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Diabetes Among Hispanic Immigrants: the Impact of Age at Migration

Nancy Hahn
Walden University

Walden University

College of Health Sciences

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Nancy Hahn

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Review Committee
Dr. Roland Thorpe, Committee Chairperson, Public Health Faculty
Dr. James Rohrer, Committee Member, Public Health Faculty
Dr. German Gonzalez, University Reviewer, Public Health Faculty

Chief Academic Officer
Eric Riedel, Ph.D.

Walden University
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Abstract

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MPH, Hunter College, 1990

BS, City University of New York, 1985

Dissertation Submitted in Partial Fulfillment

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Abstract

Diabetes is a disease that affects the Hispanic population in disproportionate numbers. With larger numbers of immigrants coming to the United States who are of Hispanic origin, the individual risk and health burden of this disease will have a major impact on the quality of life and the health care system. Research into the influence of the timing of changes in lifestyle suggested an association between specific levels of socioecological exposures and certain health conditions. This study examined that possibility. The use of the National Health Interview Survey, 2005-2011, provided adequate data for examining whether age at migration was associated with self-reported diabetes; if there was a relationship between age at migration, diabetes, and obesity; and, if the age at migration-diabetes relationship differed depending on the Hispanic subgroup. It was a quantitative, cross-sectional study using a logistic regression. The outcomes indicated that migration early in life influenced diabetes diagnosis in later life and, with the addition of obesity to the model, the relationship between age at migration and diabetes persisted. This research can be a catalyst for social change in allowing for the identification of individuals most at risk, the timeframes for that increased risk, and a better understanding of the factors that predispose individual to diabetes. Public policy initiatives to target specific time periods can provide avenues for social change among this population with preventive measures to reduce long-term negative consequences of diabetes, thus improving quality of life and providing a more effective use of the health care system.

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Dedication

This dissertation is a tribute to three people in my life who have always believed that with hard work and dedication, anything is possible.

To my father, Louis J. Giugliano, gone but never forgotten, who worked so many hours and so many jobs all his life to be able to give us, his children, something he never had, an education. To my mother, Grace R. (LaRocca) Giugliano, age 91, who was orphaned at 6, and then raised by a grandmother overwhelmed by poverty and the responsibility of 8 children and 4 grandchildren. My mother always said to us "when you go to college," never "if you go to college." She believed in the value of education and that it would change our lives. Their example of hard work and dedication changed the generation that followed and the generation that followed that. They changed everything!

To my husband, Harold Hahn, who has always had a love of learning, a great belief in education, and so much faith in me.

To Harry:

-For all the hours that I spend writing in the evenings and on the weekends, you told me, "Just to do what you needed to do."

-For all the times that we stayed at home instead of going out, you said, "Don't worry, we'll have plenty of time when you finish."

-When I didn't understand what I had to do, you said, "Keep trying, you'll get it."

-When I was frustrated and wanted to give it up, you told me, "You can't quit."

All those moments, for every act you did, for every word you said, all I heard was "I love you." You will always make my heart sing.

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It is with utmost gratitude that I acknowledge Dr. Roland Thorpe, who took on the position of chair of my committee later on in my dissertation quest. I found your help invaluable. Thank you for your time, patience, and guidance. I would like to thank, Dr. James Rohrer who also joined my committee late in the game. Your comments and input gave me additional insight into the research questions and outcomes. Dr. German Gonzalez, my thanks, for working with me on this process and for your kind and thorough evaluation of my dissertation. I would also like to thank Dr. Cassandra Arroyo. Although she was unable to complete this process with me, her assistance through the proposal stages was very much appreciated.

I also would like give my thanks to all those people whose help was so appreciated and necessary during the past five years: to my children, my daughter, Susan, who was able to read my writing (so many times) and tell me when it made no sense; and to my son, Joseph, who can format anything and make it look professional and presentable. I love you both immeasurably. Thanks to Dr. Chris Morett for his assistance and patience in teaching me so many fundamentals, and to my dear friend, Anita Dente, for her ability to correct my grammar, look at my sentence structure, and endlessly try to teach me to stop using so many commas.

To all of you, my many thanks. I have reached this threshold because of you.

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Chapter 1: Introduction to the Study

Immigration to the United States continues to grow as new ethnic groups arrive, each with specific needs and expectations. The ability to assimilate to this new environment may have implications regarding health. Acculturation, that is, the change in lifestyle associated with immigration, may impact long-term health. Among Hispanic immigrants, immigration and acculturation have a significant impact on lifestyle. Research has shown that the longer an individual resides in the United States, the more likely he or she will be diagnosed with diabetes (Perez-Escamilla & Putnik, 2007). This dissertation contains an overview of the prevalence and impact of diabetes on the Hispanic population (Centers for Disease Control and Prevention [CDC] Office of Minority Health & Health Disparities, 2011a). Because Hispanics comprise a large percentage of the population in the United States, the high rate of diabetes can potentially impact the both the quality of life and use of resources. The questions of where the impact of migration is at its highest and how this impact can be modified were the basis of this dissertation. I also examined the literature related to age at migration to the United States and diabetes, as well as whether obesity played a role in the diabetes/age at migration relationship. There was limited information on whether the age at migration is significant. In addition, I discuss the use of the socioecological theory to explore various points of influence. The purpose of exploring the possible influence of these factors was to be able to develop strategies for prevention, initiatives to reduce complications thus improving quality of life, and to reduce the potential impact of this disease on the health care system. This dissertation examined relationships between variables using population demographics from the National Health Interview Survey (NHIS 2005-2011).

Background

The United States has a long history of immigration and, with the influx of immigrants from many different countries, there has been a variety of specific cultural needs, traditions, and cultural norms introduced into the United States. The Hispanic/Latino (Hispanic) population is the fastest growing minority group in the United States. It consists of many subgroups, which although Hispanic in origin, are diverse in many of their traditions and behaviors. As this population in the United States grows, it has become clear that Hispanic Americans face some unique health problems. There are several diseases that have been demonstrated to be more prevalent within the Hispanic population. According to the NHIS (2010), 13.2% of the Hispanic population has been diagnosed with diabetes, compared to 7.6% among non-Hispanic Whites. Along with this diagnosis come the long-term consequences and complications that make diabetes not only devastating for the individual and family, but also impactful on the health care system overall (CDC Office of Minority Health & Health Disparities, 2011a).

Hispanics comprised about 12% of the population in 2011, with projection of an increase to 30% by the year 2050 (CDC, 2011e). Diabetes has been the fifth leading cause of death and the leading cause of morbidity among the Hispanic population. Among the Hispanic population over 18 years of age, over 13% have diabetes. When compared to non-Hispanic Whites, the risk of being diagnosed with diabetes is an average of 66% higher in the Hispanic population. This number represents an average for all Hispanic subgroups, but there are Hispanic subgroups whose risk is even higher (see Figure 1), namely Puerto Rican and Mexican immigrants (CDC, 2011a).

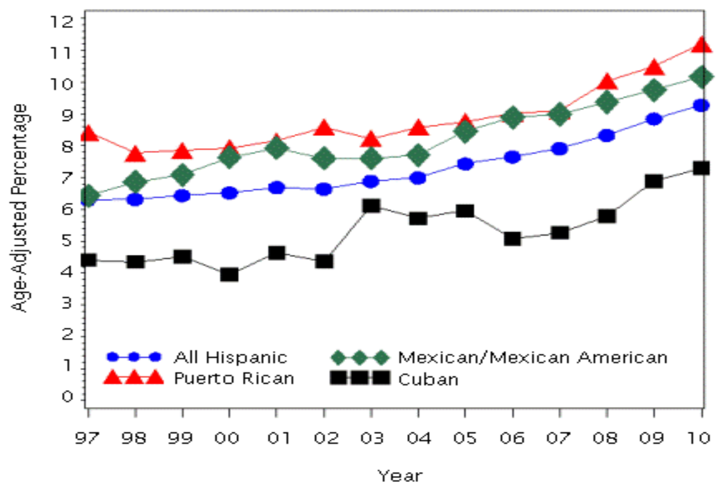

Figure 1. Number of persons with diabetes by Hispanic subgroup. From the Center for Disease Control and Prevention [CDC], (2011c).

In addition, a condition known as prediabetes, where the glucose levels are higher than normal but where a diagnosis of diabetes has not been given yet, was present in approximately 35% of the Hispanic population (CDC, 2011c). There are also Hispanics who have diabetes that is undiagnosed (CDC, 2011c). There are indications that the projected prevalence of diabetes among Hispanic population groups will increase by 127% by the year 2050 (Narayan, Boyle, & Geiss, 2006).

Acculturation is a typical evolution among immigrant populations (Gordon-Larsen, Harris, Ward, & Popkin, 2003). The newly arrived immigrants make changes in lifestyle with a movement away from the traditions of their country of origin. Often dietary consumption of fast foods, reduction in eating fruits and vegetables, decrease in physical activity, and the use of tobacco and alcohol can negatively affect health. Weight gain is often the end result of some of these changes. These alterations in diet, physical activity, smoking habits, alcohol consumption, and body composition may increase the odds of diabetes. The cause of these changes, which likely result from the process of acculturation, may include alterations in both personal and environmental factors (Perez-Escamilla & Putnik, 2007). The resultant complications from diabetes can seriously impact the quality of life, as well as the utilization of resources of the health care system. Addressing this issue needs to be the focus of health promotion and health initiatives (Mitchell, 2002).

In this study, a thorough literature review was done related to age at migration to the United States and diabetes, and whether obesity played a role in the diabetes/age at migration relationship. The literature had very limited information on the impact of age at migration on diabetes. In addition, there was little research to determine whether this relationship was different from one Hispanic subgroup to another. This represents a gap in the literature on which this dissertation was based. This information can be an addition to the current body of knowledge regarding diabetes education and initiatives. Information on how the age at migration to the United States can influence health and the odds that immigrants develop diabetes may be useful in the development of interventions for prevention and management of diabetes, as well as in the creation of new health policies. It can also be the groundwork for future research that can improve many immigrants' quality of life and may have an economic impact for the health care industry.

Statement of the Problem

The problem that this study addressed was whether age at migration to the United States could be a contributing factor in diabetes among the Hispanic population. Past research has shown that the longer an individual resides in the United States, the more likely it was he/she would be diagnosed with diabetes. However, there was limited information on whether the age at which an individual migrates is additionally significant (Perez-Escamilla, & Putnik, 2007). Obesity has been well established as a mediating factor in the development of diabetes (Perez-Escamilla, 2011). However, it has been unclear whether the age at migration influenced obesity among the Hispanic population, or among the individual Hispanic subgroups (Misra & Ganda, 2007). The timing of immigration may present a more or less significant influence on diabetes.

There are many studies that examined the impact of immigration on various population groups, focusing on length of residence, age at migration, the possibility of critical or sensitive periods in development, and what effect, if any, environmental factors may have (Whittemore, Melkus, & Grey, 2004). Research in the area of diabetes and the consequences of these influences among various Hispanic subgroups has been very limited. Additional research is needed to examine the implications of these influences as they relate to diabetes in order to provide information and education for the development of evidence-based, culturally relevant interventions.

Purpose of the Study

This quantitative, cross-sectional study explored the possibility that age at migration may have an influence on diabetes among this population. This information may be useful for the development of health care interventions, strategies for prevention of diabetes, and health initiatives to reduce the complications of uncontrolled and undiagnosed diabetes. Due to the long-term consequences that a diagnosis of diabetes has on the individuals and families, and the significance of ever-increasing numbers of individuals being diagnosed with diabetes, awareness must be raised regarding this disease (Hjelm, Mufunda, Manbozi, & Kemp, 2002).

This study explored relationships between variables using population demographics. The independent variable, age at migration, was compared to the dependent variable, self-reported diabetes. The mediating variable was obesity and there were several covariates—education, socioeconomics, geographical place of birth, and gender. Analyses were performed for Hispanic subgroups as well. This research may be an important step in addressing an issue that will have a significant impact on future health initiatives.

Research Questions and Hypotheses

SPSS (21) was used for the statistical analyses of the data. Univariate description of each variable, including measures of central tendency and variation, provided an understanding the composition of the sample investigated. Measurements of the bivariate relationships between each independent variable and the dependent variable—self-reported diabetes status—and the relationship among certain key independent variables, was done to show how these variables were associated with each other. Of special interest was how each independent variable related to obesity, because of its mediating role in my ultimate statistical model.

The plan of this study was to address the following research questions and hypotheses:

RQ1: Is age at migration associated with self-reported diabetes?

H_a1: Age at migration is associated with self-reported diabetes.

H_01: There is no association between self-reported diabetes and age at migration.

RQ2: Is the migration age-diabetes relationship explained by obesity?

H_a2: The age at migration-diabetes relationship is explained by obesity.

H_02: The age at migration-diabetes relationship is not explained by obesity.

RQ3: Within Hispanic subgroups (Mexican, Puerto Rican, Central/South American, Other Hispanic), what is the association between age at migration and diabetes and does obesity impact that relationship?

H_a3: For each subgroup, age at migration-diabetes relationship is associated with obesity.

H_03: For each subgroup, age at migration-diabetes relationship is not associated with obesity.

Theoretical/Conceptual Framework

There are a variety of factors that may negatively influence a person to develop certain health conditions. These factors can be internally derived, such as having a genetic predisposition or having family history, or externally derived, as might be a result of social or societal influences (Whittemore et al., 2004). The socioecological model (SEM) is an approach to health promotion that examines multiple influences on health.

There are five levels defined in the SEM: individual, interpersonal, organizational, community, and policy (Whittemore et al., 2004).

At the individual level, factors such as age, family history, and genetic predispositions may help determine the risk for chronic diseases. Also a factor, are the individual choices one might make such as diet, smoking, and alcohol use. Interpersonal relations with family, neighbors, friends, and social networks can be influential in behavior (Elder et al., 2007). Further, neighborhood institutions, school, work, health-related program availability, and the availability of funding and support can also provide the momentum for lifestyles and behaviors. Community involvement and public policy are part of the overall experience for the immigrant. Socioeconomic status as well as cultural norms that influence lifestyle can promote or discourage behaviors. All these possible influences provide a social environment that can either improve or negatively affect the long-term health of the immigrant. These influences can also be a starting point for interventions for change (Elder et al., 2007)).

Many individuals migrating to a new country may adopt dietary and lifestyle habits that they otherwise would not have. Acculturation is an ongoing process whereby one cultural group makes changes to its behavior, beliefs, and habits in order to become more similar to another cultural group within the adopted country (Perez-Escamilla & Putnik, 2007). The immigrant family’s ability to provide healthy foods and outside activities for their children may be limited. In many neighborhoods, there are few school and church programs that can promote positive lifestyles. Some neighborhoods lack fruit and vegetable markets, local grocery stores, or other options for healthy eating. Fast foods and quick meals become the norm, as parents spend many hours at work in order to provide for their families. Access to parks and gyms may be limited due to geographical and financial restraints, thus impacting the individual's access to opportunities for exercise (Oza-Frank, Stephenson, & Narayan, 2011). Additionally, a lack of educational resources and gainful employment may affect one's ability to produce sufficient income, which may consequently affect the ability to access healthy foods and recreation as well. The availability of health insurance and access to good health care is another factor that may negatively impact the immigrant (community factors). Many immigrants who come to the United States with limited resources are often vulnerable to the lack of services and availability in their neighborhoods. Often the available resources are not found in their areas of residence and, unless they are willing to go outside of their local geographical area, these services will not be utilized. The overlapping of these levels of influence can promote an environment that is not conducive to positive health outcomes. Acculturation may increase the risk of long-term chronic disease. The multiple influences interact across these levels (see Figure 2); therefore, multilevel interventions may be effective in lifestyle changes (Robinson, 2008).

Figure 2. The socioecological model. From http://www.balancedweightmanagement.com/theSocio-EcologicalModel.htm. (Wilson, 2001).

The social, political, and economic environment in which people live can have a great influence on their physical health and wellbeing (Robinson, 2008). There are significant variations in environment between the countries or areas of origin from which many immigrants come and the society into which they assimilate. Longer length of residence in the United States has been shown to be associated with the development of chronic diseases later in life (Kaplan, Huguet, Newsom, & McFarland, 2004). Examining the age at which immigrants migrate to the United States as well as the magnitude of negative social exposures at critical periods may provide additional information as to which factors are most influential in the development of chronic diseases such as diabetes.

There are many theories I could have applied to this research. In a broad sense, the epidemiology of chronic disease and the socioecological theory are related. Whereas chronic disease epidemiology relates chronic diseases to critical/sensitive periods in growth and development, socioecological theory places disease risk as occurring at various levels or layers in the life course (Ben-Shlomo & Kuh, 2002). The neighborhood, friends, family, food availability, and socioeconomics play different roles at different times within the life course (Kolmodin, Naar-King, Ellis & Brogan, 2007). To assess the risk of diabetes among the immigrant populations, exploring the various layers of exposure can be an avenue for the development of interventions. At the individual level, these could include educational initiatives, and health care; at the interpersonal level, support and encouragement from family and friends, which can include mentoring and peer support; organizationally, group programs and services; community resources and supports for prevention and self-management (CDC, 2009).

By examining the age at migration, a possible link was established between the age at which an immigrant arrives in a new country and the possible social influences that can impact future health. Examining influences at various timeframes may be an avenue for the development of health initiatives that target these levels of influence for preventive measures related to chronic illness, specifically diabetes.

Nature of the Study

The nature of this study was to examine the relationship between age at migration and diabetes. This information can be used in educational and informational initiatives, the development of public policy to focus on prevention, and to target specific groups within the population. Enhancing the knowledge base for prevention and management of diabetes can be used to increase individual quality of life and to positively impact the personal and economic burden that diabetes has on the current health system. By investigating the impact of the age at migration as it relates to this topic, the knowledge obtained may enhance the understanding of the various levels of impact that influence behaviors and how migration to a new country may impact future health and specifically the diagnosis of diabetes. In recognizing the role of lifestyle choices during these time periods, researchers can target the specific times for interventions and initiatives that can have the greatest impact on the future health of the population. Key variables explored were age at migration and diabetes. Obesity as a mediating variable was also examined in conjunction with several covariates. Data were obtained from the NHIS and analyzed using logistic regression analyses.

Operational Definitions

Acculturation: Acculturation is a process whereby individuals who are members of a specific cultural or ethnic group adopt the behaviors, beliefs, and lifestyle of another group. Usually the minority group adopts the habits of the majority group (Hispanic Center of Excellence, n.d.).

Age at migration: The age at which individuals move from their country of origin to another country. Age at migration can affect acculturation, thereby exposing the immigrant to U.S. culture and increasing influence on behavior (Wilkinson et al., 2005).

Length of residence: The length of residence is the amount of time an immigrant resides in a new country/region or any new area. In this study, it is the number of years that an immigrant has lived in the United States.

Body mass index (BMI): Body mass index (BMI) is a number calculated from a person's weight and height. BMI is usually used to indicate whether individuals are overweight or obese, thus increasing their risk for chronic diseases and health problems (CDC, 2011a).

Socioecological model (SEM): A model that analyzes the interrelationships between individuals, communities and environments, and their impact on health outcomes. This includes personal attributes, behavior, maturation, emotional wellbeing, and lifestyle choices (Stokols, 1996). It proposes that individual behavior is supported and influenced by numerous systems and groups (Whittemore et al., 2004).

Assumptions

Because the data used in this study were collected by the NHIS and not by me, it was necessary to make assumptions regarding the data. The NHIS collected this data as per the regulations of the National Center for Health Statistics (NCHS). According to the NHIS, the participants were randomly selected. They were informed of the importance of participation and that confidentiality would be maintained. The selected individuals had the option of not participating if they chose to decline (CDC, 2012a). The credibility of the data was of utmost importance in order to be certain that the outcomes of my research also had credibility and that they could be repeated and built upon. For the purpose of this study, I made the following assumptions based on the methods of data collection done by NHIS:

- The data presented in the NHIS were obtained from participants that had freely agreed to be part of the NHIS.
- The participants answered the questions on the NHIS truthfully.
- The participants understood the instructions for the survey and answered the questions according to instructions given.
- The NHIS preserved participants' rights.
- Data collection was done according to the Public Health Service Act (42 USC 242k).

Scope and Delimitations

The scope of this study was to determine if the age at which an individual immigrates to the United States had an influence on diabetes in the future. The participants in this study were individuals who agreed to answer the questions associated with the NHIS. They were chosen at random by the NHIS. They received information on the survey, were given the opportunity to decline, and informed as to the confidentiality of the data. These individuals were of Hispanic ethnicity and had immigrated to the mainland United States. They were not institutionalized and were between the ages of 18 and 80. Quantitative research using a large sample size that is representative of the general population will provide an opportunity to generalize the results. The larger the sample population, the more one can generalize the results (Creswell, 2009). Variables used in this research project included Hispanic immigrants, and in some analysis, the categorization of those immigrants was further narrowed to subgroups. The diagnosis of diabetes, before and after migration, was also explored as the basis of this dissertation was an examination of the age at migration and diabetes. Individuals who were diagnosed prior to migration were not included. The impact of obesity on the overall Hispanic immigrant population and within individual Hispanic subgroups, related to diabetes, was a significant part of the research. The NHIS is a large database that is representative of the general noninstitutionalized United States population (CDC, 2012a).

Limitation of Study

There were several limitations of this study. All data were obtained from the NHIS. The use of secondary data may have posed a time validity problem because the data were collected in the past. The results may not hold for time periods before or since 2005-2011. This time validity problem was unavoidable, but it was important to keep it in mind. Therefore, every effort was made to use the most current data available. There were no corrections for BMI due differences in race. However, according to the CDC (2012a), BMI provides a reliable indicator of body fatness for most people and is used as a gauge for possibility of future health problems. Additionally, all data to be collected for this study were based on self-reported information, which can be subject to recall bias (CDC, 2012a). There can also be instances where the participants may not have been forthcoming with honest responses (CDC, 2012a). However, studies done using NHIS, have been found to be strong indicators of health and disease even with the limitation of recall bias and participants' reluctance to be forthcoming regarding diabetes (McGee, Liao, Cao, & Cooper, 1999). The use of multiple years of survey data (2005-2011) can reduce the impact of recall bias and information that is not honestly given. In addition, the variable age at migration was coded as a categorical variable by subtracting the participants' ages from their years in the United States. This resulted in a categorical age at migration.

Significance of the Study

This study can add to the current body of knowledge on diabetes and the contributing factors that impact the lives of Hispanic immigrants. With the continuing increase in the prevalence of diabetes, the impact both personally and economically will be significant to families and to the health care system. Understanding the contributing factors can help clinicians make predictions about who is at highest risk for the development of diabetes. This can provide a roadmap for the initiation of appropriate interventions targeting populations at their most vulnerable times. Additional information on various Hispanic subgroups can further help delineate the different types of interventions that might be most appropriate for different populations. This study examined specific factors that could be implicated in diabetes. In pinpointing possible influences during various times of migration, I intended this research hopes to address the need for specific interventions that are able to target the potential influences at a time when they are most likely to occur. The data suggested that various prevention and educational initiatives at various points in the life course may decrease the odds of getting diabetes, thereby providing positive change in the lifestyle and health among this population.

Implications for Social Change

New information regarding the probability for being diagnosed with diabetes can be used for the development of public policy and educational initiatives. These initiatives would create a knowledge base for health professionals to augment and enhance current best practices for disease prevention and treatment. As increasing numbers of people with diabetes seek health care, there will be an extremely high burden on the health care system as it attempts to provide adequate services to the population (CDC, 2011e). The current system for providing diabetic care can be improved with additional knowledge based on an understanding of the impact that age at migration can have on contributing factors. There is a dearth of information regarding the differences among the immigrant subgroups, whose culture and traditions may vary greatly. The ability to provide a foundation for future research and/or education for both individuals and communities can create/initiate social change among populations at risk. Using this research, I hope to provide a solid background for future studies focused on the possible implications of migration timing on diabetes. Specifically targeting diabetes and the Hispanic community, it is important to understand the specific time periods that influence changes in the environment (migration to a new country/region) and can be implicated in diabetes in later life. The results of this study indicated that there are periods when migration timing can impact diabetes. Future research can narrow this approach and provide additional evidence that targets these periods for education and prevention programs that may result in reduced probability of a diabetes diagnosis. Using this information can promote the development of interventions at the level where they will be the most successful. With the limits on funding and human resources, the ability to target a population at its most vulnerable can be instrumental in the reduction of contributing factors for diabetes and the initiation of preventive measures for those who are more likely to get diabetes.

The development of policies to educate health professionals, reduce health care spending on interventions that are less successful, and the introduction of educational programs at specific timeframes may elicit a more targeted approach to health programs aimed at diabetes. The development of targeted timeframes for the initiation of preventive measures for diabetes can provide guidance for the allocation of funds for diabetes prevention and education in a manner that provides the best utilization of resources and targets those individuals who are most likely to get diabetes.

Summary

This chapter provides an overview of several aspects of the study. It highlights the disproportionately high burden of diabetes on the Hispanic population and discusses the specific types of factors that can be associated with this disease. The large numbers of people with diabetes is a health concern that requires continued investigation. Diabetes is a disease with increasing prevalence in the United States. Among Hispanic immigrants, the number of individuals with diabetes or at risk for diabetes is unusually high (CDC, 2011d). This study was designed to examine the role that age at migration has on the adoption of lifestyle behaviors that will increase this probability. It also looked at differences that may be present in the acculturation of Hispanic subgroups. Information on whether specific times of migration can be complicit in diabetes in later life can provide guidance to health care professionals in educational and informational initiatives. The results of this study can provide a starting point for other research to better define the factors associated with age at migration and how to reduce the impact that it has on diabetes. Various research projects have targeted the relationships between immigration, length of stay in the United States, changes in lifestyle behaviors, and other aspects of risk that may impact diabetes. In Chapter 2, I discuss some of those studies and the relationship between diabetes and immigration. There has been limited research that addressed the possible correlation between the timing of immigration and the long-term effect on diabetes among the Hispanic population. Most researchers did not address the differences among Hispanic immigrants based on where they were born. The socioecological theory proposes that there are many influences on chronic disease based on personal and environmental systems (Whittemore et al., 2007). This research narrowed that gap by exploring the interaction between these variables and this population.

Chapter 2: Literature Review

Diabetes is a health issue that has had an impact on the lives of Hispanic immigrants in greater proportion than to other ethnic populations (CDC Office of Minority Health & Health Disparities, 2011b). Diabetes is the leading cause of cardiovascular disease, stroke, blindness, kidney failure, and amputations (CDC, 2011c). By identifying the variables that may precipitate developing diabetes within this specific population, health care practitioners may be able to develop interventions that could significantly reduce the morbidity and mortality associated with diabetes. Upon migration to a new country, there are many facets of lifestyle change that are necessary to accommodate fully to one's surroundings. While the traditions of the country of origin may continue to provide comfort to new immigrants, the desire to assimilate and become more connected to their new country motivates these immigrants to behavior changes that may negatively affect their future health and creates increased dependence on family and health care systems. This acculturation includes language acquisition, dietary changes and changes in physical activity, as well as the acquisition of such habits as smoking and alcohol use (Gordon-Larsen et al., 2003). The timing of migration may be a factor that precipitates chronic illness, specifically diabetes, due to increased exposure to new traditions and cultural differences. Exposure to new lifestyles and behaviors at a different junctures in the life course may be significant.

This chapter summarizes the current literature on the relationship between age at migration to the United States, length of residence in the United States, and diabetes. The format of this review consists of three themes: acculturation, length of residence as related to chronic disease and health issues, and age at migration as an influence on diabetes.

Literature Search Strategy

In exploring the avenues of information for this study, I accessed articles that were published from 1996 to the present. To obtain these articles, I went to various websites including Google Scholar, PubMed, and Medline. I also used information obtained from the websites of the CDC, the Office of Minority Health & Health Disparities, and the World Health Organization (WHO). References that were used in the various articles that I reviewed for this chapter were also read for their appropriateness for this research.

Keywords and terms included the following:

Hispanic immigration, age at migration, acculturation, length of residence, duration of residence, diabetes, body mass index (BMI), obesity, chronic diseases, diabetes and the Hispanic population, Hispanic population and health statistics, health preservation, determinants of health, socio-ecological model, and *socio-ecological theory.*

Theoretical/Conceptual Framework

The theoretical framework guiding this research project was that different stages of development present different types and levels of risk for the development of various physical (among other) conditions and diseases (Wilson, 2001). Put another way, the timing of one’s exposure to certain factors—and not just the presence or duration of those factors—may play a role in whether one is diagnosed with diabetes. This study addressed whether this relationship may be influenced by other factors, including gender, current age, education, and obesity.

The socioecological theory of health is a model that evaluates the impact of various personal and societal factors on lifestyle choices and behaviors (Elder et al., 2007). It opines that family, community, genetics, biology, and environment influence individual health. The model consists of several stages or levels that are at times overlapping: individual, interpersonal, organizational, community, and public policy. The individual level pertains to change and behavior on an individual basis, including changes that may occur in behavior by acquiring knowledge, attitude, and beliefs. The interpersonal factors include family and peer groups and how they may or may not provide a social identity and support to an individual. Organizational influences consist of physical institutions such as the workplace, schools, churches, and other types of community or neighborhood organizations. At the community level, factors such as the availability of groups, and the support from community leaders and organizations may influence health. Public policies are also impactful to individuals, such as those that promote beneficial health initiatives and provide public awareness of needed changes (Robinson, 2008). All these levels of impact on the individual create avenues for health change. Although most of these influences can have a positive impact, there are instances in some levels that may create an environment that is not conducive to good behaviors and optimal healthy lifestyle (Elder et al., 2007).

Research into the influence of the timing of changes in lifestyle suggested that there may be an association between specific levels of socioecological exposures and certain health conditions, such as cancer, cardiovascular disease, and diabetes (Whittemore et al., 2007). The timing of migration may provide additional insight into the relationship between age at migration and chronic disease risk (Forouhi, Hall, & McKeigue, 2007).

Many diseases that have been associated with advanced age are now being examined for root causes that may be found in critical or sensitive periods in the life course. Lawlor, Ben-Shlomo, and Leon (2004) stated that childhood exposures, such as accelerated postnatal growth, bottle-feeding, and childhood infection, served as exposure during critical points in the life course that predisposed children to cardiovascular disease. Many models, Lawlor et al. (2004) claimed, postulate that early life exposure can result in behaviors in adulthood. The acquisition of language is a classic example of the ability to become fluent based on exposure at a sensitive period of development. Similarly, smoking habits among immigrant children tend to develop in early adolescence as they adopt the culture of the new country (Hadwiger, 2005). Critical periods of rapid weight gain among infants can result in adult obesity (Lui, Jones, & Glymour, 2010). In a study of a Hispanic population, Misra and Ganda (2007) demonstrated that younger age at migration was associated with increased rates of obesity and suggested that younger age at migration may also be associated with increased incidence of diabetes. Thus, examining events that occur during the life course may add to the knowledge base of the factors influencing adult risk factors. The time of these exposures can be evaluated from a socioecological perspective, assessing the levels of influence that occur that can change behavior. In evaluating the timing of these exposures, a relationship between the individual and the sources of impact can be examined. This can be a focal point for intervention development (CDC, 2009).

Forouhi et al. (2007) investigated the relationship between diabetes and factors from early life. They stated that although low birth-weight is a predictor of insulin resistance, childhood obesity is a stronger predictor. Gillman (2007) also examined evidence that the prenatal period through adolescence was an important period when excess weight gain can impact obesity and long-term chronic disease. He further stated that children who are overweight tend be overweight adults. Overweight adults have a higher likelihood of diabetes (Misra & Ganda, 2007). The development of interventions based on the types of influences are present at this time of life can be instrumental in reducing the potential of obesity among this population group.

Consequently, an examination of both the time of an exposure (age at migration), and the duration of the exposure (length of residence) to U.S. society and its various social and physical characteristics, including diet, physical activity, health care access and utilization, may provide useful information in understanding disease processes. Applying the theory of socioecological exposures to the age at which an immigrant arrives in a new country or region may provide information on whether the timing of migration is a factor for diabetes in later life.

Diabetes Overview

Diabetes is a global disease manifested by a lack of insulin production (type 1) or an inability of the body to utilize insulin effectively (type 2). It is the fastest-growing health diagnosis in the United States. Information and interventions to prevent, treat, and educate is an important consideration for all health professionals. The number of people with diabetes in this country will continue to escalate, with projections that between 1:3 and 1:5 will have diabetes by the year 2050 (see Figure 3) (National Health Clearinghouse, 2011). This represents an increase from 8 cases per 1,000 in 2008 to 15 cases per 1,000 in 2050. Depending on mortality rates among people with diabetes, this will present a prevalence of approximately 25%-28% of the population (Boyle, Thompson, Gregg, Barker, & Williamson, 2010).

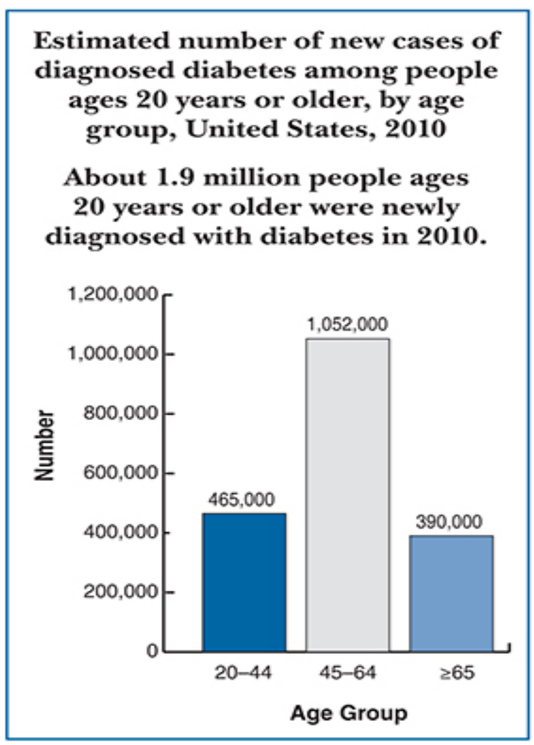

Figure 3: Newly-diagnosed diabetes among ages 20 and older-2010. From the National Health and Nutrition Examination Survey (National Diabetes Statistics: National Diabetes Clearinghouse, 2011).

Diabetes is a chronic disease that causes concentrations of glucose to accumulate in the blood (American Diabetes Association [ADA], 2011). The most common form of diabetes is type 2, which represents approximately 95% of all people with diabetes (WHO, 2011). This type of diabetes is often found among older adults, those with genetic predisposition, women who had gestational diabetes, obese individuals, and those who do not exercise (WHO, 2011). It is also more prevalent among certain ethnic groups, including Hispanics, non-Hispanic blacks, Asian/Pacific Islanders, and American Indians (National Diabetes Information Clearinghouse [NDIC], 2011). The long-term complications of this disease can impact nearly every part of the body: lower extremity neuropathies, kidney failure, blindness, cardiovascular involvement, complications of pregnancy, and loss of limbs through amputation. The overall cost of diabetes to the health care system is $174 billion per year. This includes costs of diagnosed and undiagnosed diabetes, direct medical costs, and the cost of loss of worker productivity (NDIC, 2011). Diabetes is the underlying cause of most mortality and morbidity in the United States. Nearly 26 million Americans have been diagnosed with diabetes and approximately 79 million with pre-diabetes. There are also about 7 million people who have diabetes and are not aware that they have it. Table 1 represents the proportion of people (after adjusting for age) by ethnicities that have a diagnosis of diabetes.

Table 1

Diagnosis of Diabetes by Ethnicity (Percentage of the Population)

Non-Hispanic Whites	7.10%
Asian-Americans	8.40%
Non-Hispanic Blacks	12.60%
Hispanics*	11.80%
*Cuban	7.60%
*Mexican	13.30%
*Puerto Rican	13.80%
*Central and South American	7.60%

Note. From (CDC, National Diabetes Fact Sheet [NDFS], 2011c, retrieved from http://www.cdc.gov/diabetes/pubs/estimates11.htm#4)
*Breakdown of Hispanics by country/territory of origin.

Diabetes is the seventh-leading cause of death in the United States. It is likely that this figure may be underreported because many people with diabetes also have other diagnoses, many as a result of complication due to diabetes. According to the CDC, the risk of death from diabetes is about twice that of people of the same age without diabetes (NDIC, 2011). When comparing the risk of diagnosis of diabetes among non-Hispanic whites to other ethnic groups, Hispanics have a risk that is 66% higher, Asian Americans 18% higher, American Indian/Alaska Natives (AI/AN) 14.2%, and non-Hispanic blacks, 77% higher (NDIC, 2011).

There is evidence that many people with diabetes might avoid the complications of the disease by improving diet and exercise, maintaining a BMI of <30, and avoiding smoking (WHO, 2011). With projections of increased immigration among Hispanics (see Table 2), the ability to address these issues is an important step in the development of initiatives to reduce the impact of this disease on the populations that are most at risk (United States Census Bureau, 2009).

Table 2

Percentage Distribution of Population Groups

Projection Series, Race, and Hispanic Origin	2010	2020	2030	2040	2050
NATIONAL PROJECTIONS	100.0	100.0	100.0	100.0	100.0
One race	98.2	97.8	97.4	96.8	96.3
-White	79.5	78.0	76.6	75.2	74.0
-Black	12.9	13.0	13.0	13.0	13.0
-AI/AN	1.0	1.1	1.2	1.2	1.2
-Asian	4.6	5.5	6.3	7.1	7.8
-NHPI	0.2	0.2	0.2	0.3	0.3
Two or More Races	1.8	2.2	2.6	3.2	3.7
Non-Hispanic White alone	64.7	60.1	55.5	50.8	46.3
Hispanic	16.0	19.4	23.0	26.7	30.2

Note. From United States Census Bureau, Population Division, December 16, 2009

Diabetes and Hispanic Immigration

The Hispanic population is the fastest-growing minority group in the United States. Presently, Hispanics represent about 16% of the population (CDC Office of Minority Health & Health Disparities, 2011a). This number is expected to increase dramatically with projections of approximately 30% by the year 2050 (CDC Office of Minority Health & Health Disparities, 2011a). The prevalence of diabetes among this population is high, with rates ranging from 6.2% of the Hispanic population in states such as Illinois and New York, to 9.3% among Puerto Ricans (CDC Office of Minority Health & Health Disparities, 2011a). In the Hispanic population, the diagnosis of diabetes is disproportionately high when compared to the non-Hispanic white population (CDC, 2011d). There is also a difference in prevalence among the various Hispanic subgroups (Table 1). Among the Hispanic sub-groups, there are differences in disease prevalence and other health issues. Puerto Ricans have a higher rate of low birth weight babies than Hispanics as a whole. Puerto Ricans also have a disproportionally high rate of asthma, HIVAIDS, and infant mortality, while Mexicans have higher rates of diabetes than other Hispanic groups (CDC Office of Minority Health & Health Disparities, 2011b). There is a multitude of risk factors that can have an impact on the high prevalence of diabetes among this ethnic group. Genetic, societal, and cultural determinants make this population very vulnerable to diabetes and the long-term consequences. As the number of people in this country with type 2 diabetes (T2D) continues to escalate, the Hispanic population will continue to be burdened by its long-term complications of the disease (ADA, 2011). In the United States, the percentage of individuals with diabetes among the Hispanic population is 11.8%, after adjusting for population age differences. Among other ethnic groups diabetes prevalence is 7.1% among non-Hispanic whites, 8.4% among Asian Americans, and 12.6% among non-Hispanic blacks (ADA, 2011). The need to assimilate to the new environment may be a contributing factor to the high percentage of diabetes among this group. Assimilating to a new lifestyle often consists of adopting the traditions of the new country. In a new environment, to assimilate is to adapt to new culture, diet, behaviors, and values. Acculturation is the result of this assimilation.

Acculturation

Acculturation is defined in many different ways. It is most commonly defined as an ongoing process whereby one cultural group makes changes to its behavior, beliefs, and habits in order to become more similar to another cultural group within the adopted country (Perez-Escamilla & Putnik, 2007). Changes in lifestyle generally occur as a result of migration to a new country. The desire to assimilate, the availability of food and services, and the influence of environment often motivate new immigrants to behave differently. Language assimilation, attitudes, values, socialization, and dietary changes can have a significant impact on chronic diseases (Perez-Escamilla & Putnik, 2007). There may also be health implications related to acculturation. There are researchers who believe that those who chose to migrate tend to be healthier and more able to handle the dramatic change to a new environment. The healthy migrant effect hypothesizes that individuals who migrate tend to be better able to physically and mentally handle the stress of migration and also tend to be older thus a higher age at migration. Their acculturation is also of shorter duration if they migrate as adults. This not necessarily true of their children whose migration is based on their parents' migration. Thus a shorter length of residency and shorter acculturation may have a protective effect on overall health (Schwartz, Unger, Zamboanga & Szapocznik, 2010).

The transformation that occurs for an immigrant when arriving in a new country occurs over time. Acculturation, as measured by various scales, has many overlapping variables. The majority of studies assess language, diet, and years in the United States (Kandula et al. 2008, Perez-Escamilla & Putnik, 2007). They also examine BMI as an indicator of increased weight as a result of lifestyle and behavior changes.

Kaholahula, Nacapov, Grandinetti, and Chang (2008) and Kandula, et al. (2008) used two different methods to measure acculturation in their respective studies. Both studies used cross-sectional data. Kaholahula, Nacapov, Grandinetti, and Chang (2008) used data obtained from an eight-question cultural affiliation questionnaire, with four questions about ethnic culture and four questions on Western culture. Kandula, et al. (2008) developed an acculturation scale with ratings based on nativity, language spoken at home, and years in the United States. Both studies examined the relationship between individuals with higher levels of acculturation and diabetes, and individuals with lower levels of acculturation and diabetes. The results from the Kaholahula, Nacapov, Grandinetti, and Chang (2008) study indicated a significantly larger number of participants with diabetes who were considered part of the traditional (more acculturated) group as compared to the ethnic group (less acculturated). Similarly, Kandula et al. (2008) concluded that there was also a greater prevalence of diabetes in those with a higher level of acculturation. Self-reported data on the relationship between acculturation and diabetes was also evaluated by Rodriguez, Hicks and Lopez (2012) when they examined participants in the California Health Interview Survey. They measured the relationship between self-reported diabetes and hypertension, and compared it to degree of acculturation. The result indicated that increased years of acculturation was associated with increased disease prevalence. This study used approximately 33,000 participants which included 20,000 foreign-born and 13,000 U.S.-born, all of Hispanic ethnicity (Rodriguez, Hicks & Lopez, 2012).

Acculturation can also have an impact on the severity of diabetes. Moayad, Balcazar, Pedregon, Velasco, and Bayone (2006) explored acculturation as a factor that may influence the severity of diabetes. This cross-sectional study used a sample of

Mexican-Americans who were currently being treated for T2D, and found that family cohesiveness was not a significant factor in relation to the severity of diabetes. Acculturation, receipt of food stamps, childhood in Mexico, and history of smoking were more predictive regarding the severity of diabetes (Moayad, Balcazar, Pedregon, Velasco, & Bayone, 2006).

Much evidence regarding acculturation points to its negative role in influencing changes in lifestyle, health, and behavior. But some of the effects of acculturation may in fact relate to positive changes in immigrants' behavior. Ross, Franks, Hall, Young, and Cardarelli (2011) found that higher levels of acculturation correlated with improved ability to control one's diabetes, as measured by glycemic index. They attributed the benefit to a greater understanding of the disease in those who were more assimilated into American culture. These individuals gain a better understanding of the disease process with education and information, thus reducing the possible long-term consequences of diabetes. Those with a lower level of acculturation had a less satisfactory understanding of the disease (Ross, Franks, Hall, Young, & Cardarelli, 2011). Likewise, the association between acculturation and the ability to do perform one's own care was demonstrated with those with a higher level of acculturation who were better able to perform diabetic self-care (Hadwiger, 2005).

Acculturation can also have an impact on other aspects of health, especially cardiovascular disease, hypertension, and depression, in addition to diabetes. Padilla, Steiner, Havranek, Beaty, Davidson, and Bull (2011) associated higher levels of acculturation with increases in psychological and behavioral problems, such as depression, bipolar disorder, psychotic disorder, substance and alcohol abuse, and tobacco use. The authors used three acculturation measures to examine the role of acculturation in disease among Hispanics with hypertension (Padilla, Steiner, Havranek, Beaty, Davidson & Bull, 2011).

Diet and Weight

Changes that result from acculturation are most obvious in the evaluation of diet and weight change. In separate articles, Perez-Escamilla and Putnik (2007) and Perez-Escamilla (2011) attempted to describe the relationship between acculturation among Hispanic immigrants and changes in diet as they relate to the prevalence of diabetes. The factors found in these studies that accompanied acculturation were changes in diet, physical activity, smoking habit and alcohol consumption and their association with obesity. In their 2007 article, Perez-Escamilla and Putnik (2007) compiled the results of studies that had been completed between 1985 and 2006, and concluded that the consumption of fat, sugar, and alcohol increased with increased acculturation as measured by years spent living in the United States. In a later review of literature by Perez-Escamilla (2011), the author indicated that there was a relationship between acculturation and diet/obesity, with consumption of fruits and vegetables higher in less acculturated individuals and a higher consumption of fats and sugar among more acculturated individuals (Perez-Escamilla, 2011).

Several other authors also reported based on their research that Hispanics changed their dietary habits after migration to the United States (Colby, Amoak, Kohlenberg, & Haldeman, 2005). Similar to Perez-Escamilla and Putnik (2007), the authors found that there was a relationship between acculturation and obesity with regard to dietary changes. In this study, only 4% of the population reported having diabetes, which was significantly lower than the average national rate among the Hispanic population (8%). The authors' opinion regarding these data was that the population was newly-arrived with low levels of acculturation and did not have time to develop acculturation-related diseases. Higher level of acculturation is usually accompanied by changes in diet, followed by increases in weight. The authors concluded that the participants in the study had gained an average of four pounds per year since immigrating to the United States (Colby, Amoak, Kohlenberg, & Haldeman, 2005). Increased weight can be a risk factor for diabetes (Misra & Ganda, 2007).

The changes in lifestyle among the newly-immigrated appear to be more pronounced in those who have higher levels of acculturation, that is, who have lived in the United States for longer periods of time. In two separate studies of Hispanics previously diagnosed with diabetes, Mainous et al. (2006) and Mainous, Diaz, and Geesey (2008) utilized similar acculturation scales that measured number of generations in the United States, length of residence, age at time of arrival, language, and self-reported acculturation. The authors in both studies found that Hispanics with diabetes and high acculturation levels were more likely to have a BMI of >30, whereas those with diabetes and low acculturation levels had lower BMI (Mainous et al., 2006, Mainous, Diaz, & Geesey, 2008). Likewise, Kandula, et al. (2005) had found that acculturation to a Western lifestyle was associated with a higher BMI.

Obesity is a common health problem among those who immigrate, with the accompanying lifestyle changes often predisposing the individual to chronic disease risk. This is especially true for immigrants who remain longer in the United States. The earlier the age at migration and the longer the residence in the United States, the more likely the individual will take on the habits of their new environment (Kaplan et al., 2004). As the children of immigrants become more assimilated, their risk of obesity and chronic disease, especially diabetes, may increase because they are less likely to follow the traditions of their parents. This assimilation in nutrition, reduced exercise, stress, and an environment that is not conducive to good health habits promotes the increase in weight associated with obesity and chronic disease (Misra & Ganda, 2007).

Chronic Disease

Although the focus of epidemiological studies tends to target adult populations for the purpose of gaining knowledge to be used for interventions, more information is now pointing to a focus on childhood periods of vulnerability. Michels (2003) was one of the early proponents of the life course approach to chronic diseases. She believed that many adult chronic diseases have their roots in early childhood. Diet during childhood and adolescence has been implicated in adult obesity. The author cites the Bogalusa Heart Study, which showed that atherosclerosis begins during childhood and that body composition was correlated with the degree of plaque in children's arteries (Michels, 2003). The Bogalusa Heart Study measured the prevalence of obesity among 11,478 children and adolescents ages 5-17 noting an increase from 6% to 17% over the 20-year period of the study (Freedman, Goodman, Contreras, DasMahapatra, Srinivasan, & Berenson, 2012).

Length of Residence

Increased length of residence in the United States has been associated with risk for chronic diseases. It is used by some studies as a measurement of acculturation. There is also evidence that length of residence is also implicated in weight gain, obesity, and increased risk of diabetes, so that the longer immigrants live in the United States, the more likely that they will be obese and have a chronic illness (Himmelgreen et al., 2004; Akresh, 2007, 2008; Park, Neckerman, Quinn, Weiss, & Rundle, 2008). Studies have shown that those who have migrated at a younger age are more likely to be overweight/obese than immigrants who arrived later on in life, indicating that longer residence may increase risk (Roshania, Narayan, & Oza-Frank, 2008). This change is generally the result in the timing of migration and the length of residence. The number of years one resides in a new country appears to significantly influence the level of acculturation for immigrants (Gordon-Larsen et al., 2003). The rate of acculturation may also be related to the age at which the individual migrated and the length of residence. The number of years of residence may influence diet, language acquisition, weight, and other long-term health issues, including chronic diseases such as diabetes.

Overweight, Obesity, and BMI

A commonly studied topic in health is the relationship between obesity/becoming obese, and the likelihood of developing chronic diseases, especially diabetes. Increased length of residence is sometimes implicated when discussing the probability of an immigrant gaining weight and thus increasing future health problems. The risks associated with obesity include cardiovascular disease, T2D, cancer, hypertension, high blood fats, and osteoarthritis (CDC, 2012b).

Kaplan et al. (2004) examined the relationship between obesity and length of residence. The authors concluded that those who had lived in the United States for greater than 15 years had the highest risk for developing obesity when compared with those who had resided for 5 years or less. They speculated that these changes might be the result of changes in diet and lack of physical activity (Kaplan et al., 2004). Hao and Kim (2009) examined body composition and its association with short duration of residence. It consisted of a comparison of BMI among new immigrants, earlier immigrants and native born. As per their study, they felt that there was an advantage among new immigrants that dissipated with increased length of residence. They noted that this change was more common in women than men. The authors concluded that this change in body composition was a result of changes in diet and might be a contributing factor in the obesity epidemic (Hao & Kim, 2009). Goel, McCarthy, Phillips, and We (2004), had similar findings using data from the NHIS, and reported that individuals who have been living in the United States for 15 years or more were more likely to have an increase in BMI when compared to native-born Americans. They stated that as the number of years increased, there was a corresponding increase in BMI (Goel, McCarthy, Phillips, & We, 2004).

Similarly, diet changes and increased BMI were associated with longer length of residence in two studies conducted by Akresh (2007, 2008). In studies using both the

NHIS and the National Health and Nutrition Examination Survey III (NHANES III), the author examined how long the participant was living in the United States, changes in diet, and BMI. The results indicated that the longer length of residence, the greater the change in diet, and the greater the change in diet, the larger the influence on BMI even when controlling for factors such as smoking and physical activity (Akresh, 2007, 2008). Both these studies concur with previously discussed research that implicated increased length of residence and changes in lifestyle with obesity.

Further connection was established between longer time spent in the United States and likelihood of obesity in a community-based breast health project (Wolin, Colangelo, Chui, & Gapstur, 2009). The study was the basis for a health project initiated to determine if length of time spent in the United States had an impact on obesity as measured by BMI > 30. The authors found that there was a correlation between obesity and length of time in the United States among this group namely, increased risk was associated with increased years in the United States (Wolin, Colangelo, Chui, & Gapstur, 2009).

Several authors compared Hispanic immigrants to those born in the United States with regard to risk for developing obesity (Bates, Acevedo-Garcia, Alegria, & Krieger 2008; Kaplan et al., 2004). Like Akresh (2007, 2008), Himmelgreen et al. (2004) concluded that the longer the stay in the United States, the more likely the immigrant would be obese. BMI was significantly higher in those who had resided in the United States for a greater number of years according to their study. The authors used 174 Puerto Rican women from a city in Connecticut, 34% who were considered obese. Although the authors indicated that the resulting data was consistent with other data, the convenience sample obtained was very small, with a high percentage of participants already considered obese (Himmelgreen et al., 2004). Similarly, Barcenas et al. (2007) compared Mexican-Americans to U.S. born subjects who were of Mexican descent, all living in the same geographical area. Using linear regression, the authors concluded that Mexican-born participants had a lower obesity risk when compare to native-born, and that as the length of residence in the United States increased, the risk of obesity increased as well, especially for women. The results, when compared to other studies of immigrant populations, were consistent with previous findings that longer length of residence did result in a higher risk of obesity (Barcenas et al., 2007).

Adding another dimension to the research of obesity and length of residence, the relationship between the concentration of immigrants and the level of acculturation may also be an important consideration when chronic disease is examined. Hochhausen, Perry, and Le (2010) studied the context of neighborhoods, acculturation, and associated effects on health. The authors noted that the level of acculturation tended to be lower among immigrant populations who reside in 'ethnic enclaves'. They used census tract information with a high Hispanic population. The results indicated a low acculturation score. Since this study did not measure health outcomes, the authors did not indicate if low acculturation scores meant better health but did state that there are health influences based on the composition of neighborhoods and level of acculturation (Hochhausen, Perry, & Le, 2010).

Similarly Park, Neckerman, Quinn, Weiss, and Rundle (2008) looked at neighborhood demography as it pertains to BMI in Hispanic immigrants versus U.S. born. According to the authors, the longer individuals live in the United States, the higher their BMI, with the exception of those who live in a neighborhood that had an ethnically homogeneous population. The authors theorized that living in an area that is ethnically similar to their country of origin allowed immigrants to maintain their diet and physical activity at levels similar to their native country (Park, Neckerman, Quinn, Weiss, & Rundle, 2008). Likewise, the relationship between the concentration of immigrants and the level of acculturation is an important consideration when chronic disease is examined. However, Osypuk, Roux, Hadley, and Kandula (2009) did study neighborhood concentrations of Mexican-Americans and the correlation with immigrant enclaves. They believed that neighborhood immigrant compositions had an impact on health behaviors. They also examined census tracts with a high concentration of Latin-American immigrants. With adjustments done for age, gender, income, etc., the results indicated that in neighborhoods with high immigrant populations, there was a lower consumption of high fat foods. Therefore, the authors' conclusion was that there were positive influences on health based on the composition of a neighborhood (Osypuk, Roux, Hadley, & Kandula, 2009).

The effect on obesity levels may be measured across generations as well. Bates, Acevedo-Garcia, Alegria, and Krieger (2008), compared first-, second-, and third-generation immigrants in a cross-sectional survey, and found that with each subsequent generation, BMI trended in an upward manner. The largest difference was between first-and second-generations with a smaller difference between second-and third-generation (Bates, Acevedo-Garcia, Alegria, & Krieger, 2008). This relates back to the discussion in Kaplan et al. (2004), which stated that the longer the residence, the higher the likelihood that the individual will become obese. Immigrant children who have an increase in assimilation to the new environment have a higher risk of chronic diseases, especially diabetes, than their parents who immigrated and may have still maintained some of the cultural lifestyle of their country of origin. U.S.-born children of immigrants tend to have a more rapid acculturation and thus acquire lifestyles that promote behaviors, such as smoking, diet changes, and decreased exercise, that increase risks for chronic diseases. Subsequent generations are less likely to continue the traditions of their parents and grandparents, thus increasing their risk of later-life disease risk (Gordon-Larson et al., 2003).

Antecol and Bedard (2006) studied the phenomenon known as the healthy immigrant effect (HIE), which postulates that immigrants are healthier when first migrating to the United States, when compared with after they have been residents of the United States for a period of time. Like Park, Neckerman, Quinn, Weiss, and Rundle (2008) and Barcenas et al. (2007), Antecol and Bedard (2006) compared Hispanic immigrants with those native-born, and concluded that BMI increased among immigrants to the extent that, over time, immigrant obesity converged to equal native-born. They further stated that immigrants came to the United States in better health but over time and with increasing levels of acculturation, their overall health became more like native-born

Americans. The information used in this study was cross-sectional data from NHIS (Antecol & Bedard, 2006).

As the studies discussed have indicated, weight increases over time go hand in hand with longer length of residence in the United States. The longer an immigrant remains in the United States, the more likely there will be changes in lifestyle, which includes diet. Where the traditional foods of the immigrant tend to be more focused on fruits and vegetables, the introduction of fast foods, with increased fat, salt and simple sugars, promotes increases in weight and the potential for increased risk of chronic diseases. Akresh (2007) reported that the most commonly-reported diet change among immigrants is an increase in meat and junk-food consumption, and stated that the fewer the changes in diet that are made by immigrants, the lower their BMI (Akresh, 2007).

Cardiovascular Disease and Other Health Outcomes

In addition to obesity, there are several other diseases that may be impacted by long-term residence in the United States. Using migration history, Chakraborty, et al. (2003) looked at the relationship of health habits and cardiovascular health in overweight women, ages 18-65, living in Texas. Not surprisingly, the results indicated that long-term residence in the United States was related to an increase in risk for cardiovascular disease. However, the authors also commented that the adverse effect of length of residence might be mediated by healthy exercise habits (Chakraborty, et al., 2003).

Egede (2007) also examined the risk factors associated with length of residence, such as the likelihood of developing several chronic diseases, including diabetes, and the impact on cardiovascular disease (CVD). He concluded that longer immigrants resided in the United States, the more likely that they would be obese, have hyperlipidemia, and be smokers. Egede focused on multiple ethnic groups (Egede, 2007).

Birth outcomes. There is some indication that length of residence can affect birth outcomes in Hispanic immigrants as well. Ceballos and Palloni (2010) used cross-sectional data on pregnant Mexican women and women who had recently completed a pregnancy just prior to the interview. Interestingly, the degree of acculturation had no impact on birth outcomes but increased length of residence did impact birth outcomes negatively. They indicated that the women used the clinics participating in the study and received pre-natal care in their native language as well as English. They did state that selective return migration, where immigrant mothers in better health return to their country of origin at higher rates than those who had experienced worse health, might have impacted this study (Ceballos & Palloni, 2010). In another cross-sectional study by Urquia, Frank, Moineddin and Glazier (2010), the authors linked negative pre-term (PTB) birth outcomes with longer time spent in the United States (>15 years residing in United States). They found no relationship to smaller for gestational age (SGA) birth outcomes. Also, immigrants with fewer than 10 years of residence had a lower risk of PTB than non-immigrants (Urquia, Frank, Moineddin & Glazier, 2010).

Health functioning. Like the risk for poor birth outcomes, longer length of residence in the United States may be responsible for poorer general health functioning in Hispanic immigrants. Self-reported good health was found to be less frequent among immigrants with 10 or more years of duration in the United States, among Puerto Ricans, and South and Central Americans (Cho, Frisbic, Hummer, & Rogers (2004).

Not all of the data supports the idea of poorer general health with increased length of residence. Gonzalez et al. (2009) examined cross-sectional data that indicated that older Mexican-Americans had better health functioning than their native-born counterparts. Disagreeing with Antecol and Bedard (2006), who describe the Healthy Immigrant Effect (HIE) as a phenomenon where immigrants come to the new country in good health that deteriorates with length of residence, Gonzalez et al. (2009) believed that longer residence in the United States benefits immigrants positively, and consequently their health is improved. Although younger immigrants generally are negatively impacted by acculturation, it seems that longer United States residence allowed for increased economic status that, in turn, may allow for better access to health care, and thus have improved health functioning (Gonzalez et al., 2009).

Diabetes. Several authors have been interested in understanding the effect of increased length of residence on diabetes risk. In one such study, Rahman, Kuzawa, and Lenonar (2010) recruited a random sample of women from a Chicago-based health clinic who were of mixed socioeconomic status, activity level, diet, and health status, and length of residence in the United States. Results from this study indicated that increased length of time in the United States was associated with increased rates of diabetes. Additionally, the waist-to-hip ratio, a valid measure of obesity, and BMI increased with increased length of residence (Rahman, Kuzawa, & Lenonar, 2010).

Several factors were associated with increased diabetes risk in a study by Wang et al. in 2010. Length of residence, genetic predisposition, lifestyle change, acculturation, stress of migration, and health care access influenced incidence of diabetes among a diverse population in this study. Most interestingly, as the length of residence increased, the rate of diabetes also increased (Wang et al., 2012).

Ahmed, Quinn, Caan, Sternfeld, Haque, and Van Den Eeden (2009), were interested in understanding generational differences among Hispanic-Americans, as well as differences between Hispanic-Americans and other ethnic groups in relation to incidence and risk for diabetes. The authors found that Hispanic Americans had higher levels of diabetes than whites or blacks, which could be partially explained by socioeconomics, obesity and other behaviors. The outcomes of this study indicated that in all areas, U.S. born participants had higher rates of diabetes than those born in other countries. Authors assigned Hispanics a score based on length of residence and whether they were first, second or third generation Americans (they called this migration status). The authors further demonstrated in this study, that immigrants with higher migration status (longer length of residence and/or increased generation in the United States) showed even higher risk of diabetes within the Hispanic population. They indicated that Hispanics living in the United States for more than 25 years had double the prevalence of diabetes compared to others who had immigrated within the past year. The authors reported that their findings are only partially explained by obesity, diet changes, and physical activity (Ahmed, Quinn, Caan, Sternfeld, Haque, & Van Den Eeden, 2009).

Other authors studied generational effects on onset of diabetes in Hispanic immigrants. Second-generation immigrants were found to have higher BMIs, higher cholesterol and higher socioeconomic status than first-generation immigrants (Zheng et al., 2012). They were also more likely to be smokers and have increased rates of diabetes, diabetic retinopathy, and cataracts, according to the authors. They believed that the risk factors for these disease processes are difficult to identify, but that acculturation (migration status and length of residence) can be a significant factor and should be considered in the formulating of interventions and other policies for health programs. The authors also hypothesized that first-generation immigrants may be less likely to have a lifestyle influenced by acculturation (Zheng et al., 2012).

There seemed to be a correlation between longer length of residence and an increased rate of diabetes among a group of U.S. Asian-Indians in a research study by Misra et al. (2010). The authors concluded that diabetes resulted from increased obesity and decreased physical activity in this group. Misra et al. (2010) also demonstrated that young adults were at higher risk. However, they indicated that variables such as socioeconomic status, education, and access to health care, might have affected outcomes (Misra et al., 2010).

Age at Migration

In many studies, the length of residence is difficult to separate from the age at migration when attempting to understand the risk for development of diabetes. Several authors attempted to distinguish whether residing in the United States for long periods or migrating at a young age is responsible for the health changes seen in Hispanic immigrants. Like acculturation, the actual age at migration and the period of life when there is movement to a new country/region may have a significant influence on the long-term good health of the immigrant. The timing of migration might trigger adverse health outcomes if it occurs during a particularly vulnerable period of development. This timing is also an important consideration when looking at length of residence. Both these factors, either together or separately, may have significant influences on the future health of the immigrant.

Obesity and Risky Behaviors

There is a dearth of information on the topic of age at migration and what, if any, impact of age at migration influences the immigrant's risk for obesity and, consequently, diabetes. There have been some studies that have focused on understanding this relationship. One such study, "Age at Arrival, and Risk of Obesity Among U.S. Immigrants," concluded that the prevalence of overweight/obesity was higher with greater duration of residence. Additionally, authors found an 11 times higher risk for immigrants who arrived at age 20 or younger (younger age at migration) and who resided in the United States for $\geq$ 15 years. The exception to this was among immigrants who arrived >50 years of age, who had no difference in obesity rates based on age at migration. Data were analyzed using multiple logistic regression. The respondents in this study attributed the weight gain to changes in diet (Roshania et al., 2008). Research showing that age at migration influences obesity, a key precursor of the diabetes, suggests the possibility that younger age at migration may also increase the risk for this disease (Misra & Ganda, 2007).

An assessment of age at migration was also done in a study done by Kimbro (2009). In his article, "Acculturation in Context: Gender, Age at Migration, Neighborhood Ethnicity and Health Behaviors", Kimbro (2009) examines the age at migration along with homogeneity in neighborhoods, when looking at the prevalence of smoking and binge drinking among Hispanic immigrants. The results of this study found that in ethnically homogeneous neighborhoods, there was less binge drinking and smoking. Immigrants who came to this country at a young age were more similar in behaviors to native-born than immigrants who came to the United States at an older age. Older age immigrants were less likely to assimilate and tended to stay with traditions and customs of their country of origin. The authors stated that there is significant research to support that immigration to the United States at an early age had risks that were not as evident among immigration at an older age (Kimbro, 2009).

Similarly, in a randomized community-based study of households located in the Houston area, Wilkinson, et al. (2005) compared Mexican-born immigrants and U.S.-born Mexicans and found that older age, being male, higher level of acculturation, and younger age at migration were all predictors for smoking risk. Wilkinson et al. (2005) indicated that there is a possibility that there are specific time frames for exposure that can make the immigrant more likely to adapt a specific behavior (Wilkinson et al., 2005).

Cardiovascular Disease Risk

In addition to obesity risk, early age of migration may also be related to cardiovascular risk. Colon-Lopez, Haan, Aiello, and Ghosh (2009) examined migration age of Mexican-born immigrants (before age 20 and after age 20) to determine a relationship with cardiovascular-related deaths. According to the outcomes of their study, they concluded that early migration might have risks for late chronic diseases that cannot be attributed to other factors (Colon-Lopez, Haan, Aiello, & Ghosh, 2009). Although these authors addressed the possible implication of age at migration, the parameters used were broad. Age at migration before and after age 20 may not give adequate information regarding the timing of migration and possible negative consequences.

Mortality Risk

R. Angel, J. Angel, Vengas, and Bonazzo (2010) looked at age at migration using adults who migrated after age 50 and two other groups: migration prior to age 18 and migration at ages 19-49, as compared to native-born. The data indicated that early age and mid-life migration had higher mortality rate whereas mature adulthood migration had a lower mortality rate when compared to native-born. One possible explanation is that the older immigrants did not usually come to the United States for work and usually did not adopt new language skills but rather came for the purpose of being with their families. This may have provided a support system for the elderly, which might have a positive effect on mortality (R. Angel, J. Angel, Vengas, & Bonazzo, 2010).

Diabetes Risk

As previously discussed, migration to the United States at a young age has been shown to have significant implications for the likelihood of developing obesity and cardiovascular disease. As both obesity and CVD are well established to have a possible relationship to diabetes, several authors investigated what effect, if any, age at migration has to the development of diabetes.

In an important study by Oza-Frank et al. (2011), the authors were able to gain some very interesting insights on the topic of age at migration. The authors found a positive relationship between increased length of residence in the United States and increased BMI among United States immigrants. However, they also found that this relationship is modified by age at migration. By dividing age at migration into four categories, < 18 years of age, 18-24 years of age, 25-44 years of age, and 45-74 years of age, and using chi-square tests and multivariable logistic regression analyses, the authors were able to determine that immigrants residing in the United States for >15 years were 1.7 times more likely to self-report that they had diabetes than those who were living in the United States <5 years. Similarly, immigrants who arrived at 25-44 years of age and resided in the United States for 15+ years were nine times more likely to report diabetes. The younger categories showed an association only in the 15+ years residence. The two older categories showed significant association starting at 10-<15 years of residence. The same was true for the obesity and overweight outcomes for those who reported having diabetes. The authors hypothesized that increased weight resulted from diet changes that accompanied acculturation. This study indicated a relationship between age at migration, length of residence, and increased risk of diabetes. The immigrant population was diverse, using participants from several ethnic groups (Oza-Frank et al., 2011).

Critical/Sensitive Periods of Migration

Several authors have examined the implication of specific times in the life cycle of individuals and chronic disease risk (Bates & Teitler, 2008; Schooling et al., 2004). Many research studies have looked at the potential of timing of exposure during sensitive periods of development, the possible risks that early migration has that late migration does not have, and how poor health habits may be more prevalent among those who migrate at a younger age when compared to those who migrate later in life.

The adolescent period, specifically, has been implicated as a critical period in which major changes, such as relocation to another country, may negatively impact a young person. Bates and Teitler (2008) believe that adolescence is an important time for self-identification and attention to social positions, and that migration during adolescence may lead to the assumption of habits that might otherwise not take place, for example, the initiation of smoking. This habit is most likely to develop in adolescence and early adulthood, with the likelihood of the risk of initiation decreasing with older age. In order to examine this phenomenon and its relevance to the acquisition of other chronic diseases, authors divided a large database of subjects into two groups: those who had migrated before and those who had migrated after age 13. Data demonstrated a protective effect of short duration of residence and late age at arrival in immigrants. Another interesting finding was that low birth weight in newborns was associated with maternal residence in the United States of 10 years or more and arrival prior to age 13, and more specifically, that although length of residence in the United States mattered, it mattered less if the migration occurred at age 13 or older. Although this study was diverse in the backgrounds of the population examined, there were sufficient numbers in the Hispanic subgroup to determine that there were similar patterns of low birth weight among Hispanic women when factoring in age at arrival and length of residence. Authors believe that this analysis gives support to the theory that there are ‘critical periods’ of migration and that the time of migration and the timing since migration can be used as predictors of health outcomes. Like Wilkinson et al. (2005), the authors indicated that this same pattern of critical periods could be extended to immigrants and the assumption of other changes in behavior (Bates & Teitler, 2008).

Schooling, et al. (2004) limited their study to immigration during the first 20 years of life in order to look at the effect of environmental change in the development of chronic diseases. The study looked at self-reported disease information on diabetes, hypertension, hyperlipidemia, and ischemic heart disease among Chinese men and women who had migrated at different stages of life from China to Hong Kong, resulting in improved economic status. The authors speculated that childhood living conditions might be associated with diabetes and cardiovascular disease (CVD) in later life. They stated that various life course changes might predispose an immigrant to chronic disease. Grouping the participants by age (0-7, 8-17, 18-24, and $\geq$ 25), the results of their study indicated that the development of hypertension was more likely when there had been a change in environment during puberty. They also found that the development of heart disease seemed to be associated with environmental changes in early childhood for men. Based on the results of their study, Schooling, et al. (2004) suggested that specific critical periods in the life cycle may pre-dispose individuals to chronic conditions. They also stated that this information could be utilized among populations undergoing change (Schooling, et al., 2004).

Critical periods of migration and socio-ecological influences can potentially affect the immigrants' mental health in addition to their physical wellbeing. When examining the likelihood of psychiatric disorders among Hispanic immigrants, a study by Alegria, Scribner, Woo, Torres, and Guarnaccia (2007) examined the length of residence and migration at critical periods as possible predictors for psychiatric disorders. Both longer residence and younger age at arrival to the United States were shown to be associated with increased risk level. Authors considered two critical windows in the developmental stages of the immigrants—before age 16 and after age 35—and considered both groups at higher risk for psychiatric disorder. The authors conclude that early age immigrants (before age 16) had a very high risk of psychiatric disorder-onset shortly after arrival, but do reach the levels of United States born risk over time. They believed that this might be a result of youngsters' problems with socialization, as well as conflict with parents, especially when the older generation wants to stay with cultural norms and the younger generation wants to assimilate. They speculate that among immigrants over age 35, there was less exposure to U.S. society, less assimilation for language, possibly fewer opportunities to work at their chosen profession in a new country, and consequently there may be more frequent feelings of isolation and depression (Alegria, Scribner, Woo, Torres, & Guarnaccia, 2007).

The life course approach to chronic disease gave consideration to the idea of sensitive periods for the development of diseases into adulthood. Small size at birth was correlated with an increase in overweight/obesity during childhood and early adulthood (Dabelea & Hamman, 2004). In their research, the authors examined the possible implications of early exposure such as fetal nutrition, which is a function of maternal body size, as well as placental function and metabolism, which may have an impact on future obesity. They theorized that being small at birth might promote increased weight gain during the first one to two years of life, resulting in overweight or obese toddlers.

These exposures may increase the risk of obesity in later life, and consequently increase the risk for diabetes. They also reported that there was conclusive evidence that adolescent obesity that continues into adulthood is more likely when the onset of obesity occurred at a younger age. Their research involved the infants of mothers with gestational diabetes, type 1, or type 2, diabetes, and found that infants were significantly more likely to develop T2D than mothers without diabetes (Dabelea & Hamman, 2004). Gluckman, Hanson, and Pinal (2005), were of the opinion that early onset obesity can be partially explained by an environment where a preference of high fat diets and reduced physical activity is prevalent. They further state that among immigrant populations, the risk is higher and that childhood obesity has become an increasing problem. Similarly, Lui et al. (2010) suggested that adult obesity is associated with rapid weight gain in infancy. The authors stated that in their research in mid- and later-life illness might be associated with social and physiological events experienced in utero, childhood, adolescence, and early adulthood. They are of the opinion that life course processes can be a catalyst for the development of interventions that can be a positive investment in the future health of the population (Lui et al., 2010).

In addition to the relationship between early childhood vulnerability and obesity, Tucker-Seeley, Sorensen, and Subramanian (2011) conjecture that childhood socioeconomic status may be correlated with heart disease and some cancers. Based on a cross-sectional study of over 7,000 participants from the Health and Retirement Study, there appeared to be a relationship between earnings and the presence of chronic conditions. These results were consistent with other studies that indicated an association between economic hardship during childhood and the presence of heart disease, stroke, diabetes, and some types of cancer among adults (Tucker-Seeley, Sorensen, & Subramanian, 2011).

Social environments can greatly impact childhood development, thus contributing to the adult-onset of chronic diseases. Furumoto-Dawson, Gehlert, Sohmer, Olopade, and Sacks (2007) theorize that childhood poverty, abuse, trauma, and neglect might play a role in the development of several adult chronic conditions. They specifically indicated that low socioeconomic status was related to hypertension in some ethnic groups. The authors found that there was an increase risk of cardiovascular diseases, diabetes, and cancers among individuals who had experienced episodes of stress (Furumoto-Dawson, Gehlert, Sohmer, Olopade, and Sacks, 2007). Colman and Ataullahjan (2010) suggested that many chronic diseases, including depression, have their origins in childhood. The authors hypothesize that stressful life events might be predictors of depression, and link depression to child abuse and neglect, and parental divorce. Interestingly, the authors stated that although depression tends to occur shortly after an event for children, the symptoms of depression sometimes manifest themselves many years after the event. They discuss the study of a group of males from early adolescence through adulthood. The most severe symptomatology was among those adults who had poorer childhood academic achievement and negative early life events (Colman & Ataullahjan, 2010).

Socioecological Influences

Although there are many researchers who believe that there are specific time periods where social or environmental exposure may be the causation of chronic diseases, the social ecological theory proposes that there are influences across the entire life course. In examining the life course approach, there is the potential to target specific times or levels that have the most potential to impact behavior using the social ecological approach. Each level of the life course provides various systems of impact. Whittemore et al. (2007) state that although genetics, ethnicity, and lifestyle are contributing factors in the development of type 2 diabetes, there are many social and environmental influences that cannot be ignored. Their research on diabetes prevention and management revealed that there are many variables that contribute to the risk for developing diabetes. They also state that interventions must be designed to understand impacts from other sources.

In a study initiated to improve dietary behaviors in low-income African Americans, Robinson (2008) utilized the SEM to improve fruit and vegetable intake. The author believed that the SEM provided a better overall look at how the interaction of the individual, culture, and environment influenced the dietary choices of the population. The personal taste preferences and habits, interpersonal culture and social traditions, as well as the organizational, community and public policies present in a society, can affect food availability, access, and utilization.

Kevin D. Cassel (2010) used the SEM to understand the contribution of cultural, biological, socioeconomic, and political influences on obesity in the Samoan populations. His research focused on a variety of factors that influence obesity prevalence in this population. He believed that disparities in health are a result of failure to realize that interventions must consider the multiple levels of influence that impact obesity. Strategies for improvement must be multi-faceted and dynamic, including biological, cultural, and political interventions. Trends and social conditions must also be considered, all of which can negatively affect outcomes of interventions. Similarly, Kolmodin et al. (2007) evaluated adolescent obesity within the framework of the SEM, and concluded that assessment and modification of family habits and availability and access to community resources are areas that may be prime for targeted interventions.

Review of Methodology

The articles reviewed in preparation for this study included cross-sectional investigations, randomized population-based studies, prospective cohort studies, and cross-sectional studies accompanied by chart reviews. Also reviewed were community-based observational studies and studies that used convenience samplings. Many of the studies used existing data obtained from the NHIS and National Health and Nutrition Examination Survey (NHANES).

The use of the NHIS is a common tool in research because the database is an in-depth analysis of health measures. NHIS is conducted yearly and is a cross-sectional survey of approximately 120,000 individuals from 45,000 households (CDC, 2012a). The ability to analyze data on many variables makes this database a valuable resource. Many researchers have used NHIS in the determination of probabilities and outcomes of diabetes. Logistic regression allows the researcher to predict an outcome based on a set of variables. The independent variables can be continuous, categorical, or any mix of variables (Tabachnick & Fidell, 2013). Using cross-sectional data from NHIS, Oza-Frank et al. (2011) estimated diabetes prevalence by length of residence by logistic regression analyses. The study participants consisted of immigrants from several countries. The study concluded that there was an increase in diabetes among the immigrant population based on length of residence, independent of age and obesity, and was modified by age at immigration. Approximately half of the participants were from Mexico, Central America, and the Caribbean. Antecol and Bedard (2006) also used this database and examined the evolution of immigrants' health from their country of origin to when they acquire "American health status." They evaluated immigrant status in this cross-sectional study by using a regression model. In addition, Cho, Frisbic, Hummer, and Rogers (2004) used the NHIS as the source for cross-sectional research on place of birth, length of residence and health among Hispanics. The authors used descriptive statistics followed by multivariate logistic regression in examining health disparities (Cho, Frisbic, Hummer, & Rogers, 2004). Logistic regression techniques were also used, adjusted for age, education, physical activity, and other variables by Barcenas, et al. (2007), in their cross-sectional study that examined Mexican-American adults for risk factors. Their sample consisted of individual members of a cohort living in Texas.

In developing the specific analyses plan for this study, the use of the NHIS and a planned statistical analysis was done using descriptive analysis followed by bivariate comparisons and multivariate logistic regression analysis. Many articles, as listed above, are precedent for this manner of research. The use of these types of research design allows for an in-depth analysis of diabetes and the possible impact that age at migration may have had on adult illness.

Summary and Transition

Research in the area of immigrant migration seeks to explore the complex and intertwined relationship between BMI, length of residence, ethnicity, age, gender, education, and socioeconomic status as they pertain to the development of chronic diseases. The length of residence of an immigrant, regardless of ethnicity, has been shown to influence lifestyle changes as does access to health care and ability to find work. Change in traditions and habits, such as diet, physical activity, smoking, and drinking, complicate the examiners' attempts to determine which factors may influence health. After reviewing the articles cited in this chapter, there is clear evidence that age at migration may be a significant factor regarding diabetes and future health, and may be the first underlying factor that influences the behavior change among Hispanic immigrants. Longer time spent in the United States may be the catalyst that promotes behavior that has an impact on diabetes and the long-term effects of diabetes on overall health. Many previous studies have examined length of residence (Oza-Frank et al., 2011). When examining length of residence it is important to look at the age at which the immigrant arrives, since an individual's health may have been negatively impacted by the age at migration. The number of years an immigrant resides in the United States may be a contributing factor for increasing diabetes, and the age at which they arrive may add an additional factor (Roshania et al., 2008). As a consequence, it seems that becoming Americanized may predict diabetes and its consequences. Examination of a framework for understanding the possible implications of event timing on the future prevalence of diabetes may be useful in determining interventions. The health care needs of Hispanic immigrants may be determined in part by the age at which they come to the United States. The ability to use that information for the purpose of developing models for risk of chronic diseases, especially diabetes, can give the health care professionals the tools to begin prevention initiatives and education. Health care workers of this generation are expected to work with chronic diseases, aging populations, and new diseases, while bearing the burden of wanting to enhance health. New health initiatives must be developed to allow them to narrow the gap between the desire for good health and the reality of good health (WHO, 2006).

To support the hypothesis that there are specific times in growth and development that may be influenced by migration, it is necessary to examine the age at migration and its connection to chronic diseases, specifically diabetes. Several researchers have engaged in the study of life course factors and the epidemiology of chronic diseases. Ben-Shlomo and Kuh (2002), Lynch and Smith (2005), and Barondess (2008) have delved into the possible influences of exposures and outcomes, examining the time and timing to see if there are causal links to implicate chronic disease. Where Ben-Shlomo and Kuh (2002) and Lynch and Smith (2005) specifically look at the time and timing of exposures, Barondess (2008) examines the current methods for the treatment of chronic diseases. He stated that a closer look at the earlier phases of development, as well as looking at the individual across his lifetime, might provide a more focused approach to the treatment and prevention of chronic illness by developing interventions based on specific influences at that time of life (Barondess, 2008).

The time of life and the types of influences on behavior is the basis for the socio-ecological theory. The SEM has also been used to focus on the various social and environmental influences on immigrant health (Stokols, 1996). This framework examines the various types of influences on health based on more than just a moment in time, but rather on the many moments when society and the environment provide an impact (Wilson, 2001). These levels or layers of influence may be a factor in the high prevalence of diabetes among this population. The fact that the Hispanic immigrant population is predicted to be the largest immigrant population in the United States by the year 2050 provides ample rationale to study this group (CDC Office of Minority Health & Health Disparities, 2011a). Predictions for diabetes among this population group indicate that the lifetime risk for developing diabetes for the Hispanic individual born in the year 2000 is 52% for women and 45% for men. For obese Hispanics, the rate of diabetes is double that of other groups (CDC 2011d). The long-term complications of this disease will greatly impact both the lives of the Hispanic population as well as the health care system. An expanded knowledge aimed at the impact of age at migration and the various factors that may influence health across the life course can assist in determining whether a new focus in policy and interventions targeting young immigrants can provide a positive impact on prevention, education, early diagnosis and treatment for this population.

An evaluation of the relationship between age at migration and diabetes was done in Chapter 3, by analyzing the data obtained from the NHIS. The importance of establishing a connection between these variables can be a significant factor in the development of interventions. I also explored the impact of other variables in this relationship. The methodology that was used is comparable to past research studies and may determine the possible relationship that can help predict possible behaviors that effect diabetes, and have an impact on future health initiatives.

Chapter 3: Research Method

The importance of addressing the problem of diabetes among Hispanic immigrants is significant due to the anticipated increase in immigration to the U.S. mainland and the prediction of increased prevalence of diabetes in the Hispanic population (CDC, 2011b). In order to be able to address this problem, a better understanding of the influences of lifestyle is necessary so that resources for prevention and education about the disease can be developed in areas that will provide the greatest impact. This chapter discusses my methodological approach to studying the relationship between age at migration and the prevalence of diabetes as self-reported by Hispanic immigrants to the United States. It addresses the population studied, the sampling design, the nature of the survey instrument, the variables in the analysis, and the statistical techniques used.

Research Design and Rationale

This dissertation used a quantitative, cross-sectional study design analyzing 7 years of data obtained from the NHIS, 2005-2011. The nationally representative NHIS data included information on population demographics, education, income, health-related topics, weight and height, time spent in the United States, and a variety of other topics (CDC, 2012a). The survey instrument contained questions on diabetes, and data included the country/region of origin of the participants, with information on present age and length of residence in the United States. It also contained enough Hispanic immigrant respondents to permit an analysis of this population (see Table 4). This information is collected yearly on a voluntary basis (CDC, 2012a).

Methodology

Population

My analytical sample included respondents to the 2005-2011 versions of the NHIS who were Hispanic immigrants to the United States between 18 and 80 years of age. The NHIS did not include institutionalized persons.

Sampling and Sampling Procedures

The NHIS sample was gathered using a multistage area probability design (CDC, 2012). By using a multistage sampling, the survey is able to obtain a representative sampling of U.S. households. The survey defines primary sampling units (PSU), which consist of specific geographical areas. During Stage 1 of data gathering, the NHIS chooses a sample of 400+ PSUs out of a potential 1900. Stage 2 consists of the division of each PSU into two segments. Area is Segment 1, which consists of several addresses within the PSU, and Segment 2 is types of housing (CDC, 2012a). The survey oversamples Black and Hispanic persons and more recently has oversampled Asians as well. This sampling results in four separate subgroups that can be analyzed and weighted to produce a representative sample of the United States noninstitutionalized population. Each subgroup is a representative sample of that subgroup's U.S. population. The purpose of weighing survey responses is generally to correct for oversampling so that the results of the survey better reflect the targeted population (CDC, 2012a). The NHIS uses census data to find concentrations of households that have one or more Black, Hispanic, or Asian individuals. They will then sample these groups at a higher rate (CDC, 2012a). The total Hispanic population that responded to the NHIS (2005-2011) was 147,780 (see

Table 3). Of that number, respondents who indicated they were Hispanic were 61,639 who were born in a U.S. territory (not mainland United States), or not born in the United States (see Table 4). Hispanic subgroups are represented as seen below.

Table 3

Hispanic Population by Survey Year and Country of Origin

Survey Year	Mexican	Puerto Rican	Central or South American	Other Hispanic Total	TOTAL HISPANIC
2005	16,006	1,923	3,168	2545	23,642
2006	11,840	1,458	2,549	2023	17,870
2007	12,439	1,644	2,762	1943	18,788
2008	11,587	1,599	2,505	1985	17,676
2009	14,777	1,873	3,161	2,466	22,277
2010	14,950	1,952	3,453	2,633	22,988
2011	16,171	1,897	3,604	2,866	24,538
Total	97,770	12,346	21,202	16,462	147,780

Note. Data obtained from the NHIS Survey years 2005-2011.

Table 4

Hispanic Ethnicity: Immigrant Status-All Ages

	Imm.	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	86141	58.3	58.3	58.3
	Yes	61639	41.7	41.7	100
	Total	147780	100	100	

Note. Data retrieved from NHIS data 2005-2011 using SPSS21 to determine immigration status.

According to the CDC (2011c), as of 2011 11.8% of Hispanics had diabetes. This varied based on the Hispanic subgroup. The total number of Hispanics respondents is shown above (147,780). In addressing Hispanic immigrant subgroups, the respondents that indicated that they were immigrants aged 18-80 was 55,067. Mexicans totaled 32,961; Puerto Ricans numbered 3,642; and Central and South Americans numbered 12,600 (NHIS, 2005-2011). In addition, for "Total Other Hispanic" the respondents numbered 5,864. This sample represented all Hispanic immigrants by subgroup between the ages of 18 and 80.

Effect was calculated based on past research (Oza-Frank et al. 2011). I utilized data from NHIS, 2005-2011 in order to calculate the necessary sample size. Age at migration was calculated based on subtracting the participants' number of years in the United States from the participants' age. The number of Hispanic respondents and number of Hispanic immigrants was obtained from the NHIS data, 2005-2011. Hispanic immigrants were those who responded to geographical place of birth as being outside of the mainland United States. I also limited the number of respondents to those who were between the ages of 18 and 80. Three separate calculations were made, one for each research questions. RQ1 compares the means and standard deviation for age at migration with diabetes status. RQ2 compares means and standard deviation for Hispanic immigrants' age at migration and diabetic status with BMI status. RQ3 compares the same variables as RQ2 by subgroup. Means and standard deviation were calculated using SPSS version 21; effect size and sample size was calculated using G*Power 3.1 (see Table 5).

Table 5

Means and Standard Deviation for Research Variables

Type	Means	SD	Means	SD	Effect Size	Sample Size
RQ1	41.0	12.3	32.0	11.7	0.75	80
RQ2	38.6	13.4	27.4	13.7	0.82	66
RQ3						
Mexican	34.1	12.8	23.6	11.4	0.87	60
Puerto Rican	41.4	12.6	29.9	14.5	0.84	64
S/C American	36.9	11.9	27.0	12.6	0.8	70
Other Hispanic	47.0	12.5	36.2	14.4	0.8	84

Note. Calculations done with G Power 3.1

Instrumentation and Operationalization

The NHIS provides information on the health status of United States noninstitutionalized populations. This survey is one of many programs associated with the NCHS. NCHS is a part of the CDC. The NHIS was first completed in 1957 and has continually surveyed the U.S. population (CDC, 2012a). The initiation of this study was part of the National Health Survey Act of 1956, passed to obtain accurate and current information about illness and disability and the amount and distribution of resources, as well as the types of health services provided to the United States population. The NHIS has been used to examine trends in disease and disability to provide information for the development and tracking of health objectives for the nation (CDC, 2013b). The NHIS is also used as a basis for policy provisions for health care, epidemiological data, and for the evaluation of federal programs.

Weighting is applied to the NHIS to account for differential probabilities of being selected to the sample and to adjust sample composition in terms of age and race or ethnicity to reflect the U.S. population. The NHIS uses a multistage cluster sampling and oversamples Black, Hispanic, and Asian individuals. There has been no change in the working of the survey questions relevant to the variables in my analysis over the years (CDC, 2013).

Studies performed by other researchers indicated that data regarding diabetes and other chronic diseases reported in the NHIS tended to be reliable (Weinger et al. 2005). Oza-Frank et al. (2011) reported that the pooling of data using several years of collected information from the NHIS, which was done commonly in the literature, is considered reliable when sampling adjustments are made. Additionally, the reliability and validity of the NHIS has been proved in other studies that pooled several years of data and noted consistency in the data over the years examined (e.g., Cho, Frisbic, & Rogers, 2004). The following variables were used in this study (see Table 6).

Table 6

Variables

Variable	Nature of Variable	Values/Units of Measurement
Obesity status (based on BMI)	Categorical	Series of dichotomous variables (< 18: underweight; 18-24.9: normal; 25-29.9: overweight; 30 and above: obese)
Have you ever been told by a doctor or health professional that you have diabetes or sugar diabetes?	Categorical/ nominal	Yes/no (represented by 0/1)
How old were you when a doctor or other health professional FIRST told you that you had diabetes or sugar diabetes?	Continuous	Numbers in a series
Age	Continuous	Numbers in a series
What is the HIGHEST level of school completed or highest degree received	Categorical	Series of dichotomous variables (6 categories range from No school to College +)
What are your best estimate earnings (include hourly wages, salary, tips and commissions) before taxes and deductions from ALL jobs and businesses in (last calendar year 4-digit format)?	Categorical	Series of dichotomous variables (0-$9,999, $10,000-19,999, $20,000-$34,999, $35,000-$54,999, $55,000-$74,999, $75,000 and over)
Geographical place of birth	Categorical	Name of place of birth
Age at Migration	Categorical	Series of dichotomous variables: 1=1-10; 2=11-20; 3=21-30; 4=31-40; 5=41-50; 6=51-60; 7=61-70; 8=71-80
Male or female	Categorical	Represented by 0/1
Years that person has been in the United States (length of residence)	Categorical	Series of dichotomous variables: <1(0), 1, 5, 10, 15

Note. From the NHIS 2005-2011

Dependent variable. Diabetes is the dependent variable. In evaluating the prevalence of diabetes among the participants, I will use the NHIS question: "Ever been told that you have diabetes?" Responses can be: 0-no information, 1-no or not mentioned,

2-yes or mentioned, 3-borderline, 4-unknown or refused, or 5-unknown or not certain. Respondents who were unsure of their diabetic status or who refused will be omitted from the analysis (0, 4, 5). Recoding will be as follows:

If diabetes = 1, recode as = 0 (no diabetes)

If diabetes = 2, recode as = 1 (yes diabetes)

Borderline will be analyzed with diabetes = 3, recode as = 2.

Independent variable. Age at migration is the independent variable. It was calculated by subtracting the years in the United States from current age (Oza-Frank et al., 2011). Calculation for the age at migration was done by eliminating '0' and '9' in the YRSINUS (years in United States) variable because '0' represented NIU and '9' was unknown. YRSINUS was recoded into a variable YRSINUS_REC, which is minimum number of years in the United States represented by 0, 1, 5, 10, and 15 years in the United States. Age was recoded into a categorical variable. YRSINUS_REC was subtracted from age, which created a categorical variable called Age at Migration. YRSINUS as a continuous variable is restricted, therefore limiting my ability to use this data.

Mediating variable. BMI is measured as a function of height and weight data, and is the standard measure of obesity. Individuals will be categorized depending on whether they are underweight, normal weight, overweight, or obese. According to the CDC, BMI provides a reliable indicator of body fatness (CDC. 2012b). It is used as a tool for screening for weight categories that may lead to health problems There can be variations in some individuals when using BMI as an indicator for body fat. For example, women tend to have more body fat than men; older adults have more body fat than younger adults. Athletes may have a high BMI but not a high level of body fat. It is also important to understand that BMI is one factor of consideration when assessing an individual's risk for chronic disease. It is, however, according to the CDC, one of the best methods for population assessment of overweight and obesity (CDC, 2011b).

Covariates. The analysis will control for age, education, income, and gender. Education will be a categorical variable with amount of education put in 6 categories: no education/kindergarten, Grade 1-6, Grade 7-12, high school diploma/GED, some college, and college graduate or higher (assuming there are some in the sample with graduate degrees). Income will be determined by individual yearly earnings and will also be categorical. There will be 6 categories for earnings. Gender will be represented as 0/1, male/female.

Data Analysis Plan

I will be using SPSS (21) for the statistical analyses of the data. I will begin my analysis with univariate description of each variable, including measures of central tendency and variation, in order to understand the composition of the sample that I am investigating. I will then move onto a description of the bivariate relationships between each independent variable and the dependent variable—self-reported diabetes status. My bivariate analysis will also inspect the relationship among certain key independent variables, which will help to show how these variables are associated with each other. Of special interest will be how each independent variable is related to obesity, because of its mediating role in my ultimate statistical model.

RQ1: Is age at migration associated with self-reported diabetes?

H_A1: Age at migration is associated with self-reported diabetes.

H_01: There is no association between self-reported diabetes and age at migration.

To test this hypothesis, I will move onto my multivariate analysis. I begin with a bivariate logistic regression model that estimates the effect of age at migration on diabetes. Next, I add a set of control variables to the model, including age, gender, education, income, and country/area of origin. This will account for possible confounding factors, thus helping to isolate the influence of age at migration on diabetes.

RQ2: Is the migration age-diabetes relationship explained by obesity?

H_A2: The age at migration-diabetes relationship is explained by obesity.

H_02: The age at migration-diabetes relationship is not explained by obesity.

Testing this hypothesis involves an extension of RQ1. I will add the obesity to the equation as a categorical measure, noting how this impacts the odds ratio and the statistical significance of age at migration (Misra & Ganda, 2007).

RQ3: Within Hispanic subgroups (Mexican, Puerto Rican, Central/South American, Other Hispanic), what is the association between age at migration and diabetes and does obesity impact that relationship?

H_A3: For each subgroup, age at migration-diabetes relationship is associated with obesity.

$H_0$3: For each subgroup, age at migration-diabetes relationship is not associated with obesity.

Testing this hypothesis involves using multivariate analysis and a logistic regression model as in RQ1 and RQ2. I will run the models described in RQ1 and RQ2 separately for Mexican, Puerto Rican, Central/South American, and Other Hispanic. I will omit the variable for country of origin. This analysis will not directly compare differences among Hispanic subgroups, but rather will assess each subgroup in turn. For all my models, I will use a 95% level of confidence to determine the statistical significance of my sample findings.

Threats to Validity

There are several potential threats to validity that need to be taken into account with this study. Because the data is self-reported, there is the risk of recall bias.

However, studies done using the NHIS, found that self-reported health status is a strong indicator for disease and mortality (McGee et al.,1999). Other issues that can be a threat to validity include random sampling error and unintentional over- or under-representation due to the sampling process. The validity and the reliability of NHIS sampling procedures including oversampling and weighting based on race, have been proven by a number of studies (e.g., Cho, Frisbic, & Rogers, 2004). In addition, BMI is one factor of consideration when assessing an individual's risk for chronic disease. There are many other factors including race, gender, and age. For this study, BMI has not been corrected for differences among races. BMI is, however, according to the CDC, one of the best methods for population assessment of overweight and obesity (CDC, 2011b).

The fact that this data has been collected and is readily available prevents the time needed for conducting this research from becoming prohibitive. Another potential validity problem is survey non-response. The annual response rate of the NHIS is over 90 percent of the eligible households in the sample. To the extent that non-response is systematic, this threatens the validity of the data. This can be partially mitigated by the NHIS in the assignment of sampling weights to the data (CDC, 2012a).

Ethical Procedures

Personal information collected by the NCHS follows federal law, which prohibits the release of personal information to anyone without consent of the participant. All potential participants are specifically asked if they want to participate and, if they accept, they receive information about the use of the data and to whom it will be given. Ethical issues in research are an important component of this study, and the use of confidential information will be conducted with the utmost consideration for the rights of the individual. In addition, secondary data does not have identification by participant. The purpose of using this data is to examine the gaps in the literature and not to generate information for any other reason related to personal benefit or bias. The Public Health Service Act (42 USC 242k) authorizes the data collection for this database. The CDC is prohibited from dissemination of any information that can identify any participants without their consent (CDC, 2012a). This study was submitted to the Walden University IRB and was approved (# 11-21-13-0163936).

Summary and Transition

This chapter summarizes the planned research study and methodology examining the possible relationship between age at migration and the probability of diabetes. The cross-sectional quantitative study will utilize secondary data from the NHIS. Using descriptive analysis, bivariate comparisons and logistic regression analysis, I will explore the association between age at which an immigrant comes to the United States and future chronic disease, specifically diabetes. I will also investigate one key pathway for this relationship to determine if obesity explains the association between age at migration and diabetes, and differences by country/region of origin. The methods that the NHIS uses to collect data, the possible validity issues, and the need to maintain confidentiality and protect the rights of participants are also discussed.

The subsequent chapter utilized the NHIS, 2005-2011, to collect data on variables described in this chapter. The analysis was done based on the research questions previously stated. Measures of association and statistical tests of the hypothesis using SPSS (21) were conducted.

Chapter 4: Results

In the previous chapter, a discussion of the methodology for this dissertation was presented. The use of the NHIS database for 2005-2011 for this study and the variables to be used were outlined. The specific analysis, as well as the design and rationale, was also presented. Chapter 4 consists of the results based on the cross-sectional analysis that was conducted to explore the relationship between age at migration and diabetes among the Hispanic immigrant population in the United States. Education, income, age, geographical place of birth, and sex were controlled in the analysis, while I had hypothesized obesity to have an influence on the odds of having diabetes after migration. Analysis was performed using SPSS 21 (IBM, 2012). As stated by the CDC (2011d), the long-term consequences of diabetes on individuals and families and the ever-increasing number of people being diagnosed with this disease make the investigation of the determinants of diabetes a significant area of research. One potential application of this study is the development of culturally sensitive educational initiatives, which can possibly enhance current methods used to decrease the prevalence and long-term effects of diabetes among the Hispanic immigrant population.

Research Questions

The research questions addressed in this dissertation focused on Hispanic immigrants and the possible influence of age at migration on diabetes. In the analysis, diabetes was the dependent variable and age at migration was the independent variable. Several control variables, education, earnings, sex, and obesity, were introduced to ascertain their significance in these models. The plan of study addressed the following research questions and hypotheses:

RQ1: Is age at migration associated with self-reported diabetes?

H_a1: Age at migration is associated with self-reported diabetes.

$H_0$1: There is no association between self-reported diabetes and age at migration.

RQ2: Is the migration age-diabetes relationship explained by obesity?

H_a2: The age at migration-diabetes relationship is explained by obesity.

$H_0$2: The age at migration-diabetes relationship is not explained by obesity.

RQ3: Within Hispanic subgroups (Mexican, Puerto Rican, Central/South American, Other Hispanic), what is the association between age at migration and diabetes and does obesity impact that relationship?

H_a3: For each subgroup, age at migration-diabetes relationship is associated with obesity.

$H_0$3: For each subgroup, age at migration-diabetes relationship is not associated with obesity.

Data Collection

The NHIS is a national representation of the general noninstitutionalized population (CDC, 2012a). The larger the sample population, the more one can generalize the results (Creswell, 2009). The data used in this study were obtained from the NHIS years 2005-2011. The NHIS sample was gathered using a multistage area probability design (CDC, 2012a). By using a multistage sampling, the survey is able to obtain a representative sampling of U.S. households. Also noted is the fact that the NHIS does oversample some ethnic groups. The NHIS sample was weighted with consideration for strata and PSU when performing the logistic regression. This was done to be sure that the numbers used reflected the population. The sample for this study was Hispanic immigrants who were U.S. residents, of Hispanic ethnicity, born outside of the mainland United States. There were 604,662 respondents in the original data from NHIS, 2005-2011, and 147,780 respondents indicated that they were of Hispanic ethnicity (see Table 7). Of that group, 93,444 people were between the ages of 18 and 80. This number was further reduced by immigrant status with 55,067 respondents indicating that they were born outside of the mainland United States (see Table 8). Hispanic immigrants were asked if they ever had diabetes. These results are shown by subgroup (Mexican, Puerto Rican, Central/South American, Other Hispanic) in Table 9. The total number of immigrant Hispanics ages 18 to 80 that answered the diabetes question was 19,727, my analytical sample.

Table 7

Respondents who indicated that they were of Hispanic Ethnicity by Subgroups: Data from NHIS 2005-2011

Hispanic Subgroups (all age groups)		Mexican	Puerto Rican	Central/ South American	Other Hispanic	Total
Survey year	2005	16006	1923	3168	2545	23642
	2006	11840	1458	2549	2023	17870
	2007	12439	1644	2762	1943	18788
	2008	11587	1599	2505	1985	17676
	2009	14777	1873	3161	2466	22277
	2010	14950	1952	3453	2633	22988
	2011	16171	1897	3604	2867	24539
Total		97770	12346	21202	16462	147780

Table 8

Total Hispanic Population by Subgroup and Hispanic Immigrant Population by Subgroup: Ages 18-80, from NHIS 2005-2011

Hispanic Subgroups (18-80)	Mexican	Puerto Rican	Central/ South American	Other Hispanic	Total
All Hispanics	59781	7931	15102	10630	93444
Immigrant Hispanics	32961	3642	12600	5864	55067

The numbers in Table 9 represent the sample size for each Hispanic subgroup. These respondents were placed in categories—those without diabetes, those whose diabetes was diagnosed prior to migration, and those diagnosed with diabetes/borderline diabetes post migration. Based on previous G-power calculations presented in Chapter 3, Mexican, Puerto Rican, and Central/South American had a large enough sample size for an analysis of each subgroup. The number of Cuban (5,407) and Dominican (4,378) respondents was not enough to be independently analyzed, so they were included in the category Other Hispanic. All subgroups were represented adequately.

Table 9

All Hispanic Respondents Categorized as not Having Diabetes, Diagnosed with Diabetes Before, and Diagnosed with Diabetes after Migration by Hispanic Subgroups Ages 18-80

Diabetic Status	Mexican	Puerto Rican	Central/ South American	Other Hispanic	Total
No Diabetes	10167	1379	4294	2117	17957
Diabetes prior to migration	235	113	69	69	364
Diabetes post migration	699	197	201	187	1406
Total Immigrant	11101	1689	4564	2373	19727
Missing System	48680	6242	10538	8257	73717
Total	59781	7931	15102	10630	93444

The diabetes variable was created by using the age at migration and age when first diagnosed with diabetes. Those people who responded *no* to the question were categorized as never having diabetes and people who responded *yes* to the question were categorized having diabetes at some point. To determine whether respondents were diagnosed with diabetes before or after they migrated, the age of migration was compared to the age of diagnosis. Age at migration was subtracted from age first diagnosed with diabetes, resulting in either a positive or negative number. Those with a positive number were categorized as being diagnosed after their age at migration while those with a negative number were categorized as being diagnosed prior to their age at migration. The total number of postmigration diabetes respondents was 1,406 (see Table 9). Mexicans represented the largest group of respondents who reported postmigration diabetes while the other three categories were significantly smaller due to smaller numbers of participants.

In order to determine the age at which an immigrant migrated, age at migration was calculated by subtracting the years in the United States, YRSINUS (categorical; the continuous version of years in the United States [YRSINUS] was restricted access, therefore limiting my ability to use these data to create a continuous variable for age at migration [ihis, 2014]) from a categorical version of the age variable. The variable YRSINUS denotes the minimum number of years in the United States in 5-year intervals, with possible categories of less than 1 year in United States, 1-4 years in United States, 5-9 years in United States, 10-14 years in United States, and 15 years or greater in United States (see Table 10). Age was originally a continuous variable, but it was recoded into a categorical variable with 5-year intervals. After subtracting the categorical version of the years in the United States from a person's age, the resulting variable, age at migration, had categories of 5-year intervals; these categories were later collapsed into 10-year intervals due to the small sample size in the older ages at migration (Table 11). Table 10 captures all ethnic Hispanics, regardless of the age that they migrated as long as they were within the ages 18-80 when they responded to the survey.

Table 10

Minimum Years in the United States

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	<1 year	682	0.5	1.1	1.1
	1 year to 4 years	7077	4.8	11.5	12.6
	5 years to 9 years	11985	8.1	19.4	32
	10 years to 14 years	10024	6.8	16.3	48.3
	15 years and above	31871	21.6	51.7	100
	Total	61639	41.7	100	
	Missing System	86141	58.3		
Total		147780	100		

Table 11 presents data for the Age at Migration variable with categories of 10-year increments. Age at Migration was coded into eight dummy variables, with 1 representing respondents who migrated during a specific 10-year period and 0 representing all other values. The dummy, or indicator variable, was used to categorize the individual age categories for the purpose of doing the regression analysis. This was done to estimate the specific odds of diabetes for each age at migration interval.

Table 11

Categorical Age at Migration: Ages 18-80

Value		Frequency	Percent	Valid Percent	Cumulative Percent
1	Ages 1-10	2275	2.4	4.1	4.1
2	Ages 11-20	10831	11.6	19.7	23.8
3	Ages 21-30	18935	20.3	34.4	58.2
4	Ages 31-40	12143	13.0	22.1	80.2
5	Ages 41-50	6529	7.0	11.9	92.1
6	Ages 51-60	3240	3.5	5.9	98.0
7	Ages 61-70	1033	1.1	1.9	99.9
8	Ages 71-80	81	0.1	0.1	100.0
	Total	55067	58.9	100.0	

The variable for obesity was created from the BMI variable in which 1 represents a BMI of 30 or above, and 0 represents all other values. The value used here to represent obesity is an established threshold and is based on the literature (CDC, 2011b). Approximately 27% of the Hispanic immigrants were in the obese categories (4984) as noted in Table 12. Puerto Rican had the highest percent (33.9%) of respondents who were obese.

Table 12

Hispanic Immigrants Respondents with BMI of 30 or Above: Ages 18-80

Hispanic Subgroups	Mexican	Per-cent	Puerto Rican	Per-cent	Central/ South American	Per-cent	Other Hisp-anic	Per-cent	Total
BMI 30 +	2926	28.3	553	33.9	952	22.0	553	24.3	4984

In the earnings variable, there are 6 income categories with $75,000+ as the highest. The income group with the highest relative frequency was $10,000 to $19,999 (see Table 13). More than half of the respondents reported earnings that were less than

$20,000 in the previous year. However, it is also notable that nearly 50% of the respondents did not report earnings.

Table 13

Yearly Earnings of Hispanic Immigrants by Subgroups

Earnings	Mexican	Per-cent	Puerto Rican	Per-cent	Central/ South American	Per-cent	Other Hispanic	Per-cent	Total
$01-$9999	2875	17.9	192	13.4	1106	16.6	416	15.3	4589
$10000-$19999	5533	34.5	304	21.3	2129	32.1	732	26.9	8698
$20000-$34999	4938	30.8	429	30.1	1985	29.9	790	29.1	8142
$35000-$54999	1931	12.0	303	21.2	960	14.4	465	17.1	3659
$55000-$74999	456	2.8	118	8.2	274	4.1	153	5.6	1001
$75000 +	285	1.7	78	5.4	220	3.3	157	5.7	740
Total	16018	100	1424	100	6624	100	2713	100	26829

Education was recoded into fewer/broader categories. Categories consisted of no school or kindergarten only, grades 1-6, grades 7-12, high school diploma or GED, some college, and college/graduate school (see Table 14).

Table 14

Education Attainment for Hispanic Immigrant Respondents

EDUCATION	Mexican	Per-cent	Puerto Rican	Per-cent	Central/ South Ameri-can	Per-cent	Other Hispan ic	Per-cent
No school/Kin-dergarten	389	1.2	56	0.7	262	1.8	71	0.7
Grades 1-6	3289	10.1	357	4.6	2336	16.1	596	5.8
Grades 7-12	6352	19.5	1758	22.9	2724	18.8	1870	18.0
HS Grad/GED	8925	27.5	2385	31.1	3687	25.5	2853	27.6
Some College	8252	25.4	2071	27.0	3166	21.9	3015	29.2
College/Grad uate Degree	5290	16.3	1051	13.7	2310	15.9	1929	18.7
Totals	32497	100	7678	100	14485	100	10334	100

In determining the ratio of male respondents to female respondents, the sample indicated that 48% were male and 52% were female, ages 18-80 (see Table 15).

Table 15

Hispanic Subgroups by Sex

Sex	Male	Female	Total
Mexican	19364	18578	37942
Puerto Rican	10373	11466	21839
Central/South American	3524	4407	7931
Other Hispanic	12173	13559	25732
Total	45434	48010	93444

Table 16 indicates the number of male and female respondents without diabetes, diagnosis prior to migration, and diagnosis after migration. This data shows that 57% of the post-migration diabetes samples are female, suggesting that female Hispanic immigrants are slightly more likely to have diabetes after migration. The numbers are based on the respondents who answered the question: "ever been told you have diabetes", who were immigrants, and were between the ages of 18-80.

Table 16

Hispanic Immigrants without Diabetes, Diabetes Diagnosed Prior to Migration, and Diabetes Diagnosed After Migration.

		Male	Female	Total
Immigrant Diabetes status: never, prior, or after migration	No Diabetes	8415	9542	17957
	Diabetes prior to migration	121	243	364
	Diabetes after migration	603	803	1406
Total		9139	10588	19727

Prior to performing the analysis of the research questions, the issue of collinearity was addressed. Because the age at migration variable was constructed using the age variable, there was concern about correlation between these two variables in the model and whether the use of these variables together would bias the regression model. Collinearity diagnostics measure how much the relationship between age at migration and age affected the regression model estimates. The variance inflation factor (VIF) can be an indication of collinearity if the values are equal to or greater than 10 (Jeeshim & KUCC625, 2003). Tolerance values, which are the inverse of VIF can also be predictors of collinearity when they are under 0.1 (Jeeshim & KUCC625, 2003). However, the values in Table 17 indicate that collinearity is not likely to present a problem with the data.

Table 17

Collinearity Diagnostic for Regression Models Comparing Age at Migration and Age with Diabetes

Coefficients Model		Collinearity Statistics	
		Tolerance	VIF
1	Age Mig 1-10	0.673	1.485
	Age Mig 11-20	0.593	1.687
	Age Mig 31-40	0.520	1.924
	Age Mig 41-50	0.341	2.929
	Age Mig 51-60	0.284	3.516
	Age Mig 61-70	0.393	2.544
	Age Mig 71-80	0.908	1.101
	Age as a categorical variable- 18-20	0.644	1.553
	Age as a categorical variable- 21-30	0.559	1.790
	Age as a categorical variable- 41-50	0.546	1.833
	Age as a categorical variable- 51-60	0.374	2.676
	Age as a categorical variable- 61-70	0.305	3.282
	Age as a categorical variable- 71-80	0.276	3.623

Results

The relationship between the dependent variable—self-reported diabetes status and age at migration, was examined. The plan of this study was to address the following research questions and hypotheses. All analyses were performed using weighted data and accounted for strata, PSU and sample weight.

Research Question 1

Research question 1 examined the possible association between age at migration and self-reported diabetes. The first logistic regression model for the research question used only age at migration as the independent variable with diabetes status as the dependent variable. The regression compared the odds of being in the age of migration category to the odds of not being in that age of migration category. As seen in Table 18, the results showed that the odds of having diabetes after migration increased as the age at migration increased, with the highest odds for age at migration of 51-60. However, all ages of migration after age 40 have higher odds for having diabetes when compared to those immigrants who arrived at a younger age. This outcome was not expected since the indication was that the older the individual, the more likely to have diabetes, a trend that has been well documented in the literature (ADA, 2011).

Table 18

Age at Migration and Diabetes Analysis

		95% Confidence Interval	
Age at Migration	Odds Ratio	Lower	Upper
Age Mig 1-10	0.043	0.006	0.308
Age Mig 11-20	0.100	0.018	0.563
Age Mig 21-30	0.230	0.040	1.316
Age Mig 31-40	0.750	0.136	4.125
Age Mig 41-50	1.257	0.221	7.148
Age Mig 51-60	1.667	0.303	9.182
Age Mig 61-70	1.499	0.261	8.624
Age Mig 71-80	1.000	1.000	1.000

However, in controlling for age, the addition of the categorical age variable indicated a change in results as shown in Table 19. When controlling for age, the results of a bivariate logistic regression showed that the relationship between age at migration and self-reported diabetes had an inverse trend than the trend seen in the previous regression where there was no control for age. The data below suggests a significant relationship between the odds of diabetes and the age of migration. The age at migration outcomes showed a trend toward increased odds of diabetes among the younger migration groups, a trend that opposes what is observed in the literature. The odds ratios suggested that at ages of migration 1 to 10, 11to 20, 21to 30, and 31 to 40, the odds of getting diabetes is 3 to 4 times that of other groups (a range in odds ratio from 3.083 to 4.021). The data also indicated that as the age of migration increased the possible diagnosis of diabetes decreased. The highest odds for diabetes are among age at migration 11 to 20 with an odds ratio of 4.021, greater than any other age at migration group. The lowest odds ratio is in the oldest group (see Table 19). However, when looking at the age (categorical) variable, diabetes increased with age, thus implying an opposite trend when compared to age at migration (see Table 19). This seems to indicate that there are two distinct relationships between time and diabetes. One relationship exists between age at migration and diabetes and another between age and diabetes.

Table 19

Age at Migration and Diabetes Relationship Controlling for Age

Immigrant Diabetes status- never or after migration	Odds Ratio	95% Confidence Interval	
		Lower	Upper
Age Mig 1-10	3.083	0.429	22.161
Age Mig 11-20	4.021	0.656	24.662
Age Mig 21-30	3.529	0.565	22.054
Age Mig 31-40	4.006	0.682	23.523
Age Mig 41-50	2.978	0.498	17.819
Age Mig 51-60	2.255	0.399	12.736
Age Mig 61-70	1.567	0.272	9.032
Age Mig 71-80	1.000	1.000	1.000
Age as a categorical variable- 18-20	0.006	0.001	0.028
Age as a categorical variable- 21-30	0.020	0.011	0.038
Age as a categorical variable- 31-40	0.044	0.028	0.070
Age as a categorical variable- 41-50	0.162	0.107	0.245
Age as a categorical variable- 51-60	0.380	0.267	0.541
Age as a categorical variable- 61-70	0.696	0.519	0.933
Age as a categorical variable- 71-80	1.000	1.000	1.000

Several control variables were then added to the model to determine if there is a change in outcomes based on these variables.

Education. In order to determine if there was a significant relationship between diabetes and education, the addition of education to this equation was done to determine what influence this may have on the model. When education is entered into the model, the odds ratios for the age at migration increased. The trend when adding education is similar to the trend without education, but diabetes odds increased in each category. When controlling for the effect of education, there was a stronger relationship in both the age at migration/diabetes status and in the age/diabetes status with education added as a control. The highest odds are among those with no schooling or Kindergarten only (see Table 20). This can present an additional problem for public health professions in the design of interventions for diabetes prevention and education. Innovative methods will need to be developed to target a population that maybe functionally illiterate. The usual and customary initiatives will need to be changed to adapt to this group.

Table 20

Diabetes/Age at Migration Relationship Controlling for Age and Education

Immigrant Diabetes status-never or after migration	Odds Ratio	95% Confidence Interval	
		Lower	Upper
Age Mig 1-10	3.914	0.557	27.485
Age Mig 11-20	4.839	0.803	29.147
Age Mig 21-30	4.015	0.653	24.680
Age Mig 31-40	4.777	0.829	27.548
Age Mig 41-50	3.577	0.609	21.022
Age Mig 51-60	2.735	0.492	15.213
Age Mig 61-70	1.830	0.323	10.360
Age Mig 71-80	1.000	1.000	1.000
Age as a categorical variable- 18-20	0.006	0.001	0.029
Age as a categorical variable- 21-30	0.021	0.011	0.040
Age as a categorical variable- 31-40	0.046	0.029	0.073
Age as a categorical variable- 41-50	0.170	0.112	0.257
Age as a categorical variable- 51-60	0.388	0.271	0.554
Age as a categorical variable- 61-70	0.683	0.503	0.927
Age as a categorical variable- 71-80	1.000	1.000	1.000

(table continues)

Immigrant Diabetes status-never or after migration	Odds Ratio	95% Confidence Interval	
		Lower	Upper
No School Kindergarten	3.159	1.989	5.018
Grades 1-6	2.889	2.166	3.853
Grades 7-12	2.334	1.718	3.169
HS Graduate	1.567	1.142	2.150
Some College	2.290	1.638	3.202
College Graduate +	1.000	1.000	1.000

Earnings. The addition of earnings showed changes in the odds ratio, although the trend remains the same. The overall increase in each age at migration category mimics the changes in the model when education was added. The addition of earnings did not change the trend in which younger migrants have the greatest odds of diabetes after migration and the odds diminish with increased age at migration. The highest odds of diabetes after migration continued to be at the age at migration 11 to 20, with the lowest odds at the highest age at migration (see Table 21). It should also be noted, however, that nearly 50% of this population did not report earnings.

Table 21

Diabetes/Age at Migration Controlling for Age, Education, and Earnings

Immigrant Diabetes status-never or after migration	Odds Ratio	95% Confidence Interval Lower	Upper
Age Mig 1-10	4.041	0.571	28.620
Age Mig 11-20	5.096	0.833	31.154
Age Mig 21-30	4.219	0.678	26.241
Age Mig 31-40	4.974	0.855	28.936
Age Mig 41-50	3.695	0.625	21.845
Age Mig 51-60	2.747	0.493	15.297
Age Mig 61-70	1.833	0.324	10.387
Age Mig 71-80	1.000	1.000	1.000
Age as a categorical variable- 18-20	0.006	0.001	0.029
Age as a categorical variable- 21-30	0.022	0.012	0.042
Age as a categorical variable- 31-40	0.048	0.030	0.078
Age as a categorical variable- 41-50	0.180	0.119	0.274
Age as a categorical variable- 51-60	0.408	0.285	0.585
Age as a categorical variable- 71-80	1.000	1.000	1.000

(table continues)

Immigrant Diabetes status-never or after migration	Odds Ratio	95% Confidence Interval Lower	Upper
No School Kindergarten	3.038	1.903	4.848
Grades 1-6	2.805	2.074	3.793
Grades 7-12	2.258	1.647	3.094
HS Graduate	1.519	1.097	2.103
Some College	2.237	1.588	3.150
College Graduate +	1.000	1.000	1.000
Earnings $0-$9999	0.936	0.714	1.226
Earnings-$10000-$19999	0.813	0.648	1.020
Earnings-$20000-$34999	0.773	0.593	1.006
Earnings-$35000-$54999	0.965	0.685	1.361
Earnings-$55000-$74999	0.791	0.447	1.398
Earnings-$75000	0.664	0.365	1.206

Sex. As seen in Table 22, the regression results after adding sex indicated that men had slightly lower odds of diabetes after migration than women. Age at migration 11 to 20 has the highest odds. The overall pattern remains the same with younger age at migration with increased odds and lower age at migration with decreased odds (see Table 22).

Table 22

Research Question 1: Age at Migration/Diabetes Relationship Controlling for Age, Education, Earnings, and Sex (Gender)

Immigrant Diabetes status-never or after migration	Odds Ratio	95% Confidence Interval	
		Lower	Upper
Age Mig 1-10	4.042	0.570	28.647
Age Mig 11-20	5.098	0.833	31.210
Age Mig 21-30	4.218	0.678	26.245
Age Mig 31-40	4.970	0.854	28.913
Age Mig 41-50	3.690	0.624	21.812
Age Mig 51-60	2.742	0.493	15.259
Age Mig 61-70	1.831	0.323	10.370
Age Mig 71-80	1.000	1.000	1.000
Age as a categorical variable- 18-20	0.006	0.001	0.029
Age as a categorical variable- 21-30	0.022	0.012	0.042
Age as a categorical variable- 31-40	0.048	0.030	0.078
Age as a categorical variable- 41-50	0.180	0.119	0.275
Age as a categorical variable- 51-60	0.409	0.286	0.586

(table continues)

Immigrant Diabetes status-never or after migration	Odds Ratio	95% Confidence Interval	
		Lower	Upper
Age as a categorical variable- 61-70	0.702	0.519	0.950
Age as a categorical variable- 71-80	1.000	1.000	1.000
No School Kindergarten	3.032	1.898	4.845
Grade 1-6	2.796	2.068	3.781
Grade 7-12	2.253	1.643	3.090
HS Graduate	1.519	1.097	2.102
College Graduate +	1.000	1.000	1.000
Earnings $0-$9999	0.935	0.713	1.226
Earnings-$10000-$19999	0.809	0.641	1.021
Earnings-$20000-$34999	0.765	0.583	1.004
Earnings-$35000-$54999	0.953	0.672	1.350
Earnings-$55000-$74999	0.779	0.438	1.387
Earnings-$75000	0.654	0.357	1.199
Sex	0.968	0.833	1.125

After examining the all models for RQ1 there are many trends and outcomes that can be discussed. Trends showed that younger age at migration increased odds of diabetes compared to older age at migration, and categorical age showed increased odds of diabetes as age increases. The highest odds occur at age at migration 11 to 20. The lowest odds were among the older age at migration categories. Research question 1 data analysis suggested a trend that the older that migration occurs, the lower the odds of diabetes after migration. The categorical age variables suggested that diabetes odds increased with age. The increase for diabetes as age increases has been well documented in many studies (Cho, Amoak, Kohlenberg & Halderman, 2005).

When the controls are added to the models, odds ratios change but the trend remains the same. The addition of education increased the odds ratio for diabetes for all age of migration categories. Respondents with the least education had the highest odds of diabetes after migration compared to other migrants. Adding earnings to the model resulted in a further increase of diabetes at all ages of migration. It should be noted that only 50% of the respondents indicated earnings.

Research Question 2

Research question 2 explored the possible influence of obesity on the age at migration/diabetes relationship. The model for RQ2 suggested that there was a decrease of diabetes after migration for the earliest migration age but there continued to be a high odds ratio for the ages of migration 11 to 20, 21 to 30, and 31 to 40. The trend remained the same that there was a significant decrease in the odds as age at migration increased. The overall trend still suggested that younger age at migration increased the odds of diabetes and that increased age at migration reduced those odds. This has been evident in all models with the exception to this trend in the age at migration 1 to 10 where there was a decrease in the odds ratio. Although there appeared to be a strong association between obesity and diabetes there was the suggestion that the effect may be masked when only looking at age at migration. The addition of the obesity variable changed all odds ratios indicating a decrease in odds of diabetes. This was very evident in age at migration 1 to 10 where the odds ratio decreased dramatically. In models where obesity had been added, the odds of diabetes was highest among the age at migration 31 to 40, with age at migration 11 to 20 as the second highest. This was a change from previous models without obesity as a control variable. In those models, age at migration 11 to 20 had the highest odds ratio. The odds continued to be less as the age at migration increased, indicating the same trend as other models (see Table 23). In comparing RQ1 and RQ2, indications were that obesity increased the likelihood of diabetes among Hispanic immigrants, yet it did not seem to increase the odds of diabetes after migration but rather mediates the effect, playing a role in the association between age at migration and diabetes (see Table 24). Also noted is that the effect of obesity is stronger among younger ages of migration.

Table 23

Research Question 2: Age at Migration/Diabetes Relationship Controlling for Age, Education, Earnings, and Sex with the Inclusion of Obesity

Immigrant Diabetes status- never or after migration	Odds Ratio	95% Confidence Interval Lower	95% Confidence Interval Upper
Age Mig 1-10	1.758	0.235	13.130
Age Mig 11-20	4.465	0.710	28.092
Age Mig 21-30	3.664	0.599	22.397
Age Mig 31-40	4.542	0.802	25.710
Age Mig 41-50	3.310	0.575	19.046
Age Mig 51-60	2.716	0.501	14.718
Age Mig 61-70	1.883	0.337	10.512
Age Mig 71-80	1.000	1.000	1.000
Age as a categorical variable- 18-20	0.003	0.000	0.026
Table 23 Con't			
Age as a categorical variable- 21-30	0.028	0.015	0.055
Age as a categorical variable- 31-40	0.051	0.031	0.084
Age as a categorical variable- 41-50	0.186	0.120	0.291
Age as a categorical variable- 51-60	0.422	0.288	0.618

(table continues)

Immigrant Diabetes status- never or after migration	Odds Ratio	95% Confidence Interval Lower	Upper
Age as a categorical variable- 61-70	0.692	0.507	0.945
Age as a categorical variable- 71-80	1.000	1.000	1.000
No School Kindergarten	2.570	1.553	4.255
Grades 1-6	2.398	1.733	3.318
Grades 7-12	1.962	1.405	2.742
HS Graduate	1.300	0.926	1.826
Some College	1.982	1.389	2.828
College Graduate +	1.000	1.000	1.000
Earnings $0-$9999	1.001	0.760	1.318
Earnings-$10000-$19999	0.864	0.680	1.097
Earnings-$20000-$34999	0.784	0.591	1.039
Earnings-$35000-$54999	0.922	0.641	1.326
Earnings-$55000-$74999	0.653	0.360	1.184
Earnings-$75000	0.621	0.338	1.138
Sex	0.885	0.757	1.034
Obesity	2.535	2.181	2.946

Table 24

Comparison between RQ1 (without obesity) and RQ2 (with obesity)

Comparison between RQ1 (without obesity) and RQ2 (with obesity)	RQ1 Odds Ratio	RQ2 Odds Ratio
Age Mig 1-10	4.042	1.758
Age Mig 11-20	5.098	4.465
Age Mig 21-30	4.218	3.664
Age Mig 31-40	4.970	4.542
Age Mig 41-50	3.690	3.310
Age Mig 51-60	2.742	2.716
Age Mig 61-70	1.831	1.883
Age Mig 71-80	1.000	1.000

Research Question 3

Research question 3 explored four different Hispanic subgroups: Mexican, Puerto Rican, Central/South American, and Other Hispanic to determine if there was a relationship between age at migration/self-reported diabetes and obesity within each subgroup. Table 25 represents two models for RQ3. The first model was done without the inclusion of the obesity indicator variable and the second model included obesity. The table was arranged so that a comparison of the odds ratios can be seen for each variable across subgroups with and without the inclusion of the obesity variable.

When exploring the odds of diabetes among these groups, it was determined that there was a significant difference among each Hispanic subgroup (see Table 25). Puerto Ricans had odds ratio that was greater than one while the other three groups all had odds ratios that were lower than one; this suggested that the odds of diabetes was greater for Puerto Ricans compared to all other types of Hispanics (see Subgroups in Table 25). Central/South Americans had a slightly lower odds ratio than Mexicans and Other Hispanics. The categorical age continued to show that the odds ratios increased as age increased. However, among the subgroups, the age groups with the highest ratios varied. The trend that diabetes decreased as the age of migration increased appeared to be evident in the groups, thus adding support to the hypothesis that there is a relationship between age at migration and diabetes. However, it was noted that when each subgroup was examined individually, the odds of diabetes was comparatively high from ages at migration 11 through 40, after which it trended downward. The greatest odds of diabetes when obesity was added was at age at migration 31 to 40, with slightly lower odds at age at migration 11 to 20. Table 25 represents two models for RQ3.

Table 25

Research Question 3: Age at Migration/Diabetes Relationship Controlling for Age, Education, Earnings, Sex, with and without obesity by Hispanic Subgroup

Age at Migration	Mexican	Mexican Obesity	Puerto Rican	Puerto Rican Obesity	Central/ South Amer-ican	Central/ South Amer-ican Obesity	Other Hisp-anic	Other Hisp-anic Obesity
1-10	3.667	3.121	3.792	3.180	3.262	2.797	4.010	3.349
11-20	4.717	4.339	4.849	4.411	4.305	3.987	5.062	4.585
21-30	3.945	3.742	4.042	3.784	3.647	3.471	4.192	3.920
31-40	4.716	4.558	4.776	4.559	4.380	4.233	4.954	4.734
41-50	3.555	3.389	3.501	3.303	3.301	3.144	3.679	3.475
51-60	2.678	2.691	2.624	2.610	2.500	2.517	2.745	2.737
61-70	1.792	1.875	1.775	1.846	1.692	1.776	1.835	1.908
71-80	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Categorical Age								
18-20	0.006	0.008	0.007	0.009	0.007	0.009	0.006	0.008
21-30	0.022	0.025	0.024	0.027	0.024	0.027	0.022	0.025
31-40	0.047	0.049	0.051	0.052	0.051	0.053	0.048	0.049
41-50	0.176	0.171	0.189	0.182	0.191	0.183	0.178	0.172
51-60	0.405	0.401	0.424	0.418	0.430	0.424	0.406	0.401
61-70	0.696	0.671	0.714	0.688	0.717	0.692	0.699	0.673
71-80	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Earnings								
$0-$9999	0.936	0.960	0.947	0.969	0.944	0.968	0.936	0.958
$10000-$19999	0.810	0.852	0.830	0.870	0.830	0.871	0.809	0.851
$20000-$34999	0.762	0.776	0.777	0.789	0.774	0.785	0.764	0.778
$35000-$54999	0.945	0.922	0.960	0.933	0.945	0.921	0.953	0.927
$55000-$74999	0.775	0.739	0.754	0.712	0.758	0.723	0.776	0.736
$75000 +	0.649	0.617	0.669	0.632	0.645	0.613	0.658	0.623

(table continues)

Education	Mexican	Mexican	Puerto Rican	Puerto Rican	Central/ South Amer-ican	Central/ South Amer-ican	Other Hisp-anic	Other Hisp-anic
None/Kind	2.654	2.286	3.193	2.672	2.731	2.330	2.957	2.496
Grades 1-6	2.489	2.282	2.919	2.610	2.531	2.302	2.739	2.467
Grades 7-12	2.103	1.905	2.254	2.016	2.067	1.867	2.228	1.997
HS Grad/GED	1.457	1.324	1.526	1.372	1.458	1.320	1.506	1.359
Some College	2.176	2.008	2.268	2.080	2.181	2.005	2.232	2.052
College Grad +	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Sex	0.973	0.919	0.964	0.910	0.973	0.918	0.969	0.915
Subgroup	0.805	0.837	1.455	1.404	0.642	0.679	0.894	0.912
Obesity		2.483		2.486		2.460		2.498

There appeared to be a strong relationship between age at migration/diabetes and obesity. The fact that the odds ratios for age at migration decreased across all Hispanic groups when obesity is added to the model suggested that obesity had an effect on the strength of the relationship between age of migration and the odds of diabetes. Without obesity in the model, it appeared that age at migration was affecting the odds of diabetes but after adding obesity, we saw that although this relationship is strong, it had decreased. In fact, obesity appeared to moderate that relationship.

Summary

The use of data from the NHIS, 2005-2011 gave this research a database of 147,780 respondents of Hispanic ethnicity. After eliminating those respondents who did not fulfill the criteria of this study, a total of 19,727 Hispanic immigrants age 18-80 were used to perform the data analysis. These respondents were part of four Hispanic subgroups—Mexican, Puerto Rican, Central/South American, and Other Hispanic—which consisted of Dominican, Cuban, and others, who did not specify their country of origin.

In research question 1, the relationship between age at migration and diabetes among Hispanic immigrants had outcomes that trended toward a significant association between age at migration and diabetes. The early ages at migration were more likely to have increased the odds of diabetes. The older ages at migration tended to have decreased odds. The second research question explored whether this relationship could be explained by obesity, with obesity decreasing the odds especially among the respondents that immigrated at the youngest ages. The outcomes of the research question 2 suggested that obesity had a substantial influence on diabetes but that other control variables may have had a more significant influence. The last question examined these same questions but did so using each Hispanic subgroup. The results indicated that Puerto Ricans have the highest odds of diabetes as compared to the other groups and Central/South Americans showed a lower odds ratio.

These results can be a stepping-stone to the formation of interventions and further research. While it is well documented that length of residence can be implicated in acculturation and long term chronic disease, consideration should be made in exploring the age at which an individual migrates to a new area/country (Kimbro, 2009). The changes that are encountered in the acculturation process can be exaggerated by the age of the newly immigrated individual. The timing of migration may be equally important as the length of time since migration. These ideas will further be explored in the subsequent chapter.

Chapter 5: Discussion, Conclusions, and Recommendations

Analysis of the data in relation to age at migration and diabetes provided some insight into the odds of diabetes among Hispanic immigrants when exploring various influences. The high rate of diabetes among Hispanic immigrants has been well documented (CDC, 2012c). The predictions of increased migration and increased diagnosis of diabetes provide ample reasons for health care professionals to investigate and examine various modalities to take control of this predicted increase of diabetes on both individuals and the health care system. The lifestyle and behaviors of this population should be explored to gather information that can be used to initiate educational projects addressing this disease. These initiatives can potentially contribute to a decrease in the impact of diabetes on the Hispanic population and improve the life of the individuals and families. The use of interventions that can target specific timeframes can reduce the negative health outcomes for persons with diabetes. It can also decrease the potential impact on the health care system.

After interpreting the outcomes of the analysis, it seems evident that timing may be an important consideration when developing methods to reduce diabetes. The age at migration should be an additional focus when developing models for change. While the earliest age at migration did not indicate the highest odds of diabetes, young adolescent and early adulthood data analysis did provide information that these ages at migration constituted high odds of diabetes. The odds were higher in the earlier ages of migration than in the later migration ages, with the lowest odds at the oldest age at migration. The inclusion of other covariates did not change the trend that migration between ages 11 to

20 was the age at migration with the greatest odds of diabetes for most groups. The addition of obesity did not change the overall trend but did appear to mediate the odds of diabetes, reinforcing the need for education about childhood obesity. The odds for diabetes after migration, was high among all individuals who were in the obese category. This was not surprising, as obesity has been documented as a risk for diabetes with the highest BMI constituting the greatest risk (Roshania et al., 2008). However, according to the analysis of this data, the association between age at migration and diabetes indicated that the odds of diabetes after migration was mediated by obesity; thus the odds of diabetes explained by age at migration was reduced. Among the Hispanic subgroups, the odds of diabetes were highest in the Puerto Rican group and lowest in the Central and South American group.

Interpretation of the Findings

In RQ1, the data were explored using age at migration and the categorical age as a covariate. The findings indicated that there was an inverse relationship between these two variables. The independent variable, age at migration was significant in all areas showing the highest odds of diabetes at ages of migration from 11 to 21. The increased odds of diabetes after migration, was consistently high in the earlier ages of migration, with lower odds of diabetes after migration in the later ages of migration. The categorical age variable indicated that diabetes odds increased with age. These outcomes seemed to indicate that there are two distinct relationships between time and diabetes: diabetes with age at migration and diabetes with age. These outcomes showed trends that provided possible confirmation that age at migration can be a measure in the determination of timing of interventions for diabetes initiatives. The addition of education had a negative impact and showed higher odds of diabetes after migration in all categories. The overall pattern remained the same with the high odds ratios in the age at migration category of 11 to 20 and lower odds ratio as age at migration increased. Categorical age pattern continued to indicate higher odds with greater age. The addition of earnings to the model indicated increased odds of diabetes after migration in all categories except 51 to 60 ages at migration, which showed slightly lower odds. With addition of sex, the pattern remained the same with no change in the odds ratios. It did indicate that men are slightly less likely to get diabetes than women.

Several studies corroborated these findings. According to Bates and Teitler (2008) the larger influence on diabetes was among the young adolescents and early adults. The authors stated that adolescence is a time for socializing and the formation of habits. Their study divided groups into before and after age 13. They concluded that late age at arrival and short duration of residence had a protective effect on the risk of chronic diseases. Further, the authors stated that although length of residence was significant, it mattered less if the age at migration was after age 13. This was consistent with the findings for RQ1, which indicated that the highest odds of diabetes were among age at migration 11 to 20. This study, although focused on immigrants as a whole, had a large number of Hispanic immigrants. In addition, Kimbro (2009) found that there was sufficient research to support that early age migration had risks that were not as evident among those who migrated at a later age. In limiting research to those whose age at immigration was 20 years of age or less, Schooling et al. (2004) studied self-reported diabetes, hypertension, hyperlipidemia, and ischemic heart disease. The authors concluded that changes in early life can predispose individuals to chronic diseases, also providing some corroboration to the data analysis done for this dissertation. These research studies all implied a relationship between age at migration and diabetes.

When the obesity variable was added to the models in the analysis for RQ2 and RQ3, the findings did show a reduction in the odds ratio of diabetes due to age at migration. Obesity appeared to mediate this relationship, but the trend that young age at migration incurred greater odds of diabetes after migration than late migration remained the same. In RQ3, an exploration of each Hispanic subgroup with the inclusion of obesity was done using the variables Mexican, Puerto Rican, Central/South American, and Other Hispanic. There was an indication that Puerto Rican immigrants had the highest risk of diabetes, followed by those in the Other Hispanic category, Mexican, and Central/South American.

The analysis that was completed on this data for RQ2 and RQ3 provided some insight into the information that was documented in the literature review. According to Roshania et al. (2008), the age at migration did have an impact on future health. The authors indicated that the age at migration prior to the age of 20 and residing in the United States for 15 years or longer had a higher risk of obesity and therefore a higher risk of diabetes. They also stated that the exception was those individuals who migrated after the age of 50. Many other studies also stipulated that obesity was a significant risk for diabetes, indicating that there are implications with the development of obesity especially at a young age. Obesity has been implicated in diabetes (Misra & Ganda, 2007). In a study done in 2011, Oza-Frank et al. (2011) divided immigrants into four categories based of age at migration. The results indicated that immigrants with residence of greater than 15 years were more likely to self-report diabetes. The authors stated that length of residence had an impact on obesity and that the relationship was modified by age at migration. Immigrants who arrived between 25-44 and were residents in the United States for 15+ years had a 9 times greater risk (Oza-Frank et al., 2011). The earlier the age at migration and the longer the residence in the United States, the more likely the individual will take on the habits of their new environment (Kaplan et al., 2004). As the children of immigrants become more assimilated, their risk of obesity and chronic disease, especially diabetes, may increase because they are less likely to follow the traditions of their parents. In some of the analysis for this dissertation, the larger influence on the odds of diabetes was during young adolescence and early adulthood. The data analysis showed that a relationship between age at migration/diabetes and obesity did exist and that obesity mediated the relationship between age at migration and diabetes for younger ages of migration more than for older ages of migration. It also showed that there was a relationship between age at migration/diabetes and obesity that was modified by variables such as education and earnings.

Further evaluation of these outcomes should be considered as related to the healthy migrant effect, whereby individuals who chose to migrate tended to be healthier overall with a greater ability to cope with the physical and mental stress of migration. According to Thompson, Nuru-Jeter, Richardson, Raza, and Minkler, (2013) there is a protective effect of late migration. In discussing the healthy migrant effect, their study indicated that there was a dose-response relationship between age at migration and health, in that the longer an individual lived in the United States, the poorer their health. The longer the exposure to acculturation and the stress associated with it, the more likely the immigrant will acquire diseases. The authors believed that a closer examination of the age at migration could provide a better understanding of the influence of the healthy migrant effect. There was also evidence that suggested that immigrants from developing countries have a greater positive health effect than those from more developed countries (Kennedy, McDonald, & Biddle, 2006). Kennedy, et al. (2006) also stated that the longer the immigrant was exposed to their new environment, the more likely they were to have negative influences to their health. This does provide some weight to the outcomes of this dissertation, that younger age at migration, which would also result in longer acculturation, may have a negative effect on diabetes odds. Ng (2011) also hypothesized that as the length of residence increased so did the impact of acculturation, resulting in the decrease in the health advantage. The outcomes of the research for this dissertation also concluded that younger age at migration resulted in an increase in the odds ratio for diabetes.

The implications of these outcomes and the socioecological theory (SEM) are related. When each model is closely examined, the timing of the highest odds for diabetes can be connected to the levels of impact as described in the SEM. The social, economic, and political surroundings of the individuals at each stage of life should be considered. Since these surroundings have the potential to be the most significant influences on lifestyle, a clear vision of these aspects of life needs to be the focus. Individual choices that are made— smoking, diet, exercise, and use of alcohol are all factors in future health. In many cases these choices can be traced to specific levels of influence, such as friends, co-workers, neighbors, and family, who also have an impact on behaviors. For young children (migration age 1 to 10), the impact of family is greatest. In the age at migration 11 to 20, the influences of friends and school may begin with peer pressure providing pathways to behaviors that were not experienced in the younger ages. Some ages are greatly influenced by community, employment, and local institutions. The importance of these levels of influences on lifestyle and behavior need to be examined to see how they can be used in the initiation of change. Based on the age at which an individual migrates, health care professionals can work to provide information targeting specific groups at specific ages of migration. In exploring the times when the odds of making negative behavior choices is highest, interventions can be developed that use these levels of influence to enhance positive change.

In the first model, where diabetes odds ratio is highest in the young adolescent and young adult, a consideration of the levels of influence at these stages can be explored. According to the SEM, neighborhood, friends, family, earnings, availability of appropriate food, and physical activities, should be considered. These influences should be examined so that they can be a catalyst for the development of initiatives that can use the areas of greatest impact to promote change. The exploration of the highest behavioral influences in a specific group can be one step in the creation of interventions to educate.

The inclusion of obesity in the second model indicated that obesity had an impact on the odds of diabetes. This decrease in odds of diabetes was evident in all ages of migration but appeared to be more significant in the younger ages of migration. Intervening education can be focused on age at migration groups whose long-term odds of diabetes are greatest.

When examining the influence of age at migration among each individual Hispanic subgroup, targeting those groups with highest odds ratio of diabetes would be a positive method to reduce the likelihood of diabetes and increase awareness. Puerto Rican immigrants had the highest odds for diabetes when compared to other groups. Central/South American had the lowest odds of diabetes after migration. Since in many instances diabetes odds were highest among younger immigrants, the structuring of interventions should include adult caregivers who can be significant influences on this group as per the SEM. At the youngest stage, children are learning from their caregivers, gaining knowledge, developing attitudes, and skills. The highest odds for diabetes after migration for most models, was the age at migration 11 to 20. It should be noted that, although increased knowledge from educational initiatives, can be helpful in the reduction of diabetes, pointing to the age at migration group with the highest odds for diabetes could be an effective use of resources. The limits in funding and human resources are an important consideration. The National Institute for Health funding for research lists the appropriations for grants each year. Diabetes research is not high on the list for funding following aging, genetics, behavioral health, HIV/AIDS, and lung disorders to name few (NIH, 2014). The importance of utilizing funding in a manner that targets very specific issues, will allow for the best possible use of these limited resources. Using these appropriations as carefully as possible, as targeted as possible and in the best possible manner for the most vulnerable members of the population, is a necessity. The Hispanic population needs interventions that are precise and can attain the most positive outcomes. The development of interventions should be done pinpointing the most advantageous utilization of resources. Examining where interventions will have the greatest impact is an important step in reaching the most vulnerable population.

Limitations

The data for this study were the NHIS (2005-2011). The data were collected from individuals who responded recalling events and information about their health. This self-reported data may present recall bias. There is also the possibility that respondents may not be forthcoming in their responses. However, NHIS data has been found to be strong indicators of health and disease despite the limitations of recall bias (McGee et al., 1999). In addition, no consideration was given to race, gender, or body size, when using BMI. According to the CDC (2012a), BMI is a reliable indicator of body fatness for most people and can be used as a measure for future health problems. Another limitation would be the age at migration variable. This variable was a categorical variable calculated by using years in the United States (a categorical variable) and age, with age a continuous variable that was recoded as categorical. This was done due to the restricted status of the continuous variable, years in the United States. The use of the NHIS database allowed the outcomes of this data to be generalizable. The NHIS is a national representation of the general non-institutionalized population (CDC, 2012a). The larger the sample population, the more one can generalize the results (Creswell, 2009). Data for the NHIS was collected according to the Public Health Service Act (42 USC 242k).

Recommendations

This study is step one in the research that can be done regarding age at which an individual migrates. Based on the research done in this dissertation, there are several initiatives that can be developed. Among the age at migration 11to 20, the levels of influence as delineated by the socioecological theory include school, work, and community. Health professionals can target the individuals at risk by incorporating interventions and health messages in the school system, as initiatives in the workplace, and by community outreach. Obesity and the connection to age at migration especially among the youngest migrants can provide a basis for the reduction of diabetes by reducing obesity in the very young. The development of obesity in very young children can be the topic of educational services for parents in hospital clinics and physicians' offices. Since the most significant level of influence among these young children is their home and parents, teaching parents how to keep their young children from becoming obese will greatly reduce their odds of diabetes. In addition, more specific research can be done to examine the differences in each Hispanic subgroup to determine why some groups have higher odds of diabetes than others. There is sufficient information to conclude that interventions should not only be based on age at migration but also by the subgroups targeted for the intervention. Unique and cultural competent tools that are targeted to subgroups with the highest odds ratios for diabetes after migration can be designed to impact long-term diabetes after migration.

The strengths of this study are that it shows that there are specific timeframes when migration at a specific age can increase diabetes in later life. This trend is an important consideration when developing tools for change in disease prevention. This analysis also explores the differences in the odds of diabetes at age at migration by subgroups. The use of this data in combination with information on length of residence may enhance the information that is currently available on this topic. One of the weaknesses of the study is the use of categorical instead of continuous when calculating age at migration. Also, using more years of the NHIS data would have garnered a larger sample, which would have enriched the study. This would have allowed for additional Hispanic subgroups to be analyzed independently rather that grouped together. Consideration should also be made, when exploring the possibility of future studies, to narrow the research to specific subgroups using data from additional years of the NHIS. There appear to be differences in the various Hispanic subgroups and these differences are important in the development of initiative for change.

Positive social change based on the information gleaned by this research can be the development of a knowledge base for health professionals that will augment the current practices for diabetes prevention and treatment. With the current predictions that diabetes among the Hispanic population will increase, and the expected increase in migration in this population, the importance of new initiatives and the creation of new public policy cannot be minimized. Focus can be done on immigrants that have migrated between the ages of 11 to 20, an age where outside levels of influence have the most impact on lifestyle. Initiatives that involve schools, workplaces and the community will bring information to this group. The age at migration group 11to 20 is more vulnerable to the desire to 'fit in'. This should be considered in the development of interventions.

Control of obesity among the young immigrants is a very important factor that can reduce their odds of diabetes later in life. This was noteworthy since the youngest age at migration had the largest change in odds ratio when controlling for obesity. Further research in the relationship between age at migration 1 to 10 and obesity can determine if the use of interventions during this timeframe can be a way to reduce long-term diabetes after migration. In addition, culturally competent and innovative designs for increasing educational initiatives among the various Hispanic subgroups should be considered. The Hispanic immigrant population is not a homogenous group but rather heterogeneous where different subgroups differ in their cultural norms, beliefs, and lifestyle. If the use of resources is done at the most advantageous time, and with consideration to the differing cultural preferences among the subgroups, the ability to reduce the odds of diabetes after migration will have a positive affect on the quality of life for a very significant ethnic group—a group that is predicted to be the largest ethnic group in the country within the next 30 years. In addition, the use of the health care system for the long-term effects of diabetes and the burden of increased diabetes among the Hispanic population, places the entire system at risk. Everyone deserves to be able to get quality health care. The ability to give proper and appropriate care to all individuals can be compromised by the overwhelming needs of people with diabetes. The burden that these increases will have on the health care system will be great as it attempts to service the population. The ability to provide additional knowledge based on an understanding of the impact of age at migration may be a positive contribution to diabetic care/information at a time when it will be most valuable. The focus on the differences in culture and traditions based on the individual subgroups should be considered in developing initiatives and the use of resources.

The ability to provide a different foundation for research with an approach that is focused on age at migration, and to augment the knowledge currently at hand regarding Hispanic subgroups, can be a starting point for social change for a population at great risk. In targeting the Hispanic community and the high risk of diabetes, future studies can focus on the possible implications of migration timing and an understanding that specific time periods of migration influence individuals and the environment in different ways. Future research can narrow the approach to education and prevention programs by providing additional evidence that targets specific periods for interventions. This can allow for the most cost-effective utilization of resources and also improve the quality of life for Hispanic immigrants.

Conclusion

Diabetes impacts the lives of Hispanics in greater proportion than many other ethnicities (CDC, 2011c). It robs the individual of quality of life and has a profound effect on lifestyle for both the individual and the family who care for that individual. The increase of diabetes among the Hispanic community is well documented. Increased immigration from Hispanic areas to the United States, more diagnosis of diabetes, and decrease in quality of life, are a significant part of the future for many Hispanic immigrants. Diabetes is the underlying cause of many chronic health issues, including kidney disease, cardiovascular disease, neuropathies, and blindness (NDIC, 2011). There is compelling evidence that the risk of diabetes can be lessened by improved diet, participation in exercise and physical activity, and maintenance of normal weight (WHO, 2011). This research was done to determine whether the age at migration is related to diabetes in later life. It also examined the role of obesity and if there were differences among Hispanic subgroups in the odds of diabetes after migration. The outcomes of this research indicated that there was some evidence that the age at which an immigrant arrives in a new country changed their odds of diabetes in later life. Those who migrated between the ages of 11 to 20, had an increased odds ratio for diabetes after migration. The movement from the area of birth to a new country during the early teens and into young adulthood changes the levels of influence that governed young children's lifestyle. Once an individual leaves the home for school, work, and interaction in the community, the influences that cause behavior change become much less a function of parental/home interaction and more outside influences. In one model, young children who migrated had higher odds of diabetes than their parents who migrated as adults. Interestingly when controlling for obesity, the youngest age at migration group had the largest change in odds ratio with a decrease from 4.042 to 1.758. Additional research needs to be done to examine this dramatic change. If controlling obesity at this early age can influence diabetes diagnosis in later life, it would be a significant way to increase the quality of life in the long term. Among Hispanic subgroups, Puerto Ricans had the highest odds of diabetes after migration, thus targeting this group for culturally sensitive interventions will decrease later life diabetes. The knowledge that developing diabetes due in part to the timing of migration can be the key to change among health professional as to how they approach this disease and the impending crisis on the horizon. Addressing timing of migration, obesity, age, and the changes in lifestyle associated with the process of acculturation, with consideration to the levels of influence each age group encounters, should be a consideration for future diabetes initiatives.

The use of age at migration as an influence on diabetes is an important first step in the development of culturally sensitive and evidence-based material for change. By identifying variables that can precipitate development of diabetes, health care professionals can target specific timeframes and better understand the greatest influences on future diabetes. This can focus interventions that are very specific, thus utilizing resources when they will have the greatest impact. The goal of a high quality of life is everyone's dream. Diabetes does not allow individuals to have that quality of life. The health professional community needs to approach this disease, evaluate the influences on the disease at the various ages of migration, work to reduce the risk, and reduce the long-term effects. This can only be done by education, interventions, and lifestyle changes. Hispanics have a great burden. The risk of diabetes is high and the long-term effects are profound. Reducing this risk is of the utmost importance. The starting point for change is now.

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Curriculum Vitae

Nancy Hahn, RN, MPH

Education:

Ph.D. Candidate
Walden University, Minneapolis, MN
Public Health, Community Health Education

Master's Degree in Public Health
Hunter College (CUNY), New York, NY
Community Health Education

Bachelor of Science
Brooklyn College (CUNY Baccalaureate Program), Brooklyn, NY
Health Sciences

Associate in Applied Science
Kingsborough Community College (CUNY), Brooklyn, NY
Nursing (RN)

License:

Registered Professional Nurse

Certifications:

BLS (Basic Life Support)

Rehabilitation Nursing Certificate

Professional Experience:

Americare, Incorporated: NYS Licensed Home Health Care Agency (LHCSA) — 2007-present
Vice President 2011-present
Administrator 2007-2011

Partners in Care (Visiting Nurse Service of New York): LHCSA — 2001-2007
Vice President of Home Care Services

Kingsborough Community College-City University of New York — 1985-2004

Adjunct Lecturer, Department of Health and Physical Education

Family Care Certified Services of Brooklyn: NYS Certified Home Health 1999-2001
Agency (CHHA)
Director of Clinical Services

American Health Aide Care: LHCSA 1996-1999
Director of Patient Services (Consultant)

Royal Health Care Services: LHCSA 1993-1996
Director of Professional Services (Consultant)

Methodist Hospital Home Care: CHHA 1990-1996
Community Health Nurse

Girling Health Care: CHHA 1989-1997
Community Health Nurse

Empire Health and Vocational Services: Rehabilitation Services 1986-1990
District Manager

Coney Island Hospital (NYC Health and Hospitals Corporation) 1983-1986
Registered Nurse: Medical Intensive Care