duration: *"They appreciate the message that I was giving*

them. But there were always those few, those 10%, that literally like, 'I just come in here to eat, and now I'm done eating so I'm leaving.' So, it was in that case they would just walk away."(Educator).

Coaches further struggled with retained participants in holding their interest throughout the duration of the program, as evidenced by one coach who had a class with little interest in make-up classes: *"I have one person who always does the make-up classes. But I think, although I offer them to everybody, nobody seems to be really interested in doing the make-up classes, not even over the phone." (Educator).* This claim was further supported by a retained participant, who referred to the telephone make-up class as telephone conference: *"I did not get anything out of the telephone conference." (Retained).*

External environment

Commitments

Commitments only represented a barrier to program attendance. Individuals stated having work commitments that interfered with the established NDPP class time, such as having family members to take care of, or medical appointments and keeping up with an apartment: *"I do babysit, I have one right now that's in preschool, I got him in this year… so the reason this last Tuesday I missed was because my husband had a dental cleaning…When he got home I said, I had my class at that time." (Retained); "We have activities here and I have medical appointments and keeping up my apartment seems to be all about what I can do." (Eligible).* Other participants reported working during the time of the class: *"I'm a substitute teacher, fortunately they call me a lot. It is good for me, but it's not good because I'm going to stop going to the program." (Dropout due to work commitments).*

Support System

The existence of this support component helped with participant attendance, as evidenced by several participants feeling that they benefited from the peer support from the NDPP group: *"I enjoy getting other opinions from other participants in the group. It helps keep me motivated to do what I'm supposed to do." (Retained).* This element of support was mentioned by coaches as well: *"…I try to make the classes welcoming. Try to make everyone feel comfortable." (Educator).*

Support system represented a barrier in attending the program when support from the educator, NDPP group, or home environment was not available. One participant reported not having her husband on board with her healthy eating goals at home and this being a challenge for her success in the program: *"Sometimes at home, that's a challenge for me because I know some of the things that I prepare because that's what they want, I shouldn't be eating." (Retained).*

Coach-specific

Tailored Recruitment Strategies

Tailored recruitment strategies constituted a facilitator to attendance when a coach had identified the specific audience in mind and considered intended location, timing and duration of advertising, as well as a variety of marketing strategies to reach such audience. One example was marketing in the newspaper to target an older population: *"…newspapers are dying all over the place and moving over to online versions, so I would say the newspaper is probably more effective for older age groups, but an online strategy might be more effective for younger age groups." (Educator).*

Another coach carefully thought of the verbiage to use for her marketing materials: *"I try to make most of my fliers myself because once you get to know who you're trying to reach, there's certain ways that you can figure out how you would wanna say something to entice them*

to come to whatever it is you're trying to get them to come to…It's finding ways that they could improve themselves or in the case of older adults, improve the quality of your life…" (Educator).

A barrier to enrollment was the lack of tailored strategies placed in these efforts. This occurred with one drop-out who felt the marketing material could be improved: *"I heard about it through our community newsletter at [our community], but it didn't tell you exactly what was going to happen. It was really hard to get information about what the sessions were going to be and what the commitment was." (Dropout due to lack of tailored materials).*

Tailored Retention Strategies

Coaches highlighted the importance of being in touch with participants to figure out how to best meet their needs and encourage their frequent participation:

"We have [funds] for each group to buy a big prize and it will get raffled off at the end of the classes. So I asked my groups what they thought would be a good prize. Did you want a electric pressure cooker, crockpot, and they all … said they want new sneakers." (Educator).

One coach highlighted the importance of understanding a particular group: *"I think what it comes down to is you really have to get your group, figure out your group and figure out what makes them tick or the various individuals in there because what works for one doesn't always work with the others." (Educator).*

While a coach offered a concrete example of a retention strategy she perceived to work: *"I think the make-up classes might be more successful if they would come early [at the next session]. And occasionally I've done that, if people are there early enough, I'll do the make-up class before the start of the class. And I think that's a good way to do it, when everybody else is around, because it feels more like a class to them."* Together, the presence of tailored retention

strategies was perceived to be a facilitator to program attendance, and the lack thereof was viewed as a barrier.

Program Clarity

Providing clarification about the program was perceived to help with attendance*: "And one nurse in particular reached out to me and asked some clarifying questions and that is how I got at least one our participants in the class." (Educator).*

On the other hand, program clarity seemed to detract from attendance when this component was not described in the first informational session and throughout the duration of the program: *"There was a flyer, but it didn't really give you much information about what it was going to be like, so I think everybody went in kind of blind. I'm an ex-marketing person, so I would have liked to have seen more information presented ahead of time about exactly what to expect, and we didn't get that." (Dropout due to lack of clarity about program expectations).*

Group-specific Emerging Themes

In addition to identifying overall themes that related to recruitment and retention for all study groups, we sought to understand specifically the facilitators and barriers for program retention. For that, we identified the major facilitators among the retained participants, and the barriers mentioned by the groups associated with poor retention (no-shows and drop-outs). **Table 5** lists the major factors reported by these groups.

Table 5. Group-specific facilitators and barriers pertaining to program retention.

Retained (n=10)	Eligible no-shows and Drop-outs (n= 11)
Facilitators: • Program curriculum • Motivators • Readiness • Extension network	Barriers: • Commitments • Program flexibility • Timing

Other Emerging Codes

Seventeen (17) codes were reported by less than 50% of our participants which are listed in **Table 6** in more detail along with their representative quotes.

Table 6. Codes mentioned by fewer than half of study participants and representative quotes**.**

Code	**Representative Quote**
Coach personality	*"I try to use a lot of humor in the groups. I think making people laugh helps them want to come. I'm respectful of their ideas and encourage them to share their ideas because that's what groups are all about." (Educator)* *"…they were comfortable with my teaching style and what I was out to do." (Educator)* *"I felt the instructor, like I said, that intro class, was a little disorganized, and kind of boring. Not that she wasn't knowledgeable." (Dropout)* *"[the coach] is very good at explaining things and she is very patient and I feel I'm learning a lot." (Retained)*
Incentives	*"I think we're lucky because we have another program, and because some people in the diabetes class are eligible for our snack program, I was able to do a snack program class."(Educator)* *"…I've eaten fairly healthy for years, but just, 'Here's a technique to use.' Boy, that made a difference. It's something that I use all the time now."(Dropout)* *"I've done, I've lost it, I've gained it, I've lost it, I've gained it, I lost it, I gained it. I haven't really lost, lost, lost, lost, lost, lost, lost, but I think I would be more committed. You had something like [a strong incentive] I would say, mm-mm I'm gonna find a way to do this. I'm gonna take the baby with me and walk. I would find a way."(Retained)*
Familiarity and trust with educator	*"We've been struggling to get public service announcements in the newspaper for a while. Not just this program, but all the programs and extensions. They've got a new person in charge and they're not necessarily printing all of our PSAs."(Educator)* *"And so, it was easy for me because they knew ... They were familiar with me, and they, of course, knew me. And I had provided other programs with them. So, like I said, they were comfortable with my teaching style and what I was out to do."(Educator)* *"…and I felt the instructor, like I said, that intro class, was a little disorganized, and kind of boring. Not that she wasn't knowledgeable." (Dropout)* *"You can look at [the instructor] and know that she's done it for quite a while. It's good to know somebody that's successful."(Retained)*

Location	*"…I had to walk to where it was being held and it was fairly far. So I decided not to go." (Eligible no-show)* *"…it's a nice place to meet. It's easy to get to. I don't drive out of the area so that's a big plus for me. And so far I've been able to keep up with it." (Retained)* *"So I saw they were offering this program, and I went to the intro, and initially my intention was to come, but, it's quite a distance for me to come there, takes probably at least 45 to 50 minutes one way." (Dropout)*
Familiarity and trust with NDPP	*"…I know that in our program we have one doctor who is very pleased with the results and for his patients and my next plan is to reach out to him." (Educator)* *"My personal doctor, the flyers are up all over the office. When I go in for me or my dad, I see the flyers. But I'm not sure the doctors even know what they are, know what it's all about." (Educator)* *"I don't know if they weren't familiar with the DPP or the 'Prevent Type 2' program, but like I said, it just didn't work this way." (Educator)* *"I'm kind of just also getting familiar with actually facilitating the program…" (Educator)* *"I think what deters people, like I said, was the fact that they weren't real familiar with it…"(Educator)*
Seeing results	*"Believe it or not, one of the incentives to keep people coming back is their weight loss. They're seeing at least everybody's lost some weight and they're so excited about that that they come back the next week to see how much more they've lost."(Educator)* *"That kind of motivated me...Like, yeah I can do this, like this is actually going to make the numbers go down, and I can see where that would be, because once you got through, you know the counting calories, or any, you know, once you get the main points out of the way, it is every other week…"(Dropout)* *"Then I guess I got discouraged, because my blood sugar went back up. I wasn't getting the exercise that I had been doing, because I was working. I just gave up."(Dropout)* *"I've been motivated to ... I'm so more alert food and what to look at and what to count, and what the, what is it, the polyunsaturated and all of that, and the things that I've learned, they're scary, and because I'm cooking healthier and just watching, I've already lost 11 pounds."(Retained)*

Word-of-mouth advertising	*" I mean [this community] has gotten a lot larger, of course, our population has definitely grown over the years, but we're still small enough that word-of-mouth is a big, I don't know, it influences a lot of people around here."(Educator)* *"So, the 17 participants that I have enrolled in my program love it, from what they've told me and are already talking to their physicians and talking to their family members and their friends about, 'Yeah, the next time that this offered, you've really got to get in.'"(Educator)* *"…I have a dear friend….and I told her, 'You can come and listen, see if you wanna go to another signup.'" (Retained)* *"…when I tell people about what I'm doing, they're interested in going and I tell them where to go."(Retained)* *"I have a friend that works in [a community], she works in an office. She told me she was taking some classes with the University of Arizona…"(Eligible)*
Program champion	*"One of my participants read about this program in a diabetic-- one of the diabetic magazines that her husband gets. She called asking for information about a class in [X] County. [The UA CE-NDPP director] got her in touch with me. She put up flyers and notices in the gated community where she lives. So, one of my recruitment tools is actually having a champion in a specific community. She put it in their newsletter, she put flyers up all over, and that's where I got this explosion.."(Educator)* *"I wanted to work closely with the clinic director and I couldn't get a chance to meet with the clinic director and so it was like, oh well we'll take them and we just put them out in the waiting room."(Educator)* *"And one nurse in particular reached out to me and asked some clarifying questions and that is how I got at least one our participants in the class."(Educator)* *"I was at my doctor's. He told me to look out for one of these courses, and the first I heard about it being offered was in the [community]-- our local news."(Dropout)*

Co-existing conditions	*"And we've had two people-- one had a knee replacement, so she was out for several weeks. And then, we've had someone else that was diagnosed with thyroid cancer, and so she's been dealing with that and is having surgery and has a really great prognosis. So, unfortunately, life was getting in the way for them for sure and, ironically, in turn also didn't help with weight gain and things like that because sedentary, stress, thyroid was going wacky."(Educator)* *"And now I've fallen and fractured my shoulder and torn my rotator cuff, so I'm dealing with that right now."(Dropout)* *"I have COPD, and fibrosis of the lung, and it makes me tired."(Eligible)* *"I've got osteoarthritis in [my knee]…And one of the things is I've gained weight and that's not helping it."(Retained)*
Using what has worked in the past	*"…at the [community location], we already had an account with, our office specialist already had an account with the local newspaper for advertising for a different class, so I thought, well we have that already set up in place so just that the type is one two."(Educator)* *"Once you find that person who's interested, it's a piece of cake. It is so easy. She's got the energy, the motivation. She's got all the emails. She went out, put the flyers up. I didn't even have to do that. She sent everything out to her community."(Educator)* *"So, it was just an easy way to take a few minutes after I did my regular SNAP-Ed presentation to just say, 'And we also now have this great opportunity that will be coming up. If you're interested, see me after the class.'"(Educator)* *"Because I've done it in the past, so I also contract with [county] Council for Senior Citizens and I do the Stanford University Chronic Disease Self Management workshops. I've used these organizations to recruit for that program, and for some reason with those I did quite a bit of referrals that way."(Educator)*
Buy-in from health professionals	*"The dietitian felt that it would take too much of the doctors' time and that they would try to do it as part of something else."(Educator)* *"I don't know if it's a matter of getting past the business managers that I talk to, if I need to sit down and talk with the doctors personally to explain why this program is important, find when they have meetings or if they have large doctors' meetings in the community where or I can talk to all of them rather than individual offices."(Educator)* *"I got one from a local doctor's office but because she knew it was happening she had to make the point of the doctor to have her-- to have the doctor write that up."(Educator)*

Coach familiarity with audience	*"I know some areas don't have access to a newspaper that has a large distribution, so that could be something that would inhibit the success of that strategy. The other thing is newspapers are dying all over the place and moving over to online versions, so I would say the newspaper is probably more effective for older age groups, but an online strategy might be more effective for younger age groups."(Educator)* *"… I only had 18 people because you're only supposed to have 20. I kept everybody because I know there's going to be people who leave."(Educator)* *"Well, the program is held at the Catholic church there in town, and I'm actually a parishioner. So, I was able to open that door up much easier. I'm pretty active. I'm just not a parishioner; I actually volunteer with the homebound ministry program. So I go visit the ill that come to church anymore. So, it was pretty easy for me to just contact Father and the woman that was in charge of coordinating the program at the community center"(Educator)* *"It's finding ways that they could improve themselves or in the case of older adults, improve the quality of your life. With all the pills that they take and all the whatever medications and this and that and doctors and blah blah blah, when you hear something like improve the quality of your life, it's like, oh, that sounds appealing."(Educator)*
Met expectations	*"Somebody is really taking care of you. When I went to the program I said, 'Finally somebody interested in my health. Somebody who really wants to help me.' Because I went with patients, I went with doctors and nobody's really helped me. I think they just want money. They don't want to take care of me, they really don't care if I lose weight or not. And with [my educator], I think she really cares if we are losing weight and taking care of ourselves."(Dropout)* *"My impression was that I was gonna get information regarding it so that I could help myself health wise. I think that's come to fruition."(Retained)* *"So far the program has delivered pretty much everything that I expected."(Retained)* *"Well, my main goal was to see if I couldn't reduce that A1C, and of course, lose weight. And through the T2 program I have dropped my A1C into the 5s."(Retained)*
Capacity	*"So I would say that at least every other week, I get someone who contacts me to see if they can join our class. But we're too far along, so what I do is refer them to one of the other programs."(Educator)* *"…we are limited in size of how many participants ... you know, they said ideally where it was a 12 to 15 for our group size, that I was worried that I was gonna have to turn people away."(Educator)*

NDPP team communication	*"I couldn't find the risk test with our information that fits to our program." (Educator)* *"So [the informational session] definitely took time to put together-- I did a PowerPoint form. So that took time, it took research." (Educator)* *"We didn't have the material yet. Something happened and we didn't have the material, we couldn't start [the NDPP classes]" (Educator)* *"It has been difficult checking their food and activity log. Since they weren't counting their own calories yet…I have been writing them down myself." (Educator)*
Prioritizing self	*"You know, so it's easy to ignore yourself when you're trying to take care of somebody else. This program did help me kind of snap out of it and say, 'Hey, it's important to take care of me first.'"(Dropout)* *"Maybe I have to put my foot down and not all the time but say three times a week we're gonna eat what I'm gonna eat. Maybe that's what I've gotta do for myself."(Retained)* *"I'm having fun and after I felt a little bit better, I said to my husband, 'Well, maybe I'm not going to go back to volunteering'. I said, 'Right now, I feel better and I'm just going to do my own thing for a little bit and then I'll see if I want to go back.' So, right now, I'm doing my thing."(Retained)*
Combination of factors	*"And we've had two people-- one had a knee replacement, so she was out for several weeks. And then, we've had someone else that was diagnosed with thyroid cancer, and so she's been dealing with that and is having surgery and has a really great prognosis. So, unfortunately, life was getting in the way for them for sure and, ironically, in turn also didn't help with weight gain and things like that because sedentary, stress, thyroid was going wacky."(Educator)* *"It just depends on the time in my life, I can't get through the whole year without something major happening. My husband getting sick, me being sick, me falling and breaking my shoulder, having to go to physical therapy three days a week also, that kind of thing."(Educator)*

DISCUSSION

This study aimed to explore the perceived barriers and facilitators to program attendance in the UA CE-NDPP. Four distinctive groups were interviewed: educators, retained participants, eligible no-shows, and drop-outs in order to obtain different perspectives on what influenced program attendance.

Emerging themes included 1) program implementation; 2) participant-specific factors; 3) external environment; and 4) coach-specific factors. Specific barriers and facilitators falling under these themes included interest (during the recruitment and retention phases), program curriculum (content, length, and frequency), flexibility (accommodating participant's needs), and clarity (setting clear expectations); tailored recruitment and retention strategies (adapted to audience of interest), commitments (work duties, appointments, childcare) Cooperative Extension network, motivators (fear of diabetes and complications, etc.), timing (day, time and seasonality), support system (from educator, NDPP group, and home), readiness (preparation to make changes), and cost (program-associated fees). CE is a model for the dissemination of the NDPP that addresses several of the barriers associated with the emerging themes described above. With its ability to complement the less frequent monthly meetings through its multitude of existing programs, some of which include cooking and gardening classes, Extension addresses the barrier of program curriculum by maintaining participant engagement. Since Extension hires community educators with a background in informal education to serve as lifestyle coaches, over time, these facilitators will improve in delivering clear marketing materials for the NDPP and this barrier will cease to exist. Similarly, due to the educator's previous experience, recruitment and retention strategies will be honed over time as educators learn to identify those that are successful for their communities. Extension is in a unique position to provide flexibility to communities in great need for diabetes prevention by bringing the NDPP to their doors. With offices in most counties, Extension can easily deliver the program in areas of most need. Additionally, through the model of state-funded Extension agents combined with its peer education system, Extension is able to provide the NDPP at lower cost, thus reducing or eliminating the cost to NDPP participants. In a systematic review of the effectiveness and cost-

effectiveness of peer-based interventions to maintain and improve offender health in prison settings, South et al found that compared to professionally-led interventions, peer led programs offer comparable health outcomes, highlighting the usefulness of the peer education system at little to no cost[49]. Furthermore, Ali et al found that weight change was similar across several NDPPs with the use of both clinically trained professionals or lay educators[37].

It is important to note that, although there are several actions that Extension can take to address attendance barriers, some areas are out of its reach. This is true for the barrier of interest. Coaches may be persistent in building engagement; however, some individuals are not interested in starting or continuing with the problem, and this should be respected. This is especially important if we want to keep individuals interested in future programs and not dissuade them from engaging with CE programs.

Several findings in this study are corroborated by results from studies of NDPP implementation in other states, including the peer support component as a major benefit for continued participation[37,41]. The ability to find moral support in the NDPP group, lifestyle coach, and the home are likely important factors that motivate participants with continued participation in the program, and therefore flexibility to accommodate this social support should be attempted as much as possible. NDPP educators have the potential to facilitate this environment by encouraging participants to invite friends and family to the class and by fostering camaraderie among each group session. Offering ways for participants to stay in touch outside of the regularly scheduled sessions is another strategy for strengthening the support system.

Program clarity was an additional barrier reported here that was mentioned previously[42], where pre-sessions helped participants have a better understanding of NDPP expectations, helping with long-term attendance. In this study, participants completing pre-sessions stayed, on

average, 99.8 days longer ($P<0.001$) compared to participants not completing pre-sessions[42], underscoring the importance and usefulness of laying out program expectations prior to beginning the 12-month program.

Additionally, program flexibility has been reported as a barrier elsewhere[41], such as a lack of convenient times and locations offered. While there may be limitations (both financial and in terms of staff availability) to offering the NDPP at different times of day, the barrier of flexibility suggests that maximizing adaptations to participant needs would benefit program attendance. The ability to cater to participant's needs likely plays a role in the trust building between audience and educator, facilitating attendance. One avenue of flexibility that was explored through these interviews was the idea of an online platform for the NDPP, serving as a support tool. Findings from this study revealed excitement and interest from participants, with some of them explicitly sharing that this is something they would be willing to try. An online platform could provide supplemental content as well as online make-up sessions. Moin et al show the promise of a fully online NDPP intervention where participation was higher and weight loss similar compared to the conventional in-person approach[50]. An NDPP online platform would not only help individuals seeking additional support, it might help serve the large population of part-time residents in Arizona and help keep them engaged in this preventive lifestyle program.

Unsurprisingly, the long-term format of the program has also been reported both as a barrier and a facilitator previously[41]. In our work, individuals perceiving the benefit of program duration comprehended that lifestyle modification is a time-consuming process and focused on the positive aspects of the program length and intensity. Concern expressed by individuals seeing duration as a barrier focused on the aspect of accountability toward the latter half of the program.

Likewise, other reported barriers alike to this study were cost[37], content[51], time[41], and lack of knowledge and buy-in from health professionals[51,52]. In our research cost was perceived as a barrier for recruitment and retention. Cost is a factor that needs to be carefully considered. The UA CE-NDPP is currently free of charge, which was seen as a facilitator to program attendance. Furthermore, program timing represented a barrier due to scheduling conflicts that participants faced that prevented them from attending during particular seasons of the year (summer holidays, Thanksgiving, end of year). A key suggestion for future implementation is to avoid starting a new NDPP group during the holiday season as participants are likely not to be ready to embark on such a huge commitment. Classes that start prior to the holiday season should offer incentives and additional support during this busy time to help with retention and incorporate strategies that speak directly to making lifestyle changes during a season of festivities. For example, healthier versions of common holiday foods can be demonstrated and shared. Additionally, participants interested in enrolling who may have a hard time attending the more intense first half of the program (due to prior commitments) should be encouraged to leave their contact info for the next NDPP class start date.

Local health professionals can be a good source of participant referrals to the NDPP. Lack of knowledge from health professionals about the program is a major barrier for buy-in and subsequent referrals. It is important to note that this barrier of *familiarity* and *trust with the NDPP* probably exists merely due to the fact that the Cooperative Extension NDPP in Arizona is a brand-new program. Authors hypothesize that this barrier will be eliminated as participants complete the program and word-of-mouth advertises the NDPP through community members and health clinics. Anecdotal data from program educators and participants report that this is already happening, as health providers are seeing improved clinical biomarkers in their patients

(NDPP participants) and have requested more information about the program. This barrier is similar to *coach familiarity and trust with the audience* and *NDPP team communication*. Once a coach has taught the NDPP once in the community they will get used to what that particular demographic population is interested in and what motivates them, and barriers related with lack of knowledge about resources available may disappear because the coaches will have enough time to get familiarized with all that is offered.

Our findings differed from those of previous work in the appearance of the Cooperative Extension network as a new factor facilitating program attendance. Nationally, Cooperative Extension NDPPs comprise a small fraction of the total organizations delivering the program (in fewer than 20 states does CE currently offer the NDPP[46]). However, we believe this element is important due to the unprecedented reach and community presence of the CE network, and the potential to have an impact in MUAs.

This study further explored factors that dominated the different groups of interviewees. We sought to compare facilitators prevalent in the retained group (as a measure of what facilitates retention) with barriers prevalent in the drop-outs and no-shows (as a measure of what impedes retention). We found that for the retained participant group, the most common facilitators to attendance included program curriculum, motivators, readiness, and Cooperative Extension network. This finding is corroborated by the Johnson and Melton study that found program curriculum as a popular facilitator among patients who have utilized the NDPP[41], underscoring the opportunities Extension has for maximizing participant engagement in the NDPP through its broad recruitment network, complementary programming, incentives, and readiness screening.

Among eligible no-shows and drop-outs, the top barriers preventing program engagement were commitments, program flexibility, and timing. Realmuto et al share similar findings through their qualitative interviews of NDPP drop-outs in New York State: motives for dropping out included (1) time conflicts with other commitments; (2) personal priorities and motivation; and (3) dissatisfaction with the program[40]. What Extension and other implementing organizations can do to minimize these barriers is to be as flexible as possible during the recruitment and retention phases, listen to the needs of participants, and when feasible, offer multiple simultaneous NDPP classes to capture a broader audience.

Interestingly, the only observed discrepancies among perceived factors influencing program attendance was the issue of cost. This difference in opinion was noted not only among coaches, but also among participants. For instance, some coaches shared that they believed having a program-associated fee would have no effect on attendance. Others believed that a small fee would create a buy-in among participants. A consistent thought among coaches, however, is that if a fee would be implemented it needs to consider the financial burden it would impose on participants. Among participants, different thoughts on program cost were shared. Some participants felt that having a program fee would be a burden they would not have been able to pay, thus limiting their participation in the program, while others demonstrated interest in paying a reasonable fee because they sensed the program was worthwhile. One participant shared that having a fee has no effect on her willingness to keep coming back to the program. Together, this suggests that cost is a factor that must be carefully considered, with the possibility of utilizing sliding-scale fees as to minimize participant financial burden.

In the evaluation of the real-world implementation of the NDPP by CDC researchers, only 48.3% of participants remained in the program at the sixth-month mark[39], compared to our

retention numbers of 74.4% of participants from the three NDPP groups (initial n= 39) that have already reached the halfway point. Although this data does not encompass all of the ongoing groups we currently have, it shows promise for greater retention rates compared to national averages reported by Ely and colleagues. This observed retention rate in our NDPP may be due to the Extension model that addresses several challenges with recruitment and retention.

This study brings into light important components that directly impact participant engagement in the NDPP. While some reported themes relate to factors which are outside of the control of NDPP staff, other themes allow key implications to be drawn which may provide feasible adaptations to maximize attendance during program implementation. These implications are listed in **Table 7** and can help guide program implementation and coach training. The Cooperative Extension infrastructure is well positioned to help address these implications.

Table 7. Key Implications for program implementation and coach training.

Barrier	Key Implications
Program curriculum	• Provide complementary Extension programming during the second half of the program. • Tailor curriculum to audience of interest.
Program flexibility	• Listen to participant needs. • Make up sessions (in different delivery modes). • Be inclusive of some ineligible participants because they may be important in the support system of an eligible participant.
Program clarity	• Be thorough with program layout and expectations. • Ask questions to ensure understanding. • Offer pre-sessions.
Tailored recruitment and retention strategies	• Spend time learning about audience of interest. • Ask for participant feedback.
Commitments	• Be flexible with participants. • Offer multiple modes for delivery of make-up sessions.
Motivators	• Highlight the benefits of participating. • Be aware of what motivates a specific NDPP group. • Offer incentives.

Timing	• Partner with health practitioners. • Start a new NDPP every few months. • Avoid starting an NDPP class during the holiday season.
Support system	• Encourage attendance of friends or family members. • Maintain frequent contact with participants in between classes. • Allow participants to have different avenues of contact with each other (e.g. social media).
Readiness	• Screen for readiness: encourage individuals who have conflicting commitments in the beginning of the program to enroll in an upcoming NDPP class. • Keep a tracking record of interested individuals.
Cost	• Apply for CDC recognition in order to quality for insurance reimbursement and ensure program sustainability • Consider a sliding scale fee to help offset program costs

Future studies should focus on developing informed strategies based on the emerging themes from this study to maximize program attendance. For instance, future research could focus on testing the effects of delivering complementary programming, online make-up sessions, as well as the impact of program fees on attendance. These specific strategies should be evaluated and tested to ensure their success. This will provide a solid foundation of knowledge for NDPP program implementers for effective recruitment and retention approaches.

Strengths and limitations

While this study has several strengths, a limitation is its small sample size of 28 total interviewed individuals and even smaller sample size of each study group, thus limiting the generalizability of our findings to NDPP led by CE in AZ. Additionally, the NDPP is a 12-month program. Therefore, this study's definition of "retained participant" as one who completed 9 lessons in the first 6 months of the program would be strengthened by inclusion of participants who had also attended at least 3 lessons in months 7-12 (and therefore meet the CDC guidelines for program attendance). However, due to the timeline of program implementation at the

University of Arizona Cooperative Extension, no groups had completed the full program at the time of this study. Strengths of this study include its inclusion of four distinct group of participants in order to gain an understanding of their unique perceptions to attendance. Additionally, participants from this study came from seven different counties where the UA CE-NDPP is currently being offered, likely providing a somewhat accurate representation of the entire UA CE-NDPP cohort, and all coaches that participated in this study had at least a few weeks of experience delivering the NDPP therefore were credible individuals to interview for this study.

APPENDICES

Appendix A- Open and close-ended questions utilized in the qualitative semi-structured interviews with Lifestyle Coaches.

Lifestyle Coach Interview Questions

1. Can you describe the strategies you used to recruit participants to your National Diabetes Prevention Program (NDPP) sessions?
    a. Were there any other strategies that you used for recruitment that you would like to share with me?
2. You mentioned X, Y, and X as recruitment strategies you used to engage potential participants. In your perspective, which strategies were the most effective?
    a. You mentioned you used strategy X. What led you to select this particular strategy in the DPP?
    b. How hard was it to implement this strategy?
    c. Would you use this strategy again to recruit participants to future programs?
    d. Would you recommend it to someone else?
    e. How long did you use this strategy for?
    f. What changes would you make to this strategy, if any, to improve it?
    Repeat for additional strategies mentioned in part 1.
3. You mentioned X, Y, and X as recruitment strategies you used to engage potential participants. In your perspective, which strategies were the least effective?
    a. You mentioned you used strategy X. What led you to select this particular strategy in the DPP?
    b. How hard was it to implement this strategy?
    c. Would you use this strategy again to recruit participants to future programs?
    d. Would you recommend it to someone else?
    e. How long did you use this strategy for?
    f. What changes would you make to this strategy, if any, to improve it?
    Repeat for additional strategies mentioned in part 1.
4. Were there other strategies you wanted to try to improve recruitment but weren't able to?
5. Why were you unable to try this/these strategy/strategies?
    Repeat questions 1-4 for retention.

6. What do you think about using a program fee as a retention strategy?
    a. What should the fee be?

Appendix B- Open and close-ended questions utilized in the qualitative semi-structured interviews with retained participants.

Retained Participant Interview Questions

1. Please tell me how you heard about the National Diabetes Prevention Program (NDPP).
    a. Did you know that this program is associated with the University of Arizona?
    b. If yes, How much did this affect your decision in signing up for it, if at all?
2. How long did you go from getting pre-diabetic diagnosis to signing up to the NDPP?
3. Please tell me what motivated you to enroll in the NDPP.
4. Were there additional reasons you enrolled in the program?
5. What was your impression of the program when you signed up?
6. How has this impression changed, if at all, over time?
7. Did you have any concerns or hesitations about the program when you enrolled?
    a. Did you think you'd be able to make it to all the classes when you signed up?
8. From 1 to 10 (one being not motivated at all and ten being extremely motivated), how motivated were you to change your lifestyle when you began the program?
9. From 1 to 10 (one being not ready at all and ten being extremely ready), how ready were you to start the program?
10. What parts of the program did you like? A) Was there anything else that you liked about the program?
11. What parts of the program did you not like? A) Was there anything else that you didn't like about the program?
12. What kind of challenges, if any, did you encounter when making time to come to the classes?
    a. How did you overcome these challenges?
13. What helped you keep coming to the program?
14. Was there anything else that we could have done that would have made it even easier to participate in this program?
15. What do you think of having us launch an online version of the NDPP?
16. From one to ten (ten being extremely confident and one being not confident at all), how confident are you that your overall health has improved since doing the program?

17. Using the same scale from the previous question, how confident are you in reducing your risk for type 2 diabetes since doing the program?
18. Would you refer a friend or group to the NDPP program?

Appendix C- Open and close-ended questions utilized in the qualitative semi-structured interviews with eligible no-show participants.

Eligible No-show Interview Questions

1. Please tell me how you heard about the National Diabetes Prevention Program (NDPP).
    a. Did you know that this program is associated with the University of Arizona?
    b. If yes, how much did this affect your decision in signing up for it, if at all?
2. Have you ever been diagnosed with pre-diabetes by a doctor?
3. Please describe what you think the NDPP is all about.
    a. The NDPP is a program for pre-diabetics that has been shown to reduce the risk of T2D by half.
    b. Would this have interested you? Why or why not?
4. What did you think the content was about?
    a. The content touched on healthy eating, physical activity, and ways to cope with the challenges in doing these things.
    b. Would this have interested you? Why or why not?
5. What did you think the structure would be like?
    a. The structure involves a coach guiding the sessions who provide feedback to participant's progress, participants can bring a family member with them and are expected to contribute to the discussions.
    b. Would this have interested you? Why or why not?
6. How long did you think the program was for?
    a. The program meets for a whole year.
    b. Would you have been able to make this commitment? Why or why not?
7. How often did you think you had to attend the program?
    a. Participants meet weekly on the first three months, twice a month for five months and then monthly the last four months.
    b. Would you have been able to make this commitment? Why or why not?
    c. Is there a reason why this program is not attractive to commit for a whole year?
8. What did you think the location and time was for the program?
    a. The program meets in local communities, for example we have one going on at X location meeting at X time.

b. Would you have been able to attend this? Why or why not?

9. Did you think there was a cost associated with attending the program?

a. The cost is free.

b. Would this have interested you? Why or why not?

10. Some research shows that compared to free programs, programs that have a small fee have improved attendance. What would you think if the program had a cost associated with it?

11. What do you think would have been a reasonable fee?

12. Can you please share with me why you didn't sign up for the program?

13. What do you think of having us launch an online version of the NDPP?

14. I understand you did not sign up for this program. I am curious, however, about how ready were you for this program, at the time when you were told about it? (ten being extremely ready, one being not ready at all),

15. Using the same scale above, how motivated were you at that time about making lifestyle changes?

16. Was there anything else that we could have done that would have made it easier for you to participate in this program?

Appendix D- Open and close-ended questions utilized in the qualitative semi-structured interviews with drop-out participants.

Drop-out Participant Interview Questions

1. What was your experience with the National Diabetes Prevention Program (NDPP)?
2. Please tell me how you heard about the NDPP.
    a. Did you know that this program is associated with the University of Arizona?
    b. If yes, how much did this affect your decision in signing up for it, if at all?
3. How long did you go from getting a diagnosis of pre-diabetes to signing up to the NDPP?
4. Do you mind sharing with me why you signed up for the program?
5. What was your impression of the program when you signed up?
6. How has that impression changed, if at all, over time?
7. From 1 to 10 (one being not motivated at all and ten being extremely motivated), how motivated were you about changing your lifestyle when you began the program?
8. From 1 to 10 (one being not ready at all and ten being extremely ready), how ready were you to start the program?
9. Would you mind sharing why you stopped coming to the program?
10. Was there anything else that prevented you from coming back to the program?
11. What did you think about the frequency of the classes?
12. What parts of the program did you like?
    a. Was there anything else that you liked about the program?
13. What parts of the program did you not like?
    a. Was there anything else that you didn't like about the program?
15. Was there anything else that we could have done that would have made it easier to participate in this program?
16. What do you think of having us launch an online version of the NDPP?
17. Some research shows that compared to free programs, programs that have a small fee have improved attendance. What would you think if the program had a cost associated with it?
    a. What do you think would be a reasonable fee?
    b. In your perspective, what effect would a fee have on attendance?

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