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EXAMINATION OF DIETARY HABITS AND FRUIT AND VEGETABLE INTAKE IN A CHRONIC DISEASE PROGRAM

A Thesis

by

QIAN KUANG

Submitted to the Graduate School of the
University of Texas-Pan American
In partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

August 2013

Major Subject: Biology

EXAMINATION OF DIETARY HABITS AND FRUIT AND VEGETABLE INTAKE IN A CHRONIC DISEASE PROGRAM

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August 2013

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ABSTRACT

Kuang, Qian, Examination of Dietary Habits and Fruit and Vegetable Intake in a Chronic Disease Program. Master of Science (MS), August, 2013, 37 pp., 10 tables, 24 references, 20 titles.

The AHB program is a chronic disease prevention program which provides resources for community health centers along the U.S.-Mexico border. Healthy dietary habits and fruit/ vegetable intake play important roles in maintaining human health. Eight factors were used to evaluate the success of the AHB program. Another twenty factors were considered to predict dietary habits and fruit/vegetable intake status. Chi-square and multinomial logistic regression were used to study their correlation. Results from analysis showed that factors like birth country, employment, diabetes, baseline HbA1c, limited by problems, overall program quality, group, and program duration were correlated to the dietary habits, and factors like birth country, employment, insurance, diabetes, baseline HbA1c, the family history of diabetes, group, and program duration were correlated to the fruit/vegetable intake. This study is informative to public health workers to improve border Hispanic's health.

Key words: AHB program, Dietary habits, Fruit and vegetable intake, Hispanic

DEDICATION

The completion of my master's studies would not have been possible without the love and support of my family. My mom and my dad wholeheartedly inspired and motivated me by all means to accomplish this degree. Thank you for your love and patience.

ACKNOWLEDGMENTS

I will always be grateful to Dr. Wang, co-chair of my thesis committee, for all her mentoring and advice. From database funding, research design, and data processing, to manuscript editing, she encouraged me to complete this process through her infinite patience and guidance. My gratitude goes to my co-chair Dr. Farooqui and my thesis committee members Dr. Robert Edwards and Dr. Anxiu Kuang. Their advice, input, and comments on my thesis helped to ensure the quality of my intellectual work.

I would also like to thank my colleagues at the UTPA library who helped me locate supporting documents for my research. Also, I would like to acknowledge the many volunteers who participated in the focus group research.

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CHAPTER I

INTRODUCTION

The Alliance for a Healthy Border (AHB), a chronic disease prevention program from 2006 to 2008, provided resources for nutrition and physical activity education programs at 12 federally-qualified community health centers located along the areas of the U.S.-Mexico border in Texas, New Mexico, Arizona, and California. The goals of AHB included reducing modifiable risk factors associated with diabetes and cardiovascular disease; establishing or modifying existing prevention programs which were targeted at the Hispanic and Latino population; and identifying and promoting best practices in the prevention of these diseases. To achieve these goals, 2770 people who lived in communities located along the U.S.-Mexico border region volunteered to participate in a survey at the beginning of the intervention. The same people were called back to participate in the survey at the end of AHB program and again, at six-months after program's end. The AHB program was implemented and assessed using a pre-post-post study design (Wang et al. 2012).

Healthy dietary habits and fruit and vegetable intake play important roles in maintaining human health (Turconi et al., 2008). Lack of healthy dietary habits, smoking, and lack of regular physical activity are increasingly being viewed as at least partially responsible for many human ills, including cardiovascular disease, cancer, and diabetes (Goldberg et al., 2002). Previous research has shown that alcohol and tobacco could be risk factors that are related to the development of type 2 diabetes (Johnson et al., 2003). Previous research also showed that

smokers had less weight than nonsmokers and smokers could gain weight after quitting smoking (Wack et al., 1982). It was possible that cigarette smoking might affect glycosylation of hemoglobin, however, no studies have already proven it (Jenny et al., 2002). If women have a large waist circumference greater than 35 inches, and men's waist circumference is greater than 40 inch, the risk for type 2 diabetes, dyslipidemia, hypertension, and heart disease will increase (Wang et al., 2005). Besides smoking, other life factors like physical activity, dietary habits, fruit/vegetable intake, and self-care might affect risk factors like weight reduction, waist circumference, and glycemic control, thus having an effect on diabetes and cardiovascular disease. The results showed that physical activity improvement had a significant effect on weight reduction and glycemic control (Wang et al., 2012). Fruits and vegetables contain an abundance of nutrition: vitamins (Vitamin A, C, and others), minerals, and cellulose. It was very important for people eating three to five different fruits and vegetables in one day because fruits and vegetables provide a lot of nutrition which is good to maintain health (Khalid et al., 2011). Vitamin A is essential for a variety of biological processes, many of which are related to growth, cellular differentiation, and cell-cell or cell-substrate interactions (Ross, 1992). In a recent study, Vitamin C can help transfer general cells into heart, brain, and bone cells (Challem, 2011). vitamin C can be used to make L-carnitine, and help our body burn fat to produce energy (Challem, 2011).Vitamin C is also needed to make collagen, and to produce several neurotransmitters like dopamine, norepinephrine, and epinephrine (Challem, 2011). Minerals help maintain physiological functions in the human body (WHO/FAO, 1998). For example, iron plays important roles in the body. It can carry oxygen from lungs to the tissue, it acts as a transport medium in the cell, and it also makes up the enzyme systems in many kinds of tissues (WHO/FAO, 1998). Dietary fiber helps reduce the chance of gastrointestinal problems such as

constipation and diarrhea by increasing the weight and size of stools and softening them (Eastwood et al., 2005). Additionally, fiber may also help decrease insulin spikes, and then reduce the risk of type 2 diabetes (Mayo Clinic Staff, 2012).

Previous research results have shown that gender, intellectual ability, self-concept, and personality may influence eating habits (Bester et al., 2004). Our dietary habits can be controlled by lifestyle, health, economic factors, and education (Alipour, 2009). Income and occupation can affect people's dietary habits, for example, people with a higher income care more about their eating, and can also eat in a better place (Alipour, 2010). It has been found that individuals with higher education and income have higher fruit/vegetable intake than people with lower education and income (Johansson and Andersen, 1998; McClelland *et al*., 1998). It was also found that age, gender, and smoking status can distinguish low and high fruit/vegetable consumers (Thompson *et al*.1999). Some research also indicated that boys eat fewer fruit/vegetable than girls and consume more soft drinks (World Health Organization, 2004).

In recent years, more statistical methods have been used to analyze categorical data, especially in the biomedical and social sciences. One of these statistical methods is Pearson's chi-squared test, which often has been used to test goodness of fit and independence. Another statistical method is multinomial logistic regression (MLR), which can analyze the relationship between two or more variables. The MLR model often has been used to predict a response variable depending on continuous and/or categorical explanatory variable. Thus, it can be used to determine the percentages of variance in the response variable which was explained by the explanatory variables. It can also be used to rank the relative importance of independent variables. In addition, it can be used to assess interaction effects and get the impact of covariate

control variables (Abdalla, 2012). In MLR model, the log odds of three or more contrasts are tested at the same time (Garson, 2009).

In this study, first I aimed to evaluate the AHB program. Weight, glycemic level, and waist circumference were three common risk factors which were used to evaluate the AHB program. These three risk factors can also be affected by some life factors such as smoking, physical activity, dietary habits, fruit/vegetable intake, and self-care. Further, the purpose of this research was also to study the factor effects on dietary habits and fruit/vegetable intake.

CHAPTER II

METHODOLOGY

2.1 Survey Instrument and Measurement

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. Survey instruments were used at the beginning of the intervention, at the end of the AHB program and at six months post of the program. Pre-and post- program dietary habits and fruit/vegetable intake status were also collected. The data from Phase I of AHB were analyzed using categorical data analysis procedures to study the research questions.

I analyzed a sample from where the majority of people were Hispanics who lived in the U.S.-Mexico border region. The independent variables were twenty predictors, which were combined into three types of factors: social-demographic factors, baseline health factors, and central-characteristic factors. The dependent variables included dietary habits and fruit/vegetable intake status at the start of the program, at the end of the program, and at six months post of the program.

For social-demographic factors, gender (male and female), age (categorized into three groups: 45 years or younger; 45 to 64 years; 65 years or old), marital status (married and single), birth country (US and Mexico), employment status (categorized into four groups: Employed or self-employed; unemployed or those unable to work; homemakers; retired), education level (categorized into three groups: Middle school or less; some high school or high school

graduation; college), income (categorized into four groups: $10,000 or less; $10,000 to less than $20,000; $20,000 to less than $30,000; $30,000 and more) and health insurance coverage status (yes: if respondents had any kind of 9 health insurance coverage e.g., private health insurance, prepaid plans such as HMOs, or government plans such as Medicare) were considered. For baseline health factors, we considered self-reported health conditions (categorized into three groups: Good, very good, and excellent health; fair; poor), BMI (normal: 18.5 <BMI<25; overweight: 25 <BMI<30; obese: BMI <30), baseline HbA1c (HbA1c<6; HbA1c>=6), smoking (nonsmoker: have not smoked at least 100 cigarettes in the entire life; former smoker: have smoked at least 100 cigarettes in the entire life, but now do not smoke at all; current smoker: have smoked at least 100 cigarettes in the entire life, and now smoke someday or everyday), family history of diabetes (categorized as "yes" if parents, siblings, and/or children have been diagnosed with diabetes), limited by problems (categorized as "yes" if respondents reported any limits in any activities because of physical, mental, or emotional problems), hypertension (categorized as "yes" if participants have been told to have high blood pressure by a doctor, nurse, or other health professional), and high cholesterol (categorized as "yes" if participants have been told to have a high blood cholesterol by a doctor, nurse, or other health professional). I also considered center/program characteristic factors which were an overall program quality (high versus low), session type (group versus individual education sessions), program duration in weeks (categorized into five groups: 5 weeks; 8 weeks; 9 weeks; 10 weeks; 12 weeks or more), and curriculum (adapted versus developed).

Dietary habits and fruit/vegetable intake improvements were categorized as failure (if participants did not meet the dietary habits and fruit/vegetable intake recommendations at the end of program or at six months post of the program), maintain (if participants met the dietary

habits and fruit/vegetable intake recommendations at baseline and maintained the same status at the end of the program or 6 months post of the program), and success (if participants met the dietary habits and fruit/vegetable intake recommendations at the end of the program or at six months post of the program while they did not at baseline). The definitions of these variables are listed in Table 1.

Table1: Definitions of eight modifiable factors status.

	Failure	Maintain	Success	Citation
Smoking	Non-smoker→ Smoker Smoker→ Still a Smoker	Non-smoker→ Non-smoker	Smoker→ Non-smoker	
Physical activity	Met PA baseline→ Didn't meet PA baseline Didn't meet PA baseline→ Didn't meet PA baseline	Met PA baseline→ Met PA baseline	Didn't meet PA baseline→ Met PA baseline	(baseline: being moderately active for at least 30 minutes 5-7 days a week, or vigorously active for at least 20 minutes 3-7 days a week) Wang et al. 2012
Dietary habits	ediet-bdiet<0	0=< ediet-bdiet<6	ediet-bdiet >=6	bdiet: diet score at the start of program ediet: diet score at the end of program Wang et al. 2012
Fruit and vegetable intake	bfvf>=35 and pefvf<35 bfvf<35 and pefvf<35	bfvf>=35 and pefvf>=35	bfvf<35 and pefvf>=35	bfvf: Baseline fruits and vegetables frequency pefvf: program end fruits and vegetables frequency Wang et al. 2012
Self-care	Selfcare didn't improve	Selfcare didn't change	Selfcare have improved	
Weight	Others except maintain and success	When 25>BMI>=18.5, BMI didn't change; when BMI>=25, BMI reduced by less than 5%	When25>BMI>=18.5, BMI achieved any weight reduction; when BMI>=25, BMI reduced by at least 5%.	Teixeira PJ et al. 2004

	Failure	Maintain	Success	Citation
Glycemic control	Others except maintain and success	hba1c>=6 and hba1c<7.1and (hba1c-ehba1c)/hba1c<0.05 and (hba1c-ehba1c)/hba1c>0; hba1c>=7.1 and hba1c<7.6 and (hba1c-ehba1c)/hba1c<0.1 and (hba1c-ehba1c)/hba1c>0; hba1c>=7.6 and (hba1c-ehba1c)/hba1c<0.15 and (hba1c-ehba1c)/hba1c>0	hba1c<6 and ehba1c<6 and hba1c=ehba1c; hba1c>=6 and hba1c<7.1 and (hba1c-ehba1c)/hba1c>=0.05; hba1c>=7.1 and hba1c<7.6 and (hba1c-ehba1c)/hba1c>=0.1; hba1c>=7.6 and (hba1c - ehba1c)/hba1c>=0.15	hba1c: The amount of HbA1c at the start of program ehba1c: The amount of HbA1c at the end of program Sarkadi A et al. 2001
Waist	Others except maintain and success	Male: waist <= 40 and ewaist <= 40 Female: waist <= 35 and ewaist <= 35	Male: waist > 40 and ewaist <= 40 Female: waist > 35 and ewaist <= 35	waist: waist score at the start of program ewaist: waist score at the end of program Wassink et al.2011

2.2 Sample

I conducted our analysis from data collected during Phase I of the Alliance for a Healthy Border (AHB), from January 2006 to December 2007. There were 2,516 participants taking baseline surveys with the program interview and outcome measurements; 1,728 completed the end-of-program interview with outcome measurements; and 1,446 finished the post-six-month interview and outcome measurements. Table 2 lists the rates of enrollment and completion by demographic factors and center characteristics. Comparing the retention rates over time, it seems reasonable to assume that data were missing completely at random. I included participants in my analysis if their data were complete for the corresponding outcome and 20 predictors. Therefore, for the end-of-program time point, data from 676 participants were used to evaluate dietary habits, and data from 708 participants were used to assess fruit/vegetable intake outcomes. For the post-6-month time point, data from 587 participants were used to evaluate dietary habits, and data from 635 participants were used to assess fruit/vegetable intake. Participants with complete

data had almost identical distributions on all outcomes and predictor variables when compared to all survey participants.

2.3 Statistical analysis

Descriptive statistics were reported for measurements in the survey to get the percentages of all variables. Secondly, I explored pair-wise chi-square tests to assess the association of each predictor and the corresponding outcomes at the three time points: baseline, the end of the program, and six months post of the program. Finally, multinomial logistic regression was performed to study effects of predictors on the multi-category dependent variables. All of the statistical analyses were conducted using SPSS.

CHAPTER III

RESULTS

3.1 Descriptive statistics

Table 2 lists rates of enrollment and completion by twenty factors. Total N is the number of participants who had both survey and outcome measurements at that time and previous time point(s). Among the 2516 participants who took the baseline survey and complete baseline measurements, about 77.6% were female and nearly 63% have been married. 32.5% of them were employed or self-employed. 42.2% had an annual income of less than $10,000. 45.5% of the respondents had education less than high school. 68.5% of the population took a group program.

Table 2: Rates (%) of enrollment and completion by twenty factors (Total N is the number of participants who had both survey and outcome measurements at that time and previous time point(s))

	Start (N=2516)	Program end (N=1728)	6 months post (N= 1446)
Social-demographic factors			
Sex			
Male	20.7	19.0	19.2
Female	77.6	78.2	78.4
Missing	1.7	2.8	2.4
Age			
45 years or younger	37.1	34.0	31.4
45-64 years	44.2	45.5	49.0
65 years or older	18.2	19.8	19.3
Missing	0.5	0.6	0.3
Marital status			

	Start (N=2516)	Program end (N=1728)	6 months post (N= 1446)
Married	62.7	62.4	63.4
Single	33.4	32.8	31.7
Missing	3.9	4.7	4.8
Birth country			
US	19.8	19.2	20.3
Mexico	77.3	77.3	76.5
Missing	2.9	3.5	3.2
Employment			
Employed and self-employed	32.5	30.3	30.8
Unemployed and unable to work	21.1	20.2	19.4
Homemaker	34.7	36.2	36.3
Retired	10.6	11.3	11.5
Missing	1.1	2.0	1.9
Education			
Middle school or less	45.5	45.8	44.2
High school grad or some	37.8	36.2	37.6
College (3 or 4 years)	13.7	13.8	14.5
Missing	3.0	4.1	3.7
Income			
Less than$10,000	42.2	41.1	40.2
$10,000 to less than $20,000	31.1	31.7	31.7
$20,000 to less than $30,000	13.6	14.1	15.0
$30,000 and more	6.5	6.8	7.3
Missing	6.6	6.3	5.8
Insurance			
Yes	39.0	40.7	42.5
No	55.4	53.8	52.6
Missing	5.6	5.5	4.8
Central Characteristics			
Overall program quality			
High quality	20.9	15.6	11.2
Low quality	79.1	84.4	88.8
Group			
Individual	31.5	27.3	28.6
Grouped program	68.5	72.7	71.4
Program duration			
5 weeks	5.9	6.1	7.4
8 weeks	20.0	15.9	11.8

	Start (N=2516)	Program end (N=1728)	6 months post (N= 1446)
9 weeks	18.2	23.7	26.0
10 weeks	22.7	24.8	23.1
12 weeks or longer	33.3	29.6	31.7
Curriculum			
Adapted	67.8	67.1	64.9
Developed	32.2	32.9	35.1

Table 3 shows the percentages of modifiable life factors status from the start to the end of the program and from the start to 6 months post of the program. It shows that the percentage of smoking success was 4.3% from the start of the program to the end of the program, and 5.2% from the start of the program to 6 months post of the program. The percentage of physical activity success was 23.1% from the start of the program to the end of the program, and 23.0% from the start of the program to 6 months post of the program. The percentage of dietary habits success was 43.6% from the start of the program to the end of the program, and 51.1% from the start of the program to 6 months post of the program. The percentage of fruit/vegetable intake success was 24.7% from the start of the program to the end of the program, and 28.7% from the start of the program to 6 months post of the program. The percentage of self-care success was 11.2% from the start of the program to the end of the program, and 15.8% from the start of the program to 6 months post of the program.

Table 3: Percentages of modifiable life factors status from the start to the end of the program and from the start to 6 months post of the program

		From start to end	From start to post
Smoking	N success maintain failure	1685 4.3% 72.0% 23.7%	1414 5.2% 69.0% 25.8%

		From start to end	From start to post
Physical Activity	N success maintain failure	1530 23.1% 10.9% 65.9%	1285 23.0% 9.8% 67.2%
Dietary habits	N success maintain failure	1448 43.6% 6.3% 50.1%	1217 51.1% 4.4% 44.5%
Fruit/vegetable intake	N success maintain failure	1475 24.7% 14.6% 60.7%	1291 28.7% 13.1% 58.2%
Self-care	N success maintain failure	641 11.2% 77.2% 10.6%	557 15.8% 71.6% 12.6%

Table 4 shows the percentages of modifiable risk factors status from the start to the end of the program and from the start to 6 months post of the program. It shows that the percentage of weight reduction success was 16.2% from the start of the program to the end of the program, and 26.1% from the start of the program to 6 months post of the program. The percentage of Glycemic control success was 43.2% from the start of the program to the end of the program, and 46.7% from the start of the program to 6 months post of the program. The percentage of waist circumference reduction success was 9.5% from the start of the program to the end of the program, and 13.2% from the start of the program to 6 months post of the program.

Table 4: Percentages of modifiable risk factors status from the start to the end of the program and from the start to 6 months post of the program

		From start to end	From start to post
Weight	N success maintain failure	1779 16.2% 6.1% 77.7%	1504 26.1% 4.1% 69.9%

		From start to end	From start to post
Glycemic control	N success maintain failure	1578 43.2% 14.4% 42.3%	1320 46.7% 9.4% 43.9%
Waist	N success maintain failure	1723 9.5% 24.2% 66.3%	1460 13.2% 23.2% 63.6%

3.2 Pair-wise chi-square results

3.2.1 Results for dietary habits

Table 5 summarizes distributions of the 20 factors and their respective association with dietary habits outcomes. At the end of the program, for socio-demographic predictors, participants more likely to be successful were those born in Mexico. For center and program characteristic predictors, success rates were higher among participants enrolled in low quality programs and programs that lasted 9 to 10 weeks. At 6 months post of the program, for socio-demographic predictors, participants more likely to be successful were homemakers and people born in Mexico; for baseline health factors, successful participants reported normal HbA1c levels and had no limiting physical, mental, or emotional problems. In addition to this, at 6 months post of the program, for center and program characteristic predictors, success rates were higher among participants enrolled in low quality programs, the grouped program, and programs that lasted 10 weeks.

Table 5: Rates of dietary habits intake success, maintain, failure by twenty factors at the end of the program and 6 months post of the program

		Dietary habits success						
Sociodemographic	Percent	Program end (N=676)			Percent	6 months post (N =587)		
	Total	Success	maintain	failure	Total	Success	maintain	failure
Sex								
Male	18.6	45.2	33.3	21.4	17.0	45.0	33.0	22.0
Female	81.4	44.9	36.4	18.7	83.0	50.5	34.1	15.4
Age								
45 years or younger	26.0	47.7	34.1	18.2	25.6	55.3	30.0	14.7
45-64 years	53.1	44.0	38.2	17.8	53.2	47.4	36.5	16.0
65 years or older	20.9	44.0	31.9	24.1	21.3	48.0	32.0	20.0
Marital status								
Married	68.0	47.2	34.3	18.5	68.3	50.9	33.2	16.0
Single	32.0	40.3	38.9	20.8	31.7	46.8	35.5	17.7
Birth country								
US	19.5	38.6	34.8	26.5	19.3	38.9	38.9	22.1
Mexico	80.5	46.5	36.0	17.5	80.7	52.1	32.7	15.2
				P=0.049				P=0.032
Employment								
Employed and self-employed	30.8	44.2	35.6	20.2	30.7	46.7	36.7	16.7
Unemployed and unable to work	18.2	39.8	34.1	26.0	17.9	37.1	38.1	24.8
Homemaker	37.7	48.2	36.1	15.7	38.0	57.4	30.9	11.7
Retired	13.3	44.4	37.8	17.8	13.5	50.6	30.4	19.0
								P=0.014
Education								
Middle school or less	50.0	47.3	33.7	18.9	49.6	51.5	30.9	17.5
High school grad or some	35.1	44.3	37.6	18.1	34.8	50.5	34.8	14.7
College (3 or 4 years)	14.9	38.6	38.6	22.8	15.7	41.3	41.3	17.4
Income								
Less than$10,000	43.3	44.0	35.5	20.5	42.2	49.2	34.3	16.5
$10,000 to less than $20,000	33.6	43.2	40.5	16.3	33.2	48.2	33.3	18.5
$20,000 to less than $30,000	15.4	52.9	28.4	18.6	16.0	57.4	29.8	12.8
$30,000 and more	7.7	42.3	30.8	26.9	8.5	42.0	42.0	16.0
Insurance								
Yes	43.6	46.4	32.5	21.0	47.2	52.3	30.7	17.0
No	56.4	43.8	38.3	17.8	52.8	47.1	36.8	16.1

Baseline health factors	Percent	Dietary habits success						
		Program end (N=676)			6 months post (N=587)			
	Total	Success	maintain	failure	Total	Success	maintain	failure
Self-reported health condition								
Good,very good, and excellent health	37.9	48.0	34.8	17.2	40.0	49.8	36.6	13.6
Fair	50.9	41.0	37.5	21.5	49.4	49.0	33.1	17.9
Poor	11.2	52.6	31.6	15.8	10.6	51.6	27.4	21.0
Body mass index								
Normal	8.9	41.7	41.7	16.7	9.5	46.4	41.1	12.5
Overweight	31.2	39.8	35.5	24.6	31.0	46.7	35.7	17.6
Obese	59.9	48.1	35.1	16.8	59.5	51.6	31.8	16.6
Baseline HbA1c								
HbA1c < 6	40.4	48.0	35.5	16.5	41.7	55.1	33.5	11.4
HbA1c>=6	59.6	42.9	36.0	21.1	58.3	45.6	34.2	20.2
								P=0.010
Smoking								
Nonsmoker	69.7	43.1	37.6	19.3	70.0	47.4	35.8	16.8
Former smoker	20.0	51.1	29.6	19.3	19.8	57.8	29.3	12.9
Current smoker	10.4	45.7	35.7	18.6	10.2	48.3	30.0	21.7
Family history of diabetes								
With family history	66.7	43.2	36.8	20.0	67.0	47.6	34.6	17.8
Without family history	33.3	48.4	33.8	17.8	33.0	53.6	32.5	13.9
Limited by problems								
Yes	24.7	38.9	40.1	21.0	26.7	41.4	37.6	21.0
No	75.3	47.0	34.4	18.7	73.3	52.6	32.6	14.9
								P=0.045
Hypertension								
Yes	61.5	45.7	34.1	20.2	61.0	48.3	33.8	17.9
No	38.5	43.8	38.5	17.7	39.0	51.1	34.1	14.4

	Dietary habits success							
Baseline health factors	Percent		Program end (N=676)			6 months post (N=587)		
	Total	Success	maintain	failure	Total	Success	maintain	failure
High cholesterol								
Yes	66.4	44.1	37.0	18.9	64.6	50.7	31.9	17.4
No	33.6	46.7	33.5	19.8	35.4	47.6	37.5	14.9
Central Characteristics								
Overall program quality								
High quality	11.4	24.7	40.3	35.1	9.7	17.5	52.6	29.8
Low quality	88.6	47.6	35.2	17.2	90.3	53.0	31.9	15.1
				P<0.001				P<0.001
Group								
Individual	27.1	39.9	39.3	20.8	26.9	36.1	40.5	23.4
Grouped program	72.9	46.9	34.5	18.7	73.1	54.5	31.5	14.0
								P<0.001
Program duration								
5 weeks	4.9	24.2	30.3	45.5	6.3	32.4	37.8	29.7
8 weeks	11.7	35.4	41.8	22.8	10.1	33.9	42.4	23.7
9 weeks	20.3	43.1	33.6	23.4	22.7	49.6	34.6	15.8
10 weeks	27.4	46.5	37.8	15.7	27.1	56.0	31.4	12.6
12 weeks or longer	35.8	50.8	34.3	14.9	33.9	52.3	32.2	15.6
				P=0.001				P=0.042
Curriculum								
Adapted	59.3	44.9	37.9	17.2	58.9	50.9	33.5	15.6
Developed	40.7	45.1	32.7	22.2	41.1	47.7	34.4	17.8

3.2.2 Results for fruit and vegetable intake

Table 6 summarizes distributions of the twenty factors and their respective association with fruit/vegetable intake outcomes. At the end of the program, for socio-demographic predictors, participants more likely to be successful were those retired and those born in Mexico; for baseline health factors, successful participants reported no family history of diabetes. In the case for center and program characteristic predictors at the end of the program, success rates were higher among

participants enrolled in the group program and 10 weeks program. At 6 months post of the program, for socio-demographic predictors, participants more likely to be successful were those born in Mexico; for baseline health factors, successful participants reported normal HbA1c levels; for center and program characteristic predictors, success rates were higher among participants enrolled in the group program, programs that lasted 10 weeks, and adapted curriculum.

Table 6: Rates of fruit and vegetable intake success, maintain, failure by twenty factors at the end of the program and 6 months post of the program

		Fruit/ vegetable success						
Sociodemographic	Percent	Program end (N=708)			6 months post (N=635)			
	Total	Success	maintain	failure	Total	Success	maintain	failure
Sex								
Male	17.2	17.2	13.9	68.9	17.5	21.6	11.7	66.7
Female	82.8	25.4	13.8	60.8	82.5	32.3	11.8	55.9
Age								
45 years or younger	26.6	26.6	14.4	59.0	25.2	28.1	12.5	59.4
45-64 years	53.7	22.1	12.1	65.8	54.2	33.1	10.8	56.1
65 years or older	19.8	25.7	17.9	56.4	20.6	26.0	13.7	60.3
Marital status								
Married	68.2	24.4	12.6	62.9	67.7	30.2	12.6	57.2
Single	31.8	23.1	16.4	60.4	32.3	30.7	10.2	59.0
Birth country								
US	18.9	17.2	11.2	71.6	18.9	24.2	6.7	69.2
Mexico	81.1	25.6	14.5	59.9	81.1	31.8	13.0	55.1
				P=0.04				P=0.014
Employment								
Employed and self-employed	30.9	21.5	10.0	68.5	29.9	29.5	11.6	58.9
Unemployed and unable to work	17.8	15.9	17.5	66.7	17.5	24.3	11.7	64.0
Homemaker	39.1	27.8	14.4	57.8	39.7	34.5	11.5	54.0
Retired	12.1	30.2	16.3	53.5	12.9	28.0	13.4	58.5
				P=0.022				

	Fruit/ vegetable success							
Sociodemographic	Percent	Program end (N=708)			6 months post (N=635)			
	Total	Success	maintain	failure	Total	Success	maintain	failure
Education								
Middle school or less	49.9	25.5	14.2	60.3	49.4	31.2	10.8	58.0
High school grad or some	34.7	23.6	13.8	62.6	34.8	30.8	13.6	55.7
College (3 or 4 years)	15.4	20.2	12.8	67.0	15.7	27.0	11.0	62.0
Income								
Less than$10,000	42.9	22.4	15.8	61.8	42.2	29.1	13.4	57.5
$10,000 to less than $20,000	34.0	27.0	13.7	59.3	32.9	32.5	11.5	56.0
$20,000 to less than $30,000	15.7	24.3	10.8	64.9	16.7	30.2	8.5	61.3
$30,000 and more	7.3	19.2	9.6	71.2	8.2	28.8	11.5	59.6
Insurance								
Yes	43.8	26.5	17.7	55.8	46.8	33.1	15.5	51.4
No	56.2	22.1	10.8	67.1	53.2	28.0	8.6	63.4
				P=0.004				P=0.003
Baseline health factors								
Self-reported health condition								
Good,very good, and excellent health	37.9	27.2	15.7	57.1	39.4	34.8	14.4	50.8
Fair	50.4	20.4	12.9	66.7	49.9	26.5	10.4	63.1
Poor	11.7	28.9	12.0	59.0	10.7	32.4	8.8	58.8
Body mass index								
Normal	8.5	21.7	10.0	68.3	9.0	31.6	10.5	57.9
Overweight	31.4	25.7	18.9	55.4	31.2	28.8	16.2	55.1
Obese	60.2	23.5	11.7	64.8	59.8	31.1	9.7	59.2
Baseline HbA1c								
HbA1c < 6	41.0	28.3	14.5	57.2	41.6	34.8	13.6	51.5
HbA1c>=6	59.0	21.1	13.4	65.6	58.4	27.2	10.5	62.3
							P=0.026	
Smoking								
Nonsmoker	71.9	23.0	14.9	62.1	70.2	29.6	13.9	56.5
Former smoker	18.4	26.9	11.5	61.5	20.2	33.6	7.8	58.6
Current smoker	9.7	26.1	10.1	63.8	9.6	29.5	4.9	65.6

	Fruit/ vegetable success							
Sociodemographic	Percent	Program end (N=708)			6 months post (N=635)			
	Total	Success	maintain	failure	Total	Success	maintain	failure
Family history of diabetes								
With family history	67.8	24.0	11.3	64.8	67.6	29.4	10.0	60.6
Without family history	32.2	24.1	19.3	56.6	32.4	32.5	15.5	51.9
				P=0.012				
Limited by problems								
Yes	25.0	20.9	14.7	64.4	26.6	27.8	10.7	61.5
No	75.0	25.0	13.6	61.4	73.4	31.3	12.2	56.4
Hypertension								
Yes	61.6	23.6	11.7	64.7	61.3	32.1	11.3	56.6
No	38.4	24.6	17.3	58.1	38.7	27.6	12.6	59.8
High cholesterol								
Yes	67.8	24.0	14.0	62.1	66.9	32.7	12.0	55.3
No	32.2	24.1	13.6	62.3	33.1	25.7	11.4	62.9
Central Characteristics								
Overall program quality								
High quality	11.4	17.3	17.3	65.4	9.8	25.8	19.4	54.8
Low quality	88.6	24.9	13.4	61.7	90.2	30.9	11.0	58.1
Group								
Individual	29.5	18.2	9.1	72.7	27.9	24.3	4.0	71.8
Grouped program	70.5	26.5	15.8	57.7	72.1	32.8	14.8	52.4
				P=0.001				p<0.001
Program duration								
5 weeks	4.4	29.0	32.3	38.7	5.0	18.8	12.5	68.8
8 weeks	14.1	13.0	12.0	75.0	11.8	24.0	5.3	70.7
9 weeks	19.9	27.0	13.5	59.6	22.0	33.6	18.6	47.9
10 weeks	26.6	27.7	18.1	54.3	27.6	40.0	16.6	43.4
12 weeks or longer	35.0	23.4	9.3	67.3	33.5	24.4	5.6	70.0
				P<0.001				P<0.001
Curriculum								
Adapted	59.3	23.1	14.5	62.4	59.8	34.2	13.4	52.4
Developed	40.7	25.3	12.8	61.8	40.2	24.7	9.4	65.9
								P=0.003

3.3 Multinomial logistic regression results

3.3.1 Results for dietary habits

The results from logistic regressions for dietary habits are presented in Table 7. At the end of the program, the effect size for the logistic regression model with twenty hypothesized factors was 0.164, implying that the model explained 16.4% of the variation of success in dietary habits improvement. Table 8 lists that the hypothesized factors were found to jointly predict success of diet habit improvement at the end of the program (LR χ^2 (64) =104.594, p=0.001) with a correct prediction rate of 52.1%. Participants whose birth country is the U.S. were less likely to succeed in dietary habits than those born in Mexico (odds ratio [OR] =0.576) when holding other factors constant. Overweight participants were less likely to achieve dietary habit success (OR=0.555) compared to those who were obese. Controlling other factors in the model, respondents who were enrolled in the high quality program were less likely to succeed in dietary habits (OR=0.239) than those enrolled in the low quality program. Participants who took the individual based program were less likely to succeed in weight reduction than those who participated in the group based program (OR=0.244). Participants in programs that lasted 5 weeks (OR=0.077) and/or 10 weeks (OR=0.309) were less likely to succeed than those in programs that lasted 12 weeks or longer. We also found that participants who were born in the U.S. were less likely to maintain dietary habits than those born in Mexico (odds ratio [OR] =576). Participants who were employed and self-employment (OR=0.392) and/or unemployed and unable to work (OR=0.360) were less likely to maintain dietary habits than those retired. Participants in programs that lasted 5 weeks (OR=0.219) were less likely to succeed than those in programs that lasted 12 weeks or longer. At 6 months post of the program, the effect size for the multinomial logistic regression model with twenty hypothesized factors was 0.224, implying that the model explained 22.4% of the variation of

success in dietary habit improvement. Table 8 also lists that the hypothesized factors were found to jointly predict success of dietary habit improvement at 6 months post of the program (LR χ_2 (64) =127.150, p<0.001) with a correct prediction rate of 56.9%. Respondents who were enrolled in the high quality program were less likely to succeed in dietary habits (OR=0.056) than those enrolled in the low quality program. Participants who took the individual based program were less likely to succeed in weight reduction than those who participated in the group based program (OR=0.142). Participants in programs that lasted 5 weeks (OR=0.076) were less likely to succeed than those in programs that lasted 12 weeks or longer.

Table 7: Results from multinomial logistic regression for dietary habits intake at 2 time points: at the end of the program and 6 months post of the program

	Dietary habits			
	Program end (N=676)		6 months post (N =587)	
	Success	Maintain (ref: failure)	Success	Maintain(ref: failure)
Social-demographic factors				
Sex (ref: female)				
Male	1.173	1.127	0.810	0.730
Age (ref: 65 years or old)				
45 years or younger	1.197	1.500	1.125	0.652
45-64 years	1.324	1.960	1.144	1.111
Marital status (ref: single)				
Married	0.895	0.785	0.841	0.939
Birth country (ref: Mexico)				
US	0.562 CI: 0.317-0.996 Wald: 3.890	0.540 CI: 0.302-0.964 Wald:4.341	0.764	0.859
Employment (ref: Retired)				
Employed and self-employed	0.633	0.392 CI:0.153-1.001 Wald: 3.831	1.013	1.166

	Dietary habits			
	Program end (N=676)		6 months post (N =587)	
	Success	Maintain (ref: failure)	Success	Maintain(ref: failure)
Unemployed and unable to work	0.562	0.360 CI: 0.143-0.906 Wald: 4.711	0.638	0.953
Homemaker	1.020	0.648	1.754	1.490
Education (ref: College)				
Middle school or less	1.284	0.811	1.234	0.736
High school grad or some	1.132	0.908	1.239	0.916
Income (ref: $30,000 and more)				
Less than$10,000	1.794	1.656	1.723	0.837
$10,000 to less than $20,000	1.829	2.113	1.413	0.706
$20,000 to less than $30,000	1.867	1.262	1.982	0.819
Insurance (ref: No)				
Yes	1.127	0.758	1.386	0.886
Baseline health factors				
Self-reported health condition (ref: Poor)				
Good,very good, and excellent health	0.866	1.121	1.452	2.062
Fair	0.609	1.003	1.256	1.542
Body mass index (ref: Obese)				
Normal	0.734	0.959	0.984	1.548
Overweight	0.571 CI: 0.346-0.942 Wald: 4.822	0.683	1.026	1.192
Baseline HbA1c (ref: HbA1c>=6)				
HbA1c < 6	1.231	1.086	1.730	1.464
Smoking (ref: Current smoker)				
Nonsmoker	0.805	0.908	0.997	1.361
Former smoker	0.825	0.659	2.090	1.662

	Dietary habits			
	Program end (N=676)		6 months post (N =587)	
	Success	Maintain (ref: failure)	Success	Maintain(ref: failure)
Family history of diabetes (ref: Without family history)				
With family history	0.874	1.053	0.813	0.939
Limited by problems (ref: No)				
Yes	1.052	1.505	1.081	1.261
Hypertension (ref: No)				
Yes	0.926	0.700	0.932	0.925
High cholesterol (ref: No)				
Yes	1.091	1.189	1.052	0.803
Central Characteristics				
Overall program quality (ref: Low quality)				
High quality	0.210 CI: 0.080-0.548 Wald: 10.135	0.619	0.056 CI: 0.016-0.200 Wald: 19.795	0.615
Group (ref: Grouped program)				
Individual	0.27 CI: 0.124-0.590 Wald: 10.828	0.510	0.142 CI: 0.053-0.381 Wald: 15.045	0.450
Program duration (ref: 12 weeks or longer)				
5 weeks	0.077 CI: 0.024-0.253 Wald: 17.939	0.219 CI: 0.068-0.707 Wald: 6.444	0.076 CI: 0.021-0.280 Wald: 15.042	0.271
8 weeks	0.624	0.576	2.122	1.297
9 weeks	0.405	0.455	0.965	0.698
10 weeks	0.309 CI: 0.106-0.902 Wald: 4.615	0.511	0.610	0.599
Curriculum (ref: Developed)				
Adapted	1.265	1.637	0.417	0.813

Table 8: The observed and the predicted frequencies for dietary habits improvement at the end of the program and 6 months post of the program by multinomial regression

Observed (At end)	Failure	Predicted maintain	success	%correct
Failure	27	40	63	20.8
Maintain	14	107	121	44.2
Success	16	70	218	71.7
Overall %correct				52.1
Observed (At post)				
Failure	13	42	42	13.4
Maintain	11	82	106	41.2
Success	7	45	239	82.1
Overall %correct				56.9

3.3.2 Results for fruit and vegetable intake

Table 9 shows the results from multinomial logistic regression for fruit/vegetable intake at two time points: at the end of the program and 6 months post of the program. At the end of the program, the effect size for the logistic regression model with twenty hypothesized factors was 0.171, implying that the model explained 17.1% of the variation of success in fruit/vegetable intake improvement. Table 10 lists that the hypothesized factors were found to jointly predict success of fruit/vegetable intake improvement at the end of the program (LR χ_2 (64) =109.703, $p<0.001$) with a correct prediction rate of 63.6%. I found participants whose income was from $10,000 to less than $20,000 were more likely to have fruit/vegetable intake success than those whose income was $30,000 and more (OR=2.698). I also found that participants who had a family history of diabetes were less likely to maintain fruit/vegetable intake than those without a family history of diabetes (odds ratio [OR] =0.551). Participants who had hypertension were less likely to have fruit/vegetable intake maintain than those who did not have hypertension (OR=0.582). Participants in programs that lasted 5 weeks (OR=4.390) were more likely to maintain

fruit/vegetable intake than those in programs that lasted 12 weeks or longer compared to failure. At 6 months post of the program, the effect size for the logistic regression model with twenty hypothesized factors was 0.185, implying that the model explained 18.5% of the variation of success in fruits/vegetables intake improvement. Table 10 also lists that the hypothesized factors were found to jointly predict success of fruit/vegetable intake improvement at 6 months post of the program (LR χ_2 (64) =108.121, p<0.001) with a correct prediction rate of 62.2%. I found that respondents who were nonsmokers were more likely to have fruit/vegetable intake maintain (OR=3.803) than current smokers.

Table 9: Results from multinomial logistic regression for fruit/vegetable intake at two time points: at the end of the program and 6 months post of the program

	Fruit/ vegetable intake			
Sociodemographic	Program end (N=708)		6 months post (N =635)	
	Success	maintain (ref: failure)	Success	maintain (ref: failure)
Sex (ref: female)				
Male	0.597	0.907	0.635	0.712
Age (ref: 65 years or old)				
45 years or younger	1.592	1.429	1.544	1.541
45-64 years	1.038	1.012	1.732	1.195
Marital status (ref: single)				
Married	0.805	0.658	0.836	1.218
Birth country (ref: Mexico)				
US	0.641	0.821	0.805	0.633
Employment (ref: Retired)				
Employed and self-employed	0.665	0.597	1.017	0.951
Unemployed and unable to work	0.480	0.877	0.768	0.825
Homemaker	0.848	0.898	1.159	0.769

Sociodemographic	Fruit/ vegetable intake Program end (N=708)		6 months post (N =635)	
	Success	maintain (ref: failure)	Success	maintain (ref: failure)
Education (ref: College)				
Middle school or less	1.689	1.529	1.369	1.109
High school grad or some	1.253	1.269	1.008	1.175
Income (ref: $30,000 and more)				
Less than$10,000	1.841	2.559	1.366	2.773
$10,000 to less than $20,000	2.632 CI: 1.093-6.337 Wald: 4.662	2.627	1.429	1.952
$20,000 to less than $30,000	1.865	1.754	1.188	1.114
Insurance (ref: No)				
Yes	1.435	1.443	1.309	1.809
Baseline health factors				
Self-reported health condition (ref: Poor)				
Good,very good, and excellent health	0.871	1.136	1.121	1.534
Fair	0.589	0.806	0.699	0.921
Body mass index (ref: Obese)				
Normal	0.674	0.488	0.744	0.606
Overweight	1.267	1.619	0.892	1.530
Baseline HbA1c (ref: HbA1c>=6)				
HbA1c < 6	1.604	1.134	1.503	1.251
Smoking (ref: Current smoker)				
Nonsmoker	0.797	1.640	0.989	3.803 CI: 1.072- 13.489 Wald: 4.275
Former smoker	1.204	1.398	1.331	2.203

	Fruit/vegetable intake			
Baseline health factors	Program end (N=708)		6 months post (N=635)	
	Success	maintain (ref: failure)	Success	maintain (ref: failure)
Family history of diabetes (without family history)				
With family history	1.026	0.551 CI: 0.332-0.916 Wald: 5.289	0.955	0.725
Limited by problems (ref: No)				
Yes	1.071	1.344	1.081	1.263
Hypertension (ref: No)				
Yes	0.964	0.582 CI: 0.350-0.967 Wald: 4.369	1.313	1.007
High cholesterol (ref: No)				
Yes	1.079	1.101	1.455	1.191
Central Characteristics				
Overall program quality (ref: Low quality)				
High quality	0.500	1.407	0.825	2.024
Group (ref: Grouped program)				
Individual	0.805	0.661	0.875	0.364
Program duration (ref: 12 weeks or longer)				
5 weeks	2.195	4.371 CI: 1.339-14.269 Wald: 5.970	0.931	1.222
8 weeks	1.276	0.945	1.132	0.701
9 weeks	2.339	1.158	2.247	1.920
10 weeks	2.349	1.689	2.276	1.610
Curriculum (ref: Developed)				
Adapted	0.438	0.956	0.976	1.316

Table 10: The observed and the predicted frequencies for fruit/vegetable intake improvement at the end of the program and 6 months post of the program by multinomial regression

Observed (At end)	Failure	Predicted maintain	success	%correct
Failure	415	8	17	94.3
Maintain	77	9	12	9.2
Success	140	4	26	15.3
Overall %correct				63.6
Observed (At post)				
Failure	335	2	30	91.3
Maintain	54	4	17	5.3
Success	135	2	56	29.0
Overall %correct				62.2

CHAPTER IV

DISCUSSION AND CONCLUSIONS

This study evaluated the AHB program, examined factors which affected dietary habits and fruit and vegetable intake, and also observed the predictors of success in dietary habits and fruit and vegetable intake improvements at the end of the program and six months after the program. Since there is now adequate literature on why Hispanics report less engagement in dietary habits and fruit and vegetable intake and improvement, these results are useful in designing and modifying programs related to dietary habits and fruit and vegetable intake.

I found that 43.6% of participants had a dietary habits success from the start of the program to the end of the program, and 51.1% of participants succeeded from the start to 6 months after the program. I also found that 43.2% of participants succeeded in glycemic control from the start of the program to the end of the program, and 46.7% of participants succeeded from the start of the program to 6 months post of the program, indicating that the AHB program is useful to improve dietary habits and glycemic control. However, the other factors did not appear to show much improvement. For example, only 24.7% of participants have fruit and vegetable intake success from the start of the program to the end of the program, and 28.7% from start to 6 months after, indicating the AHB program still needs improvements. Therefore, it is necessary to encourage people to eat more fruits and vegetables. In general, variables associated with a more positive status at the start were more likely to have positive dietary habits and fruit and vegetable intake success. For example, participants who have normal HbA1c and no

limitation problems were more likely to have dietary habits success. Correspondingly, those people were also more likely to improve dietary habits than their counterpart groups.

For socio-demographic factors, this study showed that U.S. born people were less likely to achieve success than Mexican-born participants, probably because the majority of the participants in our sample were born in Mexico, and they were educated promoting their dietary habits and fruit/vegetable intake. In this respect, I conclude that the AHB program was useful in encouraging their improvement in dietary habits and their fruit and vegetable intake. Surprisingly, individuals with annual income from $10,000 to less than $20,000 were more likely to succeed in fruit and vegetable intake than those with an annual income of more than $30,000. I speculate that among the border Hispanic population, adults with low income had more free time to care about their health.

For baseline health factors, obese participants were more likely to succeed in dietary habits than slightly overweight people; this may be because obese groups pay more attention to their dietary habits problems, and they were educated to change by the AHB program. As the program duration was not long enough to quit smoking for participants and most of the participants were non-smokers, the results showed that non-smokers were more likely to maintain their fruit and vegetable intake than current smokers. On the other hand, it was obvious that individuals without hypertension or family history of diabetes were more likely to maintain fruit and vegetable intake, as they are already healthier.

Participants who took the group program were found to be more likely to have dietary habits success, because they could encourage and learn from each other. Participants with less program participation were less likely to have dietary habits success. With longer program duration, people had more time to change their dietary habits. On the other hand, it was a little

strange that participants who enrolled in the high quality program were less likely to succeed in their fruit and vegetable intake than those enrolled in the low quality program. The overall program quality measurements were made by the evaluation team based on assessments of the following factors: percentage of participants who completed the program and surveys at the end of the program and 6 months later, level of organization, and quality of interaction with the teams at each community health center (Wang et al. 2011). The AHB program is not exactly designed to improve fruit/vegetable intake, thus the result is a little conflicted with common sense.

In conclusion, the AHB program was successful in maintaining and improving border Hispanic health. To improve dietary habits and fruit and vegetable intake, the AHB program still needs improvements, and a better program needs to be designed. My results suggest that preventive practices can be modified according to those significant factors, especially the center characteristic factors. As I have mentioned, good dietary habits and fruit and vegetable intake can provide enough vitamins, minerals, and fibers for the body, which can decrease insulin spikes, and maintain normal physiological functions. Thus, both are beneficial for individuals to prevent diabetes and hypertension. Non-diabetes and non-hypertensive participants were shown to be more likely to improve dietary habits and fruit and vegetable intake by following the program. With continuing modifications, a program such as that used in this study could further improve the health of the border Hispanic population.

CHAPTER V

LIMITATION AND FUTURE WORK

This study is subject to three limitations. Firstly, this study was not based on a random sample. Second, there was no control group conducted during the AHB interventions. Third, missing data were deleted assuming missing by random. The possible area for future research is to design a proper AHB program through fixing the affecting factors to improve Border Hispanic people's dietary habits and fruit/vegetable intake.

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BIOGRAPHICAL SKETCH

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