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Examine participant dropout, undiagnosed diabetes and undiagnosed prediabetes in a chronic disease prevention education program

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EXAMINE PARTICIPANT DROPOUT, UNDIAGNOSED DIABETES AND UNDIAGNOSED PREDIABETES IN A CHRONIC DISEASE PREVENTION EDUCATION PROGRAM

A Thesis

by

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ABSTRACT

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There were 2768 participants enrolled in a chronic disease prevention education program. Survey and health measurements were obtained at three time points. We examine potential factors that might contribute to participant dropout, undiagnosed diabetes and undiagnosed prediabetes respectively. Logistic regression was used to examine the association between participant dropout and predictors, and to compare the odds of being undiagnosed with diabetes and prediabetes. We found that the potential predictors for participant dropout included age, employment, insurance, diabetes, self-reported health status, session type, program duration and curriculum. Factors affecting undiagnosed diabetes and prediabetes were age, self-reported health status birth country, limited by problems, family history of diabetes, baseline BMI and fruit and vegetable intake. This research is informative to prevent the participant dropout from prevention education program and reduce rates of undiagnosed diabetes and prediabetes on the U.S.-Mexico border.

Keywords: Participant dropout; Undiagnosed diabetes; Undiagnosed prediabetes; Hispanics

DEDICATION

The completion of my master's studies would not have been possible without the love and support of my family. I dedicate this thesis to my parents who have been so close to me that I found them with me whenever I needed. They have been a source of encouragement and inspiration to me throughout my life. It is their unconditional love that motivates me to set higher targets.

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CHAPTER I

INTRODUCTION

Alliance for a Healthy Border (AHB) is a chronic disease prevention education program, provided resources for chronic disease prevention, physical activity and nutrition programs at 12 federally-qualified community health centers located along U.S.-Mexico border in Texas, Arizona, New Mexico, and California from 2006 to 2009. The goals of AHB were to modify and develop existing prevention education programs targeted the Hispanic people; to reduce modifiable risk factors related to diabetes, cardiovascular disease; to assess and improve better practices in the prevention of these diseases (Wang et al., 2012).

In AHB, participants who were recruited into the program were through promotions at health fairs, flyers at health centers, and word of mouth. Participants then took part in individual or group education sessions on chronic disease prevention, nutrition, and physical activity in 12 federally community health centers. Some centers used well-established health programs, some centers applied developed curriculum, and some centers used curriculum developed in-house. Program duration lasted from 5 to 24 weeks differently. Every prevention education program implemented in these centers had a unique curriculum and program length. The AHB program adopted a pre-post-post study design. Survey instruments were based on questions from the Centers for Disease Control and Prevention's Behavioral Risk Factor Surveillance System and the Community Tracking Study Household Survey (Wang et al., 2012). Surveys were administered at the beginning of the program, at program end, and at 6 months post program end. Pre- and Post- program clinical health check-ups and health measurements were also collected in these health centers. All works were focused on improving nutrition, increasing physical activity, and preventing chronic diseases, like diabetes and cardiovascular disease.

The United States of America and Mexico share a border that links four U.S. and six Mexican states. The AHB is a prevention education program in U.S.-Mexico border, a region with a predominantly Hispanic population during an intervention period of 3 years. Hispanic is now one of the two largest minority groups in the United States, the other group is African American. The Hispanic population is known to have high rates of obesity (CDC, 1999), low income levels (CDC, 2003), low education levels (CDC, 2003), and low levels of health care coverage (Gary et al., 2003). Hispanics have more risk-taking behaviors that contribute to diabetes, hypertension, alcoholism and many types of cancer, and violent as well as accidental death (Foreyt, 2003).

1.1 Introduction to participant dropout

Participant dropout from a chronic disease prevention education program is always a big concern to public health workers and researchers. Given a considerable proportion of participants do not complete the study in the majority of studies believable; moreover, the estimated number of dropouts is usually taken into account in the calculation, results from the studies would become less believable (Groeneveld et al., 2009). As participant dropout increases, the sample completing the program potentially becomes less representative of the recruited population at the beginning of the program, decreasing the generalizability of the results of the study (Hoerger, 2010). In particular, in a longitudinal program, when data are collected over two or more points in time, it is common for some participants to drop out of the study prematurely due to different reasons. The attrition of the original sample, which defined base on the discontinuation of program documentation on a particular participant, is always occur in research that include the follow up data collection. In fact, attrition of the original sample represents a potential threat of bias if those who drop out of the study are systematically different from those who remain in the study. The result is that the remaining sample becomes different from the original sample, resulting in what is known as attrition bias (Miller and Hollist, 2007).

Since dropout may lead to bias, it is important to investigate the difference between participants who stay and those who drop out with respect to demographic, socio-economic, and health-related and center characteristics (Groeneveld et al., 2009). It would be meaningful to know which types of participants are more likely to drop out of the health education prevention program, so that participation rates can be improved in future studies. It is also important to decide whether and how the design of these programs could be modified to avoid losing participants (Fullerton et al., 2012). Previous studies have shown that participants who are more likely to drop out are relatively more often female and have a higher level of education (Chinn et al., 2006; Lerman and Shemer, 1996). Many studies have identified associations between participant dropout and demographic or health related risk factors. In some studies, reasons for participant dropout have been identified, such as 'health problem', 'lack of time', and 'dissatisfaction' (Atlantis et al., 2006).

Researches also have shown that recruiting minority participants is more difficult than recruiting white participants; moreover, Hispanic participants drop out more often than their white counterparts (Foreyt, 2003). Studies of healthy management and chronic disease are needed in Hispanic population. Overall, AHB interventions successfully improved weight reduction and glycemic outcomes among participants (Wang et al., 2012). However, 32.4% of the participants dropped out at the end-of-program, and 22.1% stayed until end of the program dropped out at the post-6-month program. It would be also meaningful to conduct behavioral analysis of participant dropout within the Latino culture to identify the factors contributing to drop out from the helpful prevention education program. Our study aims to examine the characteristics of participant dropouts and examine which variables assessed at the time of enrollment were predictive of later dropout in the AHB program.

1.2 Introduction to undiagnosed diabetes and undiagnosed prediabetes

1.2.1 Diabetes

Diabetes is a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both (ADA, 2010). Insulin is made by the pancreas, and helps glucose enter the cells. Glucose is the main source of energy for the body’s cells. The levels of glucose in the blood are controlled by insulin. In other words, diabetes is a condition in which the pancreas no longer produces enough insulin (Type 1 diabetes) or the body can’t respond normally to the insulin that is produced (Type 2 diabetes), so that glucose in the blood cannot be absorbed into the cells of the body, which results in glucose levels in the blood to rise. The cause of diabetes, having symptoms such as polyuria, polydipsia, polyphagia, and unexplained weight loss, are unclear right now. There seem to be both genetic factors passed on in families and environmental factors involved (ADA, 2010).

The prevalence of diabetes, especially type 2 diabetes, is growing rapidly worldwide. In the United State, according to the American Diabetes Association’s National Diabetes Fact

Sheet, over 18.8 million people suffer from diagnosed cases of diabetes in 2011. Diabetes is a chronic disease that causes serious complications including kidney failure, stroke, hypertension, cardiovascular disease, nervous system disease, dental disease and blindness (Stoddard et al., 2010; Al Sayegh and Jarrett, 1979). People who have diabetes would suffer from those complications which seriously erode quality of daily life. Moreover, study has shown that patients with diabetes had the reduction in life expectancy continuously with increasing age at diagnosis (Panzram, 1987). Diabetes is well known as the sixth leading cause of death in the USA (Ray, 2011). The United Health Group estimates that about 50% of Americans could have diabetes by 2020. Study also estimates that diabetes may account for 10% of national health expenditure and this could cost the nation about $3.5 trillion by 2020 if the current trend continues (Ray, 2011). It is essential for policymakers to make plan for future public health care needs due to the growth of diabetes burden.

However, there are many people who are unaware of the fact that they have impaired glucose metabolism. Those people with diabetes are “missing” or undiagnosed. Current study estimates that 27% of individuals with diabetes remain undiagnosed, and by the time of diagnosis, often there are microvascular and macrovascular abnormalities found (Silverman, 2011; Spijerman et al., 2003).

Study concluded that life style and pharmacologic interventions reduce the rate of progression to type 2 diabetes (ADA, 2013). There are many efficacious and cost-effective interventions that can prevent or delay diabetes, but none would be carried out among people with diabetes who are unaware of their condition. Therefore, timely detection of diabetes is crucial. So, early screening is important because the treatment of diabetes can prevent or delay microvascular end-organ complications (Silverman, 2011), help the healthcare system to reduce the risks of progression of diabetes, and help the nation save considerable amount of healthcare dollars (Ray, 2011).

1.2.1 Prediabetes

According to CDC (Centers for Disease Control and Prevention), in 2005-2008, based on fasting glucose or hemoglobin A1c levels, 35% of U.S. adults aged 20 years or older had prediabetes. Applying this percentage to the entire U.S. population yields an estimated 79 million adults aged 20 years or older who have "prediabetes" in 2010. Prediabetes is defined as a condition in which blood glucose or hemoglobin A1c (HbA1c) levels are higher than normal but not high enough to be classified as diabetes (CDC, 2011). Persons with prediabetes are at high risk for developing type 2 diabetes. Each year, 11% of persons with prediabetes who do not lose weight and do not engage in moderate physical activity will progress to type 2 diabetes during the average 3 years of follow-up (CDC, 2011; Zhang et al., 2010). Prediabetes has been related to microvascular (Ray, 2011; ADA, 2013) and macrovascular complications (Ray,2011; ADA,2013; Panzram, 1987). Once prediabetes progresses to diabetes, the risk of cardiovascular disease greatly increases (ADA, 2013; Boyle, 2010; Boyle, 2010). A review of several studies of prevention of diabetes from prediabetes revealed that with life style interventions the relative risk reduction ranged from 28% to 67% while with the use of some drugs the relative risk reduction was 26-60% (ADA, 2013; Nathan et al., 2009). In other words, dietary changes, physical activity, and modest weight loss can delay or prevent type 2 diabetes in persons with prediabetes. So, identifying people with prediabetes is the first step in protecting them from diabetes.

In the United States, people with prediabetes might benefit from efforts aimed at making them aware that they are at risk for developing type 2 diabetes and that they can reduce that risk by making modest lifestyle changes. The fact is, during 2005-2006, there are only approximately 7% of persons with prediabetes who were aware that they had prediabetes. Because the vast majority of persons with prediabetes are unaware of their condition, identification and improved awareness of prediabetes are critical first steps to encourage those with prediabetes to make healthy lifestyle changes or to enroll in lifestyle-change programs aimed at prevention type 2 diabetes (CDC, 2013). It is clear that type 2 diabetes can be prevented or delayed by modest weight loss, good nutritional practices, and increased physical activity. So, efforts are needed to increase awareness of prediabetes.

While diabetes and prediabetes occur in people of all ages and races, some groups have a higher risk for developing the disease than others. Diabetes is more common in African Americans, Latinos, Native Americans, and Asian Americans/Pacific Islanders, as well as the aged population. This means they are also at increased risk for developing prediabetes. In addition, it is a fact that the prevalence of diabetes varies widely between racial and ethnic categories. 7.1% of the non-Hispanic Whites and 11.8% of the Hispanic Americans suffered from diabetes in 2011 (CDC, 2011). Research also suggested that diabetes prevalence was higher in the border region than in Mexico or the United States as a whole. Besides, the number of undiagnosed diabetes in the region is likely to be substantial, particularly in identifying border populations at highest risk of being undiagnosed (Stoddard et al., 2010).

In our research, we focus on people who have undiagnosed diabetes and undiagnosed prediabetes. We try to evaluate the potential predictors for those people what type of participants are easily to be undiagnosed and help to improve diabetes and prediabetes diagnosis on the U.S.-Mexico border.

CHAPTER II

CONCEPTUAL FRAMEWORK

2.1 Health behaviors

Health behaviors were defined in different ways. Conner and Norman (1996) defined them as “any activity undertaken for the purpose of preventing or detecting disease or for improving health and well-being”. In addition, Gochman (1997) defined them as “behavior patterns, actions and habits that relate to health maintenance, to health restoration and to health improvement”. Behaviors that satisfy the above definitions include medical service usage, like physician visits and screening at regular intervals; compliance with medical regimens, like dietary, and self-directed health behaviors, like physical activities and alcohol consumption. Health behaviors have received considerable attention from social and behavioral experts and scholars. According to their works, we now have a good understanding of the factors influencing how and why individuals are willing to engage in such health behaviors.

2.2 Health behavior models

There are many models relevant for health behaviors. It is known that health behaviors are related to personality factors, like age and gender (Adler and Matthews, 1994). On the other hand, cognitive factors also determine whether or not an individual practices health behaviors and may explain how other factors influence the personal behavior. Various cognitive variables have been studied including perceptions of health risk, social stresses to perform the behavior, communication, and control over performance of the behavior (Conner, M., 2010). Health behavior models provide a systematic method of trying to explain why people implement the things they do and how their surroundings provide the context for their health behaviors. Those models guide both our current understanding of health behaviors, as well as providing direction for our research. As a metaphor, each model provides a different roadmap of the health behavior territory. However, in this territory, there is no true map, only a map or model that best meets our needs (Redding et al., 2000).

2.2.1The theory of planned behavior

The TPB (the theory of planned behavior) was developed by social psychologists and has been used to predict and explain a wide range of behaviors, such as public relations, advertising campaigns and healthcare (Ajzen, 1991). It was also applied in a wide range of healthcare area, like weight control (McConnon, A. et al., 2012), healthy eating (Conner, M. et al., 2002), and physical activity (Presseau, J. et al., 2010).

This theory includes five elements: behavior, intention, behavioral attitude, subjective norms, and perceived behavioral control. The TPB states that behavioral achievement depends on both intention and behavioral control. Intentions are determined by three variables. The first is behavioral attitude, which is a person’s overall evaluation towards the certain behavior. The second is subjective norms, which consist of a person’s beliefs about whether significant others think he/she should engage in the behavior. The third measures the extent to which the individual perceives that the behavior is under their personal control and is called perceived behavioral control (PBC). PBC expresses a person’s expectancy that the behavior is within his/her control.

The first important predictor of intention is behavioral attitude which is a function of a person's salient behavioral beliefs and predicts likely consequences of the behavior. Ajzen (1991) stated that the attitude toward a behavior as "the degree to which a person has a favorable or unfavorable evaluation or appraisal of the behavior in question". In our study, participants may have thinking like "taking part of this prevention education program will reduce the risk of diabetes and help me to lose fat". Thus, people probably would like to keep stay in AHB if they believe that the behavior will lead to improve their health condition which they value.

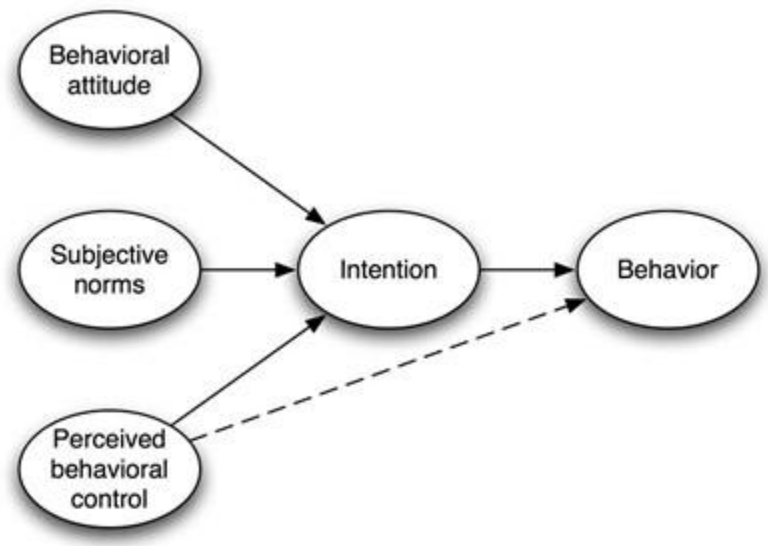


Figure 1. Theory of planned behavior

Subjective norm is a function of normative beliefs, which represent the belief about whether most people approve or disapprove of the behavior. Ajzen (1991) described it as "the perceived social pressure to perform or not to perform the behavior". In specific, subjective norm relates to a person's beliefs about whether peers and people of importance to the person think whether or not he/she should engage in the behavior. In our study, participant may be influenced by his/her family, friends and doctors.

PBC is based on beliefs concerning access to the necessary resources and opportunities to perform the behavior successfully. Ajzen (1991) defined perceived behavioral control as "the perceived ease or difficulty of performing the behavior". Therefore, in our study, one of the factors that determine perceived behavioral control is having any limits in any activities because of physical, mental, or emotional problems.

So, according to the TPB, individuals are likely to stay in a chronic disease prevention education program and diagnose chronic diseases, like diabetes, in advance, if they believe that this health behavior will lead to the desired outcome, if they believe that people whose views they value think they should engage in the program, and if they feel that they have the necessary resources and opportunities to stay in AHB and have clinic checkups.

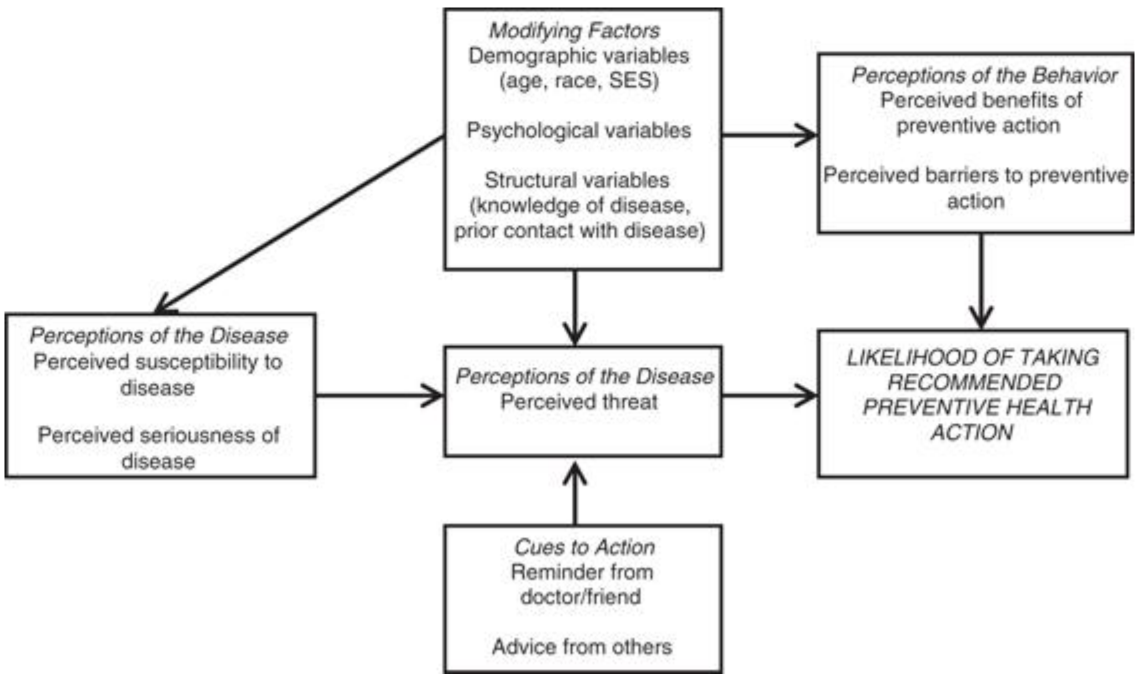
2.2.2 Health belief model

The Health Belief Model (HBM) was developed in the early 1950s by social psychologists in the public health arena as a method of predicting who would utilize screening tests and/or vaccinations (Becker, 1974; Fishbein & Becker, 1984; Janz et al., 1991;). The HBM states that a person's desire to avoid illness or disease together with a person's belief that a specific health action will prevent or cure illness will determine the likelihood that someone will take action to prevent illness and disease. This theory consists of six components: perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cue to action, and self-efficacy. The first four elements were developed as the original components of the HBM. The last two were added in order to help the HBM better fit the changing habitual unhealthy behaviors, such as being sedentary, smoking, or overeating.

Perceived susceptibility refers to a person's subjective perception of the risk of acquiring an illness or disease. Perceived severity shows one’s feelings on how serious the individual believes the results of contracting an illness or leaving the illness untreated. There is wide variation in a person's feelings of severity when people evaluate the medical consequences (e.g., death, disability) and social consequences (e.g., family life, social relationships). Perceived benefits refer to a person's evaluation of how well the effectiveness action will reduce the threat of or to cure illness or disease. Perceived barriers state a person's feelings on how difficult an advised action will be or how much it will cost, both psychologically and otherwise. People evaluate the effectiveness of the behavior against the perceptions that it may be expensive, dangerous (e.g., side effects), unpleasant (e.g., painful), time-consuming, or inconvenient. Cues to action are strategies or events to increase an individual's motivation to engage in the recommended health action. These cues can be internal cues (e.g., angina, chest pains, wheezing, etc.) or external cues (e.g., advice from others, illness or death of spouse, newspaper article, etc.). Self-efficacy is the level of a person's confidence in his/her ability to take action. Self-efficacy is a key factor of HBM, as it directly relates to whether a person performs the desired behavior.

In our study, individuals were likely to take survey and clinic check-ups, if they believed they had been exposed to diabetes, cardiovascular disease and obesity, and believed that getting obesity or diabetes or cardiovascular disease without knowledge or treatment were significant enough to try to avoid. We assume that participants believed that the recommended action of getting interview and clinic check-ups would benefit them — possibly by allowing them to get early treatment or improving health status. Participants identified their personal barriers to getting interview or clinic check-ups (i.e. limited by problem getting to the clinic) and explore ways to eliminate or reduce these barriers. Meanwhile, they received reminder cues for action (e.g. posters and flyers in health centers). Considering these components together, in the end, participant completed interview and clinic check-ups on time. Other influences upon the performance of health behaviors, such as demographic variables (e.g. age, race, socio-ecomomic status), psychological variables (e.g. personality and peer pressure) and structural variables (e.g.

knowledge of disease, prior contact with disease) are assumed to exert their effect via changes in the components of the HBM.



Individual Perceptions Modifying Factors Likelihood of Action

Figure 2. The health belief model

CHAPTER III

METHODOLOGY

3.1 Data

Our study population consisted of all participants who enrolled in the AHB from 2006 to 2009 through 12 federally qualified community health centers in communities located along the US-Mexico border region where majority of the people were Hispanic. During Phase I of AHB (January 2006 - December 2007), each of 12 centers had approximate actual expenses of $160,000 (Wang et al., 2012). 2,777 participants enrolled in the chronic disease prevention education program in Phase I of AHB.

Data were collected after obtaining participants' written informed consent, and included survey questionnaire and clinical measurements. A survey questionnaire was self-administered based on questions from the Centers for Disease Control and Prevention's Behavioral Risk Factor Surveillance System and the Community Tracking Study Household Survey, and survey instruments were used at the beginning of the program, at program end and at six-month post program end (Wang et al., 2012). The survey included eleven sections: socio-economic information, baseline health information, health care, tobacco use and alcohol consumption, diabetes, hypertension awareness, cholesterol awareness, cardiovascular disease, exercise and physical activity, and diet.

Clinical measurements were also collected at baseline, at program end and at post-six-month. During the AHB program, twelve factors, i.e. height in inches, weight in pounds, waist measurement, hip measurement, heart rate, systolic blood pressure, diastolic blood pressure, hemoglobin A1c (HbA1c), fasting plasma glucose (FPG), total cholesterol, high-density lipoprotein (HDL) and low-density lipoprotein (LDL), were measured according to the AHB protocol. These twelve measurements were related to weight reduction and glycemic success in AHB program.

3.1.1 Data for participant dropout

Upon completion of this phase, 1896 participants completed the survey and/or clinic measurements at the end of the program; and 1547 participants finished the survey and/or clinic measurements after six months. In another word, 2768 valid participants started the disease prevention education program with requirements; 899 participants dropped from the program at the end of the program; and 413 participants dropped from the program at post-six-months.

We included participants in our analysis if their data were complete for the outcome and the corresponding predictors. Therefore, the sample sizes were 1634 at the end of the program and 1188 at the post six months.

The dependent factor is participant dropout from AHB program classified as dropout and stay. Participant dropout was defined as a participant having no follow-up AHB documentation (including program survey and measurement records). Participant who only filled in the survey questionnaire or only attended the clinical health check-up was not considered as dropout. Participants who did not send the questionnaire back, and did not attend the clinical health check-ups, were defined as dropout. For the survey, we consider the participant to have finished the survey, if the person completed at least 66.7% of the basic information which includes start time, survey date, interviewer, finish time, people (“Who is filling out the survey”) and survey location ("Where was the survey administered"). For the measurement, we believed that the participant had completed the measurement if he or she had at least one out of twelve records of the health check-ups.

3.1.2 Data for undiagnosed diabetes and undiagnosed prediabetes

In this part of the research, we study the data collected at baseline. 2777 participant enrolled in baseline, of which 2628 participants finished both baseline survey and collection of measurement. The analyses for the current study were based on data from 2628 participants with valid measure of FPG and HbA1c, which, along with self-reports of diabetes or prediabetes diagnosis, was used to determine diagnosis status.

Based on FPG, diabetes was defined as having an FPG of ≥126 mg/dl, and prediabetes was having an FPG of 100-126 mg/dl. Standard World Health Organization recommended an HbA1c ≥ 6.5% to diagnose diabetes and HbA1c between 5.7% and 6.5% for identifying prediabetes (ADA, 2010). Survey respondents were classified as having diagnosed diabetes or diagnosed prediabetes if they responded positively to the question "Have you ever been told by a doctor that you have diabetes?" Women who had diabetes only during pregnancy were excluded.

So, a participant who was defined as undiagnosed diabetes if (1) FPG is ≥126 mg/dl and HbA1c ≥ 6.5% and (2) no self-reports of diabetes or prediabetes diagnosis. A person is assumed to have undiagnosed prediabetes if (1) FPG is >110 mg/dl and <126 mg/dl and HbA1c is >5.7% and < 6.5% and (2) no doctor has ever diagnosed the person as diabetic or prediabetic. This definition of diabetes and prediabetes (based on FPG and HbA1c level) is consistent with the latest guidelines issued by the American Diabetes Association (American-Diabetes-Association, 2010). FPG and HbA1c are valuable indicators of underlying health and have been used in research to predict diabetes and prediabetes among most people.

The diagnostic criteria were established by the National Diabetes Data Group (NDDG, 1979) and World Health Organization (WHO, 1980). The diagnosis of diabetes has been based on glucose criteria, either the FPG or the OGTT. The diagnostic criteria have always been modified from previously recommended by the NDDG and WHO. The recently revised criteria for the diagnosis of diabetes are shown in Table 1. At first, they have not recommended use of the HbA1C for diagnosis of diabetes. However, an International Expert Committee recommended the use of the HbA1C test to diagnose diabetes, with a threshold of ≥ 6.5% (ADA). HbA1C reflects average blood glucose levels over a 2- to 3- month period of time, which is a widely used method to diagnose diabetes. HbA1C has several advantages to FPG, such as greater convenience; evidence to suggest greater preanalytical stability; and less day-to-day perturbations during periods of stress and illness. However, the HbA1c can be misleading sometime in patients with certain forms of anemia and hemoglobinopathies (ADA). The glucose criteria for the diagnosis of diabetes still remain valid and are widely used. As there is no exact measure to diagnose diabetes, future research is needed to better characterize those patients whose glycemic status might be categorized differently by two different tests, like FPG and HbA1c, obtained precise diagnosis. In our study, we use FPG and HbA1c to evaluate undiagnosed diabetes and undiagnosed prediabetes respectively.

3.2 Measures

3.2.1 Measures for participant dropout

In our research, the independent factors come from the survey and clinical measurements were categorized into demographic factors, socio-economic factors, baseline health factors, and center characteristics factors. For demographic factors, gender (female or male), age (categorized into three groups: less than 45; 45-65; more than 65), marital status (single or married), and birth country (U.S.; Mexico; others) were considered. For socio-economic factors, we included number of children at home (categorized into three groups: none; 1-3 children; more than or equal to 4 children), education (middle school or less; high school grad or some; college), employment status (employed or self-employed; unemployed or those unable to work; homemakers; retired), income (less than $10,000; $10,000 to less than $20,000; $20,000 to less than $30,000; $30,000 and more), health insurance coverage status (yes, if respondents had any kind of health insurance coverage e.g., private health insurance, prepaid plans such as HMOs, or government plans such as Medicare; no, if respondents had not any kind of health insurance coverage e.g., private health insurance, prepaid plans such as HMOs, or government plans such as Medicare). For baseline health factors, we considered general health status, diabetes (yes, if respondents were told by doctors that they had diabetes; no, if respondents were not told by doctors that they had diabetes), baseline BMI (normal: 18.5 BMI<25; overweight: 25 BMI<30; obese: BMI >=30), baseline HbA1c (HbA1c<6; HbA1c>=6), smoking(nonsmoker; former smoker; current smoker), drinking (yes, no), limits by problems (yes, if respondents reported any limits in any activities because of physical, mental, or emotional problems; no, if respondents did not reported any limits in any activities because of physical, mental, or emotional problems). Center Characteristics are including section type (Individual: participants take part in individual class section; group: participants enrolled in interactive class section) program duration in weeks (5 weeks; 8 weeks; 9 weeks; 10 weeks; more than 10 weeks), and curriculum (adapted versus developed).

3.2.2 Measures for undiagnosed diabetes and undiagnosed prediabetes

In our research, we consider 17 potential factors. The independent factors come from the survey and clinic measurements were categorized into demographic factors, socio-economic factors, baseline health factors, and dietary and physical activity factors. For demographic factors, gender (female or male), age (categorized into three groups: less than 45; 45-65; more than or equal to 65), marital status (single or married), and birth country (U.S.; Mexico) were considered. For socio-economic factors, we included education (middle school or less; high school grad or some; college), employment status (employed or self-employed; unemployed or those unable to work; homemakers; retired), income (less than $10,000; $10,000 to less than $20,000; $20,000 and more), health insurance coverage status (yes, if respondents had any kind of health insurance coverage e.g., private health insurance, prepaid plans such as HMOs, or government plans such as Medicare; no, if respondents had not any kind of health insurance coverage e.g., private health insurance, prepaid plans such as HMOs, or government plans such as Medicare). For baseline health factors, we considered general health status, diabetes (yes, if respondents were told by doctors they had diabetes; no, if respondents were not told by doctors they had diabetes), baseline BMI, smoking (nonsmoker; former smoker; current smoker), drinking (yes, no), limits by problems (yes, if respondents reported any limits in any activities because of physical, mental, or emotional problems; no, if respondents did not reported any limits in any activities because of physical, mental, or emotional problems), family history of diabetes (yes; no). Dietary and physical activity factors include consuming more fruits and vegetable, met physical activity recommendations (yes; no), baseline dietary scale.

Table 7 lists the rates of diabetes and prediabetes based on FPG measurements and HbA1c measurements. These rates were estimated by 17 potential factors. Comparing the retention rates over time, it seems possible to assume that data were missing completely at random. We use data in our research if they were complete for the corresponding outcomes and 17 predictors. Based on FPG measurement, data from 418 participants were included to evaluate undiagnosed diabetes and data from 488 participants were used to estimate undiagnosed prediabetes. Based on HbA1c measurement, data form 472 participants were used to assess undiagnosed diabetes outcomes, and data from 434 participants were used to evaluate undiagnosed prediabetes.

3.3 Statistical analysis methods

All data were analyzed using the Statistical Program for the Social Sciences for Windows (SPSS v.15.0; SPSS Inc., Chicago). First of all, we use descriptive analysis to explore the rate of participant dropouts at the end of the program and 6 post months and baseline undiagnosed diabetes and undiagnosed prediabetes. Secondly, we explored pair-wise chi-square tests to study the association of each predictor and participant dropout, and to examine the association of undiagnosed diabetes and undiagnosed prediabetes with demographic, socio-economic, baseline health conditions and center characters factors. Thirdly, in order to investigate the association between each variable and participation, regression analyses were performed with participation as the dependent variable to identify predictors of dropout and study their effects on outcomes. Moreover, use of the same logistic regression model among survey respondents with diabetes ("diagnosed" and "undiagnosed") to examine the association between undiagnosed diabetes and indicators, undiagnosed prediabetes and indicators.

Subsequently, a binary logistic regression model was constructed to investigate the associations adjusted for other variables. A variable that had a $p\text{-value}<0.05$ in binary logistic regression model was considered to be significantly associated with participation, undiagnosed diabetes and undiagnosed prediabetes.

CHAPTER IV

RESULTS

4.1 Results on participant dropout

4.1.1 Proportions of participant dropout

Figure 3 presents a flow chart of inclusions and participant dropouts at two time points: the end of the program and 6-post-program. On the baseline, participants were categorized as valid and invalid participants. Participants enrolled with blank basic information which include age, sex, marital status, ethnicity/race, education, employment status and so on were invalid participants. Valid participants were people enrolled in the program with some basic information.

We found that, for valid participants, 32.5% participants drop out at the end of the AHB program intentionally or by chance. Among those people, 10.1**%** of the dropped participants attended the follow up survey or measurement in six months later. 89.9% of the dropped participants at the end of the program had never shown up. After 6 months of the program, 22.1% participants dropped out at the relative longer time (post-six-month) among the remaining people. Only 77.9% of the remaining participants completed the whole program.

The rate of dropout at the end of the program was 32.5% versus the rate of stay 67.5%. Since we aimed to find out the potential factor of participant dropout, we focus on the group dropped at the end of the program without completing follow up survey and outcome measures. After six months, the percentage of participant dropout was 22.1% versus the percentage stay

85.1%. We are interested in the people who had no measurement records and survey information at post six months.

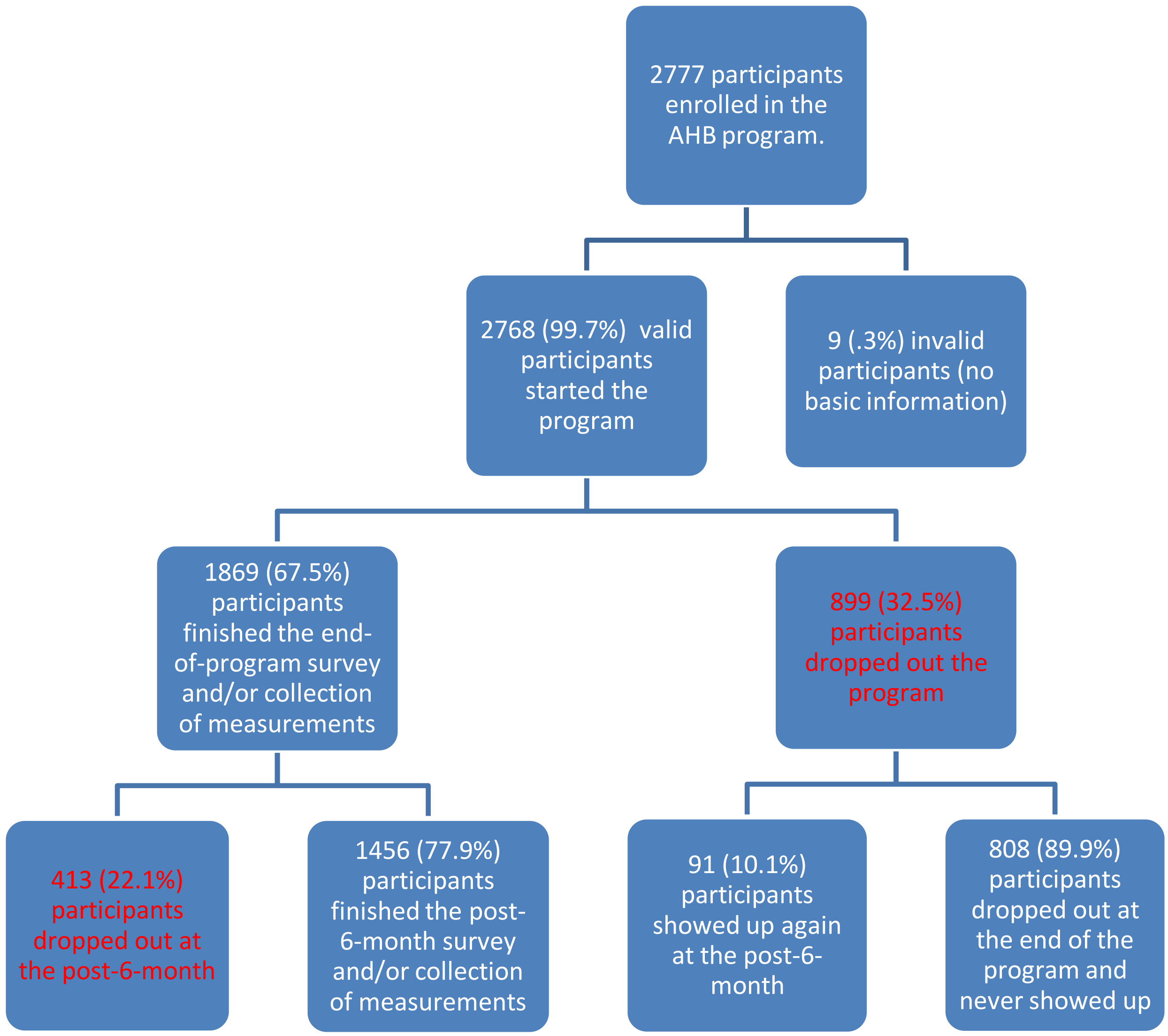


Figure 3 Flow-chart of inclusion and dropout.

Figure 4 showed the distribution of the four categories. We found that up to six months post of program, even though 52.6% participants (SS) finished the whole longitudinal program, people in SD and DD took 14.9% and 29.2% respectively. Also, it was observed that 3.3% the participants dropped out at the program at the program end and came back at post six months for some reasons.

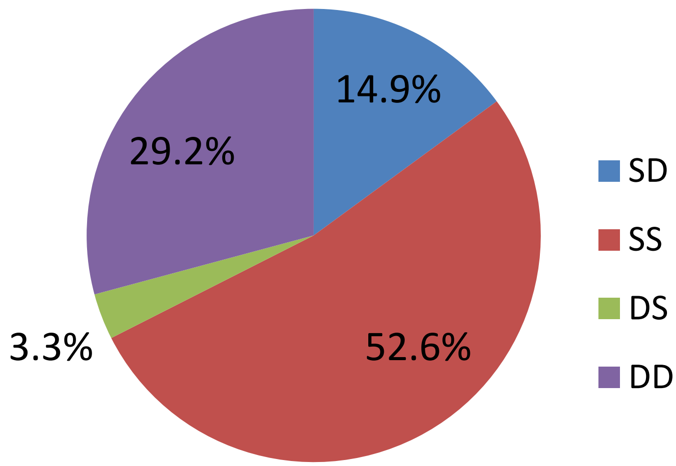


Figure 4 Participants dropout at two time points

4.1.2 Pair-wise exploration results

We calculated the percentages of participants who had dropped from the program, and participants who had not. Table 1 lists rate (%) of dropped participants by demographic factors, socio-economic factors, baseline health factors and center characteristics at program end and post-six-months.

Total N is the number of participants who had dropped out at the end of the program and 6-month-post. Among the 808 participants who dropped out at the end of AHB program, 75.6% were female and 76.1% people were born in Mexico. 44.8% of the respondents had education less than high school. 71.0% of the population reported they were not limited by activities because of physical, mental, or emotional problems. After 6 months, 413 follow up participants dropped from the program. 75.5% were females. Almost 40% of the respondents had no children. Around half of the dropped people were reported baseline HbA1c greater than or equal to 6. 81.4% of the dropped respondents in post-6-month attended in adapted curriculum.

Overall, it shows that 32.5% (95% confidence interval [CI]: 30.76%-34.24%) participants dropped out at the end of the program. There was a 22.1% (95% CI: 20.22%-23.98%) dropout rate at 6 months post program.

4.1.2.1 Participant dropout at the end of the program with all predictors. Table 3 summarizes the distribution of nineteen factors and their respective association with participant dropout at the end of the program. We found that, for demographic factors, younger participants (smaller than or equal to 45 years old) have higher rate of dropout at the end of the program. For socio-economic factors, participants who had 1 to 3 children were reported higher rate of dropout. For center characteristics factors, participants enrolled in individual and/or 8 weeks program were more likely to drop out.

In section 4.1.3.1, we will identify the significant predictors of participant dropout at the end of the program and study their effects using all nineteen independent factors in a binary logistic regression model.

4.1.2.2 Participant dropout at the post-six-month with all predictors. Table 5 states the distribution of nineteen factors and their respective association with participant dropout at 6 months post program. For demographic factors, participant dropout rates were higher among 65 years old or older participants. For socio-economic factors, participants more likely to drop were those with incomes of less than $10,000 and/or without health insurance coverage. For baseline health factors, participants reported poor were more likely to drop out. For center characteristics factors, attrition rates were higher among participants enrolled in programs that lasted 8 weeks and /or adapted curriculum.

In section 4.1.3.2, we will identify the significant potential predictors of dropout and study their effects using all nineteen independent factors in a binary logistic regression model.

4.1.3 Results from binary logistic regression

The results from binary logistic regressions for participant dropout are shown in Table 3 and Table 5.

4.1.3.1 Results at program end from binary logistic regression. Table 3 shows the results from a logistic regression analysis which was conducted to predict participant dropout predictors and their association at the end of program. The effect size for the logistic regression model with nineteen hypothesized factors was 0.098, indicating that 9.8% of the variation of participant dropout is explained by the logistic model. 76.8% of the hypothesized factors were correctly predicted and were found to jointly predict attrition levels (LR $\chi^2(32)=168.035$, $p<0.001$). When holding other factors constant, we found that people aged 45 to 64 years old were less likely to drop out (OR=0.698; 95% CI, 0.503-0.968) compared to those who were 45 years of age or younger. Compared to employed and self-employed people, those homemakers were less likely to drop out (OR=0.687; 95%CI, 0.495-0.953). Participants diagnosed with diabetes were less likely to drop than those not diagnosed with this chronic health condition (OR=0.658; 95%CI, 0.477-0.907). Participants who were in programs that lasted 9 weeks were less likely to drop the program relative to those who were in programs that lasted 8 weeks (OR=0.101; 95%CI, 0.054-

0.189). Respondents who participated in developed curriculum program were less likely to drop out compare to those who were in adapted curriculum program (OR=0.326; 95%CI, 0.201-0.530). Controlling other factors in the model, respondents who enrolled in programs that lasted 5 weeks were more likely to drop out than those in programs that lasted 8 weeks(OR=2.461; 95%CI, 1.152-5.257). Participants who enrolled in more than 10 weeks duration program were more likely to drop the program relative to those in 8 weeks duration program(OR=1.854; 95%CI, 1.105-3.012).

4.1.3.2 Results on participant dropout at post-6-month from logistic regression. Table 5 summarizes, six months after the program end, the effect size for the regression model with nineteen hypothesized factors was 0.112, indicating that the model explained 11.2% of the variation of participant dropout. Table 4 shows that prediction success overall was 82.7%. The hypothesized factors were found to jointly predict participant dropout (LR $\chi^2(32)=153.430$, $p<0.001$) .We found that controlling for other factors in the model, participants 45-64 years of age were less likely to drop out than those who were 45 years of age or younger (OR=0.392; 95%CI, 0.255-0.602). Controlling other factors in the model, respondents who enrolled in programs that lasted in 5 weeks were less likely to drop out than those in programs that lasted 8 weeks(OR=0.137; 95% CI, 0.028-0.665). Participants who enrolled in 9 weeks duration program were less likely to drop the program relative to those in 8 weeks duration program(OR=0.194; 95%CI, 0.108-0.351). People who enrolled in programs that lasted 10 weeks were less likely to drop out compared to people who enrolled in programs that lasted 8 weeks (OR=0.539; 95%CI, 0.284-0.889). And, respondents who participated in developed curriculum program were less likely to drop out compared to those who were in adapted curriculum program (OR=0.502;

95%CI, 0.284-0.889). Participants without health insurance coverage were more likely to drop out relative to those who had health insurance (OR=1.883; 95%CI, 1.268-2.799). We also found that participants who reported health status as fair (OR=1.525; 95%CI, 1.057-2.200) or poor (OR=2.247; 95%CI, 1.265-3.993) at baseline interview were more likely to drop the program than those who reported themselves as good, very good and excellent health. Controlling other factors in the model, respondents who participated in individual-based programs were more likely to drop out relative to those who participated in group-based programs (OR=1.629; 95%CI, 1.013-2.618).

4.2 Result on undiagnosed diabetes and undiagnosed prediabetes

4.2.1 Descriptive characteristic

Among 2768 valid participants on the baseline, 94.6% participants had both completed information on survey and clinic check-ups. About 4.2**%** participants finished the survey without collection of measurements, and 0.9% participants only completed the clinic measurements on the baseline. We used 2628 valid participants who finished the baseline survey and collection of measurement in our study.

Based on FPG measurement, we found that only 28.3% participants were diagnosed with diabetes at baseline in Figure 5. Among those people, 83.2% reported that they had ever been told by a doctor that they had diabetes or prediabetes. About 13.0% participants were unaware that they had diabetes or prediabetes. It indicated that around 30.3% participants were diagnosed with prediabetes, 46.0% participants were diagnosed, and 49.2% of those participants were undiagnosed.

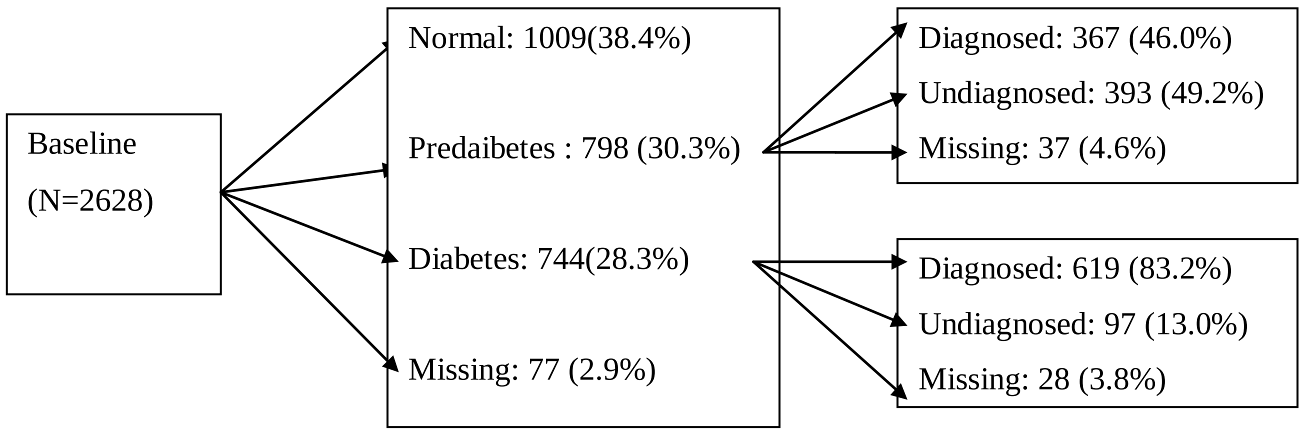


Figure 5: Proportion of diagnosed/undiagnosed diabetes and diagnosed/undiagnosed prediabetes based on FPG.

Figure 6 shows that the rate of having diabetes among 2628 participants is 31.7%. 85.9% participants were diagnosed that they had diabetes or prediabetes. Only 10.9% had undiagnosed diabetes. We found that 28.4% participants were diagnosed with prediabetes at baseline based on HbA1c. Among those people, about 37.9% participants were aware that they had diabetes or prediabetes. 57.3% reported that they had never been told by a doctor that they have diabetes or prediabetes.

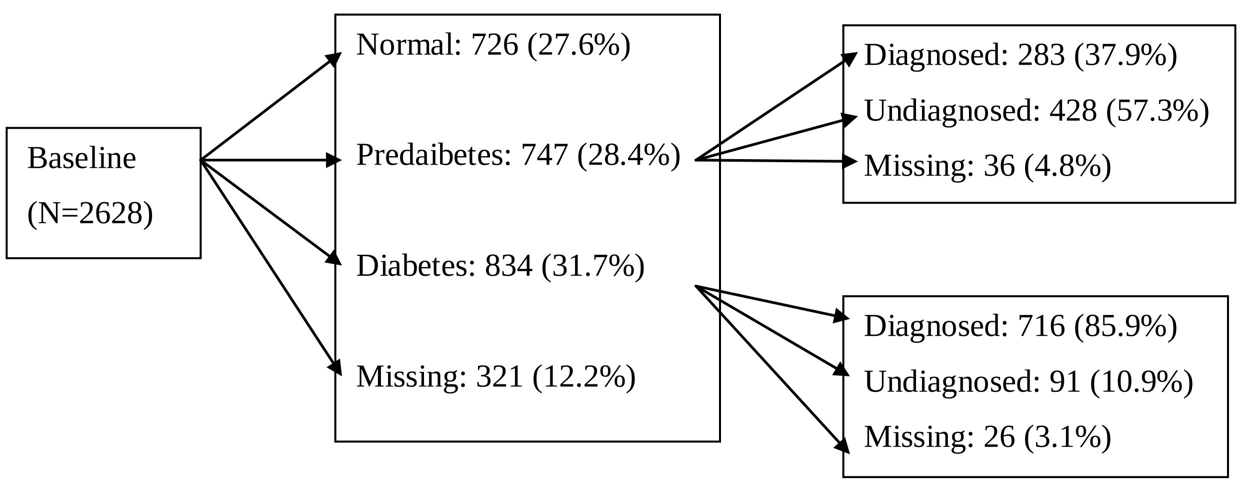


Figure 6: Proportion of diagnosed/undiagnosed diabetes and diagnosed/undiagnosed prediabetes based on HbA1c.

4.2.2 Pair-wise exploration results

4.2.2.1 Based on FPG.

Diabetes. Table 8 summarizes the distribution of seventeen factors and their respective association with undiagnosed diabetes at the baseline. We noticed that, for socio-economic factors, participants who were high school graduates or those with some high school education have higher rate of undiagnosed diabetes. For baseline health factors, undiagnosed participants reported good, very good and excellent health condition; not limited by problems; and /or no family history of diabetes.

Prediabetes. Table 8 also shows the distribution of seventeen factors and their respective association with undiagnosed prediabetes at the baseline. For demographic factors, participants more likely to be unaware of prediabetes were born in Mexico on the U.S.-Mexico border. For socio-economic factors, undiagnosed prediabetes rates were higher among participants with incomes of $10,000 to less than $ 20,000.

In section 4.2.3.1, we will further identify the significant predictors of undiagnosed diabetes and undiagnosed prediabetes based on FPG and study their effects using all seventeen independent factors in a binary logistic regression model.

4.2.2.2 Based on HbA1c.

Diabetes. Table 8 states the distribution of seventeen factors and their respective association with undiagnosed diabetes according to HbA1c criteria. For baseline health factors, participants more likely to be undiagnosed were those with no limited by problems.

Prediabetes. In Table 8, we found that, for demographic factors, participants reported 44 years old or younger, and/or born in Mexico were more likely to unaware of having prediabetes. For socio-economic factors, participants more likely to have undiagnosed prediabetes were homemakers, with incomes of $ 10,000 to less than $20,000 and/or without insurance. For baseline health factors, undiagnosed rates were higher among participants who were not limited by problems. For dietary and physical activity factors, undiagnosed prediabetes reported have smaller dietary habit scale.

In section 4.2.3.2, we will identify the significant potential predictors of undiagnosed diabetes and undiagnosed prediabetes based on HbA1c and study their effects using all seventeen independent factors in a binary logistic regression model.

4.2.3 Results from logistic regression

The results from binary logistic regressions for undiagnosed diabetes and undiagnosed prediabetes are shown in Table 9.

4.2.3.1 Based on FPG.

Effects of predictors on undiagnosed diabetes. Table 9 shows the results from a logistic regression analysis which was conducted to predict undiagnosed diabetes predictors and their association based on FPG. The effect size for the logistic regression model with seventeen hypothesized factors was 0.182, indicating that 18.2% of the variation of undiagnosed diabetes is explained by the logistic model. 87.1% of the hypothesized factors were correctly predicted and were found to jointly predict attrition levels (LR $\chi^2(8)=5.402$, $p=0.714$). When holding other factors constant, we found that people self-reported fair (OR=0.473; 95% CI, 0.245-0.911) or poor (OR=0.233; 95% CI, 0.069-0.785) were less likely to be undiagnosed compare to those who reported good, very good, and excellent health condition. Compared to people who were 44 years old or younger, those who are more than 44 years old and less than 64 years old were less likely to drop out (OR=0.475; 95%CI, 0.231-0.978).

Effects of predictors on undiagnosed prediabetes. Table 9 indicates the results from a logistic regression analysis which was conducted to predict undiagnosed prediabetes predictors and their association based on FPG. The effect size for the logistic regression model with seventeen hypothesized factors was 0.101, indicating that 10.1% of the variation of participant dropout is explained by the logistic model. The hypothesized factors 87.1% correctly predicted and were found to jointly predict attrition levels (LR $\chi^2(8)=4.139$, $p=0.844$). Participants born in Mexico were more likely to be undiagnosed than those born in U.S. (OR=1.789; 95%CI, 1.108-2.891). Controlling other factors in the model, respondents who reported income level of $10,000 to less than $20,000 more likely to be undiagnosed than those with less than $10,000 (OR=1.584; 95%CI, 1.031-2.434). Participants who reported no family history of diabetes were more likely to have undiagnosed diabetes relative to those having family history of diabetes (OR=1.663; 95%CI, 1.088-2.544).

4.2.3.2 Based on HbA1c.

Effects of predictors on undiagnosed diabetes. Table 9 summarizes, according to HbA1c, the effect size for the regression model on undiagnosed diabetes with seventeen hypothesized factors was 0.161, indicating that the model explained 16.1% of the variation of participant dropout. Table 10 shows that prediction success overall was 89.6%. The hypothesized factors were found to jointly predict participant dropout (LR $\chi^2(8)=3.000$, $p=0.934$) . When controlling other factors constant in the model, we noticed that participants who were high school graduates or those with some high school education were more likely to be undiagnosed than those who were middle school graduates or less (OR=2.200; 95% CI, 1.053-4.598).

Controlling other factors in the model, respondents who reported consuming more vegetables and fruits were more likely to be unaware of diabetes (OR=1.018; 95% CI, 1.002-1.035).

Effects of predictors on undiagnosed prediabetes. According to Table 9, we found that the effect size for the regression model on undiagnosed prediabetes on the basis of HbA1c with seventeen hypothesized factors was 0.281 , indicating that the model explained 28.1% of the variation of participant dropout. Table 12 shows that prediction success overall was 71.2%. The hypothesized factors were found to jointly predict participant dropout (LR $\chi^2(8)=10.257$, $p=0.247$) . When holding other factors constant, participants 45-64 years of age were less likely to be undiagnosed relative to those who were 44 years of age or younger (OR=0.459; 95% CI, 0.261-0.805); participants who were 65 years of age and older were less likely to undiagnosed relative to those who were 45 years of age or younger (OR=0.218; 95%CI, 0.088-0.540). People who reported higher BMI index were less likely to be unaware of prediabetes (OR=0.963; 95%CI, 0.928-0.998). Controlling for other factors in the model, respondents born in Mexico were more likely to have undiagnosed prediabetes compare to those born in U.S. (OR=2.163; 95%CI, 1.194-3.917). Participants who reported income level of $10,000 to less than$20,000 were more likely to be undiagnosed relative to those with less than $10,000 income (OR=2.918; 95%CI, 1.710-4.980); participants with income level of $20,000 or more were more likely to be unaware of prediabetes relative to those with less than $10,000 income (OR=1.702; 95% CI, 0.880-3.290). We also found that participants who reported unknown on their family history of diabetes were more likely to be unaware of prediabetes compared to those known their family history of diabetes (OR=2.777; 95%CI, 1.186-6.505). When we control other factors in the model, respondents who reported not limits in any activities because of physical, mental, or emotional problems were more likely to be unaware of prediabetes relative to those who limited by any problems (OR=3.144; 95%CI, 1.838-5.377).

CHAPTER V

DISCUSSIONS

5.1 Discussion on participant dropout

Of the 2777 participants who enrolled in AHB program at U.S.-Mexico border, 99.7% participants were used in our study. This study investigated the factors of participant dropout at two time points: end of program and post 6 months. 32.5% participants dropped out at program end. Dropouts were generally younger, having no self-reported diabetes, but their baseline health profile did not differ significantly from that of the non-dropouts. After 6 months, 22.1% participants dropped out. Our finding shows that participants who are young, without covered insurance, and in fair/poor health status were more likely to drop. Dropouts in our study remained higher than in several other public health studies involving chronic disease and lifestyle counseling (Lindquist and Cooper, 1999; Fullerton, 2012), probably because the different of definition of dropout or the different target populations. In generally, factors related to health status at baseline are associated with participant dropout. In other words, participants who cared more about their health were less likely to drop the program.

At the end of the program, older participants were less likely to drop. We notice that older participants were not only more willing to participate but also to complete the study. Our finding is consistent with several other trials (Edye, 1989; Emmons, 1999; Yannakoulia, 2007). It shows that participants who reported have diabetes at baseline were less likely to drop than their counterpart group. Diabetes is a serious epidemic that affects more than 220 million people worldwide (WHO, 2010). According to the National Diabetes Prevention and Control Program, 1 in 10 (2 million) Hispanic adults in the United State, have diabetes. In addition, Hispanics with type 2 diabetes are 2 times more likely to develop diabetes-related complications than their non-Hispanic white counterparts (Lavery et al., 2003). Most people in the U.S-Mexico border have the aware of the dangerous of diabetes. As AHB's goals were to reduce modifiable risk factors associated with diabetes and to promote best practices in the prevention of this disease (Wang et al., 2012). That makes sense that the people who live with diagnosed diabetes were more likely to complete the prevention education program, and they have the confidence in the chronic disease prevention education program, which can help them to improve the health status.

After 6 months, it is not surprising that younger participants were more likely to drop. We notice that participants who did not have any health insurance coverage were likely to drop at post-6-month point. According to National Health Interview Survey, 2005, the most common reason for lacking health insurance was cost, followed by a change in employment. For uninsured females, the reasons for no health insurance coverage were a change in marital status or death of a parent. In addition, Hispanic persons who are known as low income and were more likely than non-Hispanic white, non-Hispanic black, and non-Hispanic Asian persons to be uninsured due to loss of a job or a change in employment (CDC, 2005). Covering with health insurance is related to socio-economic factors. Combining all the factors, we suppose they were in unstable living status and had higher probability of dropout, compare to persons with health insurance coverage. Surprisingly, considering respondent-assessed health status, adults reported in fair/poor status were more likely to drop after 6 months. We speculate that among the border population, those people would prefer to stay in AHB program to improve their health status, rather than keep health behavior in the future.

Participant dropout could not easily be avoided, and nor could lack of time, motivation, or inconvenient. According to our study, we believe, some, but not all of these problems might have been prevented. Clearly, planning of counseling sessions and clinic health check-ups should have been accurate to prevent disappointment and involuntary dropout. Since, center characteristics have significant related to dropout. We used three center characteristics to capture the variation in intervention features across participating health centers. All of them affected participant dropout rates remarkably at two time points. Group programs had relatively high retention rates than individual programs. Participants who enrolled in developed curriculum had high retention were less likely to drop compare to participants who enrolled in adapted curriculum. Compare to programs that lasted 8 weeks, participants enrolled in other programs were more likely to drop out. Shorter program (5-weeks duration) and longer programs (10-week and 12-week duration) are not relatively effective for preventing dropout in our study.

Moreover, culture also plays an important role in explaining our research results, since it indicates how people perceive and react to behave. In Hispanic culture, a great deal of emphasis is placed on religion, the family, and traditional beliefs that include cultural norms, gender roles, and holistic ideologies pertaining to health. In addition, in Hispanic culture, relationships and family networks are far more important than individual members of a social network. Hispanics trust their family and other members of their social groups and strive to achieve the goals of the group. The American Cancer Society outlines several Hispanic cultural values that help to describe their health behaviors. It shows that the Hispanic notion includes uncles, aunts, cousins, grandparents, as well as close family friends. Many times patients may company with their family members to medical office visits. During the patient and doctor relationship-building process, mutual respect between the patient and doctor plays an important role. In a doctor-patient relationship, the doctor would communicate in a personal, warm, and friendly tone in which the doctor would demonstrate interest in the patient's personal life, family, or other interests. These Hispanic cultural values contribute to relationship-building within communities (Puig, 2007).

In AHB intervention, we learned that the chronic disease risks and health related factors were positively associated with participation, but this association was mainly due to age. Reasons for participant dropout were mainly related to perceived health, socio-economic factors, center characteristics and lack of motivation. In future studies, some of these problems could be anticipated, therefore increasing completion rates.

5.2 Discussion on undiagnosed diabetes and undiagnosed prediabetes

5.2.1 Undiagnosed diabetes.

Among participants with diabetes in AHB program, undiagnosed diabetes contributes to approximately 13.0% according to standard FPG measurement, and around 10.9% is undiagnosed based on HbA1c measurement. According to our research, the prevalence of undiagnosed diabetes, using HbA1c measurement, is slightly lower than the prevalence on the basis of FPG. However, less than half of the people with undiagnosed diabetes according to FPG criterion were likewise identified by HbA1c (Bonaldi, C. et al., 2011). We noticed that undiagnosed diabetes rate in our study remained lower than the fact in National Diabetes Fact Sheet, 2011, probably because the different populations. AHB is a prevention education program along the U.S.-Mexico border, and the participants enrolled in the program are greatly due to the health centers' recruiting works.

We found that age is one of the significant factors associated with undiagnosed diabetes. Younger adults with diabetes in the region in general were less likely to be diagnosed than older adults. Actually, it is a fact that the risk of diabetes is less in young people than in older people, however, in young people, the opportunity for screening and clinic health check-ups may also be less frequent, since young people are usually healthier than older people. Their younger age may have resulted in greater missed chance to be aware of diabetes.

Eating well to maintain a healthy weight is one of the most important things we can do to lower the risk for diabetes. Fresh vegetables and fruits is an essential part to build a healthier plate. However, we found that participants who intake more vegetables and fruits were more likely to be unaware of their diabetes status. Healthier eating habit let them ignore the probability of having diabetes. Similarly, those people who reported good, very good, and excellent health status also exposed to the danger of undiagnosed diabetes. They feel confident on their health condition, but, in fact, they are unaware of their status. Those people with undiagnosed diabetes are at high risk of complications.

5.2.2 Undiagnosed prediabetes

Among participants with prediabetes in AHB who were undiagnosed, Mexico born participants were more likely to be undiagnosed than U.S.-born participants. At the national level in the United States, Mexican Americans with diabetes, combining U.S.- and Mexico-born, are less likely to be undiagnosed than non-Hispanic whites (Stoddard et al.,2010). In an area with a large Hispanic population like the U.S. border region, levels of awareness may be even more pronounced to lower population prevalence of undiagnosed diabetes and prediabetes. Results suggest that any increased awareness among public health efforts have mainly benefitted U.S-born Hispanics rather the Mexican immigrants (Stoddard et al., 2010). Undiagnosed diabetes represented an important health problem along the U.S.-Mexico border. Since Mexicans and Mexican immigrants with diabetes living in the border region were more likely to be undiagnosed than other border groups, efforts to improve screening and diagnosis should focus on these populations.

It makes sense that participants with family history of diabetes have high awareness of prediabetes. And, participants limited by problems were less likely to be unaware of prediabetes. They believed they may have been exposed to diabetes, and believed that getting diabetes were significant enough to try to avoid. We assume that participants believed that access to health care or a place to receive routine health care and keep healthy life style would allow them to get early treatment improving health status and prevent them from the risk of prediabets. Participants identified their personal barriers (i.e. limited by problem; having family history of diabetes) and explore ways to eliminate or reduce these barriers.

Because younger adults were more likely to be unaware of prediabetes, their younger age might have resulted in greater missed screening in health centers. We found that people who had small BMI were more likely to be unawareness. Those people have confidence in their health. They missed regular clinic check-ups, since hey believed they were young, slim and health. The opportunity for making them aware that they are having prediabetes and at risk for developing type 2 diabetes also be less frequent for those people.

CHAPTER VI

LIMITATIONS AND FUTURE WORK

In our study, some limitations should be mentioned. Firstly, there was no control group for the AHB interventions. Secondly, this study was not based on a random sample. Thirdly, we deleted missing data by assuming missing by random. Moreover, for participant dropout study, we did not know the reasons for dropout of the whole participants who dropped the program and the definition of participant dropout may not have been accurate, because we expected that some dropouts would complete the second follow-up measurement; for undiagnosed diabetes and undiagnosed prediabetes study, data may produce bias since they were collected in health centers in the border region. It was not possible to compare diagnosis rates among or non-border area.

Based on these findings, we would recommend that for future interventions investigators should (1) anticipate possible reasons for non-participation in a pilot study of the target population, and take into consideration our proposed solutions for stimulating participation and preventing participant dropout; (2) adjust the recruitment strategy in order to include the entire target population; (3) adjust the center characteristics (program session, curriculum, and duration) to avoid losing participants.

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APPENDIX

APPENDIX

Table 1: Criteria for the diagnosis of diabetes

1. HbA1C ≥6.5%. The test should be performed in a laboratory using a method that is NGSP certified and standardized to the DCCT assay.*

OR

2. FPG ≥ 126 mg/dl (7.0 mmol/l). Fasting is defined as no caloric intake for at least 8 h.*

OR

3. 2-h plasma glucose ≥ 200 mg/dl (11.1 mmol/l) during an OGTT. The test should be performed as described by the World Health Organization, using a glucose load containing the equivalent of 75 g anhydrous glucose dissolved in water.*

OR

4. In a patient with classic symptoms of hyperglycemia or hyperglycemic crisis, a random plasma glucose ≥ 200 mg/dl (11.1 mmol/l).

*In the absence of unequivocal hyperglycemia, criteria 1-3 should be confirmed by repeat testing.

Table 2: Rate (%) of participant dropout by demographic factors, socio-economic factors, baseline health factors and center characteristics at program end and post-six-months.

	Program end (N=808)	6 months post (N=413)
Demographic Factors		
Sex		
Male	22.0	21.3
Female	75.6	75.5
Missing	2.4	3.1
Age		
45 years or younger	45.7	38.0
45-64 years	40.3	40.4
65years or older	13.4	20.3
Missing	.6	1.2
Marital status		
Married	62.1	56.9
Single	33.1	39.2
Missing	4.8	3.9
Birth country		
U.S.	18.7	21.3
Mexico	76.1	73.8
Other	1.7	1.2
Missing	3.5	3.6
Socio-economic Factors		
Number of children		
None	31.6	39.5
1-3	50.4	42.9
More than or equal to 4	7.0	6.1
Missing	11.0	11.6
Education		
Middle school or less	42.1	48.9
High school grad or some	40.8	34.6
College (3or4 years)	12.4	13.1
Missing	4.7	3.4
Employment		
Employed & self-employed	35.4	31.0
Unemployed & unable to work	24.4	24.2
Homemaker	30.2	30.5
Retired	7.5	12.8
Missing	2.5	1.5
Income		
Less than $10,000	42.8	46.5
$10,000 to less than $20,000	27.7	31.5
$20,000 to less than $30,000	11.3	9.7
$30,000 and more	6.4	5.6
Missing	11.8	6.8
Insurance		
Yes	32.9	34.4

No	58.7	56.2
Missing	8.4	9.4
Baseline Health Factors		
Self-reported health condition		
Good, Very good, and excellent health	38.5	30.0
Fair	46.7	55.2
Poor	10.4	11.6
Missing	4.5	3.1
Diabetes		
No	73.2	55.0
Yes	26.8	38.7
Missing	7.7	6.3
Baseline HbA1c		
HbA1c < 6	29.7	32.9
HbA1c ≥ 6	35.9	53.8
Missing	34.4	13.3
Baseline Body mass index		
Normal	9.9	10.2
Overweight	28.3	28.1
Obese	50.1	57.1
Missing	11.6	4.6
Smoking		
Nonsmoking	72.3	73.8
Former smoker	13.4	15.5
Current smoker	10.8	7.0
Missing	3.5	3.6
Drinking		
Nondrinker	78.1	83.1
Drinker	16.1	14.0
Missing	5.8	2.9
Limited by problems		
Yes	22.2	26.9
No	71.0	67.8
Missing	6.8	5.3
Center Characteristics		
Section type		
Individual	36.4	31.5
Group program	63.6	68.5
Program duration		
5 weeks	7.5	1.7
8 weeks	30.6	29.3
9 weeks	4.8	14.0
10 weeks	19.3	25.7
More than 10 weeks	37.7	29.3
Curriculum		
Adapted	62.3	81.4
Developed	37.7	18.6

Table 3: The observed and the predicted frequencies for participant dropout at the end of the program by logistic regression.

Observed	Predicted		
	stay	dropout	Percentage Correct
Stay	1235	17	98.6
Dropout	362	20	5.2
Overall Percentage			76.8

Table 4: shows distributions of nineteen factors based on participant dropout at end program, and its logistic regression. P-values from Chi-squared tests of association are provided for those factors significantly (at 0.05 significance level) associated with the dependent variables.

	Percent N=1634	stay	drop	OR	p-value CI Wald
Demographic Factors					
Sex				ref: male	
Male	19.7	72.7	27.3		
Female	80.3	77.6	22.4	0.824	
Age		p=0.003		ref: 45 years or younger	
45 years or younger	33.1	71.5	28.5		
45-64 years	49.8	79.2	20.8	0.698	0.031 (0.503,0.968) 4.631
65years or older	17.1	78.9	21.1	0.725	
Marital status				ref: married	
Married	66.9	76.1	23.9		
Single	33.1	77.6	22.4	0.779	
Birth Country				ref: US	
US	20	75.2	24.8		
Mexico	80	77.0	23.0	1.005	
Socio-economic Factors					
Number of children		p= 0.016		ref: none	
None	47.7	79.5	20.5		
1-3	47.0	73.4	26.6	1.301	
More than or equal to 4	5.3	79.1	20.9	0.791	
Education				ref: middle school or less	
Middle school or less	47.4	78.3	21.7		
High school grad or some	37.3	74.4	25.6	1.031	
College (3or4 years)	15.3	76.8	23.2	0.837	
Employment		p=0.016		ref: employed & self-employed	
Employed & self-employed	32.0	73.2	26.8		
Unemployed & unable to work	20.5	73.7	26.3	1.059	
Homemaker	36.9	80.1	19.9	0.687	0.025 (0.495,0.953) 5.050
Retired	10.6	80.3	19.7	0.737	
Income				ref: less than $10,000	
Less than $10,000	44.2	75.8	24.2		
$10,000 to less than	33.4	77.5	22.5	0.748	

$20,000					
$20,000 to less than $30,000	15.2	78.3	21.7	0.788	
$30,000 and more	7.2	74.4	25.6	0.814	
Insurance				ref: yes	
Yes	43.0	76.8	23.2		
No	57.0	76.5	23.5	0.946	
Baseline Health Factors					
Self-reported health condition				ref: good, very good and excellent health	
Good, Very good, and excellent health	38.8	75.4	24.6		
Fair	50.8	78.2	21.8	0.988	
Poor	10.4	73.5	26.5	1.270	
Diabetes		p=0.048		ref: no	
No	59.8	74.9	25.1		
Yes	40.2	79.1	20.9	0.658	0.011 (0.477,0.907) 6.525
Baseline HbA1c				ref:HbA1c<6	
HbA1c < 6	44.0	75.8	24.2		
HbA1c ≥ 6	56.0	77.3	22.7	1.076	
Baseline Body mass index				ref: normal	
Normal	8.9	74.7	25.3		
Overweight	32.6	74.1	25.9	0.990	
Obese	58.5	78.3	21.7	0.785	
Smoking				ref: current smoker	
Nonsmoking	74.1	76.9	23.1		
Former smoker	16.9	77.5	22.5	0.994	
Current smoker	9.1	73.0	27.0	1.096	
Drinking				ref: nondrinker	
Nondrinker	81.2	76.9	23.1		
Drinker	18.8	75.6	24.4	0.980	
Limited by problems				ref: yes	
Yes	26.5	76.0	24.0		
No	73.5	76.9	23.1	0.986	
Center Characteristics					
Group		p=0.007		ref: group program	
Group program	71.4	78.4	21.6		
Individual program	28.6	72.2	27.8	1.260	
Program duration		p= 0.000		ref: 8 weeks	
5 weeks	5.1	71.1	28.9	2.461	0.020 (1.152,5.257) 5.410
8 weeks	16.8	68.6	31.4		
9 weeks	18.5	95.4	4.6	0.101	0.000 (0.054,0.189)

					51.026
10 weeks	28.5	74.4	25.6	0.672	
more than 10 weeks	31.2	72.7	27.3	1.854	0.019 (1.105,3.012) 5.463
Curriculum		p=0.030		ref: adapted	
Adapted	66.9	75.0	25.0		
Developed	33.1	79.9	20.1	0.326	0.000 (0.201,0.530) 20.461

Table 5: The observed and the predicted frequencies for participant dropout at post-six-mnths by logistic regression.

Observed	Predicted		
	stay	dropout	Percentage Correct
Stay	1040	18	98.3
Dropout	206	32	13.4
Overall Percentage			82.7

Table 6: shows distributions of nineteen factors based on participant dropout at post 6 months, and its logistic regression. P-values from Chi-squared tests of association are provided for those factors significantly (at 0.05 significance level) associated with the dependent variables.

	Percent N=1296	stay	drop	OR	p-value CI Wald
Demographic Factors					
Sex				ref: male	
Male	18.9	81.6	18.4		
Female	81.1	81.6	18.4	0.868	
Age		p=0.000		ref: 45 years or younger	
45 years or younger	30.7	76.1	23.9		
45-64 years	51.8	87.6	12.4	0.392	0.000 (0.255,0.602) 18.335
65years or older	17.5	73.6	26.4	1.048	
Marital status				ref: married	
Married	66.4	83.0	17.0		
Single	33.6	78.9	21.1	1.134	
Birth Country				ref: US	
US	20.1	81.2	18.8		
Mexico	79.9	81.7	18.3	0.732	
Socio-economic Factors					
Number of children				ref: none	
None	49.6	82.9	17.1		
1-3	45.1	81.2	18.8	1.224	
More than or equal to 4	5.3	73.9	26.1	1.386	
Education				ref: middle school or less	
Middle school or less	48.5	79.3	20.7		
High school grad or some	36.1	83.5	16.5	0.764	
College (3or4 years)	15.4	84.5	15.5	0.727	
Employment				ref: employed & self-employed	
Employed & self-employed	30.9	84.5	15.5		
Unemployed & unable to work	19.8	78.2	21.8	1.288	
Homemaker	38.0	81.9	18.1	0.892	
Retired	11.2	78.6	21.4	1.158	
Income		p=0.009		ref: less than $10,000	
Less than $10,000	43.5	78.7	21.3		
$10,000 to less than $20,000	34.0	81.1	18.9	0.903	
$20,000 to less than	15.6	87.1	12.9	0.645	

$30,000					
$30,000 and more	6.9	90.0	10.0	0.521	
Insurance		p=0.033		ref: yes	
Yes	43.6	84.2	15.8		
No	56.4	79.6	20.4	1.883	0.002 (1.268,2.799) 9.817
Baseline Health Factors					
Self-reported health condition		p= 0.004		ref: good, very good and excellent health	
Good, Very good, and excellent health	38.4	85.9	14.1		
Fair	51.6	79.5	20.5	1.525	0.024 (1.057,2.200) 5.099
Poor	10.0	76.0	24.0	2.247	0.006 (1.265,3.993) 7.625
Diabetes				ref: no	
No	57.7	82.1	17.9		
Yes	42.3	81.0	19.0	0.825	
Baseline HbA1c				ref: HbA1c<6	
HbA1c < 6	43.1	83.9	16.1		
HbA1c ≥ 6	56.9	79.9	20.1	1.310	
Baseline Body mass index				ref: normal	
Normal	8.6	79.5	20.5		
Overweight	31.5	81.4	18.6	0.779	
Obese	59.9	82.1	17.9	0.731	
Smoking				ref: nonsmoking	
Nonsmoking	73.8	80.4	19.6		
Former smoker	17.5	85.0	15.0	0.667	
Current smoker	8.7	85.0	15.0	0.797	
Drinking				ref: nondrinker	
Nondrinker	81.5	80.7	19.3		
Drinker	18.5	85.8	14.2	0.781	
Limited by problems				ref: yes	
Yes	26.7	82.7	17.3		
No	73.3	81.3	18.7	1.340	
Center Characteristics					
Group				ref: group program	
Group program	71.6	82.0	18.0		
Individual program	28.4	80.7	19.3	1.629	0.044 (1.013,2.618) 4.058
Program duration		p= 0.000		ref: 8 weeks	
5 weeks	4.6	96.7	3.3	0.137	0.014 (0.028,0.665)

					6.083
8 weeks	14.5	65.4	34.6		
9 weeks	22.4	90.7	9.3	0.194	0.000 (0.108,0.351) 29.632
10 weeks	27.5	77.9	22.1	0.539	0.022 (0.317,0.916) 5.224
more than 10 weeks	30.9	83.8	16.2	0.598	
Curriculum		p=0.000		ref: adapted	
Adapted	66.6	78.4	21.6		
Developed	33.4	88.0	12.0	0.502	0.018 (0.284,0.889) 5.594

Table 7: Rate (%) of diabetes and prediabetes based on FPG and HbA1c.

	FPG		HbA1c	
	Diabetes N=744	Prediabetes N=798	Diabetes N=834	Prediabetes N=747
Demographic Factors				
Sex				
Male	25.5	22.1	24.0	18.9
Female	72.4	76.6	74.6	79.4
Missing	2.0	1.4	1.3	1.7
Age				
454years or younger	21.0	26.9	18.2	29.5
45-64 years	58.3	53.4	58.4	49.7
65years or older	20.6	19.3	23.3	20.6
Missing	0.1	0.4	0.1	0.3
Marital status				
Married	61.0	61.9	59.2	64.7
Single	34.7	34.2	36.8	31.3
Missing	4.2	3.9	3.8	4.0
Birth country				
U.S.	21.4	22.6	22.6	19.1
Mexico	75.5	74.2	74.2	77.2
Missing	3.1	3.3	3.3	3.6
Socio-economic Factors				
Education				
Middle school or less	50.7	51.0	51.2	51.7
High school grad or some	34.8	36.0	33.5	32.4
College (3or4 years)	10.6	10.3	11.3	13.1
Missing	3.9	2.8	4.1	2.8
Employment				
Employed & self-employed	29.0	32.3	27.2	30.8
Unemployed & unable to work	23.1	20.9	25.3	19.8
Homemaker	35.6	32.1	33.5	35.3
Retired	11.4	13.4	13.2	13.0
Missing	0.8	1.3	0.8	1.1

Income				
Less than $10,000	43.1	48.9	42.7	43.9
$10,000 to less than $20,000	31.5	30.8	32.7	29.9
$20,000 and more	17.3	14.8	16.8	20.7
Missing	8.1	5.5	7.8	5.5
Insurance				
Yes	41.9	37.8	41.6	42.0
No	50.1	56.6	50.2	52.7
Missing	7.9	5.5	8.2	5.2
Baseline Health Factors				
Self-reported health condition				
Good, Very good, and excellent health	25.3	34.6	25.5	38.2
Fair	57.4	52.5	56.6	50.2
Poor	15.5	10.9	15.9	9.6
Missing	2.4	2.0	1.9	2.0
Smoking				
Nonsmoking	67.6	72.6	66.7	71.9
Former smoker	18.8	16.2	19.4	17.4
Current smoker	10.2	8.6	10.1	8.4
Missing	3.4	2.6	3.8	2.3
Drinking				
Nondrinker	81.2	81.0	82.7	80.7
Drinker	16.5	15.9	15.3	16.7
Missing	2.3	3.1	1.9	2.5
Limited by problems				
Yes	30.5	25.7	31.5	25.2
No	65.2	71.1	64.6	71.2
Missing	4.3	3.3	3.6	3.6
Family history of diabetes				
Yes	69.0	59.4	69.1	56.9
No	19.8	29.3	19.5	30.4
Unknown	7.9	7.6	8.2	8.2

Missing	67.6	3.6	3.2	4.6
Baseline BMI				
Mean	33.4	33.1	33.3	32.6
Median	32.2	31.8	32.0	31.6
Std. Deviation	7.5	7.0	7.3	6.8
Missing	0.5	1.0	0.6	1.2
Dietary and Physical Activity Factors				
Met physical activity recommendations				
No	67.7	73.7	73.0	74.2
Yes	18.4	17.4	17.5	16.3
Missing	13.8	8.9	9.5	9.5
Dietary habit				
Mean	31.3	30.2	31.4	30.1
Median	31.0	30.0	31.0	29.0
Std. Deviation	6.0	6.1	6.1	6.0
Missing	14.2	12.4	13.1	14.1
Baseline fruit & vegetable frequency				
Mean	24.1	24.2	23.8	26.1
Median	20.0	19.2	19.5	22.0
Std. Deviation	17.4	19.5	17.8	18.2
Missing	13.8	9.8	13.1	11.6

Table 8: Rates of undiagnosed diabetes and undiagnosed prediabetes based on FPG and HbA1c by 17 factors.

	FPG				HbA1c			
	Undiagnosed Diabetes N=418	Diagnosed Diabetes	Undiagnosed Prediabetes N=488	Diagnosed Prediabetes	Undiagnosed Diabetes N=472	Diagnosed Diabetes	Undiagnosed Prediabetes N=434	Diagnosed Prediabetes
Demographic Factors								
Sex								
Male	14.7	85.3	55.3	44.7	14.0	86.0	55.3	44.7
Female	13.6	86.4	51.9	48.1	9.8	90.2	62.8	37.2
Age							p=0.000	
44years or younger	21.5	78.5	60.9	39.1	12.5	87.5	76.9	23.1
45-64 years	12.0	88.0	49.6	50.4	12.2	87.8	59.1	40.9
65years or older	10.7	89.3	50.0	50.0	10.7	89.3	42.5	57.5
Marital status								
Married	15.1	84.9	54.9	45.1	12.8	87.2	64.3	35.7
Single	11.3	88.7	48.2	51.8	7.1	92.9	55.0	45.0
Birth country			p=0.041				p=0.002	
U.S.	10.5	89.5	44.4	55.6	8.7	91.3	47.1	52.9
Mexico	14.8	85.2	55.3	44.7	11.4	88.6	65.1	34.9
Social-economic Factors								
Education	p=0.028							
Middle school or less	10.7	89.3	50.0	50	8.5	91.5	56.6	43.4
High school grad or some	19.9	80.1	53.8	46.2	15.2	84.8	65.5	34.5
College (3or4 years)	9.6	90.4	60.3	39.7	8.2	91.8	68.6	31.4
Employment							p=0.028	
Employed & self-employed	16.8	83.2	51.5	48.5	15.6	84.4	61.2	38.8
Unemployed & unable to work	9.3	90.7	47.7	52.3	7.0	93.0	53.3	46.7
Homemaker	14.2	85.8	57.0	43.0	10.5	89.5	69.0	31.0
Retired	13.5	86.5	52.8	47.2	8.3	91.7	50.0	50.0
Income			p=0.036				p=0.000	
Less than $10,000	14.1	85.9	47.0	53.0	9.2	90.8	50.8	49.2
$10,000 to less than $20,000	13.2	86.8	59.1	40.9	12.1	87.9	71.6	28.4
$20,000 and more	14.6	85.4	57.5	42.5	12.0	88.0	69.1	30.9
Insurance							p=0.007	

Yes	13.5	86.5	54.0	46.0	8.0	92.0	54.1	45.9
No	14.2	85.8	51.8	48.2	13.1	86.9	66.9	33.1
Baseline Health Factors								
Self-reported health condition	p=0.001						p=0.000	
Good, Very good, and excellent health	23.1	76.9	56.4	43.6	15.6	84.4	71.1	28.9
Fair	11.1	88.9	51.8	48.2	9.2	90.8	56.9	43.1
Poor	6.3	93.7	44.2	55.8	8.2	91.8	38.9	61.1
Smoking								
Nonsmoking	14.0	86.0	51.4	48.6	10.1	89.9	61.4	38.6
Former smoker	17.6	82.4	62.3	34.7	14.1	85.9	61.3	38.7
Current smoker	5.0	95.0	46.8	53.2	8.9	91.1	63.2	36.8
Drinking								
Nondrinker	13.2	86.8	53.6	46.4	9.8	90.2	62.1	37.9
Drinker	16.9	83.1	49.0	51.0	15.5	84.5	59.3	40.7
Limited by problems	p=0.017				p=0.042		p=0.000	
Yes	8.1	91.9	47.3	52.7	6.6	93.4	40.6	59.4
No	16.7	83.3	54.6	45.4	12.8	87.2	68.3	31.7
Family history of diabetes	p=0.028							
Yes	11.3	88.7	48.5	51.5	9.3	90.7	57.3	42.7
No	22.5	77.5	59.9	40.1	14.4	85.6	66.7	33.3
Unknown	13.8	86.2	57.5	42.5	16.2	83.8	70.0	30.0
Baseline BMI								
Mean	33.6	34.0	33.8	32.8	35.8	33.7	32.5	33.6
Median	32.5	32.9	32.4	31.6	34.4	32.4	31.6	32.3
Std. Deviation	6.1	8.0	7.7	6.7	7.8	7.9	6.6	6.7
Dietary and Physical Activity Factors								
Met physical activity recommendations								
No	15.5	84.5	53.1	46.9	11.5	88.5	62.9	37.1
Yes	7.8	92.2	50.6	49.4	8.1	91.9	54.8	45.2
Dietary habit							p=0.042	
Mean	30.6	31.6	29.9	30.3	30.1	31.6	29.7	30.6
Median	30.0	31.0	29.0	30.0	30.0	31.0	29.0	30.0
Std. Deviation	6.4	6.1	5.7	6.2	6.3	6.1	5.1	6.7
Baseline fruit & vegetable intake								
Mean	26.5	25.0	23.8	23.6	28.7	24.1	26.6	26.0
Median	20.3	19.8	19.3	20.0	24.5	19.3	22.0	21.5
Std. Deviation	18.2	19.2	16.9	19.9	22.0	17.3	17.7	20.5

Table 9: Results from logistic regression for both undiagnosed diabetes and undiagnosed prediabetes.

	FPG		HbA1c	
	Undiagnosed Diabetes N=418	Undiagnosed Prediabetes N=488	Undiagnosed Diabetes N=472	Undiagnosed Prediabetes N=434
Demographic Factors				
Sex ref: Male				
Female	1.222	0.790	0.850	1.142
Age ref: 44years or younger				
45-64 years	0.475 p=0.043 CI: 0.231-0.978 Wald: 4.081	0.735	1.264	0.459 p=0.007 CI: 0.261-0.805 Wald: 7.367
65years or older	0.287	0.657	0.519	0.218 p=0.001 CI: 0.088-0.540 Wald: 10.843
Marital status ref: Married				
Single	0.659	0.927	0.559	1.032
Birth country ref: U.S.				
Mexico	1.363	1.789 p=0.017 CI: 1.108-2.89 Wald: 5.653	1.605	2.163 p=0.011 CI: 1.194-3.917 Wald: 6.474
Socio-economic Factors				
Education ref: College (3or 4 years)				
Middle school or less	1.883	1.352	1.018	1.078
High school grad or some	0.740	2.547	2.240	1.396
Employment ref: Employed & self-employed				
Unemployed & unable to work	1.056	1.020	0.826	1.297
Homemaker	1.096	1.325	0.858	1.810
Retired	2.103	1.242	1.788	1.771
Income ref: $20,000 and more				
Less than $10,000	0.721	1.584	1.117	2.918
$10,000 to less than $20,000	0.753	1.301	0.898	1.702
Insurance ref: Yes				
No	0.989	0.858	1.514	1.239
Baseline Health Factors				

Self-reported health condition ref: Good, Very good, and excellent health				
Fair	0.473 p=0.025 CI: 0.245-0.911 Wald: 5.006	0.964	0.591	0.634
Poor	0.233 p=0.019 CI: 0.069-0.785 Wald: 5.526	0.760	0.536	0.650
Smoking ref: Nonsmoking				
Former smoker	1.396	1.683	1.456	1.435
Current smoker	0.271	0.929	0.922	1.205
Drinking ref: Nondrinker				
Drinker	1.272	0.741	1.272	0.692
Limited by problems ref: Yes				
No	1.487	1.353	1.945	3.144 p=0.000 CI: 1.838-5.377 Wald: 17.491
Family history of diabetes ref: Yes				
No	1.908	1.663 p=0.019 CI: 1.088-2.544 Wald: 5.508	1.581	1.513
Unknown	1.462	1.414	1.969	2.777 p=0.019 CI: 1.186-6.505 Wald: 5.534
Baseline BMI				
	0.984	1.025	1.036	0.963 p=0.041 CI: 0.928-0.998 Wald: 4.174
Dietary and Physical Activity Factors				
Met physical activity recommendations ref:No				
Yes	0.408	0.847	0.829	0.587
Dietary habit				
	0.978	0.984	0.957	0.975
Baseline fruit & vegetable frequency				

	1.008	1.001	1.018 p=0.029 CI: 1.002-1.035 Wald: 4.752	1.009

BIOGRAPHICAL SKETCH

She is ambitious to be professional in applying theoretical knowledge into practice. She completed her master degree in mathematics from the University of Texas-Pan American, Edinburg, Texas in August, 2013. During the two years in master's program, she focused on applied statistics. She obtained her bachelor's degree in Mathematics, Fuyang Normal University, Fuyang, Anhui in July, 2011. She was applying comprehensive theoretical knowledge, including mathematics and statistics, in four years' study.

Being a teaching assistant in math department in UTPA for two years, she got good grades in teaching evaluations. She taught Math 1334, intermediate algebra for three sections, and Math 1340, college algebra for one section. The greatest success in her teaching experiences is her encouragement to the students to become confident in math studies. She worked as a research assistant with Dr. Xiaohui Wang in June, 2013. She concentrated on applied statistics in public health. Besides, she made several presentations with regard to the participant dropout in prevention education program among Hispanics. She can be contacted via email: caotangr@gmail.com.