2016

Acculturation, Inflammation, and Depression Among Hispanic Adults in the United States

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Walden University
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Abstract

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Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Public Health

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Abstract

Disparities exist in the recognition and treatment of depression among Hispanics in the United States, creating a social, ethical, economic, and public health burden. This study was designed to generate an improved understanding of the causes of and/or contributors to depression within this population. It was specifically designed to 1) assess the prevalence and severity of depression among Hispanic adults in the United States relative to adults of other race/ethnicities in the United States; 2) clarify the inconsistent results in the literature concerning the relationship between acculturation and depression among Hispanic adults in the United States; and 3) fill a gap in the literature by evaluating the potential for inflammation to mediate the relationship between acculturation and depression among Hispanic adults in the United States. The biopsychosocial model was used as a theoretical foundation for this study. Data from the 2009-2010 National Health and Nutrition Examination Survey were analyzed descriptively and via logistic regression. Findings confirmed higher prevalence of depression among Hispanic adults compared with non-Hispanic White adults, and that a lower degree of acculturation was consistently associated with a decreased likelihood of depression among Hispanics. No mediating effect of inflammation on the relationship between acculturation and depression was observed. The findings from this study are intended for use by health care providers, health educators, and public health practitioners to improve depression prevention, diagnosis, and treatment opportunities within this population and to accordingly to affect positive social change.

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Dedication

In memory of my mother, Nancy Laine Marano (1946-2011)

And for my father, John Paul Marano, Jr. (1942-)

With much gratitude and love.

Acknowledgments

Many thanks to Reynolds American, Incorporated, and specifically, RAI Services Company, Department of Regulatory Oversight. Particular appreciation goes to Dr. James E. Swauger and Dr. Geoffrey M. Curtin.

Thank you to Walden University, in particular the College of Health Sciences and Dr. Loretta Cain, Dr. Wen-Hung Kuo, and Dr. Amy Thompson.

Thank you to all those who kept asking “how’s school,” “how is your dissertation,” and “are you done yet?” These individuals and these questions kept me inspired, focused, and cheered.

Much gratitude to my family, John P. Marano, Lauren A. Marano, Annie C. Potts, Ellie J. Potts, Ryan J. Potts, Griffin T. Wells, Sebastien B. Wells, and Scott T. Wells. Thank you for listening, making me laugh, opening my eyes, and for just being you. The successes in each of you are truly inspirational. Indebted thanks to Ryan J. Potts for unconditional love, unending reinforcement, and enduring encouragement and patience.

This surely would not have happened without each and all of the above support.

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Chapter 1: Introduction to the Study

Background

Disparities exist in the recognition and treatment of depression among Hispanics, the largest minority group in the United States (Alegría et al., 2008; Lewis-Fernandez, Das, Alfonso, Weissman, & Olfson, 2005; Lopez, Barrio, Kopelowicz, & Vega, 2012). Disparities in the recognition of depression among Hispanics have been attributed to a variety of causes including language differences, health literacy issues, and the use of culturally specific terms to describe poor health (Lewis-Fernandez et al., 2005). Hispanics are also less likely to access treatment for mental health issues than non-Hispanic Whites (Alegría et al., 2008; Lopez et al., 2012). This presents a social, ethical, economic, and public health burden that should be addressed through an improved understanding of the causes of and/or contributors to depression within this population (Public Health Leadership Society, 2002; Ruiz, Stowe, Brown, & Wommack, 2012). An improved understanding of the causes and/or contributors to depression within this population is necessary to enhance prevention, diagnosis, and treatment opportunities and to affect positive social change.

In the United States, the percent of Hispanic adults with major depression is 4.0%, other depression is 7.5%, and any current depression is 11.4% (Gonzalez et al., 2010). These same values among non-Hispanic White adults are lower at 3.1% (0.9 percentage points less), 4.8% (2.7 percentage points less), and 7.9% (3.5 percentage points less), respectively (Gonzalez et al., 2010). Findings from a study in the United States between 2005 and 2010 indicated an increased odds of depressive symptoms for Other Hispanics

compared with Whites (Wittayanukorn, Qian, & Hansen, 2014). An earlier meta-analysis of community based studies in the United States comparing depression among Latinos with non-Latino Whites indicated no difference in lifetime prevalence of major depressive disorder, although Latinos reported more depressive symptoms than non-Latino Whites (Menselson, Rehkopf, & Kubzansky, 2008).

Both biological and psychosocial factors have individually been empirically demonstrated to affect depression. These include:

- genetic predisposition;
- predisposition as a result of perinatal cerebral damage; predisposition as a result of childhood psychological stress;
- predisposition due to neuroticism;
- predisposition as a result of poor social status and/or poor social adjustment;
- increased incidence as a result of certain physical illness, pharmaceuticals, and toxic substances;
- association with certain structural neuroimaging findings; and
- association with precipitating stressful life events (Garcia-Toro & Aguirre, 2007; Schotte et al., 2006).

Additionally, improved depressive symptoms have been associated with biological treatments including changes in neurotransmitter activity and electrical and magnetic brain disturbances, as well as with psychosocial treatments (Garcia-Toro & Aguirre, 2007; Schotte et al., 2006). It is not clear how these biological and psychosocial factors interact, but it is logical that they would (Garcia-Toro & Aguirre, 2007).

Acculturation is a potentially significant factor in Hispanic adult depression rates. Acculturation has been defined as "a transitional process that occurs as immigrant groups gain increasing exposure to beliefs, traits, and lifestyles of the dominant culture" (Ruiz et al., 2012a, p. E1). It has also been defined as a "sociocultural process in which members of one cultural group adopt the beliefs and behaviors of another group" (Lopez-Class, Castro, Ramirez, 2011, p. 1556). Acculturation has diverse potential consequences. Siatkowski (2007) noted Hispanics experience positive changes in health care decision-making and health care practices with increased acculturation. However, increased acculturation has also been linked to an increase in risky health behaviors among Hispanics, including alcohol consumption and cigarette smoking (Siatkowski, 2007). Increased acculturation can lead to increases in social activity, comfort, and ability to function within the new culture (i.e., positive outcomes; Al-Omari & Pallikkathayil, 2008; Siatkowski, 2007).

Lower levels of acculturation among Hispanics have been associated with healthier diets (e.g., increased fiber intake and decreased fat intake; Siatkowski, 2007). However, Hispanics with lower levels of acculturation are more likely to have decreased use of preventative health care and increased self-reporting of poor health status (Siatkowski, 2007), and lack of acculturation or unsuccessful acculturation can lead to stress, psychological and social dysfunction, isolation, and confusion regarding identity (Al-Omari & Pallikkathayil, 2008). This stress and adverse effect on psychological function may lead to poor health behavior choices as well as poor mental health outcomes (Al-Omari & Pallikkathayil, 2008).

This study was designed to generate a fuller understanding of both the biological and psychosocial factors related to depression among Hispanic adults in the United States, so as to facilitate future improvements in prevention, diagnosis, and treatment within this population. This study was specifically conducted to evaluate the potential mediating effect of the biological process of inflammation on the relationship between acculturation and depression among Hispanic adults in the United States.

An association between acculturation and depression among Hispanic adults in the United States has been suggested in some studies (Driscoll & Torres; 2013; Hahn, Kim, & Chiriboga, 2011; Gomez, Miranda, & Polanco, 2011; Johnson, Carroll, Fulda, & Cardarelli, 2010; Kwag, Jang, & Chiriboga, 2012; Ruiz et al., 2012a, 2012b; Sadule-Rios, 2012; Sin, 2012; Torres, 2010), but not others (Fortner, Pekow, Dole, Markenseon, & Chasan-Taber, 2011; Green et al., 2010; Lorenzo-Blanco & Delva, 2012; Ornelas & Perreria, 2011; Robinson & Monsivais, 2011; Sánchez et al., 2014; Valencia-Garcia, Simoni, Alegría, & Takeuchi, 2012; Walker et al., 2012). In particular, available studies generally have indicated either that increased acculturation is associated with increased depression or that no statistical relationship exists. Additionally, depression has been positively associated with inflammation (Almond, 2013; Anisman, 2011; Dantzer, O'Connor, Freund, Johnson, & Kelley, 2008; Krishnadas & Cavanagh, 2012; Nemade et al., 2007; Raison & Miller, 2011). Specifically, the biological marker (biomarker) of inflammation, C-reactive protein, has been observed to be elevated among individuals with depression relative to non-depressed individuals is some analyses (Howren, Lamkin, & Suls, 2009; Kuo et al., 2005; Valkanova, Ebmeier, & Allan, 2013). No studies of

acculturation, inflammation, and depression among Hispanic adults in the United States, however, have been identified in the literature. Thus, this research was designed to address a gap in the literature concerning the potential for inflammation to mediate the relationship between acculturation and depression. Findings from this study provide data to inform opportunities for prevention, earlier diagnosis, and improved treatment of depression among Hispanic adults in the United States.

This chapter provides additional detail related to the research topic of this study. In particular, the problem statement is presented, the purpose of the study is described, and the theoretical framework applied to the study is summarized. Additionally, a description of the nature of the study, the research questions and hypotheses, relevant definitions of terms, assumptions, limitations of the study, scope and delimitations, and the significance of the study are documented herein.

Problem Statement

This study was designed to address a gap in the literature regarding the potential mediating effect of inflammation on the relationship between acculturation and depression among Hispanic adults in the United States. Study analysis controlled for potentially confounding factors including age, gender, body mass index (BMI), education level, income, and current cigarette smoking. Disparities exist in the recognition and treatment of depression among Hispanics, the largest minority group in the United States (Alegría et al., 2008; Lewis-Fernandez et al., 2005; Lopez et al., 2012). Additionally, data suggest that there is an increased prevalence of depression among Hispanic adults in the United States (Gonzalez et al., 2010). Results from some studies have suggested

increased acculturation is associated with increased depression, among Hispanic adults in the United States, although findings generally are inconsistent (Sadule-Rios, 2012).

A clear relationship between inflammation and depression has been detailed in the literature (Almond, 2013; Lopresti, Maker, Hood, & Drummond, 2014). In particular, the association between elevated levels of the biological marker of inflammation, C-reactive protein, and depression has been well documented (Howren et al., 2008; Kuo et al., 2005; Valkanova, Ebmeier, & Allan, 2013). Few studies, however, have been identified in the literature regarding the relationship of white blood cells, another biomarker of inflammation, and depression. Similarly, no studies have been identified that have evaluated whether biological markers of inflammation play a role in mediating the relationship between acculturation and depression among Hispanic adults in the United States; thus, to-date, a gap in the literature exists in this area. This situation presents a social, ethical, economic, and public health burden that should be addressed (Public Health Leadership Society, 2002; Ruiz, Stowe, Brown, & Wommack, 2012). Through a fuller understanding of the psychosocial and biological factors related to depression among Hispanic adults in the United States, a reduction in the existing disparities is possible concurrent with improved prevention, diagnosis, and treatment of depression within this population.

Purpose of the Study

There were three objective of this study. The first was to assess the prevalence and severity of depression among Hispanic adults relative to adults of other race/ethnicities in the United States. Additionally, this study intended to clarify the

inconsistent results in the literature concerning the relationship between acculturation and depression among Hispanic adults in the United States. Finally, this study filled a gap in the literature by quantitatively evaluating the potential for inflammation, specifically the biomarkers of inflammation C-reactive protein levels and white blood cells, to mediate the relationship between acculturation and depression among Hispanic adults in the United States while controlling for age, gender, BMI, education level, income, and current cigarette smoking. The findings from this research have the potential to improve depression prevention, diagnosis, and treatment opportunities within this population and to accordingly affect social change.

Research Questions and Hypotheses

1. Among adults in the United States, is there a difference in the prevalence and severity of depression among Hispanics compared with other race/ethnicities?
    - Hypothesis 1_0: In the United States, the prevalence and severity of depression is not different among Hispanic adults compared with other race/ethnicity groups.
    - Hypothesis 1_A: In the United States, the prevalence and severity of depression is greater among Hispanic adults compared with other race/ethnicity groups.
2. Among Hispanic adults in the United States, is there an association between prevalence and severity of depression and acculturation status?
    - Hypothesis 2_0: An association between acculturation and depression/depression severity does not exist among Hispanic adults in the United States.

- Hypothesis 2_A: An association between acculturation and depression/depression severity exists among Hispanic adults in the United States.

3. Among Hispanic adults in the United States, what is the effect of inflammation on the relationship between acculturation and depression?
    - Hypothesis 3_0: Among Hispanic adults in the United States, inflammation does not mediate the relationship between acculturation and depression.
    - Hypothesis 3_A: Among Hispanic adults in the United States, inflammation mediates the relationship between acculturation and depression.
4. Among Hispanic adults in the United States, what is the effect of inflammation on the relationship between acculturation and the severity of depression?
    - Hypothesis 4_0: Among Hispanic adults in the United States, inflammation does not mediate the relationship between acculturation and depression severity.
    - Hypothesis 4_A: Among Hispanic adults in the United States, inflammation mediates the relationship between acculturation and depression severity.

Theoretical Framework

The biopsychosocial model suggests that in order to appropriately understand health and illness, the biological, psychological, and social factors involved must be recognized (Borrell-Carrió, Suchman, & Epstein, 2004; Malhi et al., 2013). The biopsychosocial model was first described by Engel (1977) to address the perceived

inadequacy of the existing biomedical model, which views illness only via objectively measureable biological processes (Engel, 1977; 1980). The biopsychosocial model has been used to study diverse issues including:

- adverse pregnancy outcomes, such as preterm birth and low birth weight (Dunkel Schetter, 2011),
- bipolar disorder (Bender & Alloy, 2011),
- low back pain (Pincus et al., 2013), and
- psychosis (McCormack, Tierney, Brennan, Lawlor, & Clarke, 2014).

Because the complexity of depression can be conceptualized via a combination of biological, psychological, and social factors, the biopsychosocial model is a good foundation for understanding depression (Cattapan-Ludewig & Seifritz, 2010; Garcia-Toro & Aguirre, 2007; Leventhal & Antonuccio, 2009; Malhi et al. 2013; Schotte et al., 2006). Attempting to understand depression among Hispanic adults in the United States via predictors of acculturation, a psychosocial construct, and inflammation, a biological construct, is well bounded and grounded within the biopsychosocial model.

Nature of the Study

This study employed a quantitative, cross-sectional design and was guided by the biopsychosocial model of disease. The study and its research questions were designed to determine if statistical relationships and patterns existed between the identified variables. The purpose of this quantitative study was to understand and describe the potential for inflammation to mediate the relationship between acculturation (the independent variable) and depression (the dependent variable) among Hispanic adults in the United

States. In order to isolate the effect of acculturation and inflammation on depression, controlled variables included age, gender, BMI, education level, income, and current cigarette smoking. Data on the relevant independent (acculturation), mediating (inflammation), dependent (depression), and potentially confounding (age, gender, BMI, education level, income, and current cigarette smoking) variables were obtained via survey responses linked with biospecimen collection.

This study made use of secondary data from the 2009-2010 National Health and Nutrition Examination Survey (NHANES; Center for Disease Control and Prevention [CDC], 2014a), which included survey questions related to acculturation and depression. Acculturation was evaluated five different ways, including:

- language spoken at home (identified as the acculturation variable in NHANES),
- country of birth,
- length of time in the United States,
- language of survey, and
- citizenship status.

Depression was measured via the 9-item Patient Health Questionnaire (PHQ-9; CDC, 2011b). The PHQ-9 determines the frequency of depressive symptoms over the previous two weeks (CDC, 2011b). Responses, including “not at all,” “several days,” “more than half the days,” and “nearly every day,” were all scored and summed in the data set. The PHQ-9 has a history of reliability and has been validated in use with community samples (Kroenke & Spitzer, 2002; Kroenke,Spitzer, & William, 2001; Manea, Gilbody, McMillan, 2012; Martin, Rief, Klaiberg, & Braehler, 2006; Patten & Schopflocher, 2009;

Wittkampf, Naeije, Schene, Huyser, van Weert, 2007). Similarly, the NHANES contains data from analysis from biospecimen collection, including white blood cell counts and C-reactive protein concentrations. These biomarker of inflammation data were linked with survey responses on acculturation and depression.

Rationale for the inclusion of potentially confounding variables was based on previous findings in the literature. Evidence exists for the effect of acculturation on health behavior to differ by age and socioeconomic status (Chakraborty & Chakraborty, 2010). Additionally, evidence exists for differences between health behaviors and health outcomes by BMI and cigarette smoking status (Chakraborty & Chakraborty, 2010). Thus, age, education level, income, and current cigarette smoking, in addition to gender, were accounted for as covariates (i.e., confounding variables) in the analysis. Statistical methodologies included chi-square analyses and logistic regression.

Definitions

The following provides definitions of variables and attributes relevant to the study.

Acculturation: This study used Lopez-Class, Castro, and Ramirez's (2011) definition of acculturation as "a sociocultural process in which members of one cultural group adopts the beliefs and behaviors of another group" (p. 1556).

Biomarker: This study used Strimbu and Tavel's (2010) definition of biomarker as "…a broad subcategory of … objective indications of medical state observed from outside the patient – which can be measured accurately and reproducibly" (p. 463). Used synonymously with *biological marker*.

Current cigarette smoking: In this study, smoking cigarettes in the past five days.

C-reactive protein: A protein produced by the liver and whose concentrations of can be measured in blood; C-reactive protein levels rise when inflammation exists in the body (Teitel, 2013).

Depression: This study used Rogge's (2012) definition of clinical depression as "a mood disorder in which feelings of sadness, loss, anger, or frustration interfere with everyday life for a longer period of time".

Hispanic: This study used the U.S. Census Bureau's (2012) definition of Hispanic as a term describing a "person of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin regardless of race" (slide 2).

Inflammation: An immune system response, typically to tissue damage or infection (Punchard, Whelan, & Adcock, 2004).

White blood cells: A component of the immune system and an indication of inflammation (Dugdale, 2011). White blood cells include lymphocytes, monocytes, neutrophils, eosinophils, and basophils (Dugdale, 2011); also called leukocytes.

Assumptions

There are a few assumptions that must be considered in the context of the study conducted and documented herein. First, it was assumed that participants in the NHANES, and the sample analyzed, recalled and responded to the survey questions accurately. Secondly, it was assumed that proxy indicators of acculturation are accurate and reliable indicators of acculturation, and similarly, the PHQ-9, accurately and reliably captures depression and depression severity; there are quantitative data to support the

latter. Finally, it was assumed that the NHANES documented processes and procedures for sampling and data collection were followed.

Scope and Delimitations

This study examined the potential mediating effect of inflammation on the relationship between acculturation and depression among Hispanic adults in the United States via a cross-sectional design with statistical control for potential confounders in order to maintain internal validity. For the main research questions, specific to Hispanic adults in the United States, the sample population included self-identified Mexican Americans and self-identified Other Hispanics. Due to the probabilistic sampling methodology, these study results are generalizable to Hispanic adults in the United States generally, maximizing external validity.

Limitations

Limitations of the study include the cross-sectional design, the use of proxy indicators for measures of acculturation, the combining of All Hispanics in some analyses, and the relatively large amount of missing data related to the outcome of interest (i.e., depression). Each one of these potential limitations is further described below.

Cross-sectional study designs capture point-in-time or time-bounded information. Thus, the cross-sectional nature of the proposed study imposes a limitation insofar as conclusions regarding the direction and temporality of any identified association between the independent and dependent variables cannot be determined. Additionally, the internal validity of the study is somewhat compromised due to the cross-sectional nature of the

study design. However, control for relevant covariates upon statistical analysis has minimized some of this threat to internal validity. It is notable that in the context of research on acculturation, cross-sectional designs "fail to describe changes in values or practices occurring over time and across differing contexts and environments" (Lopez-Class et al., 2011, p. 1557), a potentially necessary component of acculturation.

Additionally, the use of the proxy indicators for acculturation may be viewed as a limitation of this study. For example, Thomson and Hoffman-Goetz (2009) have suggested that the "[u]se of … [proxy] measures without consideration of other factors may produce misleading results" (p. 988). However, New et al. (2013) have reported "[t]here is currently no gold standard measure of acculturation; several proxies exist that may assess different constructs of the multidimensional process" (p. 2386).

In some analyses, Hispanics were combined into one group (i.e., All Hispanics). Evaluating as one homogenous group the diverse subgroups of cultures considered Hispanic in the United States (e.g., Mexican, Puerto Rican, Central American, South American), may be viewed as a limitation of this study. According to Siatkowski (2007), "Hispanic culture in the United States consists of diverse subcultures, including individuals from Mexico, Central America, parts of the Caribbean (Cuba, Dominican Republic, and Puerto Rico), and most of South America" (p. 317). Thus, it may not be appropriate to group these individuals within one group deemed "Hispanics," in particular if there is a differential effect of the relationship among acculturation, inflammation, and depression by Hispanic subpopulation. Previous research on acculturation and depression has indicated differences among heterogeneous Hispanic

subpopulations (e.g., Puerto Rican, Central American, South American; Green et al., 2010; Sanchez et al., 2014), and Lara, Gamboa, Kahramanian, Morales, and Bautista (2005) have reported "important indicators of population health vary among Latinos of Mexican, Puerto Rican, Cuban, and other Latino origin or cultural heritage" (p. 368). However, others have noted that although differences likely exist across these subcultures, similarities such as language, history, and health/sickness perceptions exist (Siatkowski, 2007).

It has been noted that the largest subgroup of Hispanics in the United States is Mexicans, estimated to be 64% in 2012;

- 9% are Puerto Rican,
- 4% are Cuban,
- 4% are Salvadoran,
- 3% are Dominican,
- 2% are Guatemalan, and
- 14% are "Other" (CDC, 2014b).

According to the United States Census Bureau (2011), this "Other" category can be further stratified into

- approximately 1% of each of the following: Columbians, Spaniards, Ecuadorians, Peruvians, and Hondurans;
- less than 1% of each of the following: Argentinians, Bolivians, Chileans, Uruguayans, Venezuelans, Costa Ricans, Nicaraguans, and Panamanians; and
- approximately 7% not otherwise specified.

This study specifically investigated the research questions using the largest subpopulation of Hispanics in the United States: Mexican Americans.

Finally, an additional limitation of this study is the relatively large amount of missing data for the outcome variable of interest, depression (i.e., 44 to 66% depending on the Hispanic subgroup). Missing data have the potential to bias results (Sterne et al., 2009), which has possibly occurred in this study. Missing data also potentially lead to a loss of precision and a loss of statistical power (Sterne et al., 2009).

Significance

In an effort to improve the mental health status of Hispanic adults in the United States, it is of interest to understand the relationships between and among acculturation, inflammation, and depression, within a nationally representative sample of Hispanic adults residing in the United States. This research has attempted to resolve the conflicting findings in the literature regarding the relationship between acculturation and depression among Hispanic adults in the United States. It additionally has filled a gap in the literature regarding certain biological mechanisms (i.e., inflammation) potentially related to the relationship between acculturation and depression among Hispanic adults in the United States.

Perhaps more importantly, this research attempted to provide data to influence social change by way of improved diagnosis (e.g., via earlier identification of at-risk individuals in need of mental health assistance), as well as the development of improvements in more relevant and targeted interventions for treatment (e.g., through a better understanding of social and cultural factors that influence the outcome).

Ultimately, findings from this study have the potential to improve the mental health status of Hispanic adults within the United States and ultimately affect social change, via enhanced prevention, diagnosis, and treatment, leading to improved overall public health.

Summary

This chapter provided the background information regarding the research study, which evaluated depression prevalence, the relationship between acculturation and depression, and the potential mediating effect of inflammation on the relationship between acculturation and depression among Hispanic adults in the United States. Contextual information on acculturation and depression was presented. The inconsistency of findings regarding the relationship between acculturation and depression among Hispanic adults in the United States in the existing literature was identified along with the gap in the literature regarding a biological mechanism, specifically inflammation, potentially affecting the relationship between acculturation and depression in this population. Additionally, the problem statement clearly articulated that this research is current, relevant, and significant. The purpose of the study, including specific research questions and hypotheses were additionally documented. The biopsychosocial model, which was the foundation of the study, was introduced, and the study design, variables, and methodology were briefly described. Key definitions were provided and the study limitations were clearly defined. Finally, the significance of the study, and the potential for social change, were summarized.

The following chapter, Chapter 2, provides a fuller discussion of the biopsychosocial theory and how it relates to the specific research questions. Additionally

Chapter 2 provides a review of the published literature from 2005 to 2015 for the key constructs related to the current study including those of acculturation, depression, the relationship between acculturation and depression, and the relationship between depression and inflammation. Subsequent to Chapter 2, Chapter 3 provides a full description of the methods used in the study, including, for example, details regarding the population, sampling, procedures, the instruments used for measurement, threats to validity, and the data analysis plan.

Chapter 2: Literature Review

Introduction

This study had three objectives. The first was to assess the prevalence and severity of depression among Hispanic adults relative to adults of other race/ethnicities in the United States. The second was to clarify the inconsistent results in the literature regarding the relationship between acculturation and depression among Hispanic adults in the United States. The third was to address a gap in the literature by quantitatively evaluating the potential for inflammation to mediate the relationship between acculturation and depression among Hispanic adults in the United States.

Survey data generally have indicated that the prevalence of depression among Hispanic adults is higher than that among non-Hispanic White adults in the United States (Gonzalez et al., 2010; Reeves et al., 2011). Evidence of a relationship between acculturation and depression among Hispanic adults is mixed, with the results of some studies suggesting increased depression with increased acculturation (e.g., Torres, 2010) while other studies do not (e.g., Valencia-Garcia, Simoni, Alegría, & Takeuchi, 2012; Walker, Ruiz, Chinn, Marti, & Ricks 2012). Epidemiological findings indicate a clear positive association between depression and inflammation in most studies (Howren, Lamkin, & Suls, 2009; Kuo et al., 2005; Valkanova, Ebmeier, & Allan, 2013) but not all (Baune et al., 2012; Chocano-Bedoya et al., 2014). No studies have been identified that address the potential for inflammation to mediate the relationship between acculturation and depression among Hispanic adults in the United States. Thus, the current study provides further evidence regarding the relationships between acculturation and

depression, and additionally addresses the gap in the literature regarding the potential mediating effect of inflammation on the relationship between acculturation and depression among Hispanic adults in the United States.

This chapter defines the biopsychosocial model and describes how it applies to the current study. In addition, acculturation and depression are defined, and how these constructs have been measured is described. Results of the literature search and review related to epidemiology of depression and depression among Hispanic adults in the United States, acculturation and depression among Hispanic adults, and depression and inflammation are presented herein.

Literature Search Strategy

Literature searches were conducted via the MEDLINE with full text database and the PsychINFO database in the Walden University Library. Generally, articles were limited to those presented in English language and those with full text available via the Walden University Library or GoogleScholar. Additional publications were identified via manual review of the reference lists of relevant publications. Publications regarding the biopsychosocial model were identified via separate searches with search terms limited to "biopsychosocial theory" and "biopsychosocial model." In this case, no time or other filters or restrictions were applied, as all theoretical discussions were deemed relevant without reference to time. In order to identify available literature regarding depression among Hispanic adults in the United States, searches were restricted to review articles, published between 2005 and 2015, among adults.

Search terms included “depression” AND “Hispanic” OR “Latino” AND “United States.” Similarly, to gain a general understanding of acculturation among Hispanics, review articles, limited to adults, published between 2005 and 2015 were identified using the search terms “acculturation” AND “Hispanic” OR “Latino.” The search term “depression” was added for additional specificity. In order to identify primary literature related to acculturation and depression among Hispanics, the search terms included “acculturation” AND “depression” AND “Hispanic” OR “Latino” AND “United States” with the “review article” filter removed and limited to literature published between 2005 and 2015. In order to identify relevant publications regarding depression and inflammation, searches using the search terms “depression” AND “inflammation,” were limited to review articles, among adults, published between 2005 and 2015. Using the same filter limits, searches were conducted using the terms “depression” AND “C-reactive protein.” Searches conducted with the search terms “depression” AND “white blood cells” were conducted removing the “review article” and “adult” filters, as fewer publications were identified for this set of terms.

Theoretical Foundation

This section discusses the biopsychosocial model, which served as the theoretical foundation for this study. According to Adler (2009), it is necessary to discuss theoretical aspects of medicine and health, because "without theory practical medicine is blind, and theory of medicine without practical medicine is lame" (p. 609). Similarly, Jones, Edwards, and Gifford (2002) have noted that theoretical frameworks of health and disease provide a foundation and structure for bringing together basic science and clinical understanding to enable improved practical application. Schotte, Van Den Bossche, De Doncker, Claes, and Cosyns, (2006) have made analogous statements noting the importance of conceptual models, incorporating etiology and pathology, specific to the understanding of depression. This section discusses the biopsychosocial model as it relates to the understanding of the relationships among acculturation, inflammation, and depression within Hispanic adults in the United States.

Relevant to the biopsychosocial model, McDaniel (1995) has noted, "each biological problem has psychosocial consequences, and each psychosocial problem has biological correlates" (p. 117). The biopsychosocial model is founded in the notion that in order to appropriately understand and address health and disease, the biological, psychological, and social factors involved must be recognized and considered (Borrell-Carrió, Suchman, & Epstein, 2004; Malhi et al., 2013; Nemade , Reiss, & Dombaeck, 2007a). Thus, the biopsychosocial model provides a valuable foundation for understanding and treating diseases and disabilities (Malhi et al., 2013).

George Engel first articulated the biopsychosocial model in 1977 (Engel, 1977; Adler, 2009; Nemade et al., 2007a). This model, proposed for understanding health and illness, was conceived in response to what Engel described as limitations of the biomedical model (Engel, 1977, 1980). The following discusses criticism of the biomedical model. The biomedical model views illness only through relations with underlying measureable biological processes, and has been interpreted as not reflecting illness as it is actually experienced by individual patients (Engel, 1977; Jones et al., 2002). According to Engel (1980), "[t]he crippling flaw of the [biomedical] model is that it does not include the patient and his attributes as a person, a human being" (p. 536). Engel criticized the dualistic nature of the biomedical model, that is, the separation of body and mind, and that the biomedical model emphasized the disease "to the exclusion of the person who was suffering" (Borrell-Carrió et al., 2004, p. 577). Similarly, Engel disagreed with the reductionist view of the biomedical model, which limited explanations of illness to those that could "be objectively verified and explained at the level of cellular and molecular processes" (Borrell-Carrió et al., 2004, p. 577).

The utility of the biopsychosocial model is that is incorporates more than the biological aspects of health and illness. According to Novack et al. (2007), thoughts and emotions, which result from interpersonal and environmental interactions, bring about physiological processes that affect both good and bad health. According to the biopsychosocial model, the mind and the body are interconnected and dependent on each other, such that individuals' psychology and social situations affect physical well-being and vice versa (Nemade et al., 2007a). The biopsychosocial model links science and

humanism via a systems approach, and was developed from general systems theory. In this model, biological, psychological, behavioral, environmental, and social aspects are considered important elements of illness, health, and health care (Borrell-Carrió et al., 2004; Engel, 1977; 1980; Goodman, 1991; Jones et al., 2002; McDaniel, 1995; Novack et al., 2007; Smith, 2002).

As noted, the biopsychosocial model links science and humanism via a systems approach. In biology, systems theory suggests a hierarchy within nature, with larger and more complex units rising above the smaller and less complex units (Engel, 1980; Goodman, 1991). An individual is, at the same time, the highest of the organism hierarchy and concurrently the lowest of the social hierarchy (Engel, 1980). Each level or unit of the hierarchy (e.g., cell, organ, individual, family) is its own system, with unique characteristics, relationships, and criteria for study, and each system is a component of the higher-level system (e.g., cell is component of organ, organ is component of individual; Engel, 1980). Thus, each system is both a whole and a part, and all are interconnected (Engel, 1980). No single unit can be adequately characterized in isolation and without characterizing the system as a whole, of which each unit is a part (Engel, 1980).

The biopsychosocial model supports the relationship between psychosocial and biological dimensions of illness (Jones et al., 2002). Thus, health and illness are affected by interacting factors ranging from the genetic and cellular level to the lifestyle and social networks level, and understanding these interactions is imperative in order to understand health (Novack et al., 2007). Accordingly, given the same biological evidence of illness,

manifestation of disease may be different among individuals, depending on the patients' environmental and psychosocial experiences (Borrell-Carrió et al., 2004; Engel, 1977; Smith, 2002). A well-known example of this biological and social interaction is the graded relationship between socioeconomic status and health, with lower socioeconomic status associated with poorer health and higher socioeconomic status associated with improved health (Novack et al., 2007).

Several studies have suggested that the complexity of depression is best understood and treated via a construct combination of biological, psychological, and social factors (Cattapan-Ludewig & Seifritz, 2010; Garcia-Toro & Aguirre, 2007; Leventhal & Antonuccio, 2009; Malhi et al. 2013; Schotte et al., 2006). Acculturation, which can impose changes in values, identity, behavior, and/or language upon an individual (or group of individuals) could be accompanied by stress and/or distress (Al-Omari & Pallikkathayil, 2008; Dinh, Castro, Tein, & Kim, 2009). Stress is related to adverse physical and mental health outcomes (American Psychological Association, 2012; Cohen, Janicki-Deverts, & Miller, 2007; Hammen, 2005), as well as increased biological markers of inflammation (Black & Garbutt, 2002; Steptoe, Hamer, & Chida, 2007). There is evidence of brain-immune system interactions, with stressful experiences and affective states altering immune function in humans, and depression associated with altered immune function (Novack et al., 2007). Thus, Novack et al. (2007) have proposed psychosocial factors could affect health and disease through the biological mechanism of immune system alteration.

Additionally, there are biological and psychosocial factors that have individually been empirically demonstrated to affect depression and these factors have informed simple and reductionist theories of depression (Garcia-Toro & Aguirre, 2007; Schotte et al., 2006). These include

- genetic predisposition;
- predisposition as a result of perinatal cerebral damage;
- predisposition as a result of childhood psychological stress;
- predisposition due to neuroticism;
- predisposition as a result of poor social status and adjustment;
- increased incidence as a result of certain somatic illness, pharmaceuticals, and toxic substances;
- association with certain structural neuroimaging findings;
- association with precipitating stressful life events;
- improved depressive symptoms associated with biological treatments, including changes in neurotransmitter activity and/or electrical/magnetic brain disturbances; and
- improved depression with psychosocial treatments (Garcia-Toro & Aguirre, 2007; Schotte et al., 2006).

It is not clear how these factors interact, but it is logical that they would (Garcia-Toro & Aguirre, 2007).

According to Garcia-Toro and Aguirre (2007) and consistent with the biopsychosocial theory, “[t]he mind is inseparable from the brain in function…

cognitions and emotions…interact and modulate in a constant and reciprocal manner" (p. 685). Thus, the mind/brain is a complex, dynamic, network system, with neurons and cognitions closely interconnected and constantly interacting (Garcia-Toro & Aguirre, 2007). Schotte et al. (2006) have also reported that the mind (psychological system) and brain/body (biological system) are necessarily and irreversibly connected. Additionally, Schotte et al. (2006) have noted that simple biological or psychosocial models of depression alone do not adequately account for "the complex pathogenic process in the heterogeneous diagnostic depression groups and take too little account of developmental aspects and the reciprocal effects of biological processes and interactions between persons, environments, and symptoms" (p. 314). Biological, individual psychological, social, environmental, and stress elements should be incorporated to adequately understand depression (Schotte et al., 2006).

Nemade et al. (2007a) has summarized the importance of the biopsychosocial model in the context of understanding of health generally, and depression specifically, as follows:

> [t]he biopsychosocial model suggests, and the scientific evidence has tended to confirm, that the interdependent factors…(biological, psychological, and social factors) all end up influencing each other and feeding into each other in an interdependent way…This interdependent nature; [sic] the way that the various causes of depression affect one another; make it urgent that all factors be taken into account when attempting to form a complete explanation of depression (para. 6).

Thus, as this study intended to evaluate the potential mediating effect of inflammation (biological) upon the relationship between acculturation (psychological and social) and depression among Hispanic adults in the United States, the biopsychosocial model provided a meaningful structure and foundation. This study conformed to the mind-body connection premise of the biopsychosocial model with the intention of evaluating the combined potential effects of biological (inflammation) and psychological and social (acculturation) factors relevant to depression.

Literature Review Related to Key Variables and Concepts

The following section provides a discussion related to acculturation, depression, and inflammation based on a review and synthesis of the peer-reviewed literature published between 2005 and 2015. Herein, acculturation and depression are defined, and how these constructs have previously been measured is documented. Additionally, a review and synthesis of the available literature, regarding evaluations of an association between acculturation and depression among Hispanic adults in the United States is presented. Similarly, a summary of the available literature published between 2005 and 2015 and discussing the relationship between inflammation and depression is presented.

Acculturation Defined

Acculturation has been defined different ways in peer-reviewed literature. Acculturation has been described as:

- "the process by which individuals adopt the attitudes, values, customs, beliefs, and behaviors of another culture" (Abraído-Lanza, Armbrister, Flórez, & Aguirre, 2006, p. 1342);

- “the process of change occurring when a group of people from one culture experience continuous contact with another culture” (Al-Omari & Pallikkathayil, 2008, p. 127);
- “the process of social and psychological exchange that takes place when there are ongoing encounters between individuals of different cultures, with subsequent changes in either or both groups” (Caplan, 2007, p. 94);
- “a process of changes of cultural features that occurs as a result of continuous contact between two or more groups;” “adoption of some specific features of one culture by a different cultural group” (Chakraborty & Chakraborty, 2010, p. 1180);
- “the ongoing process of modification of the culture of a group as the result of contact with another cultural group” (Flaskerud, 2007, p. 543); “the acquisition of the cultural elements of the dominant society – language, food choice, dress, music, sports, etc.” (Lara, Gamboa, Kahramanian, Morales, & Bautista, 2005, p. 369);
- “a sociocultural process in which members of one cultural group adopt the beliefs and behaviors of another group” (Lopez-Class, Castro, Ramirez, 2011, p. 1556); “changes that result from sustained contact between two distinct cultures” (Matsudaira, 2006);
- “changes that take place as a result of contact with culturally dissimilar people, groups, and social influences…most often studied in individuals living in

countries of regions other than where they were born" (Schwartz, Unger, Zamboanga, & Szapocznik, 2010, p. 237); and

- "behavioral and value changes that occur when individuals of an ethnic group consistently interact with individuals from another ethnic group" (Siatkowski, 2007, p. 318).

Thus, behavior, culture, and value changes, noted here and that occur with acculturation, and which can occur at the both the individual and group levels, include different language, beliefs, values, attitudes, behaviors (including health behaviors), identities, customs, social structure, social norms, social climate, economic base, and political structure (Al-Omari & Pallikkathayil, 2008; Matsudaira, 2006).

Acculturation has been conceptualized as unidimensional, bidimensional, and multidimensional, which is reflected in the various definitions identified in the literature (Buscemi, 2011; Lara, Gamboa, Kahramanian, Morales, & Bautista, 2005; Siatkowski, 2007; Thompson & Hoffman-Geotz, 2009). Unidimensional definitions conceptualize acculturation on a linear continuum from not at all acculturated (i.e., maintaining the culture of origin) to fully acculturated (i.e., complete adoption of the new culture; Lara et al., 2005). Thus, within the unidimensional construct, as an individual becomes acculturated into the new culture, the culture of origin is lost (Lara et al., 2005, p. 370). Unidimensional definitions of acculturation skew towards the notion of assimilation (Lara et al., 2005).

Within the bidimensional definition of acculturation, adapting to a new culture is not dependent on maintaining the culture of origin (Lara et al., 2005, p. 370). The notion

of acculturation as bidimensional places more emphasis on the concept of integration or biculturalism, where individuals are comfortable in both the culture of origin and the new culture, including recognizing the values, respecting the norms of, and identifying with both cultures (Lara et al., 2005). Under the bidimensional model of acculturation, four acculturation strategies or categories have been suggested that include: assimilation (discards culture of origin, adopts new culture), separation (keeps culture of origin, rejects new culture), integration/biculturalism (keeps culture of origin, adopts new culture), and marginalization (rejects both culture of origin and new culture; Al-Omari and Pallikkathayil, 2008; Lara et al., 2005; Lopez-Class, Castro, Ramirez, 2011; Matsudaira, 2006; Schwartz et al., 2010; Siatkowski, 2007; Thompson & Hoffman-Goetz, 2009). Of note, there is evidence to suggest that integration/biculturalism is associated with the best psychosocial outcomes (e.g., higher self-esteem, lower depression; Schwartz et al., 2010). It should be noted that biculturalism does not necessarily equate with the equal distribution of preference for new and old culture within an individual (Lara et al., 2005).

More recently, acculturation has been viewed as multidimensional (Lopez-Class et al., 2011). Thus, Lopez-Class et al., (2011) have noted that "[t]he acculturation experience is dynamic, multifaceted and complex" (p. 1560). Within the context of multidimensional acculturation, individuals and groups may adjust, adapt, and change in the new cultural environment within multiple areas such as language, socioeconomic position, and/or cultural orientation (i.e., values and attitudes; Lopez-Class et al., 2011).

In the bi- and multidimensional constructs, acculturation is defined by two separate processes, which include maintaining the culture of origin and incorporating recognition of the new culture (Thompson & Hoffman-Goetz, 2009). Thus, acculturation is distinct from the notion of assimilation, within which the culture of origin is lost and there is a complete adoption of the new culture (Al-Omari & Pallikkathayil, 2008; Flaskerud, 2007, p. 543). With (bi- and multidimensional) acculturation, a distinction between the culture of origin and the new culture is maintained (Chakraborty & Chakraborty, 2010). That is, an individual gains the ability to operate in the new and dominant culture, although the values, beliefs, and language of the individual's original culture might also be retained (Flaskerud, 2007; Matsudaira, 2006; Siatkowski, 2007). Acculturation does not necessitate a complete rejection of an individual's culture of origin, but rather individuals can maintain two separate cultural identities concurrently (Buscemi, 2011; Matsudaira, 2006). Thus, "modifications instead of fusion and absorption" are emphasized (Al-Omari & Pallikkathayil, 2008, p. 129). Al-Omari & Pallikkathayil (2008) have identified attributes that define acculturation including language used at home and with friends versus at work and at school, socialization and communication (i.e., with whom), daily lifestyle, and cultural customs (e.g., food), identity (e.g., ethnic and national), and values. Specific to Hispanics, Siatkowski (2007) has noted,

> acculturation among Hispanics is a multidimensional iterative process that occurs when Hispanic individuals migrate into a new culture or society in the United States and integrate the beliefs, values, and practices of the new

> society, while simultaneously maintaining beliefs, values, and practices of the original Hispanic culture (p. 319).

In essence, acculturation is about cultural change. As such and in order to understand acculturation, one must understand the term *culture* (Chakraborty and Chakraborty, 2010; Schwartz et al., 2010). Schwartz et al. (2010) define culture as "shared meanings, understandings, or referents held by a group of people" (p. 240). Examples of cultural elements include attitude, language, tradition, family values, lifestyle, life experience, knowledge, and behaviors (Chakraborty & Chakraborty, 2010). Accordingly, cultural elements, then, likely affect other outcomes such as education, achievements, health-related behaviors, and health status (Chakraborty & Chakraborty, 2010). Al-Omari and Pallikkathayil (2008) have suggested that an individual's sense of self in inextricably linked with culture and therefore adaptation to a new culture is not inconsequential in that changes in sense of self may be required.

Similarly, Schwartz et al. (2010) believe that defining *ethnicity* and understanding *language* are important to an understanding of acculturation. Ethnicity is characterized as "membership in a group that holds a specific heritage and set of values, beliefs, and customs" (Schwartz et al., 2010, p. 240); regarding language Schwartz et al. have stated "shared language is part of the fabric of national identity" (p. 240). It is noteworthy that during the adjustment or acculturation process, "immigrants experience many stressors and difficulties, which may lead to emotional or psychological problems" (Al-Omari & Pallikkathayil, 2008, p. 126).

As noted, acculturation can be conceptualized at both the individual and group levels, i.e., as a process within individuals or groups (e.g., families, communities, societies; Al-Omari & Pallikkathayil, 2008; Buscemi, 2011). Some have made a distinction between psychological acculturation among individuals and social acculturation among groups (Al-Omari & Pallikkathayil, 2008; Matsudiara, 2006). Acculturation involves changing individual behaviors, values, attitudes and identities, as well as changes in group social, economic, and political affiliations and dynamics (Al-Omari & Pallikkathayil, 2008; Buscemi, 2011). Buscemi (2011) has noted that for immigrants, biculturalism is a standard, and "underacculturation or overacculturation is associated with maladjustment" (p. 40).

It has been suggested that there are three levels of learning about a new culture within the process of acculturation; that is, first at a superficial level (e.g., food and media), second at an intermediate level (e.g., language and ethnicity of social circle preference), and finally a significant or more permanent level of learning (e.g., new values; Lara et al., 2005, p. 371). Additionally, there are generally three phases of acculturation, during which changes in individual and groups occur, including

1) contact (i.e., between two distinct cultural groups);
2) conflict (i.e., perceived or real, between the two); and
3) adaptation, including adjustment (i.e., behaviors of minority become similar to that of the dominant);

with adaptation including the three sub-phases of a) adjustment (i.e., minority becoming similar to majority), b) reaction (i.e., disagreement of minority with views of the

majority), and c) withdrawal (i.e., minority rejects joining majority; Chakraborty & Chakraborty, 2010).

It has been noted that understanding acculturation necessitates understanding contextual and structural factors in which acculturation might occur and how these might influence outcomes (Lara et al., 2005; Lopez-Class et al., 2011; Matsudiara, 2006; Schwartz et al., 2010; Siatkowski, 2007; Thompson & Hoffman-Goetz, 2009). For example, individuals' characteristics (e.g., education, socioeconomic status), countries of origin, experience prior to and during immigration, country and community of settlement, neighborhood characteristics, the school system, fluency with language in the settlement area, heterogeneity of the new society, immigration policy, prejudice and discrimination, and stress and coping capacity are all examples of ecological or contextual factors that can affect the acculturation process, behaviors within the process, the measurement of acculturation, and the well-being of individuals undergoing the process (Lara et al., 2005; Lopez-Class et al., 2011; Matsudiara, 2006; Schwartz et al., 2010; Thompson and Hoffman-Goetz, 2009). Similarly, Al-Omari & Pallikkathayil (2008) have described eight conditions that are related to and affect acculturation including contact of the two distinct cultures, knowledge and education about the new culture, expectations for the future, the type of contact (i.e., voluntary versus involuntary), physical appearance (i.e., distinctiveness from individual in new culture), national policies of the new culture, how welcoming the new culture is, and adaptability characteristics of individuals.

It is worth noting here that the consequences of acculturation can be diverse. For example, increased acculturation might lead to increases in social activity, comfort, and

ability to function within the new culture (i.e., positive outcomes; Al-Omari & Pallikkathayil, 2008; Siatkowski, 2007). Similarly, Siatkowski (2007) have noted that changes in health care decision-making and health care practices can occur, in particular among Hispanics with increased acculturation; lower levels of acculturation among Hispanics have been associated with decreased use of preventative health care and increased self-reporting of poor health status, but healthier diets (e.g., increased fiber intake and decreased fat intake; Siatkowski, 2007). Alternatively, increased acculturation might also lead to an increase in risky health behaviors among Hispanics including alcohol consumption and cigarette smoking (Siatkowski, 2007). In contrast, lack of acculturation or unsuccessful acculturation might lead to stress, psychological and social dysfunction, isolation, and confusion regarding identity (Al-Omari & Pallikkathayil, 2008). This stress and adverse effect on psychological function may lead to poor health behavior choices as well as poor mental health outcomes (Al-Omari & Pallikkathayil, 2008).

According to Chakraborty and Chakraborty (2010), the focus of most acculturation studies is the cultural exchange aspect, i.e., adaptation from values and norms of culture of origin to the new cultural values and norms. In health research among ethnic minorities, acculturation is an important factor (Matsudaira, 2006). Evidence exists for the association between acculturation and mental health, psychiatric symptoms, and beliefs about illness and psychological care (Matsudaira, 2006). Thus, although the exact mechanism by which acculturation affects health outcomes among

minorities is not clear, it is important to recognize there is an effect (Thompson & Hoffman-Goetz, 2009).

In summary and as noted by Siatkowski (2007),

> [a]cculturation is a complex, multidimensional process involving not only language but also many other sociocultural factors, including country of origin, age of entry into the United States, perceived ethnicity, ethnicity of individuals with whom the person socializes, preference of language for the media and entertainment, socioeconomic status, educational level, sociocultural context, religious beliefs and values, family traditions and values, and health care beliefs and practices (p. 319).

Measures of Acculturation

Multiple scales have been developed to measure acculturation, likely related to the variety of definitions (e.g., unidimensional, bidemensional, and multidimensional; Abraído-Lanza et al., 2006; Lara et al., 2005; Lopez-Class, Castro, Ramirez, 2011). Constructs included in measurement scales include, to varying degrees, culture-specific behavior, country of nativity, generational status, duration of United States residence, language preferences, perception of cultural identity, and embracing of culturally specific values (Abraído-Lanza et al., 2006; Lara et al., 2005). According to Lara et al. (2005), the available and various scales have differing propensities for use and differing levels of validation. Thus, for example, there are unidimensional, bidimensional, and multidimensional instruments for acculturation measurement (Thompson & Hoffman-Goetz, 2009). Per the definition of unidimensional acculturation, unidimensional

acculturation instruments assume the acculturation process is a linear continuum ranging between unacculturated and acculturated, and thus measure acculturative change as loss from one culture with corresponding gains from the other culture (Thompson & Hoffman-Goetz, 2009). Unidimentional instruments are limited as a result of these underlying assumptions. With unidimensional instruments, there is an implied preference for the new culture, which may lead to an obfuscation of potentially protective results that might be associated with limited acculturation (Thompson & Hoffman-Goetz, 2009). An example of a unidirectional instrument is the Short Acculturation Scale for Hispanics (Thompson & Hoffman-Goetz, 2009). With bidimensional instruments, changes are measured and scored separately in each culture – the culture of origin and the new culture (Thompson & Hoffman-Goetz, 2009). An example of a bidimensional instrument is the Bidimensional Acculturation Scale (Thompson & Hoffman-Goetz, 2009). Finally, multidimensional instruments evaluate elements of the acculturative process individually, and in each culture separately, in an attempt at improved measurement (Chakraborty & Chakraborty, 2010; Flaskerud, 2007; Thompson & Hoffman-Goetz, 2009). Multi-dimensional approaches account for additional factors, such as ethnic pride and food preferences (Lopez-Class et al., 2011). Limitations of multidimensional instruments of acculturation measure include 1) the subjective nature of language and cultural preference, with the potential for responses to be driven by social acceptability and/or extreme values; 2) the non-standardized treatment of missing values and lack of validation of a summed score used in some studies; and 3) the additional time required for administration (Chakraborty & Chakraborty, 2010; Flaskerud, 2007). On the up side,

however, Chakraborty and Chakraborty (2010) have noted that within a particular sample, there is evidence that unidimensional acculturation indicators might not correlate with health outcomes, although a multidimensional instruments do. An example of a multidimensional instrument is the Acculturation Rating Scale for Mexican Americans II (Thompson & Hoffman-Goetz, 2009).

Acculturation scales can be used to measure both external (e.g., language, diet, social interactions) and internal (subjective; e.g., values, beliefs, perception of affiliation and identity) changes (Matsudaira, 2006). The most commonly used indicator of acculturation is language use and preference (e.g., at home versus at work; Al-Omari & Pallikkathayil, 2008; Matsudaira, 2006; Thompson & Hoffman-Goetz, 2009). It has been suggested that, despite the range of factors included in an instrument, the primary factor in current instruments is change in language use, preference, and proficiency, as changes in values and beliefs are incremental at best and difficult to measures regardless (Thompson & Hoffman-Goetz, 2009). Some have indicated concern regarding "the disproportionate role of language as used to measure acculturation" (Lopez-Class et al., 2011, p. 1557), and Lara et al. (2005) have suggested that the majority of variance in acculturation scales is attributed to the language items versus other items. However, the benefit is that language items are relatively easy to measure (Lara et al., 2005). Value and behavioral dimensions of acculturation can be measured via individual indicators or scales, and include psychological and sociodemographic factors, such as language use and language preference, generation status and length of time in the United States, location of parents' birth, ethnicity of current and previous friends, cultural heritage and

identification (self and parents), ethnicity of neighborhood, mainstream culture interaction, recreational and entertainment preference (e.g., music, television, books), dietary preference, ethnic pride, perceived discrimination, with whom individuals communicate (e.g., culture of origin versus new culture), social activities and cultural traditions, and cultural identity (Al-Omari & Pallikkathayil, 2008; Chakraborty & Chakraborty, 2010; Flaskerud, 2007). It has been suggested that the use of acculturation indicators including generational status, age at arrival, and length of residence in new culture may not be appropriate, as mere exposure to the new culture is not synonymous with involvement with the new culture (Matsudaira, 2006).

In addition to measurement scales, individual proxy measures for acculturation exist. Proxy measures of acculturation are commonly used, specifically in population studies (Thompson & Hoffman-Goetz, 2009). These measures are simple and useful and commonly correlate with more fulsome acculturation measurement scales (Thompson & Hoffman-Goetz, 2009). Examples of proxy measures include immigration status, length of residence, place of birth, language preference, and language of interview (Thompson & Hoffman-Goetz, 2009). Limitations regarding the use of proxy measures include the fact that they are not direct measures of change due to acculturation (e.g., beliefs and behaviors), and thus the utility of the findings may be limited (Thompson & Hoffman-Goetz, 2009). Additionally, proxy measures have been criticized for "their limited scope and sensitivity" and that "not all proxy measures are the same" (Thompson & Hoffman-Goetz, 2009, p. 988). According to Thompson and Hoffman-Goetz (2009), "[u]se of

such [proxy] measures without consideration of other factors may produce misleading results" (p. 988).

Acculturation Among Hispanics in the United States

Previous findings have indicated a positive correlation between both generation of residence and length of residence in the United States with language preference/use among Mexican Americans; a negative correlation between age at migration and language preference/use has similarly been documented among Mexican Americans; and "acculturation scored by language preference is noted to be highly predictive of health behavior change" (Chakraborty & Chakraborty, 2010, pp. 1182-1183).

Depression Measurement

Depression is typically diagnosed via patient interviews and patient self-reported responses to check-lists and questionnaires, with symptoms typically derived from the Diagnostic and Statistical Manual of Mental Disorders (DSM; Lopresti et al., 2014). Commonly used self-administered depression scales include the Beck Depression Inventory, the Clinically Useful Depression Outcome Scale, the Patient Health Questionnaire (PHQ-9), the Center for Epidemiologic Studies Depression Scale, the Composite International Diagnostic Interview Short-Form, and the Quick Inventory of Depressive Symptomatology (Kessler et al., 2003; Radloff, 1977; Zimmerman, 2011). The PHQ-9 includes nine items for assessment of major depressive disorder according to the DSM, including one item assessing negative psychosocial status (Zimmerman et al., 2011). The PHQ-9 is relatively quick to administer, has been thoroughly studied as a screening tool in primary care settings, and it has been determined to have appropriate

test-retest reliability, internal consistency, and sensitivity to change (Zimmerman, 2011). Total scores on the PHQ-9 range between 0 and 27, with recommended severity scores of 0 to 4 (no depression), 5 to 9 (mild depression), 10 to 14 (moderate depression), 15 to 20 (moderately severe depression), and 21 to 27 (severe depression; Kroenke & Spitzer, 2002). The PHQ-9 is available for unlimited clinical use (Zimmerman, 2011).

Depression in the United States

Data from the United States National Health and Nutrition Examination Survey (NHANES) for the years 2005-2008 indicated that 6.8% of adults overall had depression (PHQ-9 $\geq$ 10) during the 2 weeks before the survey (Reeves et al., 2011). Data from the United States Behavioral Risk Factors Surveillance Survey (BRFSS) for the year 2006 indicated that approximately 8.7% of adults currently had depression, and for the years 2008, 8.2% currently had depression (PHQ-8 $\geq$ 10; Reeves et al., 2011). Data from NHANES 2005-2008 stratified by race/ethnicity indicated a higher prevalence of depression among Mexican-Americans (7.2%) and non-Hispanic Blacks (9.7%) compared with non-Hispanics Whites (6.2%; Reeves et al., 2011). Similarly, combined data for BRFSS, 2006 and 2008, indicated higher percentages of any current depression among Hispanics (11.4%), non-Hispanic Blacks (12.8%), and Other race/ethnicities (10.6%) compared with non-Hispanic Whites (7.9%; Gonzalez et al., 2010). Wittayanukorn, Qian, and Hansen (2014) reported an analysis of depressive symptoms from NHANES 2005-2010 (measured via PHQ-9 score $\geq$ 5). Findings indicated the current prevalence of depressive symptoms in 2005-2006 was approximately 21%, and in 2009-2010 was approximately 26% (Wittayanukorn et al., 2014). In the 2009-2010

survey years, the distribution of prevalence of depression severity was approximately 16% mild, 6% moderate, 3% moderately severe, and 1% severe (Wittayanukorn et al., 2014). In addition, multivariate analysis indicated that self-reported race/ethnicity of Other Hispanic was statistically significantly associated with having depressive symptoms (Wittayanukorn et al., 2014).

Acculturation and Health Among Hispanics

In the context of public health research among Hispanics, acculturation is an important construct (Abraído-Lanza et al., 2006; Siatkowski, 2007). According to Nemade, Reiss, and Dombeck (2007b), "[c]ulture and ethnicity are important aspects of health and illness" (para. 2). According to Siatkowski (2007), "[a]cculturation has been widely used as a research variable to measure the effects of cultural beliefs and values on health and to study how those effects may change as individuals integrate some of the values of the mainstream culture" (p. 316).

It has been noted that the acculturative process coincides with modifications and transformations that may be associated with either beneficial or adverse effects on health for immigrants and/or succeeding generations born in the United States (Abraído-Lanza et al., 2006). In fact, by definition acculturation encompasses cultural modifications that can affect beliefs, attitudes, and behaviors that necessarily will affect health promotion and disease prevention experiences and outcomes via exposure to different examples of health behavior, responses to discrimination, and changes in social networks, all of which may affect health outcomes, both physical and mental (Abraído-Lanza et al., 2006). Thus, understanding the effect of acculturation among Hispanics will lead to improved

knowledge of what constitutes physical and mental health within this population (Abraído-Lanza, et al., 2006).

Acculturation has a well-established relationship with relative risk, health status, and health behavior (Chakraborty & Chakraborty, 2010; Flaskerud, 2007). Siatkowski (2007) has noted that low levels of acculturation among Hispanic individuals are associated with lower socioeconomic position, decreased likelihood of health insurance coverage, and decreased likelihood of having visited a health care provider within the past year. Thus, with increasing levels of acculturation among Hispanics, there is an increased use of preventative health measures, increased treatment compliance, and improved access to health care and health insurance coverage (Siatkowski, 2007). In contrast, however, increasing levels of acculturation among Hispanics is also associated with increases in poor health behaviors, such as cigarette smoking and fat intake via the diet (Siatkowski, 2007). Findings from an earlier literature review (Lara et al., 2005) of studies that had evaluated the association between acculturation and health-related outcomes among Hispanics left the authors reporting

> our most important overall finding is that the effect of acculturation, or more accurately, assimilation to mainstream U.S. culture, on Latino behavior and health outcomes is very complex and not well understood…depending on the subject area, the measure of acculturation used, and factors such as age, gender, or other measured or unmeasured constructs, acculturation may have a negative, positive, or no effect on the health of Latinos (Lara et al., 2005, p. 374).

According to Chakraborty and Chakraborty (2010), “acculturation has been shown to be associated with risk factors of complex disease phenotypes,” and acculturation is useful to study in order to understand health disparities among minorities in the United States (p. 1184). However, results of studies are not always consistent, which may be attributed to the use of different indicators of acculturation across studies as well as heterogeneity of the population sample under study (e.g., age distribution, Hispanic subgroup contribution, genetics; Chakraborty & Chakraborty, 2010). The relationship between acculturation and depression among Hispanic adults will be discussed in the following section.

Depression and Acculturation among Hispanic Adults

It has been suggested that an individual’s culture affects the prevalence of depression due to cultural differences in social structure, identity, and biology, including genetics (Nemade et al., 2007b). It is notable that in an earlier review of the literature regarding acculturation and overall health, no clear relationship between acculturation and mental health outcomes was identified (Lara et al., 2005). The following section presents a summary of the results of a literature review regarding the relationship between acculturation and depression among Hispanic adults from peer-reviewed articles published between 2005 and 2015.

Consistent with other literature reviews of acculturation and health outcomes among Hispanics, the results of this review indicated that findings are inconsistent across studies, likely due to different definitions and measures of acculturation employed, as well as heterogeneity of the sample populations across studies.

A slight majority of the identified publications (11 primary studies and one review article) provided evidence of a relationship between indicators of acculturation and indicators of depression among Hispanics adults in the United States (Crockett et al., 2007; Dinh et al., 2009; Driscoll &Torres; 2013; Hahn, Kim, & Chiriboga, 2011; Gomez, Miranda, & Polanco, 2011; Johnson et al., 2010; Kwag, Jang, & Chiriboga, 2012; Ruiz et al., 2012a, b; Sadule-Rios, 2012; Sin, 2012; Torres, 2010). Generally, results from these studies indicated that increased acculturation (and thus acculturative stress) was associated with increased depression, with two exceptions. Dinh et al. (2009) reported less depression associated with greater acculturation among Mexican American women in the Southwestern region of the United States, and Kwag et al. (2012) reported lower acculturation associated with increased depression among older Hispanics in the Sacramento area of California. Results from the remaining identified publications (eight primary studies) provided no evidence of a statistical relationship between acculturation and depression among Hispanic adults in the United States (Fortner, Pekow, Dole, Markenseon, & Chasan-Taber, 2011; Green et al., 2010; Lorenzo-Blanco & Delva, 2012; Ornelas & Perreria, 2011; Robinson & Monsivais, 2011; Sánchez et al., 2014; Valencia-Garcia, Simoni, Alegría, & Takeuchi, 2012; Walker et al., 2012).

The majority of the studies reviewed were of cross-sectional design. Notably, studies of cross-sectional design are limited in terms of conclusions about causality and directionality of associations (Fink, 2013). One of the identified studies, which indicated an association between acculturation and depression among Hispanic adults in the United States, incorporated a longitudinal design with baseline and a follow-up of participants

after two years (n=152; Hahn et al., 2011); another one of the studies, which indicated an association between acculturation and depression among Hispanic adults in the United States, was a secondary data analysis of data from a randomized controlled trial (n=87; Sin, 2012); and, as noted, one of the publications was a review of the literature regarding depression among Hispanics in later life, which also indicated an association between acculturation and depression among Hispanic adults in the United States (Salude-Rios, 2012). Additionally, in the majority of the studies identified and reviewed, convenience samples were employed, which limits generalizability of the individual study findings. Among these studies, samples sizes were typically in the hundreds (i.e., 200 to 900), although larger and smaller samples were seen in some studies.

Depression and Inflammation

Although it is notable that inflammation is not a necessary or a sufficient predictor of depression (Krishnasdas & Cananagh, 2012; Raison & Miller, 2011), evidence exists to indicate that depression is associated with increased inflammation, that an increased risk of depression is associated with inflammation, and that differential depression severity is associated with different levels of inflammatory markers (Almond, 2013; Anisman, 2011; Dantzer, O'Connor, Freund, Johnson, & Kelley, 2008; Krishnadas & Cavanagh, 2012; Nemade et al., 2007a; Raison & Miller, 2011). Additionally, various antidepressant medications have been shown to increase anti-inflammatory responses and to decrease levels of pro-inflammatory compounds (Almond, 2013; Anisman, 2011; Krishnadas & Cavanagh, 2012; Li, Soczynska, Kennedy, 2011). Berk et al. (2013) have suggested that inflammation is a mediator between environmental risk factors for

depression (e.g., psychosocial stressors, poor diet, lack of physical exercise, obesity, and cigarette smoking) and depression.

It has been suggested that symptoms associated with depression may be the result of inflammatory processes affecting brain function (Anisman, 2011; Krishnadas & Cavanagh, 2012); there is both evidence of immune suppression (i.e., decreases in inflammatory markers) and immune activation (i.e., increases in inflammatory markers) associated with depressive symptoms (Li et al., 2011). There are three discrete lines of evidence that support the association between inflammation and depression including:

1) on average, individuals with depression (and no other concomitant physical illness) exhibit elevated levels of certain inflammatory biomarkers compared with individuals who are not depressed;
2) greater rates of depression are observed in individuals with inflammatory physical illness; and
3) there is a greater risk of developing depression in individuals treated with certain pro-inflammatory factors (i.e., cytokines; Krishnadas & Cavanagh, 2012; Raison & Miller, 2011).

Biomarkers

According to Lopresti et al. (2014), biomarkers are objective measures of normal and abnormal biological processes, as well as measures of "pharmacological responses to therapeutic interventions, and have proved invaluable in expanding our understanding and treatment of medical diseases" (p. 102). Biomarkers can be considered diagnostic and predictive, and metrics of treatment response (Lopresti et al., 2014). Biomarkers of

inflammation can be used to understand intermediate mechanism of disease in lieu of the evaluation of clinical endpoints (Dantzer et al., 2008).

Depression and C-Reactive Protein

C-reactive protein concentration measured in blood is a reliable indicator of chronic inflammation (Chocano-Bedoya et al., 2014; De Berardis et al., 2009; Harley, Luty, Carter, Mulder, & Joyce, 2010). In epidemiological studies, elevated levels of C-reactive protein have been consistently observed in individuals with depression and depressive symptoms in both cross-sectional and prospective studies and among various populations (Copeland et al., 2013; Duivis, Vogelzangs, Kupper, de Jonge, & Penninx, 2013; Harley, Luty, Carter, Mulder, & Joyce, 2010; Gimeno et al., 2009; Howren et al., 2008; Krishnadas & Cavanagh, 2012; Li et al., 2011; Liukkonen et al., 2006; Luukinen, Jokelainen, Hedberg, 2010; Matthews et al., 2010; Müller et al., 2011; Pasco et al., 2010; Pikart et al., 2009; Valkanova, Ebmeier, & Allan, 2013; Wium-Andersen, Ørsted, Nielsen, & Nordestgaard, 2013). However, other studies, both cross-sectional and prospective, have not observed this association (Baune et al., 2012; Bremmer et al., 2008; Chocano-Bedoya et al., 2014). In addition, a correlation between concentrations of C-reactive protein and severity of depression has been reported (Müller et al., 2011). High concentrations of C-reactive have been suggested to be an early indicator of cognitive symptoms of depression (Müller et al., 2011). Finally, in a meta-analysis reported by Hiles, Baker, de Malmanche, and Attia (2012), reductions in C-reactive protein were observed following administration of anti-depressant medication. However, in a more recent cross-sectional analysis of females participating in the Nurses' Health Study no

significant association was observed between C-reactive protein and anti-depressant use (Chocano-Bedoya et al., 2014).

Evidence exists to indicate that race moderates the relationship between C-reactive protein levels and depression (Case & Stewart, 2014; Deverts et al., 2010; Morris et al., 2011). Findings are inconsistent, however. Case and Stewart (2014) reported associations overall and among non-Hispanic Whites, but not among non-Hispanic Blacks, Mexican Americans, or Other Hispanics, and Deverts et al. (2010) reported an association among African Americans but not among Whites.

Depression and White Blood Cells

A limited number of publications with information regarding evaluations of white blood cells and depression were identified in the literature. Depression has been reported to be associated with an increased number of circulating lymphocytes as well as increased numbers of peripheral mononuclear cells (Müller et al., 2011). In a study of 15 depressed individuals, Canan & Ataoglu (2009) reported no statistically significant change in white blood cells, neutrophils, monocytes, eosinophils, and basophils pre- and post-administration of an antidepressant medication; however, statistically significant increases in lymphocytes were observed post-treatment.

Acculturation and C-Reactive Protein

Only one study of acculturation and C-reactive protein was identified in the scientific literature (Rodriguez, Peralta, Green, & López, 2012); depression was not evaluated in this study. Among Hispanic adults within the 1999-2008 continuous NHANES, higher level of acculturation was independently associated with higher C-

reactive protein concentrations after controlling for potentially relevant clinical factors that included history of diabetes, cardiovascular disease and/or hypertension, body mass index, smoking status, estrogen use, and statin use (Rodriguez et al., 2012). Strengths of this analysis include the nationally representative sample, which maximizes external validity. A limitation of the study is the cross-sectional design, which precludes conclusions regarding the temporality of the association.

No literature was identified that addressed the question of the potential mediating effect of biomarkers of inflammation, specifically C-reactive protein and white blood cells, on the relationship between acculturation and depression among Hispanic adults in the United States.

Summary and Conclusions

In summary, this chapter has provided a discussion, including a review of the literature regarding the biopsychosocial theory and its application to the proposed research project, acculturation (i.e., how it has been defined and how it might be measured), depression (i.e., how it has been measured and its epidemiology in the United States and among Hispanics), the relationship between acculturation and depression among Hispanic adults in the United States, and the relationship between inflammation and depression. With the exception of the construct of the biopsychosocial theory, literature reviewed was limited to that published between 2005 and 2015. In the next chapter, Chapter 3, details will be provided regarding the study methodology used to evaluate the potential mediating effect of inflammation (C-reactive protein and white

blood cells) on the relationships between acculturation and depression among Hispanic adults in the United States, as specified via the research questions.

Chapter 3: Research Method

Introduction

There were three objectives of this study. The first was to assess the prevalence and severity of depression by race/ethnicity in the United States. Additionally, this study aimed to clarify the inconsistent results in the literature with regards to the relationship between acculturation and depression among Hispanic adults in the United States. Finally, this study intended to fill a gap in the literature by quantitatively evaluating whether inflammation, specifically measured by the biomarkers of inflammation C-reactive protein and white blood cells, mediates the relationship between acculturation and depression among Hispanic adults in the United States.

This chapter provides a detailed description of the methodology that was used in this research study quantitatively evaluating whether inflammation, specifically measured by the biomarkers of inflammation C-reactive protein and white blood cells, mediates the relationship between acculturation and depression among Hispanic adults in the United States. Specifically, this chapter documents details of the research design and rationale, including the target population, the sample and sampling strategy, procedures for recruitment and procedures for data collection, instrumentation and operationalization of constructs. The data analysis plan, threats to validity, and ethical procedures additionally are additionally discussed in this chapter.

Research Design and Rationale

This quantitative study used a cross-sectional research design. The ultimate purpose of this quantitative study was to understand and describe the potential for

inflammation (specifically the biomarkers of inflammation white blood cell counts and C-reactive protein concentrations) to mediate the relationship between acculturation and depression among Hispanic adults in the United States. Secondary data from the 2009-2010 survey cycle of the continuous National Health and Nutrition Examination Survey (NHANES) were used in this study; since the NHANES data were collected cross-sectionally, this research inherently used a cross-sectional study design. Data interpretation was guided by the biopsychosocial model of disease.

In order to isolate the effect of acculturation and inflammation on depression, several control variables were used: age, gender, body mass index (BMI), education level, poverty to income ratio (PIR, a metric of income), and current cigarette smoking. Data on the relevant independent (acculturation), mediating (biomarkers of inflammation), dependent (depression), and potentially confounding (age, gender, BMI, education level, PIR, and current cigarette smoking) variables were obtained via secondary data from the archival survey responses and linked data from biospecimen collection in the source study. This study investigated if statistical relationships and patterns existed between the identified variables.

Methodology

Population

The target population for this study consisted of Hispanic adults 20 years of age and older living in the United States. In 2013, the estimated size of the United States was approximately 316 million individuals, of which approximately 243 million (77%) were adults (United States Census Bureau, 2014). Approximately 54 million Hispanic

individuals live in the United States, making up approximately 17% of the total population (Centers for Disease Control and Prevention [CDC], 2014b). In 2012, approximately 33 million Hispanics were 20 years of age and older (United States Census Bureau, 2012). The largest subgroup of Hispanics in the United States is Mexicans, estimated to be 64% in 2012 (CDC, 2014b). Other major Hispanics subgroups in the United States include

- Puerto Ricans (9%),
- Cubans (4%), Salvadorans (4%),
- Dominicans (3%), and
- Guatemalans (2%; CDC, 2014b).

An aggregate of 14% are classified as "Other" (CDC, 2014b). This 14% "Other" category consists of

- approximately 1% of each of the following: Columbians, Spaniards, Ecuadorians, Peruvians, and Hondurans;
- less than 1% of each of the following: Argentinians, Bolivians, Chileans, Uruguayans, Venezuelans, Costa Ricans, Nicaraguans, and Panamanians; and
- approximately 7% not otherwise specified (United States Census Bureau, 2011).

Hispanic race/ethnicity data are available in the NHANES data set and are stratified by self-reported Mexican American and Other Hispanic.

Sampling and Sampling Procedures

The sampling frame for the NHANES is the United States population, as defined as the civilian, non-institutionalized population residing in the 50 United States and the

District of Columbia (Johnson et al., 2013). Thus, the following individuals were excluded: individuals in institutionalized care or custody residing in the United States, and active-duty military, active-duty military family members, and other residents of the United States living outside of the United States and the District of Columbia (Johnson et al., 2013).

A complex, multi-stage, probability sample design was used in NHANES (Johnson et al., 2013). This sampling strategy includes the following four stages:

1. identification of 15 individual counties (out of approximately 3,000) in and across the United States as primary sampling units (PSU);
2. identification of segments (approximately 360) within the individual counties;
3. identification of households or dwelling units within the identified segments (approximately 11,500 households and approximately 12,600 dwelling units screened); and
4. identification of individuals within a household or dwelling unit (approximately 6,500 individuals sampled; Curtin et al., 2013; Johnson et al., 2013).

For the 2007 to 2010 survey periods, NHANES oversampled Hispanic individuals. This oversampling was intended to increase the precision of estimates among this population (Curtin et al., 2013; Johnson et al., 2013). According to Curtin et al. (2013), sampling for NHANES was planned such that a sample size of approximately 150 is needed for a prevalence statistic, in any age-sex Hispanic strata (and certain other oversampled domains), to achieve a relative standard error of less than or equal to 30%, assuming a design effect of 1.5. Similarly, a sample size of approximately 420 is needed

in order to detect absolute difference of 10% between strata, assuming an alpha of 0.05 and power of 90% (Curtin et al., 2013).

For the 2009-2010 survey cycle, data were collected between January 2009 and December 2010 (CDC, 2011a). The screened sample consisted of 13,272 individuals (Johnson et al., 2013). The resulting (unweighted) interview sample size was 10,537, indicating a 79% response rate; the resulting (unweighted) examined sample size was 10,253, indicating a 77% response rate (Johnson et al., 2013). The examined sample of adults ≥20 years of age consisted of 6,059 individuals (CDC, 2013).

Generally, with analyses of survey data, because the data are already collected, a *post-hoc* analysis of statistical power is necessary to ensure the sample sizes were sufficient to draw reliable conclusions from the analyses, in contrast to an *a priori* sample size calculation (Bierman & Bubolz, n.d.). Regardless, an *a priori* sample size was calculated using G*Power (Faul, Erdfelder, Lang, & Buchner, 2013). Using the assumptions under a z test and logistic regression, with an alpha of 0.05, power of 80%, an odds ratio of 1.3, and a two tailed, lognormal distribution, a sample size of 170 was determined to be needed.

Procedures for Recruitment, Participation, and Data Collection

Data for NHANES 2009-2010 were collected under a contractual agreement (CDC, 2011a). In general, the NHANES questionnaires were administered at home with subsequent physical examination, including physical measurements, oral examination, and the collection of blood and urine samples (i.e., biospecimen) for further analysis

(e.g., for the biomarkers analysis; Johnson et al., 2013). The physical examinations occurred in mobile examination centers (MEC; Johnson et al., 2013).

The sampling procedures followed a prescribed process starting with a household being identified for inclusion in the NHANES sample. First, a letter was sent to the address to inform the occupants that an interviewer would visit the home in the future (CDC, 2011a). On the day the interviewer arrived at the home, the interviewer provided appropriate identification, briefly explained the purpose of the study, and asked the household member to answer a short questionnaire in order to determine NHANES participation eligibility (CDC, 2011a). If potentially eligible individuals were identified, the interviewer attempted to recruit the individuals by explaining the questionnaire, informing individuals of their rights, and reaffirming (per the advance letter) the confidentiality of the NHANES data (CDC, 2011a).

Participation in the health examination component occurred following participation in the household interview (included signing an interview consent form), and included review of a second informed consent packet, and signing a second informed consent (CDC, 2011a). The interviewer scheduled the examination appointment on the date of the original interview, and the participants were informed that they would receive compensation for their time, any childcare expenses, and transportation (CDC, 2011a).

For the health examination component at the MEC, participants were randomly assigned to exams in the morning or in the afternoon/evening (CDC, 2011a). While a survey was ongoing, there were two locations where examinations were conducted (CDC, 2011a). Upon arrival at the MEC, the participant's identifier information was

confirmed and the participant was asked to provide a urine sample (CDC, 2011a). The exam took up to four hours to complete (CDC, 2011a). Participants were compensated when the exam was completed (CDC, 2011a).

Data and data documentation for the NHANES 2009-2010 are publicly available for download and were accessed in SAS XPT files via the National Center for Health Statistics (NCHS) website (CDC, 2015).

Instrumentation and Operationalization of Constructs

Acculturation. Currently, a gold standard for the measurement of acculturation does not exist; however, several proxy measures are available and have been used (New et al., 2013; Wakeel et al., 2014). In this study, acculturation was evaluated using five different proxy indicators. First, the question "What language(s) {do you/does [sample participant]} usually speak at home?" was used. This variable is labeled as "Acculturation" within NHANES 2009-2010 (CDC, 2012). Options for responses included:

- "Only Spanish,"
- "More Spanish than English,"
- "Both equally,"
- "More English than Spanish,"
- "Only English,"
- "Refused,"
- "Don't know," and
- "Missing."

Details for the data documentation and coding are presented in the Appendix (see Appendix Table A-1a). This indicator of acculturation was treated as a dichotomous variable, with "Only Spanish" and "More Spanish than English" combined and "More English than Spanish" and "Only English" combined. Other responses were set to Missing for the final analysis. In this study, the category "Only Spanish" and "More Spanish than English" was considered lower acculturation compared with the category "More English than Spanish" and "Only English." According to Al-Omari and Pallikkathayil (2008) language use and preference when interacting with friends and family is the most common indicator to measure acculturation. Additionally, it has been reported that "acculturation scored by language preference is noted to be highly predictive of health behavior change" (Chakraborty & Chakraborty, 2010, p. 1183). Examples exist in the literature of studies conducted in the past five years and evaluating health outcomes that have used language use and preference as a marker of acculturation status (see, e.g., Gee et al., 2012; New, Xiao, Ma, 2013; Wakeel, Witt, Wisk, Lu, & Chao, 2014).

The second indicator for acculturation was country of birth, which included the question "In what country {were you/was [sample participant]} born?" Options for responses included "Born in 50 US States or Washington, DC," "Born in Mexico," "Born in Other Spanish Speaking Country," "Born in Other Non-Spanish Speaking Country," "Refused," "Don't Know," and "Missing." Details for the data documentation and coding are presented in the Appendix (see Appendix Table A-1b). For this indicator, acculturation was treated as a dichotomous variable, with "Born in Mexico" and "Born in

Other Spanish Speaking Country" combined and compared with "Born in 50 US States or Washington, DC." The category "Born in Mexico" and "Born in Other Spanish Speaking Country" was considered less acculturation compared with the category "Born in 50 US States or Washington, DC." Other responses were set to Missing for the final analysis. Thompson and Hoffman-Goetz (2009) have noted the use of place of birth as a proxy measure of acculturation.

The third indicator of acculturation was length of time in the United States. Response options were categorical and included "less than 1 year;" "1 year, less than 5 years;" "5 years, less than 10 years;" "10 years, less than 15 years;" "15 years, less than 20 years;" "20 years, less than 30 years;" "30 years, less than 40 years;" "40 years, less than 50 years;" "50 years or more;" "Refused;" "Don't Know;" "Missing." Details for the data documentation and coding are presented in the Appendix (see Appendix Table A-1c). In this study, responses were dichotomized into "less than 10 years" and "greater than or equal to 10 years," with the category "less than 10 years" indicating less acculturation compared with the category "greater than or equal to 10 years." The responses Refused and Don't Know were set to Missing for the final analysis. Thompson and Hoffman-Goetz (2009) have noted the use of length of residence as a proxy measure of acculturation.

The fourth indicator of acculturation was citizenship status, which included the question "{Are you/Is [sample participant]} a citizen of the United States?" Responses included "Citizen by birth or naturalization," "Not a citizen of the US," "Refused," "Don't know," "Missing." Details for the data documentation and coding are presented

in the Appendix (see Appendix Table A-1d). In this case, acculturation was treated as a dichotomous variable, with the category "Not a citizen of the US" indicating less acculturation compared with the category "Citizen by birth or naturalization." The responses "Refused" and "Don't Know" were set to Missing for the final analysis. Thompson and Hoffman-Goetz (2009) have noted the use of immigration status as a proxy measure of acculturation.

Finally, language of interview was used as a proxy measure of acculturation. The interview could have been conducted in English or in Spanish. Details for the data documentation and coding are presented in the Appendix (see Appendix Table A-1e). Interview conducted in Spanish was considered an indication of less acculturation compared with interview conducted in English. Thompson and Hoffman-Goetz (2009) have noted language of interview has been used as a proxy measure of acculturation.

Depression. Depression and depression severity were measured using the nine-item Patient Health Questionnaire (PHQ-9) as presented in the 2009-2010 survey cycle of NHANES (CDC, 2011b). Details for the data documentation and coding are presented in the Appendix (see Appendix Table A-2). The PHQ-9 was developed by Kurt Kroenke, Robert L Spitzer, and Janet B. W. Williams (Kroenke, Spitzer, & Williams, 2001). This instrument includes eight items that evaluate the frequency of depressive symptoms, plus one item that assesses negative psychosocial status, over the previous two weeks (Kroenke et al., 2001; Zimmerman et al., 2011). The nine items of the PHQ-9 encompass the criteria used for a diagnosis of depressive disorder via the Diagnostic and Statistical Manual Fourth edition (DSM-IV). Thus, results from the PHQ-9 are consistent with

results from the DSM-IV in the context of identification of depressive disorders (Kroenke et al., 2001). Each item is scored as a value between 0 and 3 (i.e., "not at all" to "nearly every day"), and the values for each of the nine items are summed to achieve a cumulative score, with a net score of 0 to 27 possible (Kroenke et al., 2001). A cumulative score of 0 to 4 is considered "minimal," 5 to 9 "mild," 10 to 14 "moderate," 15 to 19 "moderately severe," and 20 to 27 "severe" depression (Kroenke et al., 2001; Kroenke & Spitzer, 2002). The PHQ-9 is both reliable and valid (Kroenke & Spitzer, 2002; Kroenke et al., 2001; Manea, Gilbody, McMillan, 2012; Martin, Rief, Klaiberg, & Braehler, 2006; Patten & Schopflocher, 2009; Wittkampf, Naeije, Schene, Huyser, van Weert, 2007). For the PHQ-9, Cronbach's alpha has been reported to be 0.89 and scores have been associated with disability days, clinic visits, and general difficulty associated with symptoms (Kroenke et al., 2001). Additionally, the PHQ-9 discriminates well between persons with major depression and those without (Kroenke et al., 2001). The PHQ-9 is relatively quick to administer (Zimmerman, 2011).

For this study, the PHQ-9 data were used to evaluate depression in two ways, 1) having depression versus not having depression (i.e., yes versus no), and 2) depression severity, i.e., mild to moderate versus moderately severe to severe. These strata were defined in a manner consistent with how the PHQ-9 is typically scored (noted above). Specifically, for the analysis of yes versus no depression, a score of 0 to 4 was defined as no and a score of 5 to 27 was defined as yes. For the analysis of mild to moderate versus moderately severe to severe, a score of 5 to 14 was defined as mild to moderate and a score of 15 to 27 was defined as moderately severe to severe.

C-Reactive Protein. C-reactive protein concentrations were used as a biomarker of inflammation in this study, as C-reactive protein concentration data were available in the NHANES 2009-2010 survey cycle (CDC, 2011c). Per NHANES procedures, after blood samples were collected in the MEC, C-reactive protein was measured in serum via nephelometry (CDC, 2011c;d). C-reactive protein data were measured in units of mg/dL (or equivalently, ng/mL) and the lower limit of detection during the 2009-2010 survey cycle was 0.02 mg/dL (CDC, 2011c;d; See Appendix Table A-3 for additional details). C-reactive protein data were presented as continuous, and for this analysis the data were categorized as low/average (0.01-0.34 mg/dL) and high/very high (≥0.35 mg/dL; Mayo Clinic, 2015a).

White Blood Cells. White blood cell counts were used as a second biomarker of inflammation in this study. White blood cell counts data were available in the NHANES 2009-2010 survey cycle (CDC, 2011e). Per NHANES procedures, after blood samples were collected in the MEC, whole blood was analyzed for white blood cell counts using the Coulter method (CDC, 2011e;f). White blood cell count data were measured as 1,000 cells per μL (See Appendix Table A-4 for additional details). White blood cell count data were presented as continuous, and for this analysis the data were categorized as low/average (≤3.4-10.5) and high (≥10.6; Mayo Clinic, 2015b).

Covariates. Covariate data from NHANES 2009-2010 included gender (male/female), age (≥20 years; categorized as 20-44 and 45+ years), educational attainment (categorized as less than or equal to high school graduate and greater than or equal to some college), ratio of family income to poverty (categorized as <1 representing

below and ≥1 representing normal and above), body mass index (BMI; continuous variable categorized as underweight/normal [<18.5-24.9 mg/kg^2] and overweight/obese [≥25.0 mg/kg^2] (CDC, 2011h)), and current cigarette smoking (a dichotomous variable categorized as current cigarette smoking in the past 5 days and not current cigarette smoking in the past 5 days; CDC, 2011i). Current cigarette smoking was defined as having used cigarettes in the past five days per the questionnaire administered in the MEC. See Appendix Table A-6 for additional details regarding covariates.

In these analyses, Hispanics were evaluated in three different ways: 1) Mexican American alone; 2) Other Hispanic alone; and 3) Mexican American combined with Other Hispanic representing an All Hispanic group.

Data Analysis Plan

Data from the NHANES 2009-2010 survey cycle were used to evaluate the following Research Questions and Hypotheses:

1. Among adults in the United States, is there a difference in the prevalence and severity of depression among Hispanics compared with other race/ethnicities?
    - Hypothesis 1_0: In the United States, the prevalence and severity of depression is not different among Hispanic adults compared with other race/ethnicity groups.
    - Hypothesis 1_A: In the United States, the prevalence and severity of depression is greater among Hispanic adults compared with other race/ethnicity groups.
2. Among Hispanic adults in the United States, is there an association between prevalence and severity of depression and acculturation status?

- Hypothesis 2_0: An association between acculturation and depression/depression severity does not exist among Hispanic adults in the United States.
- Hypothesis 2_A: An association between acculturation and depression/depression severity exists among Hispanic adults in the United States.

3. Among Hispanic adults in the United States, what is the effect of inflammation on the relationship between acculturation and depression?
    - Hypothesis 3_0: Among Hispanic adults in the United States, inflammation does not mediate the relationship between acculturation and depression.
    - Hypothesis 3_A: Among Hispanic adults in the United States, inflammation mediates the relationship between acculturation and depression.
4. Among Hispanic adults in the United States, what is the effect of inflammation on the relationship between acculturation and the severity of depression?
    - Hypothesis 4_0: Among Hispanic adults in the United States, inflammation does not mediate the relationship between acculturation and depression severity.
    - Hypothesis 4_A: Among Hispanic adults in the United States, inflammation mediates the relationship between acculturation and depression severity.

Data were analyzed using IBM SPSS Statistics 21 (SPSS). The Complex Sample procedures in SPSS were used in order to appropriately account for the NHANES weighting (i.e., PSU, strata, and MEC weights) in the analyses.

Descriptive statistics were used to present the prevalence and severity of depression by race/ethnicity, and chi-square analysis was used to determine if a statistical relationship existed between race/ethnicity and depression and/or depression severity (Research question/Hypothesis 1).

Bivariate logistic regression was used to evaluate the relationship between the independent variable (i.e., acculturation indicators) and the dependent variables (i.e., depression and depression severity). Wald chi square analyses were used to determine statistical significance. Subsequently, multivariate logistic regression was used to evaluate the relationship between acculturation and depression/depression severity, for each of the five acculturation indicator, for each of the three Hispanic subgroups controlling for the identified set of potentially confounding variables. (Research question/Hypothesis 2). Wald chi square analyses were used to determine statistical significance, and findings were presented as odds ratios (OR) and 95% confidence intervals (CI).

For each of the acculturation indicators with a statistically significant association with depression/depression severity, additional multivariate logistic regression models were evaluated that included the biomarkers of inflammation (i.e., C-reactive protein and white blood cells; Research questions/Hypotheses 3 and 4). Wald chi square analyses

were used to determine statistical significance, and findings were presented as OR and 95% CI.

Before statistical analysis, variables were reviewed for missing values and outliers (i.e., values more than three standard deviations from the mean). Missing values were excluded, and because all data were ultimately categorized, outliers were not modified or removed.

Threats to Validity

The threat to external validity in this study was minimized, due to the probabilistic nature of the NHANES sampling procedures. Thus, the findings from this study would be considered generalizable to the United States population. The internal validity of the study is somewhat compromised, due to the cross-sectional nature of the study design. However, the control for relevant covariates upon statistical analysis minimized this threat to internal validity. Although all available data were used, internal validly was threatened as a result of missing data.

Given the *a priori* sample size calculation conducted, the threat to statistical conclusion validity was minimized, as the statistical power was determined to be adequate. Ultimately, sample sizes were greater than 170 (as calculated with alpha equal to 0.05 and 1-beta equal to 0.8). Additionally, underlying assumptions of logistic regression were not deemed to be violated in these analyses. Finally, the threat to construct validity was minimized, as the Cronbach's alpha for the metric used for the dependent variable, depression, is good at 0.89.

Ethical Procedures

The details of this study were submitted for review to the Institutional Review Board of Walden University in order to ensure that the ethical standards of Walden University and any applicable federal regulations and guidelines were met. The Institutional Review Board of Walden University granted approval for this study on July 8, 2015 (IRB approval #: 07-08-15-0419730).

Care was taken in the NHANES data collection methods to ensure that individuals who participated in the survey were appropriately consented and were not personally identifiable or linked with any data (Johnson et al., 2013). No geographical information, including location of actual PSUs was made public, protecting the identity of the NHANES participants (Johnson et al., 2013).

Summary

This chapter presented details of the research design and rationale for this research study, which evaluated the relationship between acculturation and depression as well as the potential mediating effect of inflammation on the relationship between acculturation and depression among Hispanic adults in the United States. The target population, the sample and sampling strategy, procedures for recruitment and procedures for data collection, instrumentation and operationalization of constructs were described in this chapter. Additionally, the data analysis plan, threats to validity, and ethical procedures were summarized.

Chapter 4: Results

Introduction

This chapter provides the results of the research study. There were three objectives of this study. The first was to assess the prevalence and severity of depression by race/ethnicity in the United States. The second was to clarify the inconsistent results in the literature regarding the relationship between acculturation and depression among Hispanic adults in the United States. Finally, this study was designed to fill a gap in the literature by quantitatively evaluating whether inflammation, specifically measured by the biomarkers of inflammation C-reactive protein concentration and white blood cell counts, mediates the relationship between acculturation and depression among Hispanic adults in the United States. Accordingly, the following Research Questions and accompanying Hypotheses guided this research:

1. Among adults in the United States, is there a difference in the prevalence and severity of depression among Hispanics compared with other race/ethnicities?
    - Hypothesis 1_0: In the United States, the prevalence and severity of depression is not different among Hispanic adults compared with other race/ethnicity groups.
    - Hypothesis 1_A: In the United States, the prevalence and severity of depression is greater among Hispanic adults compared with other race/ethnicity groups.
2. Among Hispanic adults in the United States, is there an association between prevalence and severity of depression and acculturation status?

- Hypothesis 2_0: An association between acculturation and depression/depression severity does not exist among Hispanic adults in the United States.
- Hypothesis 2_A: An association between acculturation and depression/depression severity exists among Hispanic adults in the United States.

3. Among Hispanic adults in the United States, what is the effect of inflammation on the relationship between acculturation and depression?
    - Hypothesis 3_0: Among Hispanic adults in the United States, inflammation does not mediate the relationship between acculturation and depression.
    - Hypothesis 3_A: Among Hispanic adults in the United States, inflammation mediates the relationship between acculturation and depression.
4. Among Hispanic adults in the United States, what is the effect of inflammation on the relationship between acculturation and the severity of depression?
    - Hypothesis 4_0: Among Hispanic adults in the United States, inflammation does not mediate the relationship between acculturation and depression severity.
    - Hypothesis 4_A: Among Hispanic adults in the United States, inflammation mediates the relationship between acculturation and depression severity.

Data Collection

SAS XPT files for the relevant variables and/or variable domains for National Health and Nutrition Examination Survey (NHANES) 2009-2010 were downloaded from the National Center for Health Statistics (NCHS) website (CDC, 2015). SAS XPT files were converted to SPSS, merged into one data file, and any variables not relevant to the current study were removed. Any responses of "Refused" or "Don't Know" were recoded as Missing.

Normality and Outliers

Continuous variables were evaluated for normality (Table 1) and outliers. Normality tests indicated that variables were generally normally distributed or slightly skewed to the right. Within the Mexican American and Other Hispanic subsamples, outliers (i.e., a value more than three standard deviations from the mean) were investigated and identified. Based on the following outliers were identified:

- one outlier each among the white blood cell count values among the Mexican American and Other Hispanic samples;
- for C-reactive protein, 13 outliers among the Mexican American sample and two among the Other Hispanic sample; and
- for BMI, 12 outliers among the Mexican American sample and three outliers among the Other Hispanic sample.

Because all continuous variables were ultimately categorized, these values were not modified.

Table 1

Tests of Normality for Continuous Variables

	Mexican American			Other Hispanic		
Variable	*M* (*SD*)	*Mdn*	Skew	*M* (*SD*)	*Mdn*	Skew
BMI	29.7 (5.82)	28.9	1.10	29.0 (6.38)	28.1	1.66
CRP	0.455 (0.849)	0.210	6.96	0.415 (0.911)	0.190	13.1
Depression Sum	5.75 (5.16)	4.00	1.58	5.63 (5.17)	4.00	1.62
PIR	1.74 (1.30)	1.35	1.19	2.13 (1.56)	1.64	0.636
WBC	7.46 (3.44)	7.10	18.6	7.21 (1.91)	7.05	0.735

Notes. BMI, body mass index; CRP, C-reactive protein; PIR, poverty to income ratio; WBC, white blood cells.

Missing Values

With the Mexican American and Other Hispanic subsamples, all variables were evaluated for missing values (Table 2). Notable proportions of missing values included poverty to income ratio (PIR), current cigarette use, the acculturation indicator length of time in the United States, and the outcome variable of depression.

Table 2

Missing Values Among Analytic Variables

Domain Variable	Mexican American			Other Hispanic		
	Valid	Missing	% Missing	Valid	Missing	% Missing
Demographics						
Age	1,101	0	0	615	0	0
Education	1,101	0	0	615	0	0
Race/ethnicity	1,101	0	0	615	0	0
PIR	944	157	14%	505	110	56%
Health behavior						
BMI	1,096	5	0.4%	601	5	0.8%
Current cigarette use	958	143	13%	541	74	12%
Inflammation						
CRP	1,051	50	5%	587	28	5%
WBC	1,051	50	5%	590	25	4%
Acculturation						
Country of Birth	1,101	0	0	601	14	2%
Citizenship	1,093	8	0.7%	611	4	0.7%
Language at home	1,101	0	0	615	0	0
Language of interview	1,101	0	0	615	0	0
Length of time in US	684	417	38%	432	183	30%
Outcome						
Depression	621	480	44%	371	244	66%

Notes. BMI, body mass index; CRP, C-reactive protein; PIR, poverty to income ratio; WBC, white blood cells.

Sample

The sample sizes (i.e., weighted counts) by race/ethnicity from the NHANES 2009-2010 are presented in Table 3. As expected, the results were not inconsistent with those presented by the Unite States Census (2014), suggesting that the sample was representative of the general United States population. Accordingly, findings from this study are likely generalizable to the United States population.

Table 3

Sample Size by Race/Ethnicity, NHANES 2009-2010

Population	Weighted Count	% of Total
Mexican American	18,821,934	8.6%
Other Hispanic	11,011,080	5.0%
All Hispanic[a]	29,833,014	13.6%
Non-Hispanic White	148,782,914	67.9%
Non-Hispanic Black	24,948,524	11.4%
Other Race – Including Multi Racial	15,521,688	7.1%
Total	219,086,139	100%

Note. Weighted counts are estimates.
[a]All Hispanic is the combination of Mexican American and Other Hispanic

Results

Data were analyzed using the Complex Sample procedures in SPSS to account for the complex, multistage sampling procedures used in NHANES data collection (i.e., to account for primary sampling units (PSU), strata, and mobile examination center (MEC) weights).

Sample Description

Descriptive demographic, acculturation, health behavior, and inflammation indicators among the Mexican American, Other Hispanic, and All Hispanic samples are presented in Tables 4, 5, 6, and 7. These populations were largely 24 to 44 years of age, at or above the PIR, less than college educated, speaking Spanish at home, and citizens of the United States but born elsewhere. In addition, the majority had resided in the United States for more than 10 years, were overweight or obese, were not currently smoking cigarettes, and had low to normal C-reactive protein levels and white blood cell counts.

Table 4

Demographics by Hispanic Race/Ethnicity

	Mexican American	Other Hispanic	All Hispanic
Gender			
Weighted count	18,821,934	11,011,080	29,833,014
Male	53%	49%	51%
Age, years			
Weighted count	18,821,934	11,011,080	29,833,014
20-24	15%	12%	14%
25-44	49%	50%	49%
45-54	17%	20%	18%
55-64	10%	8%	9%
65+	9%	9%	9%
PIR[a]			
Weighted count	16,355,584	9,157,515	25,513,099
Below	34%	34%	34%
Normal and above	66%	66%	66%
Education			
Weighted count	18,794,937	10,973,804	29,768,741
<9th grade	34%	17%	28%
9-11th grade	20%	17%	19%
High school/GED	20%	20%	20%
Some college	19%	31%	23%
College or above	7%	16%	10%

Notes. Weighted counts are estimates. Values are rounded.
[a]Poverty to income ratio

Table 5

Acculturation Indicators by Hispanic Race/Ethnicity

	Mexican American	Other Hispanic	All Hispanic
Language at home			
Weighted count	16,059,283	9,168,025	25,227,308
Only Spanish + more Spanish than English	72%	64%	69%
Only English + more English than Spanish	28%	36%	31%
Language of interview			
Weighted count	18,821,934	11,011,080	29,833,014
English	45%	52%	48%
Spanish	55%	48%	52%
Country of birth			
Weighted count	18,821,934	10,749,529	29,571,462
United States	39%	33%	36%
Mexico/Other Spanish speaking country	61%	67%	63%
Citizenship status			
Weighted count	18,660,985	10,950,310	29,611,295
Citizen	53%	61%	56%
Not a citizen	48%	39%	44%
Years in the United States			
Weighted count	10,673,389	6,912,906	17,586,294
Less than 10	30%	35%	32%
10 or more	70%	65%	68%

Notes. Weighted counts are estimates. Values are rounded.

Table 6

Health Behavior Measures by Hispanic Race/Ethnicity

	Mexican American	Other Hispanic	All Hispanic
Body mass index			
Weighted count	18,737,900	10,960,530	29,698,430
Underweight	<1%	<1%	<1%
Normal	19%	27%	22%
Overweight	40%	38%	39%
Obese	40%	35%	38%
Current cigarette smoking			
Weighted count	16,254,212	9,638,359	25,892,572
Yes	20%	18%	20%
No	80%	82%	80%

Notes. Weighted counts are estimates. Values are rounded.

Table 7

Inflammation Measures by Hispanic Race/Ethnicity

	Mexican American	Other Hispanic	All Hispanic
C-reactive protein			
Weighted count	17,856,772	10,496,029	28,352,801
0.01-0.34 mg/dL (Low/average)	68%	72%	69%
0.35-1.44 mg/dL (High)	28%	23%	26%
≥1.45 mg/dL (Very high)	5%	5%	5%
White blood cells			
Weighted count	17,850,200	10,545,579	28,395,779
≤10.5 x 10^3 cells per μL (Low/average)	93%	94%	93%
≥10.6 x 10^3 cells per μL (High)	7%	6%	7%

Notes. See text for details regarding inflammation measures. Weighted counts are estimates. Values are rounded.

Prevalence of Depression

In order to determine if depression and depression severity were different among Hispanics compared with other race/ethnicities (Research Question 1), prevalence estimates and 95 percent confidence intervals were generated. Results are presented in Table 8. Findings indicated an increased prevalence of depression among All Hispanics (43.4%) compared with non-Hispanic Whites (35.4%). The prevalence of depression among Mexican Americans (43.7%) and Other Hispanics (42.8%) also trended higher compared with non-Hispanics Whites (35.4%). Similarly, the prevalence of moderately severe to severe depression among All Hispanics (19.1%), Mexican Americans (15.5%), and Other Hispanics (19.1%) trended higher compared with non-Hispanic Whites (13.5%).

Chi square test for independence was applied to determine if an association existed between race/ethnicity and depression (yes versus no) and/or depression severity (mild to moderate versus moderately severe to severe). A significant association between race/ethnicity and depression and depression severity was identified. This occurred for both depression (chi-square = 21.96, $p = 0.003$) and depression severity (chi-square = 14.30, $p = 0.020$) when Hispanics were evaluated as Mexican American and Other Hispanics, as well as for both depression (chi-square = 21.92, $p = 0.003$) and depression severity (chi-square = 13.74, $p = 0.007$) when Hispanics were recoded and evaluated as All Hispanics (Table 8).

Table 8

Depression Estimates (95% Confidence Intervals) by Race/Ethnicity

	Mexican American	Other Hispanic	All Hispanic	Non-Hispanic White	Non-Hispanic Black	Other Race Incl. Multi Race	*p*-value[a]
Depression[d]							
Yes	43.7% (38.8-48.8)	42.8% (36.7-49.1)	43.4% (39.1-47.7)	35.4% (32.1-38.9)	43.0% (38.5%-47.7)	45.7% (37.4-54.3)	0.003
No	56.3% (51.2-61.2)	57.2% (50.9-63.3)	56.6% (52.3-60.9)	64.6% (61.1-67.9)	57.0% (52.3-61.5%)	54.3% (45.7-62.6)	Ref
Weighted Count	10,621,127	6,710,334	17,331,461	90,145,433	13,766,266	7,379,573	
Depression[e]							
Mild-Moderate	84.5% (77.2-89.8)	80.9% (71.8-87.5)	83.1% (80.6-85.4)	86.5% (83.5-89.0)	78.1% (72.6-82.8)	92.9% (82.7-97.3)	Ref.
Moderately Severe-Severe	15.5% (10.2-22.8)	19.1% (12.5-28.2)	16.9% (14.6-19.4)	13.5% (11.0-16.5)	21.9% (17.2-27.4)	7.1% (2.7-17.3)	0.020[b]/ 0.007[c]
Weighted Count	4,646,147	2,871,276	7,517,422	31,930,942	5,923,037	3,372,209	

Notes. Ref., reference.

[a]Chi-square test for independence

[b]For analysis, race/ethnicity stratifications included non-Hispanic White, non-Hispanic Black, Mexican American, Other Hispanic, and Other Race Incl. Multi Race

[c]For analysis, race/ethnicity stratifications included non-Hispanic White, non-Hispanic Black, All Hispanic, and Other Race Incl. Multi Race

[d]Depression was measured by the nine item Patient Health Questionnaire. A score of 0 to 4 was defined as No and a score of 5 to 27 was defined as Yes.

[e]Depression was measured by the nine item Patient Health Questionnaire. A score of 5 to 14 was defined as Mild to Moderate and a score of 15 to 27 was defined as Moderately Severe to Severe.

Depression (Yes Versus No) – All Hispanics

Bivariate logistic regression – depression (yes versus no), All Hispanics. Bivariate (BV) logistic regression was performed for the five indicators of acculturation (i.e., citizenship, country of birth, language of interview, length of time in the United States, language spoken at home) to assess the possibility of statistical associations with depression, yes versus no, among All Hispanics (Research Question 2). Wald chi-square analyses indicated that country of birth was statistically significantly associated with depression among All Hispanics (Table 9). In particular, among All Hispanics, individuals born in Mexico or another Spanish speaking country had statistically significantly decreased odds of depression. No other statistical associations were observed between acculturation and depression among All Hispanics in BV analyses.

Multivariate logistic regression – depression (yes versus no), All Hispanics. For each of the five acculturation indicators, multivariate (MV) logistic regression of depression was performed including the six potentially confounding variables (i.e., age, gender, BMI, PIR, education, and current cigarette smoking) among All Hispanics (Research Question 2; Table 9). For four of the five acculturation indicators (i.e., citizenship, country of birth, language of interview, and language spoken at home), the odds of depression was statistically significantly decreased ($p<0.05$) among less acculturated All Hispanics in the MV analyses (Table 9). In particular, among All Hispanics, individuals who were not citizens of the United States had a statistically significantly decreased odds of depression compared with citizens of the United States; individuals born in Mexico or another Spanish speaking country had statistically

significantly decreased odds of depression compared with individuals born in the United States; individuals who performed the interview in Spanish versus English had statistically significantly decreased odds of depression; and individuals who spoke Spanish at home had statistically significantly decreased odds of depression compared with individuals who spoke English at home.

Table 9

Odds Ratios and 95% Confidence Intervals for Bivariate and Multivariate Logistic Regression Models of Acculturation and Depression, Among All Hispanics

	Bivariate	Multivariate				
Acculturation Indicator	OR (95% CI), Depression (Yes versus No)					
US Citizen	Ref.	Ref.	--	--	--	--
Not US Citizen	0.839 (0.646, 1.09) *p*=0.155	0.768 (0.590, 1.00) *p*=0.034	--	--	--	--
Country of Birth US	Ref.	--	--	--	Ref.	--
Country of Birth Mexico/ Other Spanish	0.777 (0.621, 0.973) *p*=0.018	--	--	--	0.662 (0.481, 0.911) *p*=0.006	--
Length of time in US ≥10 yrs.	Ref.	--	--	Ref.	--	--
Length of time in US <10 yrs.	0.890 (0.601, 1.32) *p*=0.528	--	--	0.859 (0.551, 1.34) *p*=0.470	--	--
Interview English	Ref.	--	Ref.	--	--	--
Interview Spanish	0.955 (0.739, 1.23) *p*=0.700	--	0.737 (0.558, 0.974) *p*=0.020	--	--	--
Language at home English	Ref.	--	--	--	--	Ref.
Language at home Spanish	0.796 (0.618, 1.02) *p*=0.055	--	--	--	--	0.694 (0.483, 0.996) *p*=0.032

Notes. Ref., reference; --, not included in model. Multi-variate models included age, gender, body mass index, current cigarette smoking, poverty to income ratio, and education.

For those acculturation indicators for which a statistically significant association was observed with depression, the potential mediating effect of inflammation, as measured by C-reactive protein levels and white blood cells counts, was evaluated by including these variables in the models (Table 10). Findings from these analyses indicated no mediating effect of inflammation on the relationship between acculturation and depression, as no change in the magnitude of the association was observed (Research Question 3).

Table 10

Evaluation of Mediating Effects of Inflammation: Odds Ratios and 95% Confidence Intervals for Multivariate Logistic Regression Models of Acculturation and Depression Among All Hispanics

Acculturation Indicator	OR (95% CI), Depression (Yes versus No)			
US Citizen	Ref.	--	--	--
Not US Citizen	0.765 (0.585, 1.00) *p*=0.034	--	--	--
Country of Birth US	--	--	Ref.	--
Country of Birth Mexico/ Other Spanish	--	--	0.664 (0.474, 0.931) *p*=0.010	--
Interview English	--	Ref.	--	--
Interview Spanish	--	0.715 (0.532, 0.962) *p*=0.017	--	--
Language at home English	--	--	--	Ref.
Language at home Spanish	--	--	--	0.683 (0.481, 0.970) *p*=0.021

Notes. Ref., reference; --, not included in model. Multivariate models included age, gender, body mass index, current cigarette smoking, poverty to income ratio, education, C-reactive protein, white blood cells.

For those acculturation indicators for which a statistically significant association was observed with depression, the potential moderating effect of inflammation, as measured by C-reactive protein levels and white blood cells counts, was also evaluated

by examining the interaction between acculturation and inflammation. The interactions between the acculturation indicators citizenship status, country of birth, and language spoke at home and inflammation (C-reactive protein level and white blood cell counts) were not significant ($p>0.05$), so these interaction terms were not retained and thus inflammation did not moderate these relationships. In these instances, there was no evidence of a moderating effect of inflammation on the relationship between acculturation and depression. The interaction between language of interview and white blood cell counts was not significant ($p>0.05$) so this interaction term was not retained; however, the interaction between language of interview and C-reactive protein level was significant ($p= 0.027$), so this interaction term was retained in the model (Table 11). Findings from this analysis indicated the relationship between acculturation, as measured by language of interview, and depression was no longer statistically significant, and a moderating effect of inflammation was suggested.

Table 11

Evaluation of Moderating Effects of Inflammation: Odds Ratios and 95% Confidence Intervals for Multivariate Logistic Regression Models of Acculturation and Depression, among All Hispanics

Acculturation Indicator	OR (95% CI), Depression (Yes versus No)
Interview English	Ref.
Interview Spanish	1.28 (0.701, 2.35)
	p=0.395

Notes. Ref., reference; --, not included in model. Multivariate models included age, gender, body mass index, current cigarette smoking, poverty to income ratio, education, C-reactive protein, and interaction of language of interview and C-reactive protein.

Depression (Yes Versus No) – Mexican Americans

Bivariate logistic regression – depression (yes versus no), Mexican Americans. BV logistic regression was performed for each of the five indicators of acculturation to assess the possibility of statistical association with depression, yes versus no, among Mexican Americans (Research Question 2). Wald chi-square analyses indicated that no acculturation indicators were statistically significantly associated with depression among Mexican Americans in BV analyses (Table 12).

Multivariate logistic regression – depression (yes versus no), Mexican Americans. For each of the five acculturation indicators, MV logistic regression was performed on depression (yes versus no) including the potentially confounding variables (i.e., age, gender, BMI, PIR, education, and current cigarette smoking) among Mexican Americans (Research Question 2). For one of the five acculturation indicators, language of interview, the odds of depression was statistically significantly decreased (p<0.05) among less acculturated Mexican Americans (Table 12). That is, individuals who performed the interview in Spanish versus English had decreased odds of depression.

Table 12

Odds Ratios and 95% Confidence Intervals for Bivariate and Multivariate Logistic Regression Models of Acculturation and Depression Among Mexican Americans

	Bivariate	Multivariate
Acculturation Indicator	OR (95% CI), Depression (Yes versus No)	
US Citizen	Reference	--
Not US Citizen	0.956 (0.756, 1.21) *p*=0.687	--
Country of Birth US	Reference	
Country of Birth Mexico/ Other Spanish	0.821 (0.605, 1.11) *p*=0.169	--
Length of time in US ≥10 yrs.	Reference	--
Length of time in US <10 yrs.	0.971 (0.526, 1.80) *p*=0.920	--
Interview English	Reference	Reference
Interview Spanish	0.887 (0.673, 1.17) *p*=0.354	0.694 (0.473, 1.02) *p*=0.043
Language at home English	Reference	--
Language at home Spanish	0.808 (0.479, 1.36) *p*=0.385	--

Notes. --, not included in model. Multivariate model included age, gender, body mass index, current cigarette smoking, poverty to income ratio, and education; only multivariate models with statistically significant results are presented.

For the one acculturation indicator for which a statistically significant association was observed with depression, the potential mediating effect of inflammation, as measured by C-reactive protein levels and white blood cells counts, was evaluated by including these variables in the model (Table 13). Findings from this analysis indicated no mediating effect of inflammation on the relationship between acculturation and depression, as no change in the magnitude of the effect was observed (Research Question 3).

Table 13

Evaluation of Mediating Effects of Inflammation: Odds Ratio and 95% Confidence Intervals for Multivariate Logistic Regression Model of Acculturation and Depression Among Mexican Americans

Acculturation Indicator	OR (95% CI), Depression (Yes versus No)
Interview English	Reference
Interview Spanish	0.667 (0.459, 0.969)
	p=0.022

Notes. Multivariate model included age, gender, body mass index, current cigarette smoking, poverty to income ratio, education, C-reactive protein and white blood cell counts.

For the one acculturation indicator for which a statistically significant association was observed with depression, the potential moderating effect of inflammation, as measured by C-reactive protein levels and white blood cells counts, was also evaluated by examining the interaction between acculturation and inflammation. The interaction between language of interview and white blood cell count was not significant (p>0.05), so this interaction term was not retained; however, the interaction between language of interview and C-reactive protein was significant (p= 0.034), so this interaction term was retained. Findings from this analysis indicated the relationship between acculturation, as measured by language of interview, and depression was no longer statistically significant, and a moderating effect of inflammation was suggested (Table 14).

Table 14

Evaluation of Moderating Effects of Inflammation: Odds Ratio and 95% Confidence Intervals for Multivariate Logistic Regression Model of Acculturation and Depression Among Mexican Americans

Acculturation Indicator	OR (95% CI), Depression (Yes versus No)
Interview English	Reference
Interview Spanish	1.17 (0.596, 2.29) *p*=0.630

Notes. Multivariate model included age, gender, body mass index, current cigarette smoking, poverty to income ratio, education, C-reactive protein, and interaction of language of interview and C-reactive protein

Depression (Yes Versus No) – Other Hispanics

Bivariate logistic regression – depression (yes versus no), Other Hispanics. BV logistic regression was performed for each of the five indicators of acculturation to assess the possibility of statistical associations with depression, yes versus no, among Other Hispanics (Research Question 2). Wald chi-square analyses indicated that no measures of acculturation were statistically significantly associated with depression among Other Hispanics in BV analyses (Table 15).

Multivariate logistic regression – depression (yes versus no), Other Hispanics. For each of the five acculturation indicators, MV logistic regression was performed on depression, yes versus no, including the potentially confounding variables (i.e., age, gender, BMI, PIR, education, and current cigarette smoking) among Other Hispanics (Research Question 2). For two of the five acculturation indicators, citizenship and country of birth, the odds of depression was statistically significantly decreased

($p<0.05$) among less acculturated Other Hispanics (Table 15). That is, among Other Hispanics, individuals who were not citizens of the United States had a statistically significantly decreased odds of depression compared with citizens of the United States; and individuals born in Mexico or another Spanish speaking country had statistically significantly decreased odds of depression compared with individuals born in the United States.

Table 15

Odds Ratios and 95% Confidence Intervals for Bivariate and Multivariate Logistic Regression of Acculturation and Depression Other Hispanics

	Bivariate	Multivariate	
Acculturation Indicator	OR (95% CI), Depression (Yes versus No)		
US Citizen	Reference	Reference	--
Not US Citizen	0.661 (0.404, 1.08) *p*=0.076	0.563 (0.310, 1.02) *p*=0.042	--
Country of Birth US	Reference	--	Reference
Country of Birth Mexico/ Other Spanish	0.709 (0.463, 1.09) *p*=0.088	--	0.548 (0.292, 1.03) *p*=0.044
Length of time in US ≥10 yrs.	Reference	--	--
Length of time in US <10 yrs.	0.790 (0.496, 1.26) *p*=0.282	--	--
Interview English	Reference	--	--
Interview Spanish	1.07 (0.770, 1.49) *p*=0.659	--	--
Language at home English	Reference	--	--
Language at home Spanish	0.769 (0.494, 1.20) *p*=0.207	--	--

Notes. --, not included in model. Multivariate models included age, gender, body mass index, current cigarette smoking, poverty to income ratio, education; only multivariate models with statistically significant results are presented.

To evaluate potential mediating effects of inflammation, additional MV logistic regression analyses, which included inflammation, as measured by C-reactive protein levels and white blood cells counts, were conducted for both citizenship and country of birth because these indicator were statistically significantly associated with depression. Findings from these analyses indicated no mediating effect of inflammation on the relationship between acculturation, as measured by citizenship and country of birth, and depression among Other Hispanics, as no change in the magnitude of the association was observed (Table 16; Research Questions 3).

Table 16

Evaluation of Mediating Effects of Inflammation: Odds Ratios and 95% Confidence Intervals for Multivariate Logistic Regression of Acculturation and Depression Among Other Hispanics

Acculturation Indicator	OR (95% CI), Depression (Yes versus No)	
US Citizen	Reference	--
Not US Citizen	0.531 (0.276, 1.02) *p*=0.041	--
Country of Birth US	--	Reference
Country of Birth Mexico/ Other Spanish	--	0.548 (0.275, 1.09) *p*=0.065

Notes. --, not included in model. Multivariate models included age, gender, body mass index, current cigarette smoking, poverty to income ratio, education, C-reactive protein, and white blood cell counts

For the two acculturation indicators with a statistically significant relationship with depression, additional analyses were also conducted to evaluate the potential moderating effect of inflammation, as measured by C-reactive protein and white blood cell counts. For citizenship status, the interaction with inflammation was not significant ($p>0.05$), so these interaction terms were not retained, and thus inflammation did not moderate this relationship. For country of birth, interaction with C-reactive protein was not significant, so this term was not retained; however, the interaction between country of birth and white blood cells was significant ($p=0.034$), and this interaction term was retained (Table 17). Findings from this analysis indicated the relationship between acculturation, as measured by country of birth, and depression was no longer statistically significant, and a moderating effect of inflammation was suggested.

Table 17

Evaluation of Moderating Effects of Inflammation: Odds Ratios and 95% Confidence Intervals for Multivariate Logistic Regression of Acculturation and Depression Among Other Hispanics

Acculturation Indicator	OR (95% CI), Depression (Yes versus No)
Country of Birth US	Reference
Country of Birth	0.228 (0.037, 1.42)
Mexico/ Other Spanish	$p=0.106$

Notes. --, not included in model. Multivariate models included age, gender, body mass index, current cigarette smoking, poverty to income ratio, education, white blood cell count, interaction of country of birth and white blood cell count.

Depression Severity – All Hispanics

Bivariate logistic regression – depression severity, All Hispanics. BV logistic regression was performed for each of the five indicators of acculturation to assess the possibility of statistical associations with depression severity (i.e., moderately severe to severe versus mild to moderate) among All Hispanics (Research Question 2). Wald chi-square analyses indicated that length of time in the United States (i.e., less than 10 years versus greater than or equal to 10 years) was statistically significantly associated (chi-square = 4.08, $p = 0.043$) with decreased odds of moderately severe to severe depression among All Hispanics (OR [95% CI] = 0.543 [0.283, 1.04]).

Multivariate logistic regression – depression severity, All Hispanics. For each of the five acculturation indicators, MV logistic regression was performed including the potentially confounding variables (i.e., age, gender, BMI, PIR, education, and current cigarette smoking) on depression severity among All Hispanics (Research Question 2). None of the acculturation indicators was statistically significantly associated with depression severity among All Hispanics in MV analyses. Because none of these relationships was significant, no additional analyses regarding the potential mediating and/or moderating effect of inflammation on the relationship between acculturation and depression severity were conducted (Research Question 4).

Depression Severity – Mexican Americans

Bivariate logistic regression – depression severity, Mexican Americans. BV logistic regression was performed for each of the five indicators of acculturation to assess the possibility of statistical associations with depression severity among Mexican

Americans. Among Mexican Americans, no acculturation measure was statistically significantly associated with depression severity in BV analyses (Research Question 2).

Multivariate logistic regression – depression severity, Mexican Americans. For each of the five acculturation indicators, MV logistic regression of depression severity was performed including the potentially confounding variables (i.e., age, gender, BMI, PIR, education, and current cigarette smoking) among Mexican Americans (Research Question 2). None of the acculturation indicators was statistically significantly associated with depression severity among Mexican Americans in MV analyses. Because none of these relationships was significant, no additional analyses regarding the potential mediating and/or moderating effect of inflammation on the relationship between acculturation and depression severity were conducted (Research Question 4).

Depression Severity – Other Hispanics

Bivariate logistic regression – depression severity, Other Hispanics. BV logistic regression was performed for each measure of acculturation to assess the possibility of statistical associations with depression severity among Other Hispanics (Research Question 2). Wald chi-square analyses indicated that none of the acculturation measures were statistically significantly associated with depression severity among Other Hispanics.

Multivariate logistic regression – depression severity, Other Hispanics. For each of the five acculturation indicators, MV logistic regression of depression severity was performed including the potentially confounding variables (i.e., age, gender, BMI, PIR, education, and current cigarette smoking) among Other Hispanics (Research

Question 2). None of the acculturation indicators was statistically significantly associated with depression severity among Other Hispanics in MV analyses (Research Question 2). Because none of these relationships was significant, no additional analyses regarding the potential mediating and/or moderating effect of inflammation on the relationship between acculturation and depression severity were conducted (Research Question 4).

Summary

Results from these analyses indicated differences in the prevalence and severity of depression among Hispanics compared with individuals of other race/ethnicities (Research Question 1). Specifically, the prevalence of depression was higher among All Hispanics, Mexican Americans, and Other Hispanics compared with non-Hispanic Whites, based on this sample from NHANES 2009-2010. Additionally, these data indicated a higher prevalence of moderately severe to severe depression compared with the prevalence of mild to moderate depression among All Hispanics, Mexican Americans, and Other Hispanics compared with non-Hispanic Whites in this sample.

Some acculturation indicators were statistically significantly associated with depression among different subsets of Hispanics in MV analyses controlling for confounders (Research Question 2). In particular, less acculturation was associated with decreased odds of depression for the following: among All Hispanics, citizenship, country of birth, language of interview, and language spoken at home; among Mexican Americans, language of interview; among Other Hispanics, citizenship and country of birth. Additional multivariate analyses conducted to evaluate the potential mediating

effect of inflammation, as measured by C-reactive protein and white blood cells, on the relationship between acculturation and depression indicated no mediating effect of inflammation (Research Question 3). Additional multivariate analyses were also conducted to evaluate the potential moderating effect of inflammation on the relationship between acculturation and depression, and these analyses suggested some potential moderating effects when acculturation was evaluated as language of interview among All Hispanics and Mexican Americans, and when acculturation was evaluated as country of birth among Other Hispanics.

None of the acculturation indicators was statistically significantly associated with depression severity among All Hispanics in MV analyses controlling for confounders (Research Question 2). Because none of these associations was statistically significant, no additional analyses were conducted to evaluate the mediating and/or moderating effect of inflammation on the relationship between acculturation and depression severity (Research Question 4).

The next chapter, Chapter 5, will discuss and interpret the findings presented herein in the context of public health and medical practice and the potential for social change. In particular, Chapter 5 will provide recommendations for future research and implications of this research for social change.

Chapter 5: Discussion, Conclusions, and Recommendations

Introduction

The purpose of this study was three-fold: 1) to assess the prevalence and severity of depression by race/ethnicity in the United States; 2) to clarify the inconsistencies in the literature regarding the relationship between acculturation and depression among Hispanic adults in the United States; and 3) to fill a gap in the literature by quantitatively evaluating whether inflammation mediates the relationship between acculturation and depression among Hispanic adults in the United States. Based on data from NHANES 2009-2010, results of this study indicated that the prevalence of depression and depression severity was higher among All Hispanics, Mexican Americans, and Other Hispanics, as compared with non-Hispanic Whites in the United States (Objective 1). For Objective 2, distinct results were found for different subpopulations: among All Hispanics, lower acculturation was associated with decreased odds of depression for four of five acculturation indicators; among Mexican Americans, for one of the five acculturation indicators, lower acculturation was associated with decreased odds of depression; and among Other Hispanics, for two of the acculturation indicators, lower acculturation was associated with decreased odds of depression.

When inflammation was evaluated for any mediating effect on the statistical relationship between acculturation and depression among any Hispanic subgroup (i.e., All Hispanics, Mexican Americans, and Other Hispanics), no mediating effect of inflammation was observed (Objective 3). Finally, none of the acculturation indicators was associated with depression severity among any Hispanic subgroup. Accordingly,

because no statistical association was observed between acculturation and depression severity, no further analyses to understand the effect of inflammation on acculturation and depression severity were conducted (Objectives 2 and 3).

Interpretation of the Findings

The results from this study indicate a higher prevalence of depression and severe depression among Hispanics compared with non-Hispanic Whites. These findings are generally consistent with the literature. However, the depression prevalence findings in this study were substantially higher than what has been observed previously among all race/ethnicity subgroups (Gonzalez et al., 2010; Reeves et al., 2011). The general trends in the findings, however, are consistent with what have been reported earlier. This discrepancy in the actual prevalence estimates by race/ethnicity between this study and what has been published previously is possibly attributed to the relatively large proportion of missing values (40-70%) for the depression outcome variable in this study, which was a likely source of quantitative bias. Additionally, this discrepancy in prevalence estimates might be attributed to different methods of depression measurement (i.e., PHQ-9 in this study versus PHQ-8 in some previous reports) and/or different interpretations of the PHQ scores (i.e., depression indicated by PHQ >5 versus PHQ >10).

The literature review for this study showed that reported findings in the literature regarding the relationship between acculturation and depression among Hispanic adults are inconsistent. In particular, identified studies have generally indicated increased acculturation to be associated with increased depression among Hispanic adults when a

statistical relationship was observed. However, no statistical association was observed in many earlier studies. The inconsistent findings in the literature might be attributed to study design differences (e.g., sampling methodologies) and/or differences in how acculturation and/or depression were measured. Similar to what has generally been observed in the literature, the current analyses indicated a potentially protective effect of lower acculturation; that is, results of this study consistently indicated that lower acculturation was associated with decreased odds of depression. This finding was observed among all three subgroups of Hispanics (i.e., All Hispanics, Mexican Americans, and Other Hispanics), and to varying degrees, with different indicators of acculturation. These findings extend the existing knowledge regarding the statistical relationship between acculturation and depression among Hispanic adults in the United States. In comparison with other previously conducted studies available in the literature, a strength of this study is its nationally representative sample and relatively large sample size.

In the context of the broader research topic of acculturation and health and/or health behaviors, the potentially protective effect of lower acculturation associated with depression is not inconsistent with previous research. Lara et al.'s (2005) literature review suggested that increased acculturation was more often associated with negative effects on health behaviors such as nutrition and substance abuse. Similarly, Abraido-Lanza, Chao, and Florez (2005) reported that higher acculturation among Latinos was associated with unhealthy behavior indicators including, higher body mass, current smoking, and greater likelihood of alcohol consumption. Campos, Podus, Anglin, and

Warda (2008) reported that low acculturation was associated with a lower risk of substance abuse problem among a sample of Latino females in California. Acevedo-Garcia, Soobader, and Berkman (2007) also reported a protective effect of low acculturation on birth weight among Latino females in the United States. Finally, qualitative research among first and second generation Mexican immigrant females in the United States suggested that there was a more pronounced *othering* effect on the second, more acculturated generation compared with the first, less acculturated generation (Viruell-Fuentes, 2007).

According to Viruell-Fuentes (2007) "findings point to 'othering' and discrimination as potential pathways through which the health of immigrants and their descendants erodes" (p. 1524). Thus, these findings from the literature are consistent with the outcomes from this study indicating lower acculturation associated with lower odds of depression. It has been suggested that Hispanic cultural norms, including social networks, are responsible for these differences in health behaviors and health outcomes (Abraido-Lanza et al., 2005; Viruel-Fuentes, 2007). Thus, Hispanics cultural norms, including social networks, may have a protective effect on health and/or health behavior, and specific to this study and these findings, Hispanic cultural norms may have a protective effect on the outcome of depression.

In this study, a statistical relationship was observed between acculturation and depression when depression was classified as yes versus no, but not when depression was classified as mild to moderate versus moderately severe to severe. This result is possibly due to sample size limitations when the sample was stratified into the mild to moderate

versus moderately severe to severe categories. In particular, within depression, the majority (i.e., greater than 80%) of individuals were classified as mild to moderate within each Hispanic subgrouping (i.e., All Hispanics, Mexican Americans, and Other Hispanics). Thus, the proportion of individuals in the moderately severe to severe depression group was less than 20%, which resulted in a relatively small number of valid responses (i.e., 31 to 76 depending on the Hispanic subgrouping). Thus, these analyses were likely underpowered potentially resulting in a lack of statistical relationship.

No literature was identified that addressed the potential mediating effect of inflammation, specifically the biomarkers of inflammation C-reactive protein and white blood cells, on the relationship between acculturation and depression. The findings from the current study consistently demonstrated no mediating effect of inflammation on the relationship between acculturation and depression (yes versus no), when the relationship between acculturation and depression was statistically significant. This lack of mediating effect (Baron & Kenny, 1986) indicates there is no evidence that the relationship between acculturation and depression is explained by inflammation, as measured by C-reactive protein levels and white blood cell counts. As such, these findings suggest that there is no pathway between acculturation to depression through inflammation. That is, it may not be, as originally proposed, that acculturation leads to stress, stress is associated with inflammation (Black & Garbutt, 2002), and inflammation is linked with depression (Almond, 2013).

Additional analyses were conducted to evaluate the potential for moderating effects of inflammation on the statistical relationship between acculturation and

depression. Although generally the findings indicated no moderating effect of inflammation of the relationship between acculturation and depression (yes versus no), there were a few instances of a moderating effect. Among All Hispanics and Mexican Americans, when acculturation was measured by language of interview, a significant interaction was observed between inflammation (i.e., C-reactive protein levels) and acculturation. This interaction resulted in an attenuation of the statistical relationship between acculturation and depression, such that the relationship was no longer significant.

Similarly, among Other Hispanics, when acculturation was measured by country of birth, an interaction was observed between inflammation (i.e., white blood cell counts) and acculturation. This interaction resulted in an attenuation of the statistical relationship between acculturation and depression, such that the relationship was no longer significant. In these instances, the apparent moderating effect (Baron & Kenny, 1986) of inflammation indicated a differential relationship between acculturation and depression by categories of inflammation. In other words, the protective effect of lower acculturation on odds of depression disappears at different levels of inflammation.

Additionally, these findings suggest that certain indicators of acculturation may be differentially affected by inflammation, given the effect was observed for some acculturation indicators but not others, which is possibly due to inherent differences in each acculturation indicator. Notably, instances of interaction between inflammation and acculturation were not consistently observed, and it is possible that these few occurrences were due to chance alone. The more consistent lack of moderating effects of

inflammation on the relationship between acculturation and depression would indicate no differential relationship between acculturation and depression by categories of inflammation. It is unclear as to why the relationship between acculturation and depression would be differentially affected by different levels of inflammation.

In the context of the biopsychosocial model, these findings are consistent with the biopsychosocial model regarding the understanding of depression among Hispanic adults in the United States. Specifically, although these findings did not support a mediating effect of inflammation (the biological component) on the relationship between acculturation (the psychosocial component) and depression, some suggestion of a moderating effect was observed, supporting the application of the biopsychosocial model. Additionally, it is possible that inflammation and/or inflammation measured by C-reactive protein concentration and white blood cell counts are not the best biological explanatory indicators for the relationship between acculturation and depression. More research is needed in this area to determine if other biological pathways and/or other markers of inflammation (e.g., cytokines) are more specific for mediating the relationship between acculturation and depression.

Limitations of the Study

Limitations of the study include the cross-sectional design, the use of proxy measures for acculturation, the combining of Hispanics into All Hispanics in some analyses, and the large amount of missing data related to the main outcome variable of interest, depression.

Cross-sectional study designs capture point-in-time or time-bounded information. Thus, the cross-sectional nature of this study imposes a limitation insofar as conclusions regarding the direction and temporality of the identified association between acculturation and depression cannot be determined. Additionally, the internal validity of the study is somewhat compromised due to the cross-sectional nature of the study design, although control for relevant covariates upon statistical analysis minimized some of this threat to internal validity. Additionally, it is notable that in the context of research on acculturation, it has been previously suggested that cross-sectional designs "fail to describe changes in values or practices occurring over time and across differing contexts and environments" (Lopez-Class et al., 2011, p. 1557), a potentially necessary component of acculturation.

The use of proxy measures of acculturation may additionally be viewed as a limitation of this study. Regarding the use of proxy measures for acculturation, Thomson and Hoffman-Goetz (2009) have suggested that the "[u]se of … [proxy] measures without consideration of other factors may produce misleading results" (p. 988). However, Thomson and Hoffman-Goetz have also stated that "[t]here is currently no gold standard measure of acculturation; several proxies exist that may assess different constructs of the multidimensional process" (p. 2386). The fact that in this study multiple proxies of acculturation were independently statistically significantly associated with a decreased odds of depression provides confidence in the reliability of the findings.

In some analyses presented herein, Mexican Americans and Other Hispanics were combined into a group of All Hispanics. Evaluating as one homogenous group the

diverse subgroups of cultures considered Hispanic in the United States (e.g., Mexican, Puerto Rican, Central American, South American), may be viewed as a limitation of certain analyses of this study. According to Siatkowski (2007), "Hispanic culture in the United States consists of diverse subcultures, including individuals from Mexico, Central America, parts of the Caribbean (Cuba, Dominican Republic, and Puerto Rico), and most of South America" (p. 317). Thus, it may not be appropriate to group these individuals within one group deemed "Hispanics," in particular if there is a differential effect of the relationship among acculturation and depression by Hispanic subpopulation. Previous research on acculturation and depression has indicated differences among heterogeneous Hispanic subpopulations (e.g., Puerto Rican, Central American, South American; Green et al., 2010; Sanchez et al., 2014), and Lara et al. (2005) have reported "important indicators of population health vary among Latinos of Mexican, Puerto Rican, Cuban, and other Latino origin or cultural heritage" (p. 368). However, others have noted that although differences likely exist across these Hispanic subcultures, similarities such as language, history, and health/sickness perceptions exist (Siatkowski, 2007). In the United States, the largest subgroup of Hispanics is Mexican, estimated to be 64% in 2012. In addition,

- 9% are Puerto Rican,
- 4% are Cuban,
- 4% are Salvadoran,
- 3% are Dominican,
- 2% are Guatemalan,

- and 14% are “Other” (CDC, 2014b).

According to the United States Census Bureau (2011), this “Other” category can be further stratified into

- approximately 1% of each of the following: Columbians, Spaniards, Ecuadorians, Peruvians, and Hondurans;
- less than 1% of each of the following: Argentinians, Bolivians, Chileans, Uruguayans, Venezuelans, Costa Ricans, Nicaraguans, and Panamanians;
- and approximately 7% not otherwise specified.

Consistent with the largest subgroup of Hispanics in the United States being Mexican, these analyses were able to stratify by that specific Hispanic subgrouping, which provides confidence in the overall findings.

Finally, an additional limitation of this study is the relatively large amount of missing data for the main outcome variable of depression. Specifically, 44% of depression responses were missing among the Mexican American subgroup and 66% of depression responses were missing among the Other Hispanic subgroup. Missing data have the potential to bias results (Sterne et al., 2009), which might have occurred in this study. In particular, although depression prevalence numeric trends by race/ethnicity were consistent with what has been previously observed and reported in the literature (Gonzalez et al., 2010; Reeves et al., 2011), the actual quantitative values were higher. Missing data also potentially can lead to a loss of precision and a loss of statistical power (Sterne et al., 2009). Notably, 621 valid responses were available for Mexican Americans and 371 valid responses were available for Other Hispanics in this study, and

these sample sizes exceeded the sample size calculations determined in pre-hoc power analysis. Thus, precision and power may not have been affected in this study.

Recommendations

Consistent with some previous findings, the current study findings suggest lower acculturation is associated with decreased odds of depression among Hispanics adults in the United States. It is possible that Hispanic cultural norms, including social networks, are health protective, including protective against depression. Although NHANES data are generalizable to the United States population, these analyses should be repeated to determine if these results are consistently observed in other samples, in other places, and at other times. Additionally, and in order to better assess whether acculturation is causally associated with depression, a prospective longitudinal design is recommended. In particular, individuals with low acculturation and without depression at baseline could be followed over time for the determination of increased acculturation and increased depression. A prospective longitudinal study design can provide more specific conclusions regarding the directionality of the relationship between acculturation and depression among Hispanic adults in the United States. Finally, future research is needed to determine what aspects of acculturation (i.e., cultural beliefs, attitudes, and behaviors) in particular are protective against depression in this population. With more specificity regarding the aspects of acculturation that directly affect depression among Hispanic adults in the United States, additional improvements in prevention, diagnosis, and treatment of depression will be likely, with the potential for a greater impact on positive social change in this population and accordingly in public health generally.

Implications

The findings of this study indicate the prevalence and severity of depression is increased among Hispanics, and lower levels of acculturation are associated with decreased odds of depression. This implies that decreased levels of acculturation among Hispanics are protective against depression, and that the modifications and transformation associated with the acculturative process may be associated with adverse effects on mental health for immigrants and/or succeeding generations born in the United States. The findings from this study have the potential to affect social change in that, with recognition by health care providers, health educators, and public health practitioners that the acculturative process can potentially adversely affect mental health outcomes in this population, the prevention, identification, and treatment of depression among Hispanics in the United States can be improved. In particular, culturally specific depression prevention messages, identification processes, and treatment procedures can all be implemented, which will affect positive social change in this population and in the public health generally.

Conclusions

Consistent with the literature, findings from this study indicated higher prevalence of depression and more severe depression among Hispanic adults compared with non-Hispanic White adults in the United States. These data support the potential for disparities to exist in the recognition and treatment of depression among Hispanic adults in the United States, as previously documented in the literature. The data presented here consistently indicated that lower acculturation was associated with decreased odds of

depression among Hispanic adults in the United States, which was consistent with some but not all previous findings. Inconsistent findings among studies identified in the literature and in comparison with the current study might be attributed to differences in study designs as well as differences in how acculturation and depression were measured. The potentially protective effect of low acculturation on depression identified in this study is not inconsistent with other studies of acculturation and health outcomes or behavior among Hispanic adults, generally.

The findings from this study extend the existing knowledge regarding the statistical relationship between acculturation and depression among Hispanic adults in the United States, by consistently demonstrating a protective effect of lower acculturation on depression outcomes in this population. Recognition of the potential for the acculturative process to negatively affect the mental health, specifically depression, of Hispanics in the United States by health care providers and the public health community will positively affect social change in that with this understanding, more culturally specific prevention, diagnosis, and treatment procedures can be implemented. Future research is needed to confirm these findings in similar and prospective study designs, as well as to determine which aspect(s) of the acculturative process (i.e., beliefs, attitudes, behaviors) are most important to understanding depression outcomes among Hispanic adults in the United States.

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Appendix: Data Documentation

Table A-1a
Acculturation, NHANES 2009-2010

Variable Name	SAS Label	English Text	Code or Value	Value Description
ACD040	Language(s) usually spoke at home	Now I'm going to ask you about language use. What language(s) {do you does [sample participant]} usually speak at home?	1	Only Spanish
			2	More Spanish than English
			3	Both equally
			4	More English than Spanish
			5	Only English
			7	Refused
			9	Don't know
			.	Missing

Note. Data source: CDC, 2012

Table A-1b
Country of Birth, NHANES 2009-2010

Variable Name	SAS Label	English Text	Code or Value	Value Description
DMDBORN2	Country of Birth - Recode	In what country {were you/ was [sample participant]} born?	1	Born in 50 States or Washington, DC
			2	Born in Mexico
			4	Born in Other Spanish Speaking Country
			5	Born in Other Non-Spanish Speaking Country
			7	Refused
			9	Don't know
			.	Missing

Note. Data source: CDC, 2011g

Table A-1c
Length of Time in US, NHANES 2009-2010

Variable Name	SAS Label	English Text	Code or Value	Value Description
DMDYRSUS	Length of time in US	Length of time [sample participant] has been in the US	1	Less than 1 year
			2	1 yr., less than 5 yrs.
			3	5 yrs., less than 10 yrs.
			4	10 yrs., less than 15 yrs.
			5	15 yrs., less than 20 yrs.
			6	20 yrs., less than 30 yrs.
			7	30 yrs., less than 40 yrs.
			8	40 yrs., less than 50 yrs.
			9	50 years or more
			77	Refused
			99	Don't know
			.	Missing

Note. Data source: CDC, 2011g

Table A-1d
Citizenship Status, NHANES 2009-2010

Variable Name	SAS Label	English Text	Code or Value	Value Description
DMDCITZN	Citizenship Status	{Are you/Is [sample participant]} a citizen of the United States?	1	Citizen by birth or naturalization
			2	Not a citizen of the US
			7	Refused
			9	Don't know
			.	Missing

Note. Data source: CDC, 2011g

Table A-1e

Language of SP Interview, NHANES 2009-2010

Variable Name	SAS Label	English Text	Code or Value	Value Description
SIALANG	Language of SP Interview	Language of Sample Person Interview Instrument	1 2 .	English Spanish Missing

Note. Data source: CDC, 2011g

Table A-2
Depression Screener, NHANES 2009-2010

Variable Name	**SAS Label**	**English Text** Over the last 2 weeks, how often have you been bothered by the following problems…	**Code or Value**	**Value Description** … would you say…
DPQ010	Have little interest in doing things	…little interest or pleasure in doing things	0 1 2 3 7 9 .	Not at all Several days More than half of the days Nearly every day Refused Don't know Missing
DPQ020	Feeling, down, depressed or hopeless	…feeling down, depressed or hopeless?	0 1 2 3 7 9 .	Not at all Several days More than half of the days Nearly every day Refused Don't know Missing
DPQ030	Trouble sleeping or sleeping too much	…trouble falling or staying asleep, or sleeping too much?	0 1 2 3 7 9 .	Not at all Several days More than half of the days Nearly every day Refused Don't know Missing

DPQ040	Feeling tired or having little energy	…feeling tired or having little energy?	0 1 2 3 7 9 .	Not at all Several days More than half of the days Nearly every day Refused Don't know Missing
DPQ050	Poor appetite or overeating	… poor appetite or overeating?	0 1 2 3 7 9 .	Not at all Several days More than half of the days Nearly every day Refused Don't know Missing
DPQ060	Feeling bad about yourself	…feeling bad about yourself - or that you are a failure or have let yourself or your family down?	0 1 2 3 7 9 .	Not at all Several days More than half of the days Nearly every day Refused Don't know Missing
DPQ070	Trouble concentrating on things	… trouble concentrating on things, such as reading the newspaper or watching TV?	0 1 2 3 7 9 .	Not at all Several days More than half of the days Nearly every day Refused Don't know Missing
DPQ080	Moving or speaking too slowly or too fast	… moving or speaking so slowly that other people could have noticed? Or the opposite – being so fidgety or restless that you have been moving around a lot more than usual?	0 1 2 3 7 9 .	Not at all Several days More than half of the days Nearly every day Refused Don't know Missing

DPQ090	Thought you would be better off dead	… Thoughts that you would be better off dead or of hurting yourself in some way?	0 1 2 3 7 9 .	Not at all Several days More than half of the days Nearly every day Refused Don’t know Missing

Notes. Data Source CDC, 2011b

Table A-2

Depression Screener, NHANES 2009-2010

Variable Name	**SAS Label**	**English Text**	**Code or Value**	**Value Description**
DPQ100	Difficulty these problems have caused	How difficult have these problems made it for you to do your work, take care of things at home, or get along with people?	0 1 2 3 7 9 .	Not at all difficult Somewhat difficult Very difficult Extremely difficult Refused Don’t know Missing

Notes. Data Source CDC, 2011b

Table A-3
C-Reactive Protein, NHANES 2009-2010

Variable Name	SAS Label	English Text	Code or Value
LBXCRP	C-reactive protein (mg/dL)	C-reactive protein (mg/dL) Missing	0.01 to 18.01 .

Notes. Data Source CDC, 2011c

Table A-4
White Blood Cell Count, NHANES 2009-2010

Variable Name	SAS Label	English Text	Code or Value
LBXWBCSI	White blood cell count (1000 cells/μL)	White blood cell count: SI Missing	1.4 to 99.9 .

Notes. Data Source CDC, 2011e

Table A-5

Covariates for Analysis, NHANES 2009-2010

Variable Name	**SAS Label**	**English Text**	**Code or Value**	**Value Description**
RIAGENDER	Gender	Gender of the sample person	1	Male
			2	Female
			.	Missing
RIDAGEYR	Age at screening adjudicated – Recode	Best age in years of the sample person at time of HH screening. Individuals 80 and over are topcoded at 80 years of age	0 to 79	Range of values
			80	≥80 years
			.	Missing

Table A-5

Covariates for Analysis, NHANES 2009-2010

Variable Name	SAS Label	English Text	Code or Value	Value Description
RIDRETH1	Race/ethnicity – Recode	Recode of reported race and ethnicity information	1	Mexican American
			2	Other Hispanic
			3	Non-Hispanic White
			4	Non-Hispanic Black
			5	Other Race – Including Multi-Racial
			.	Missing

DMDEDUC2	Education Level – Adults 20+	What is the highest grade or level of school {you have/SP has} completed or the highest degree {you have/SP has} received?	1 2 3 4 5 7 9 .	Less than 9th grade 9-11th grade (includes 12th grade with no diploma) High school grad/GED Equivalent Some College or AA degree College Graduate or Above Refused Don't Know Missing
INDFMPIR	Ratio of family	A ratio of family income to	0 to 4.99 ≥5	Not applicable

Table A-5

Covariates for Analysis, NHANES 2009-2010

Variable Name	SAS Label	English Text	Code or Value	Value Description
	income to poverty	poverty threshold		
BMXBMI	Body Mass Index (mg/kg^2)	Body Mass Index	12.58 to 84.87 . Missing	Not applicable

Notes. Data Source CDC, 2011a, g, h

Table A-6

Covariate Current Cigarette Smoking, NHANES 2009-2010

Variable Name	SAS Label	English Text	Code or Value	Value Description
SMQ680	Used tobacco/nicotine last 5 days?	The following questions ask about use of	1 2 7	Yes No Refused

	tobacco or nicotine products in the past 5 days. During the past 5 days, did {you/he/she} use any product containing nicotine including cigarettes, pipes, cigars, chewing tobacco, snuff, nicotine patches, nicotine gum, or any other product containing nicotine?	9 .	Don’t know Missing

SMQ690A	Used last 5 days – Cigarettes	Which of these products did {you/he/she} use?	1 77 99 .	Cigarettes Refused Don’t know Missing

Notes. Data Source CDC, 2011i

Curriculum Vitae

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Education

- **Ph.D.**, Public Health – Epidemiology, February 2016
  Walden University, Minneapolis, Minnesota
- **Master of Public Health**, Certificate in Health Finance and Management, May 2002
  Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland
- **Master of Science**, Analytical Chemistry, August 1997
  Emory University, Atlanta, Georgia
- **Bachelor of Science**, Behavioral Neuroscience, May 1994 *cum laude*
  Lehigh University, Bethlehem, Pennsylvania

Professional Experience

RAI Services Company, Regulatory Oversight, Winston-Salem, North Carolina (July 2011-present)
Director

- Lead quantitative risk assessment efforts for regulatory engagement and submissions for the operating companies under Reynolds American Inc.
- Support behavioral research via the population health standard per the Family Smoking Prevention and Tobacco Control Act for the operating companies under Reynolds American, Inc.

R. J. Reynolds Tobacco Company, Research & Development, Product Integrity, Winston-Salem, North Carolina (October 2008-July 2011)
Senior Staff Scientist

- Support epidemiology and quantitative risk assessment efforts for risk assessment of tobacco products and chemical constituents of potential concern

ENVIRON International Corporation, Arlington, Virginia (June 2002-October 2008)
Manager

- Provide regulatory and litigation consulting support for chemical human health risk assessment: drugs, medical devices, food, cosmetics, environmental exposures, occupational exposures

Johns Hopkins Bloomberg School of Public Health, Departments of Epidemiology and Molecular Microbiology and Immunology, Baltimore, Maryland (1999-2002)
Research Technician

- Project management, data analysis, and presentation for various collaborations

National Institutes of Health, National Institute on Drug Abuse, Baltimore, Maryland (1998-1999)

Analytical Chemist

- Management and maintenance of high performance liquid chromatography systems for analysis of neurotransmitter molecules

Centers for Disease Control and Prevention, National Center for Environmental Health, Atlanta, Georgia (1997-1998)
Research Fellow

- Analysis of genetic data for use within a quality assurance/quality control program

Memberships & Certifications

American Public Health Association (2003-present)
Society for Risk Analysis (2008-present)
Certification in Public Health, National Board of Public Health Examiners (2009-present)

Publications

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