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Ninety percent of the population keeps an unhealthy diet; which results in 80,000,000 with at least one type of cardiovascular disease in the US. This study aims to determine the relationship between family history of disease and quality of diet among adults and how this relationship is influenced by acculturation.

Bivariate, linear regression, mediation analysis showed that those with a family history of CVD have lower homocysteine levels when compared to those without a family history ($p < 0.001$). Also, less acculturated individuals have lower homocysteine levels than more acculturated individuals ($p < 0.01$). The association is explained in part by the 18% mediation effect found in acculturation ($p < 0.0001$). Acculturation and family history influence quality of diet among adults.

ACCULTURATION INFLUENCES THE ASSOCIATION BETWEEN
FAMILY HISTORY OF DISEASE AND QUALITY OF DIET

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CHAPTER 1

INTRODUCTION

Family history of can be used to assess risk of disease, but its applicability in the clinical and public health setting is not clear because of its complexity as an assessment tool (National Human Genome Research Institute, NIH & John Hopkins University School of Medicine, August 24-26, 2009). However, its value as part of the overall goal to family health is undeniable. Because individuals do not exist in isolation, it is the dynamic interaction with family, and surrounding environment that has the most impact on dietary health behavior.

Poor quality of diet is the underlying determinant of CVD, type II diabetes, and cancer (Hu, Manson, & Willett, 2001; Hurley et al., 2009; Kaluza, Hakansson, Brzozowska, & Wolk, 2009). Today, a total of 8% of the population (23.6 million) have type 2 diabetes (American Diabetes Association, 2009), 23% suffer from cardiovascular disease (Kavey et al., 2003) and approximately 4% are diagnosed with some type of cancer. Poor quality of diet is also associated with hypertension which can lead to other co-morbid diseases. These dietary behaviors have contributed to a total of 80,000,000 diagnosed with CVD (American Heart Association, 2008). Poor quality of diet resulting in obesity is prevalent among minority and low socioeconomic groups. Because population dynamics are changing, public health professionals have focused disease prevention practices on these groups. With increased obesity, the problem lies in that

subsequent generations are growing up with an indiscriminant increased risk of developing chronic disease.

Purpose of the Study

This study aims to determine the relationship between family history of disease and quality of diet among adults and how this relationship is influenced by acculturation.

Hypothesis 1: Family history of disease is associated with low homocysteine levels and increased fiber intake. *Hypothesis 2:* Increased acculturation is associated with higher levels of homocysteine and low fiber intake among adults.

CHAPTER 2

LITERATURE REVIEW

The Effects of Poor Quality of Diet

Research has shown that quality of diet among US Americans needs to be addressed. Data from the USDA reported that in 1999 - 2000, 74% (score: 51-80) of the population needed to improve quality of diet, 16% (score: < 51) of the population was classified as 'poor' and only 10% (score >80) of the population showed to have a good quality of diet. These poor dietary behaviors have contributed to a total of 80,000,000 diagnosed with cardiovascular disease (American Heart Association, 2008). In addition, to chronic disease, there are also a series of secondary health complications. For example, mental health is positively associated with a good quality of diet (O'Sullivan et al., 2009). On the other hand, weight gain, obesity, and type II diabetes is inversely related to obstructive sleep apnea, which ultimately form a destructive cycle. (Miller, Taveras, Rifas-Shiman, & Gillman, 2008). Quality of diet is important as early as fetal development. At 15 weeks gestation, the mother's diet directly impacts the development of the fetus as gustatory receptors are developed. Her diet will help the fetus attain greater affinity for certain receptors, salty, sweet, sour, etc. At 30 week gestation, the number of adipose cells increases one last time. Although fat cells expand and shrink throughout life in proportion to growth and development of the fetus, the number of fat cells remains constant from this point forward; therefore, at this stage the maternal diet directly determines the weight of the fetus at birth (Knittle, Timmers, Ginsberg-Fellner, Brown, &

Katz, 1979; Rosenbaum & Leibel, 1998), and acculturation (Ayala, Baquero, & Klinger, 2008; Perez-Escamilla, 2009).

Role of Homocysteine in Diet

Homocysteine, an amino acid found in blood plasma has been studied in its relationship to quality of diet and also as an independent risk factor for CVD. Studies have shown that this amino acid in the blood is associated with common CVD risk profile characteristics of smoking, high blood pressure, cholesterol, lack of exercise, males, and old age (Nygard et al., 1995; Tonstad, Refsum, & Ueland, 1997). Table 1 shows four different studies in which assessed levels of homocysteine with risk of mortality. All studies showed a similar trend in which increased risk of homocysteine levels is associated with increased risk of mortality.

Figure 1 shows results of association between history of coronary heart disease and homocysteine levels among children, stratified by race. Although association among White children indicated that homocysteine levels increase with family history of disease; results among Black children indicates that those with a history of disease have lower homocysteine levels. Nonetheless, this shows that homocysteine levels among children indicate to a trend that is differentiate among race. It is important to further determine how these relationships change with adjustments of covariates.

There are genetic and nutritional factors that influence homocysteine levels. A recessive gene trait can be passed on to cause the build up of homocysteine in blood plasma, although this is only found in 10% of the population. Specifically, the mutation

of methylenetetrahydrofolate reductase (MTHFR) will inhibit the breakdown of folate. See Figure 2. There may also be other mutations that can directly impact the normal process of the methionine-homocysteine cycle ((Humphrey, Fu, Rogers, Freeman, & Helfand, 2008; Nygard et al., 1995)). When B12, B6, and folate are insufficient in the body, high levels of homocysteine accumulate in the plasma. These insufficiencies can be as a result of mostly nutritional problems. Vitamin B6 and B12 are needed for processing carbohydrates, proteins and fats and help make blood cells. Vitamin B12 is stored in the liver. Foods that contain B12 are liver, meat, egg yolk, poultry and milk. B16 is found in liver, meat, brown rice, fish, butter, wheat germ, whole grain cereals, and soybeans. Plasma homocysteine consists of that which is protein bound, free-oxidized, and reduced in the blood. Normal levels range from 5 – 15 μ m/L, increased levels or those with moderate hyper-homocysteinemia range from 15-30 μ m/L (Humphrey et al., 2008; Nygard et al., 1995) (*Homocysteine, folic acid and cardiovascular disease*.2009). To date, accumulation of homocysteine has been associated to increased fatty deposits in the peripheral arteries thereby deteriorating the lining and promoting blood clots. Excess homocysteine in the blood plasma is related to increased risk of coronary heart disease, stroke, and peripheral vascular disease (Humphrey et al., 2008; Nygard et al., 1995).

Figure 1: Positive History Coronary Artery Disease by Homocysteine Stratified by Race
(Greenlund et al., 1999)

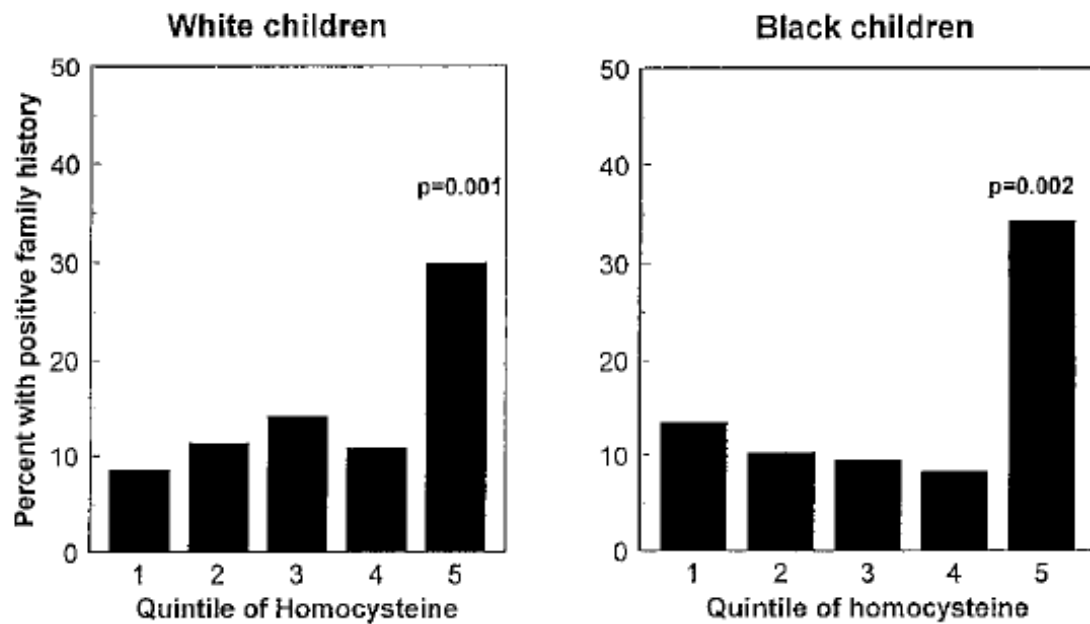


Figure 2: Biochemical Cycle Involving Homocysteine (Robinson, 2000)

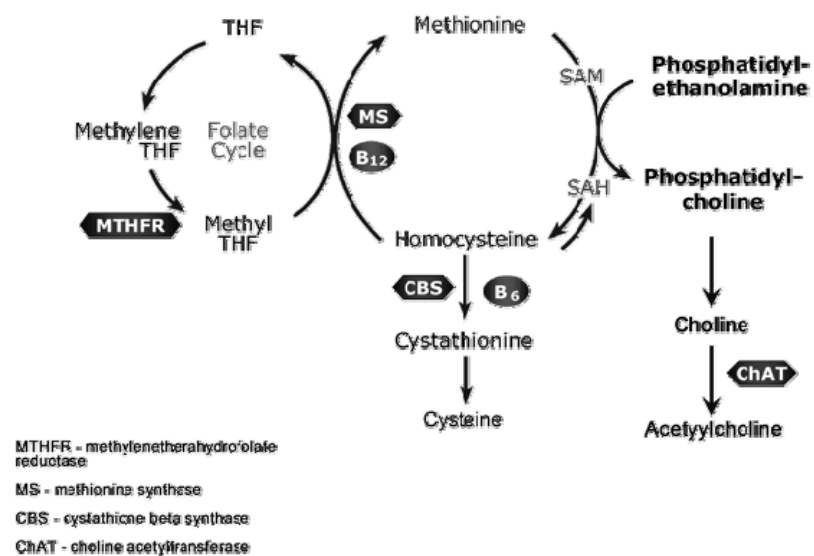


Table 1: Homocysteine and Risk for Mortality (Bostom et al., 1999; Hoogeveen et al., 2000; Kark et al., 1999; Vollset et al., 2001)

Homocysteine Level (μmol/l)	Increased Mortality Rate
1999, Bostom, USA, Framingham Study. 1,933 people age 59-91 after 10-13 years follow-up	
< 14.26	Controls
> 14.26	1.54
Adjusted for: age, sex, diabetes, smoking, BP, cholesterol.	
1999, Kark, Israel 1,788 people age ≥ 50 after 9-11 years follow-up	
≤ 8.52	Controls
11.90-14.69	1.53
≥ 14.7	1.97
Adjusted for: age, BP, plasma glucose, health status, Plasma creatinine. A SS association between plasma homocysteine and increased risk of mortality was found for all deaths, CVD, CHD, and all other causes, but not for cancer.	
2000, Hoogeveen, Netherlands 811 people age 50-70 (at entry) after 5 years follow-up	
< 14.0	Controls
> 14.0	1.34 ^{NS}
5 μmol/l increase	1.17 ^{NS}
In subjects without Type II diabetes. Adjusted for cholesterol, BP, age, sex, smoking, and albumin. From data given, it appears that if subjects > 14 were compared to subjects with < 10, there would have been a SS difference.	
2001, Vollset, Norway 4,766 people age 65-67 after a median of 4.1 years follow-up	
5.1-8.9	Controls
15.0-19.9	2.10
20.0-137	1.64
5 μmol/l increase	1.49
For those with no history of heart attack, stroke, angina, diabetes, or high BP treatment; and adjusted for total cholesterol, blood pressure, smoking, body mass index, physical activity, age, and gender.	

The Role of Fiber in Quality of Diet

The total daily fiber intake among adults is less than the recommended minimum of 25 grams (US Department of Agriculture,). Fiber is characterized into two types; water soluble and water-insoluble. Foods rich in water-insoluble fiber are vegetables, cereal grains, specifically wheat and corn. This type of fiber helps to regulate bowel movement. Dried beans, oats, barley, and some fruits and vegetables contain high levels of water-soluble fiber (Shamliyan, Jacobs, Raatz, Nordstrom, & Keenan, 2006). Of the total dietary fiber intake, approximately 80% is water-insoluble and 20% is water-soluble. Recent studies have found that water-soluble fiber is important in lowering CVD risk by lowering LDL level without affecting HDL levels. More importantly, the mean reduction LDL level of $-0.029 \mu\text{mol/L}$ ($-0.0029 \mu\text{mol/dL}$) is expected for each additional gram of water-soluble fiber in the diet. Optimal levels for LDL cholesterol are less than 100 mg/dL. Although the reduction is not extensive, it does show a direct relationship to the benefit of fiber intake. (Anderson, Randles, Kendall, & Jenkins, 2004; Shamliyan et al., 2006).

Significance of Family History

Literature shows that family history of disease is a risk factor for cancer, diabetes and CVD, which is the leading cause of overall death. CVD encompasses heart disease, stroke, heart failure, high blood pressure, and congenital cardiovascular defects. A total of 80 million people suffer from CVD. Today, approximately 21 million adults suffer from diabetes and each year another 1.5 million are diagnosed. (Center for Disease

Control and Prevention, July 21, 2009). Although the onset of these chronic conditions is noted at adulthood, family history of disease can help to identify those who are at risk and have yet to display symptoms. (Barker, 2006; Berenson et al., 1998; Labarthe, Nichaman, Harrist, Grunbaum, & Dai, 1997; Lauer, Lee, & Clarke, 1988; Li et al., 2003; McMahan et al., 2006; Raitakari et al., 2003).

The NIH has acknowledged the important role of family history of disease plays in primary care, research, genomics and public health. However, the implications of using this data as an assessment tool are still being investigated. There are many factors that must be considered if it is collected as a risk assessment tool. The number of relatives with the disease, degree of familial relationship, age at which disease began, ethnicity, and family lineage all would need to be determined. Other environmental, social and cultural conditions would also need to be considered as these also influence the disease outcome (National Human Genome Research Institute, NIH & John Hopkins University School of Medicine, August 24-26, 2009). In addition, technicalities such as when family history should be used must also be determined. Lastly, patient recommendations of how this information is transferred into disease prevention, is still under study. Literature shows that adverse outcomes of implementing a systematic family history assessment are minimal because increased familial anxiety does decrease over time (Qureshi et al., 2005).

Social and Behavioral Dynamics in Quality of Diet

Concepts within the social cognitive theory help to explain the relationship between family history and individual health. Reciprocal determinism defines that behavior is dynamic, as it is equally interacting with the persona and the environment. These interactions can result in implications that can lead to personal change, increased skill, and even environmental change. As shown in Figure 3, a person may have raised awareness as a result of a family member's disease (situation) and therefore this may have an affect on his behavior (Bandura, 1986). The family reciprocal determinism model, shown in Figure 4 is more complex in that helps to understand the details of disease in a family. It has been used as a way to explain family and health behaviors such as diet. The family context dynamics are explored under the macrocosm. For example, in the presence of disease, family dynamics shift. Family members may be negatively affected by the health consequences of the disease, which include financial constraints and the ability to take action (Bandura, 1986; Gruber & Haldeman, 2009). Studies show that caregivers can be overburdened as a result of the daily stress. In extreme cases, family members acquire increased anxiety, depression, and increased isolation (Yi, 2009). On the other hand, family members can achieve increased understanding of the disease, appreciation for life, and increased health awareness and respect for the patient. As family members learn to cope with chronic disease, they learn to interact with the environment such as primary care physicians, social workers among other health care professionals. The steps of learning to cope with an illness are vulnerability, illness appraisal, response, and adaptation (Doherty, 1991). This increased knowledge is part of

what constitutes the social environmental interactions. Emergent family characteristics are defined as the frequent interactions between members as part of the social environment. Other researchers further define these interactions as family cohesion, adaptation, or support (Bandura, 1986). This concept helps to delineate the family concept as part of the social environment. These interactions are important as they can benefit, but also cripple growth as family compensates in skills. For example, one family member may have the skills to prepare and purchase certain kinds of meal, another family member desires. Most importantly, increased knowledge through health professionals may help to raise overall health awareness.

Figure 3: Model of Reciprocal Determinism (Bandura, 1986).

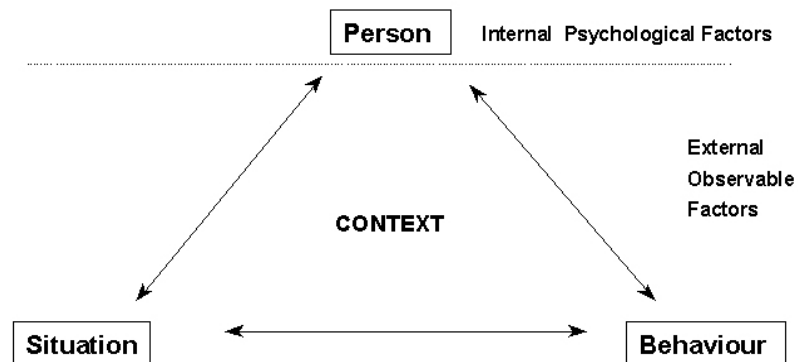
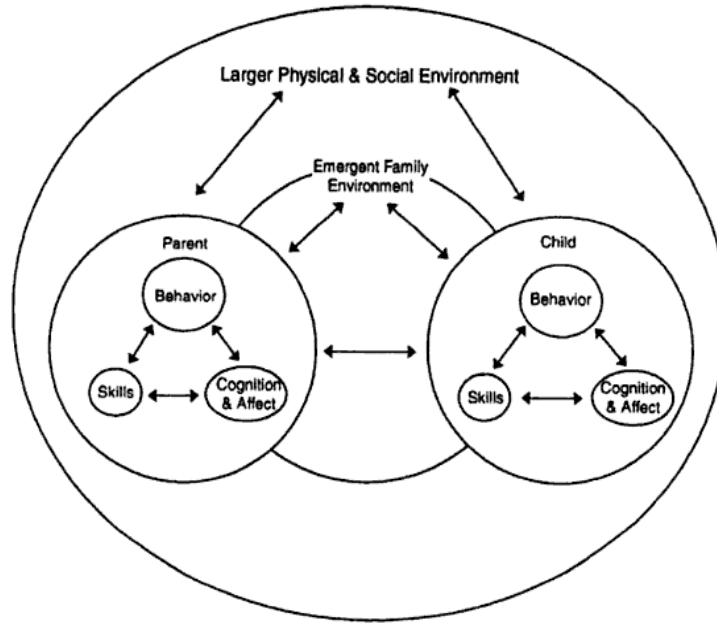


Figure 4: Model of Family Reciprocal Determinism (Gochman, 1997).



Acculturation and Quality of Diet

Acculturation is the assimilation of cultural beliefs and behaviors of dominant group and it plays a unique role in quality of diet. Studies have shown that acculturation has a positive relationship with self-perception of health; however it is also associated with chronic disease and obesity. Acculturation as measured by language is associated with increased disparities in insurance coverage, access to care, and preventative care received. However, a study found that when stratified by type of language, Spanish speakers were more likely receive preventative care, such as pap smears than women who spoke English (Derosé, Escarce, & Lurie, 2007). When stratified by race/ethnicity, research has shown that Hispanics have increased social support when compared to other groups (Reyes-Ortiz et al., 2008; Sundquist & Winkleby, 2000).

Acculturation contributes to unhealthy eating habits. Although it is a relatively new concept among researchers, acculturation is a social and behavioral component that is inversely associated with quality of diet. Studies have shown that less fruits and vegetables are consumed the longer immigrants live in the US (Angelopoulos, Kourlaba, Kondaki, Fragiadakis, & Manios, 2009). Immigrants often struggle with the availability of traditional foods in the US market; simultaneously however, they are introduced to affordable, convenient fast-food chains. Because recent immigrants are only able to obtain low-income jobs, they are more likely to find other jobs to supplement income, willing to take up odd-working hours, and end up have less time to prepare healthy meals. Ultimately, Hispanic health begins to deteriorate after approximately 10 years of living in the US; increased acculturation, results in decreased protective health factors (Ayala et al., 2008; Perez-Escamilla, 2009). Quality of diet should therefore be top priority especially among those of low SES status and acculturation. Although many studies have outlined the importance of quality of diet and made associations with various risk factors, no study has shown whether people have learned healthier eating behaviors as a result of family history of disease.

Language is an important measure of acculturation and it has been used to by other studies as a measure of ethnic identity. There is a wide variation may describe acculturation within Hispanics; socioeconomic status, country of origin, and how much contact they have with the country of origin. Studies agree that health efforts need to attend to acculturation differences by focusing on family, language, and cultural traditions (Ayala et al., 2008; Stimpson & Urrutia-Rojas, 2007) .

As youths grow into adulthood, family influence on diet is diminished. However, with age, adults gain greater understanding of their own health and of those around them. In addition, as adults learn more about their parent's health condition, this helps to create a unique familial relationship. Characteristic of immigrant families, second generations and other family members find themselves participating in the decision making process care of the parent's health (Robinson, 2000). This connection with the parent serves as the foundation for increased knowledge of any health condition.

A study compared family history and cardiovascular risk factors and odds ratio tests found that aspirin use and recent cholesterol check within the last 5 yrs were behaviors more likely found among those at moderate and high risk of CVD. These are both typical prevention behaviors that physicians suggest along with a healthy diet and regular physical activity (McCusker et al., 2004). However, more complicated behaviors such as diet, smoking habits, and physical activity were not any different from those who did not have a family history of CVD. This suggests that short, easy behavior modifications are welcomed among those with a family of CVD, but diet and physical activity behaviors are more difficult behaviors to change.

Studies have shown that those with a family history of disease already show an increased risk for these conditions. For example, a study analyzed the changes in body fat among adolescents who had a family history of cardiovascular disease. They found that groups of low SES had greater increases in BMI, waist circumference, and triceps skin fold thickness. However, no age, gender, race/ethnic difference was found (Moore, Howell, & Treiber, 2002). Nonetheless, it is important to note that health risk changes

through time as family members grows older, health status changes due to surrounding dynamic environmental factors. Therefore, continual updating of family history increases awareness of increased risk of disease. Until now, it has been readily shown that controlled diet and physical activity can prevent or delay the complications of disease (Kant, Schatzkin, Graubard, & Schairer, 2000; Kavey et al., 2003; Popkin, Siega-Riz, & Haines, 1996).

Although it does not define acculturation, long work hours with low pay, endured by low and middle class families allow little opportunity for family meals and routine physical activities. This is only part of what a growing number of low acculturated groups experience and increasing environmental determinants, unhealthy eating behaviors over the past 3 decades have resulted in 65% of adults classified as overweight or obese (Barba & Russo, 2006).

Gaps in the Literature

No studies have specified fiber and homocysteine as variables of quality of diet as they pertain to CVD. Although studies have measured homocysteine levels that are specific for Koreans, Iranians and Mediterranean adults, there are no studies that have stratified homocysteine measures by race/ethnicity that is relevant to the US such as Hispanics. Most measures of homocysteine have been stratified by gender (Diakoumopoulou et al., 2005; Fakhrzadeh et al., 2006; Lim & Heo, 2002). No studies have established how homocysteine, as a measure of quality of diet for CVD is related to

family history of disease among adults (Casanueva, Cid, Cancino, Borzone, & Cid, 2003).

In addition, although many studies have analyzed family history of disease as risk factor for disease, only one study has been found to explore the health behaviors of those with family history of disease (McCusker et al., 2004). This study did not find a relationship between diet and history of disease; however, they did find a positive association between increased motivation and family history of CVD.

Family history of disease is information that is readily obtained in the healthcare setting. However, there is still much debate as to the type of information that is obtained and how it will be used. The public health significance is evident, however, no studies that have addressed whether patients use this information as a way to dictate their diet.

Lastly, the US population is made up of various race/ethnicities, therefore, it is important to assess whether there are any health disparities among those with a history of CVD. A systematic review found a difference of acculturation when related to diet (Ayala et al., 2008). It has been found that people who are foreign born are more likely to consume fruits, high-fiber foods, and eat less snacks and desserts (Duffey, Gordon-Larsen, Ayala, & Popkin, 2008). Recently, studies urge that communication efforts should focus on family while attending to language and acculturation (Elder, Ayala, Parra-Medina, & Talavera, 2009). To date, acculturation through the measure of language has not been associated as a mediator for quality of diet using homocysteine and fiber.

CHAPTER 3

METHODOLOGY

Study Aims

This study aims to determine the relationship between family history of disease and quality of diet among adults and how this relationship is influenced by acculturation.

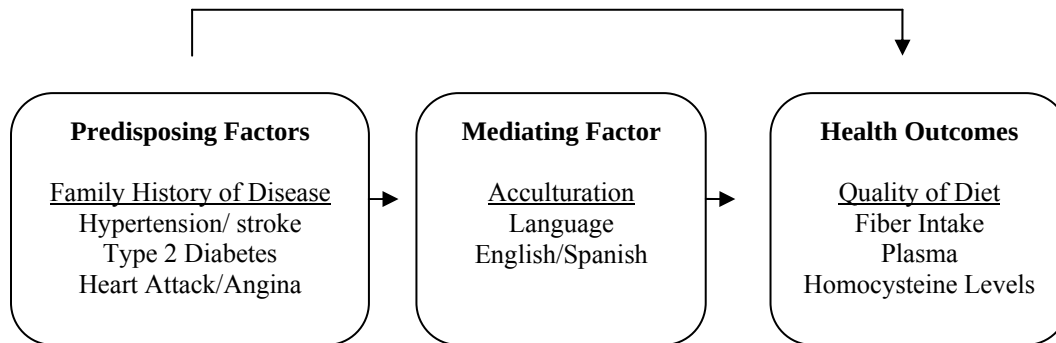
Aim 1: To determine a mechanism for healthy diet. Hypothesis 1: Family history of disease is associated with low homocysteine levels and increased fiber intake.

Hypothesis 2: Increased acculturation is associated with higher levels of homocysteine and low fiber intake among adults.

Conceptual Model

A modified version of the Andersen Model explains how the predisposing factors are related to health outcomes (Andersen, 1995). See Figure 5. Family history of disease includes hypertension/stroke, type 2 diabetes, and heart attack/angina. Upon analysis these variables are combined to form family history of CVD. This predisposing factor is associated with quality of diet as the health outcome. Quality of diet is measured by fiber intake and plasma homocysteine levels. The mediating factor, acculturation, is analyzed by the language spoken at home.

Figure 5: Conceptual Model



Sampling Methods, Data Collection and Instrumentation

This study will use secondary data collected from National Health and Nutrition Examination Surveys NHANES (1999-2004). NHANES are nationally representative, cross-sectional surveys that are conducted by the National Center for Health Statistics. The sampling design of NHANES is a stratified, multistage cluster, probability sample (Center for Disease Control and Prevention, June 02, 2009). The data from these surveys was collected through two methods, the home interview and the health examination. In the health examination section, during which blood samples were collected a mobile exam center (MEC) was used (Center for Disease Control and Prevention, July 16, 2009). The sample size for the NHANES 1999-2004 data combined is 15,332. The data is available for the public to download.

Data Measures

Outcome variables, plasma homocysteine and fiber intake levels are considered two measures of quality of diet. Homocysteine is presented as a continuous variable as $\mu\text{mol/L}$. Data in this study will be presented as means $\pm$ standard error. Dietary fiber is a parameter that is part of the dietary interview of individual foods. The data is recorded in grams and is also collected as a continuous variable.

The main predictor variable is family history of CVD and includes the following 4 parameters: 1) family history of hypertension or stroke; 2) family history of heart attack or angina; 3) family history of diabetes. For this study, these parameters were clustered into one, 4) history of any CVD. The control variables used are as follows: age, gender, race/ethnicity, education (less than high school, high school and college/graduate education), and marital status.

Acculturation is measured by the question, ‘What language is usually spoken at home? Responses available are English, Spanish and other. Responses used in the analysis were recoded to English and Spanish/other. Those in the other group represent a smaller group; however they were included as they are help to assess acculturation.

Figure 6: Predictor, Outcomes and Covariates

Main Predictor Variables	Covariates/ Mediator*	Outcome Variable
Family History of Disease ❖ Hypertension or stroke ❖ Type 2 Diabetes ❖ Heart attack/angina ❖ Any of above three	Age Gender Race/Ethnicity Education Marital Status *Language	Fiber Homocysteine

Data Analysis

Descriptive statistics, as means (SE) and percentages were used to describe the study population. Bivariate analyses using the Wald-Chi-square, the t-test or ANOVA, where appropriate, were used to test associations between the outcome variables (homocysteine and fiber) and the main predictor variables (family history of diseases). Multivariate analyses were used to test associations between the outcome variable (homocysteine and fiber) and the predictor variables (parents' history of diseases) when adjusting for other variables, such as demographics. Additional analyses was completed to assess the differences of homocysteine levels by gender, race/ethnicity.

Mediation analysis was completed to explore whether acculturation has a mediation role in the pathway for homocysteine plasma levels (Dudley, Benuzillo, & Carrico, 2004). Specifically, it was hypothesized that acculturation mediated the association between family history of disease and homocysteine plasma levels. An indirect effect estimation was completed by using a simple mediation model and tested whether the estimation of mediation due to variable mediator is statistically significant through the Sobel and Goodman's (I & II) tests, by using a SAS mixed mediation macro designed by (Jasti S, Dudley WN, & Goldwater E., 2008). The Statistical Analysis System (SAS®) for Windows Release 9.1 (The SAS Institute, Cary, NC) was used for all analyses. Significance level was set up at p-value <0.05. With the exception of the mediation analysis, all data presented was weighted.

CHAPTER 4

RESULTS

Table 2 shows the overview of the sample analyzed. Demographic information is stratified by NHANES 2 year periods. In this table it was found that approximately 50% of the sample population had a family history of diabetes. Also, the variable, history of any CVD, which includes anyone with at least one diagnosed condition (diabetes, stroke/hypertension, angina), averages to 60% of the sample population across all NHANES 2 year groups. The predictor variables, homocysteine and fiber levels remained consisted across the three 2-year periods. Homocysteine levels for our data averaged $8.9 \pm 4.7 \mu\text{m/L}$, well within the normal level range of 5 -15 $\mu\text{m/L}$. The average age of the sample is 50 years old and gender was evenly distributed. Race is distributed by 50% white, 19% Black/African American, and 27% Hispanic. The sample is made up of 53% married, and 47% not-married. Also, 43% have completed college or graduate degree, and 33% have less than a high school degree. Lastly, 75% of the sample speaks English at home and 25% speak Spanish or any other language.

Table 2: NHANES 99-04 Demographic, Predictor, and Outcome Frequencies /Means

Variables	NHANES 99-00 N(%) or Mean± SE	NHANES 01-02 N(%) or Mean± SE	NHANES 03-04 N(%) or Mean± SE	NHANES Total N(%) or Mean ± SE
Predictor Variables				
History of Diabetes				
Yes	2269 (46.5)	2608 (48.2)	2451 (48.6)	7328 (47.8)
No	2611 (53.5)	2803 (51.8)	2590 (51.4)	8004 (52.2)
History of Stroke/Hypertension				
Yes	1249 (25.6)	1541 (28.5)	1478 (29.3)	4268 (27.8)
No	3631 (74.4)	3870 (71.5)	3563 (70.7)	11064 (72.2)
History of Heart Attack/Angina				
Yes	555 (11.4)	627 (11.6)	689 (13.7)	1871 (12.2)
No	4325 (88.6)	4784 (88.4)	4352 (86.3)	13461 (87.8)
History of any of the above (CVD)				
Yes	2865 (58.7)	3336 (61.7)	3141 (62.3)	9342 (60.9)
No	2015 (41.3)	2075 (38.4)	1900 (37.7)	5990 (39.1)
Outcome Variables				
Quality of Diet				
Homocysteine ($\mu\text{m/L}$)	8.4 ± 4.7	9.0 ± 4.7	9.4 ± 4.8	8.9 ± 4.7
Fiber (g)	15.8 ± 10.9	16.1 ± 10.3	15.5 ± 9.4	15.8 ± 10.2
Demographics				
Age	50.5 ± 19.2	50.0 ± 19.5	50.85 ± 19.7	50.5 ± 19.5
Gender				
Male	2269 (46.5)	2536 (46.9)	2418 (48.0)	7223 (47.1)
Female	2611 (53.5)	2875 (53.1)	2623 (52.0)	8109 (52.9)
Race/Ethnicity				
Hispanic	1592 (32.7)	1350 (25)	1137 (22.5)	4079 (26.7)
White	2214 (45.4)	2858 (52.8)	2689 (53.3)	7761 (50.6)
Black/AA	910 (18.7)	1012 (18.7)	994 (19.7)	2916 (19.0)
Other	164 (3.4)	191 (3.5)	221 (4.4)	576 (3.8)
Covariates				
Marital Status				
Married	2442 (50.0)	3045 (56.3)	2690 (53.4)	8177 (53.3)
Not Married	2438 (50.0)	2366 (43.7)	2351 (46.6)	7155 (46.7)
Education				
< High School	1898 (39.1)	1671 (31.0)	1487 (29.6)	5056 (33.1)
High School	1097 (22.6)	1266 (23.5)	1269 (25.2)	3631 (23.8)
Col /Graduate	1863(38.4)	2458 (45.6)	2271 (45.2)	6592 (43.1)
Language Spoken at Home				
English	3437 (70.4)	4141 (76.5)	3981 (79.0)	11559 (75.4)
Other	1443 (29.6)	1270 (23.47)	1060 (21.0)	3773 (24.6)

History of any CVD includes history of diabetes, stroke/hypertension or angina

Table 3 shows the results of a bivariate analysis between family history of disease and homocysteine levels. Results showed that across the three NHANES 2-year groups, those with a family history of diabetes have lower homocysteine levels than those without history of disease. In addition, the same is true for those with a family history of stroke, angina/hypertension, and any history of CVD. Although significant values were found, they were not consistent across the table. Those with a family history of diabetes, stroke/hypertension and history of any CVD had significantly lower (p-value: <0.0001) homocysteine levels compared to those with no history of disease among the 1999-2004 NHANES 2-year group.

Table 3: Bivariate Analysis: Assessing Plasma Homocysteine by Family History of Disease

Variables	NHANES 99-00 N(%) or Mean± SE	NHANES 01-02 N(%) or Mean± SE	NHANES 03-04 N(%) or Mean± SE	NHANES Total N(%) or Mean ± SE
History of Type 2 Diabetes				
Yes	8.34 ± 0.11	8.73 ± 0.09†	9.21 ± 0.10†	8.77 ± 0.06§
No	8.48 ± 0.10	9.16 ± 0.10	9.64 ± 0.10	9.10 ± 0.06
History of Stroke/Hypertension				
Yes	8.23 ± 0.14	8.63 ± 0.13†	9.09 ± 0.13†	8.67 ± 0.07§
No	8.48 ± 0.09	9.07 ± 0.08	9.57 ± 0.09	9.05 ± 0.05
History of Angina				
Yes	7.99 ± 0.21*	8.81 ± 0.20	9.41 ± 0.19	8.80 ± 0.12
No	8.47 ± 0.08	8.96 ± 0.07	9.43 ± 0.08	8.96 ± 0.04
History of any CVD				
Yes	8.34 ± 0.09	8.77 ± 0.08‡	9.22 ± 0.08‡	8.79 ± 0.05§
No	8.52 ± 0.11	9.24 ± 0.11	9.76 ± 0.12	9.17 ± 0.07

P-values: * <0.05 † <0.01 ‡ <0.001 § <0.0001

A bivariate analysis was also conducted to assess the association between fiber and each history of disease derivative. Results on table 4 showed that although there were consisted results with history of stroke across HANES 99-00, 01-02, and NHANES

total. However, no significant association was made on any other history of diseases, including history of CVD. Bivariate analysis on fiber showed no significant association with family history of CVD, therefore, study analysis is focused on plasma homocysteine.

Table 4: Bivariate Analysis Assessing Fiber Intake by to Family History of Disease

Variables	NHANES 99-00 N(%) or Mean± SE	NHANES 01-02 N(%) or Mean± SE	NHANES 03-04 N(%) or Mean± SE	NHANES Total N(%) or Mean ± SE
History of Type 2 Diabetes				
Yes	15.79 ± 0.24	16.02 ± 0.21	15.39 ± 0.20	15.74 ± 0.13
No	15.88 ± 0.23	16.08 ± 0.21	15.50 ± 0.20	15.82 ± 0.12
History of Stroke/Hypertension				
Yes	15.25 ± 0.33*	15.03 ± 0.27§	15.16 ± 0.26	15.14 ± 0.17§
No	16.04 ± 0.19	16.47 ± 0.18	15.57 ± 0.17	16.04 ± 0.10
History of Angina				
Yes	15.60 ± 0.49	15.46 ± 0.43	14.77 ± 0.38	15.25 ± 0.25*
No	15.87 ± 0.18	16.13 ± 0.16	15.56 ± 0.15	15.86 ± 0.09
History of any CVD				
Yes	15.70 ± 0.22	15.96 ± 0.18	15.46 ± 0.18	15.71 ± 0.11
No	16.03 ± 0.26	16.19 ± 0.24	15.42 ± 0.23	15.89 ± 0.14

P-values: * <0.05 † <0.01 ‡ <0.001 § <0.0001

Tables 5 and 6 are linear regression models to establish the association between homocysteine and history of CVD using NHANES data 99-04. Table 5 shows there is a significant association in model 1, when comparing plasma homocysteine and history of disease (p: <0.05). Those with a history of disease have lower plasma homocysteine levels than those with no history of disease. Model 2 shows that those who are less acculturated, speaking any language other than English, are more likely to have lower plasma levels than those who speak English at home. Regression analysis on model 3 shows a significant association, when both history of any CVD and language are included

at the same time to predict the plasma homocysteine levels. However, model 4 had no longer a significant association after adjusting for age, gender, race/ethnicity, education and marital status. The significance of association was lost due to the effect of the covariates. Table 6 does not show significance in any of the regression models between fiber and history of any CV disease.

Table 5: Regression Analysis of Plasma Homocysteine Levels According to Family History of CVD, NHANES 1999-2004

Variables	Model 1 β (SE)	Model 2 β (SE)	Model 3 β (SE)	Model 4 β (SE)
History of CVD				
Yes (1)	-0.22(0.08)*		-0.25 (0.09)†	0.12 (0.08)
No (0)	-		-	-
English				
Yes (1)		-	-	-
No (0)		-0.65 (0.12)§	-0.68 (0.12)§	-0.20 (0.14)

P-values: * <0.05 † <0.01 ‡ <0.001 § <0.0001 Model 4 is adjusted for age, gender, race/ethnicity, education and marital status

Table 6: Regression Analysis of Fiber Intake According to Family History of CVD, NHANES 1999-2004

Variables	Model 1 β (SE)	Model 2 β (SE)	Model 3 β (SE)	Model 4 β (SE)
History of CVD				
Yes (1)	-0.21 (0.23)		-0.12 (0.23)	0.28 (0.23)
No (0)	-	-	-	
English				
Yes (1)		-	-	-
No (0)		2.46 (0.36)	2.44 (0.37)	2.84 (0.48)

Model 4 is adjusted for age, gender, race/ethnicity and marital status

Additional analyses in Tables 7, 8 and 9 are focused on only one outcome variable, plasma homocysteine. Table 7 shows that plasma homocysteine is higher in men than in women. In addition, homocysteine levels are higher among men with no family history of CVD than those with a history of CVD. Table 8 assesses plasma homocysteine by predictor history of CVD and race/ethnicity. Among the entire population, homocysteine levels are higher among Blacks (9.61 ± 0.09 , $p= 0.001$) and lowest among Hispanics (8.44 ± 0.07 , $p= 0.001$). Among those with a history of CVD, homocysteine levels are also highest among Blacks (9.50 ± 0.11 , $p= 0.001$) and lowest among Hispanics (8.24 ± 0.07 , $p= 0.001$). Those with no history of CVD show similar results; Blacks (9.74 ± 0.13 , $p= 0.0001$) and Hispanics (8.74 ± 0.10 , $p= 0.0001$). Analysis was adjusted by age and gender

Table 7: Regression analysis of Plasma Homocysteine by Gender, NHANES 1999-2004

Gender	Total Population Mean $\pm$ SE	Family History of CVD Mean $\pm$ SE	No Family History of CVD Mean $\pm$ SE
Male, n=7,223	9.81 ± 0.05 §	9.64 ± 0.08 §	10.07 ± 0.07 §
Female, n=8,109	8.15 ± 0.05 §	8.14 ± 0.07 §	8.14 ± 0.07 §

P-values * <0.05 † <0.01 ‡ <0.001 § <0.0001 Means are adjusted by age

Table 8: Regression analysis of Plasma Homocysteine by Race/Ethnicity, NHANES 1999-2004

Race/Ethnicity	Total Population Mean $\pm$ SE	Family History of CVD Mean $\pm$ SE	No Family History of CVD Mean $\pm$ SE
Hispanics, n=4,079	8.44 ± 0.07 §	8.24 ± 0.07 §	8.74 ± 0.10 ‡
Blacks, n=2,916	9.61 ± 0.09 §	9.50 ± 0.11 §	9.74 ± 0.13 ‡
Other, n=576	9.11 ± 0.20	9.00 ± 0.28	9.32 ± 0.26
Whites, n=7,761	8.95 ± 0.05	8.79 ± 0.07	9.23 ± 0.07

Reference group: Whites P-values * <0.05 † <0.01 ‡ <0.001 § <0.0001. Means are adjusted by age and gender

Table 9 shows a regression analysis of plasma homocysteine by acculturation among Hispanics. Regression results show that compared to those who speak English at home, Spanish speakers are more likely to have lower, more protective levels of plasma homocysteine values. This analysis is adjusted by age, gender and family history of any CVD.

Table 9: Regression analysis of Plasma Homocysteine by Acculturation Level among Hispanics, NHANES 1999-2004

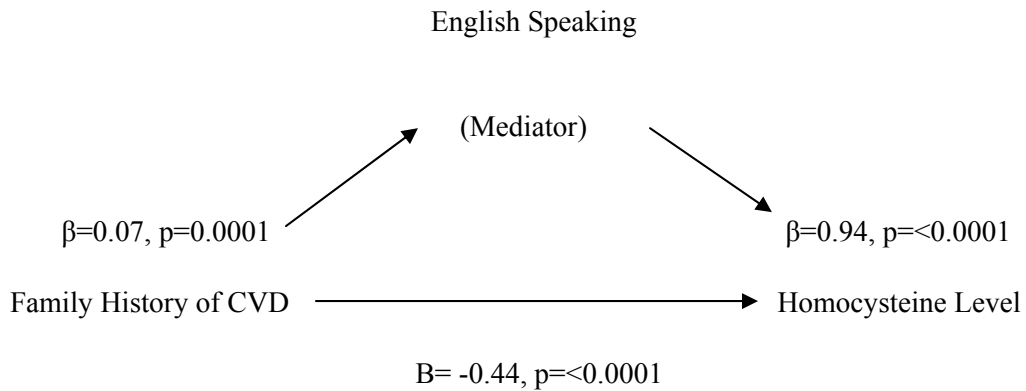
Acculturation Level	β (SE)	Mean $\pm$ SE
English n=1,753	0.00	8.36 $\pm$ 0.09
Spanish n=2,326	-0.39 (0.11) ‡	7.97 $\pm$ 0.08‡

P-values * <0.05 † <0.01 ‡ <0.001 § <0.0001 Regression analyses and means are adjusted by age, gender family history of any CV disease.

Figure 7 below presents the mediation effect of acculturation, as measured by language on the predictor and outcome variables. Before testing the total mediation effect of language, three conditions were met: 1- There was an association (or direct effect) between family history of CVD and homocysteine levels; 2- There was an association between family history of CVD and language (English speaking, the potential mediator); and 3- There was an association between English speaking (the potential mediator) and homocysteine levels. Thereafter, the relationship between family history of disease and homocysteine plasma levels was mediated (all $p < 0.0001$ for Sobel, Goodman I & II tests) by acculturation, (language). The amount of mediation or the indirect effect that is defined as the reduction or increase (synergism) of the initial predictor effect (family history of disease) on the outcome (homocysteine plasma levels) was 18.4%. In

other words, acculturation accounts for 18.4% of the association between family history of disease with homocysteine plasma levels.

Figure 7: Mediation of acculturation on the relationship between any family history of cardiovascular disease with homocysteine plasma levels among adults, NHANES 1999-2004 (n=15,332)



To test the moderator effect, a regression model included the main effects of family history of disease and acculturation plus interaction term of these effects on homocysteine plasma levels. The result did not reveal any moderator effect for family history of disease and acculturation ($p>0.05$).

CHAPTER 5

DISCUSSION

The purpose of this study was to assess the relationship between history of disease and quality of diet and whether acculturation serves as a mediator of this relationship. Using NHANES data from 1999-2004, the predictor variables family history of diabetes, heart attack/angina, hypertension /stroke into one variable called, family history of any CVD. The outcome variables identified were plasma homocysteine levels and fiber intake. Although fiber was also used to assess quality of diet, no significant association was made with family history of CVD. It may be important to consider other dietary factors and their relationship with family history of CVD for future studies.

Plasma homocysteine levels, however, did show a association with family history of CVD. However, after adjusting a list of covariates, the association was no longer significant. Even though homocysteine is a strong risk factor for CVD, those with a family history of CVD had lower levels of plasma homocysteine when compared to those without a family history of CVD.

The association may be in part explained by the 18.4% mediation effect found in acculturation. In this study, language served as mediator between family history of CVD and homocysteine. The results found in this study parallel other studies that have shown that less acculturated people are more likely to have a healthier diet, rich in fruits and vegetables that help contribute to lower levels of homocysteine (Angelopoulos et al., 2009). Because significance was lost when the model was adjusted for confounders, age,

gender, race/ethnicity and marital status other analysis will need to be completed in order to assess specifically which contribute to the association and which cause the association to break.

Today, homocysteine serves as an important assessment tool to determine the risk of CVD when symptoms are not yet present. On the other hand, family history of disease is still being assessed by researchers at NIH to determine its value as an assessment tool. Although all agree on its importance, clinicians find it difficult to implement it as it carries a variety of implication depending on the disease.

Undoubtedly, in order to understand the individual, the surrounding environment must also be studied. The social cognitive theory's concept of reciprocal determinism is a way in which the association between family history of disease and quality of diet is explained. This concept brings about the importance of encompassing multiple levels of behavioral assessment in public health. This concept not only includes the individual but also the surrounding social and physical environment. The family reciprocal determinism provides means in which the primal and habitual familial unit equally influences the individual. It is important to acknowledge that in the clinical and public health setting that family plays an important role in dietary health (Bandura, 1986; Glanz, Lewis, & Rimer B, 1997). When a family member is sick, this change in dynamic affects the entire family. The family system involves the interconnection between individuals of that family. As a consequence of disease, family cohesion, increased flexibility and communication are increased as a result. Families with diseased family members have reported improved well-being, psychological health, and positive life goals In addition;

some studies have shown that family members show increased sensitivity, empathy, personal maturation, appreciation for life (Yi, 2009). As a result of disease adaptation, health promotion from health professionals help to influence family members learned behaviors that may positively influence their health.

CHAPTER 6

LIMITATIONS

The multi-year cross sectional design of the NHANES cannot establish a causal pathway between the variables analyzed in this study. Although language has been used as a measure of acculturation in many studies, it is a limited variable, as there are specific surveys that measure acculturation that have been tested through validity and reliability measures. Lastly, self-reported data can contribute to social desirability such as in the case of variables, fiber intake and family history of disease. This along with social desirability can cause (Reyes-Ortiz et al., 2009; Stimpson & Urrutia-Rojas, 2007).

CONCLUSION

In conclusion, family history of cardiovascular disease is associated with homocysteine levels. This shows that the families' role on diet behaviors may facilitate the consumption of healthy foods which decrease homocysteine levels in adults. Language acculturation is also associated with homocysteine levels. Less acculturated individuals (Spanish or other language rather than English) have lower homocysteine levels than more acculturated individuals (English speaking). There is a mediation effect of language acculturation on the relationship between family history of CV disease with homocysteine levels. This suggests that acculturation explains part of the effect of family history of disease on homocysteine levels. Results of this study help to encourage culture identity to keep traditional foods as a way to deter poor quality of diet. Further studies

are needed to explore how family history of disease is related to other health behaviors, and how acculturation may mediate or modify those relationships.

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