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A Multi-Level Examination of Influenza Vaccination Disparities from the 2009 Behavioral Risk Factor Surveillance System

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A MULTI-LEVEL EXAMINATION OF INFLUENZA VACCINATION DISPARITIES FROM THE 2009 BEHAVIORAL RISK FACTOR SURVEILLANCE SYSTEM

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Vaccinations were noted as the top public health achievement in the 20th century (Centers for Disease Control and Prevention 1999). However, not everyone is getting vaccinated. Taking a sociological approach this study examined the extent to which African Americans, American Indian/Alaska Natives, and Latino populations received an influenza vaccination compared to whites at a micro and macro level from the 2009 Behavioral Risk Factor Surveillance System. Previous research on racial and ethnic health disparities, attitudinal difference, and other demographic characteristics are reviewed in the literature. The Behavioral Model of Health Services was employed as the theoretical framework for this study. The methods consisted of three levels of analysis beginning with multivariate logistic regression at the individual level, least squares dummy variable modeling (LSDV), and hierarchical logistic regression modeling to incorporate aggregate data from the 50 United States. The results from the logistic regression show African Americans and Latino respondents have lesser odds of receiving the flu vaccine compared to whites after controlling for medical costs, access to health care, and a variety of socio-demographic characteristics. Results also show American Indian/Alaska Natives had greater odds of receiving the flu vaccine compared to whites after introducing similar control variables. Least Squares Dummy Variable Modeling controlled for the effects states have on receiving a flu vaccine. The results presented

were African Americans and Latinos have significant lesser odds of receiving the flu vaccine compared to whites. While American Indian/Alaska Natives had greater odds of receiving a flu vaccine compared to whites, statistical significance was lost once states were used as control variables. It was also found 13 states had greater odds and 13 states had lesser odds of receiving the flu vaccine compared to North Dakota. Hierarchical logistic regression models examined the influence of state level covariates on the odds of individuals receiving the flu vaccine, and the results indicated that African Americans and Latinos had lesser odds of receiving an influenza vaccine compared to whites, but American Indian/Alaska Natives were found to have greater odds compared to whites, with the results not being statistically significant. The implications of these results are discussed.

Introduction

It has been predicted that influenza causes 36,000 deaths (Thompson, Shay, Weintraub, Brammer, Cox, Anderson, Fukuda 2003; *Healthy People 2020* 2011; Logan 2009) and 200,000 hospitalizations each year in the United States (Healthy People 2020). Across literatures this number is not consistent because of the variability from one flu season to the next (Centers for Disease Control and Prevention 2011). It was estimated that 173,000 to 362,000 people were hospitalized and 7,880 to 16,460 died between April to December 12, 2009 from flu related diseases. Of these hospitalizations and deaths, minority populations were hit the hardest (Centers for Disease Control and Prevention 2011). In 2009 it was predicted that the world GDP would lose around $2.5 trillion during the influenza pandemic (Oxford Economics 2009).

The Centers for Disease Control and Prevention (2011) encourages everyone over six months of age to receive the flu vaccination every flu season. Even with this recommendation, people are either choosing not to be vaccinated, are lacking education of its importance, do not have access to health care, or a combination of factors.

The health status of the United States as a whole is improving. However, minority groups such as African Americans, American Indians/Alaska Natives (AIAN), and the Hispanic or Latino population still experience poorer health and access to health care compared to whites in the population. Minority groups in the United States are experiencing larger population increases compared to whites, and therefore will increasingly account for larger percentages of the country's overall health needs for the foreseeable future (The Office of Minority Health and Health Disparities 2011).

According to 2010 census data the African American population in the United States increased 12.3 percent in the past decade and individuals who identified themselves as American Indian or Alaska Native alone increased 18.4 percent (Humes, Jones, and Ramirez 2011). The largest percentage increase was seen in the Latino population with an increase of 43 percent. Over half of the Latino population is located in the three states of Texas, California, and Florida (Ennis, Rios-Vargas, and Albert 2011).

Due to large number of influenza associated deaths and hospitalizations (Nichol, Wuorenmna, and Von Sternberg 1998), and the increasing minority population this study examines the extent to which different racial/ethnic groups receive the flu vaccine and whether the individual patterns hold after controlling for socio-demographic and socio-economic factors. Moreover, this analysis seeks to extend previous work done in this field by introducing a multi-level analysis to examine the extent to which racial/ethnic differences in flu vaccination exist across states. This multi-level study focuses on African American, American Indian/Alaska Native, and Latino odds of receiving the flu vaccination compared to whites using data from the 2009 Behavioral Risk Factor Surveillance System (BRFSS).

Literature Review

Vaccinations are not a new concept, and their importance has been stressed throughout the years. Over the past several decades vaccines have helped to prevent diseases such as smallpox, polio, measles, mumps, rubella, and the focus of this study, influenza (Colgrove 2007).

The modern vaccine era began during the nineteenth and early twentieth centuries. Throughout the years many vaccines have been produced, but not everyone has access to vaccinations or wishes to be vaccinated. There are multiple plausible explanations as to why this is the case. Some researchers hypothesize ignorance; others predict it is the high costs and structure of the health care system in the United States (Colgrove 2007). However, researchers such as Samuel Katz (1973) make the claim that a multitude of factors from several areas interact to prevent more immunizations in our society.

The following sections discuss different factors that have been studied to explain racial/ethnic health disparities compared to whites. It begins with information about influenza advisory, an overview of variable differences between racial/ethnic groups, and disparities that have been found regarding healthcare in previous literature. I then goes on to explain research that has been conducted regarding perceptions and beliefs towards healthcare, and then ends with a discussion of other socio-demographic variables such as sex, marital status, and states' health.

Influenza Vaccination Advisory

The World Health Organization (2011) claims that the best way to prevent influenza is through vaccination. The vaccination is estimated to prevent 70 to 90

percent of flu specific illnesses in healthy adults under 65 years of age. High risk groups such as the elderly, individuals with existing chronic diseases, children six months to two years of age, and those who work in the health field are more highly emphasized to receive a vaccination due to their higher risk (World Health Organization 2011; Centers for Disease Control and Prevention 2011).

The report *Healthy People 2020* (2011) suggests that vaccinations are essential to cost effective preventive health. Approximately 42,000 adults die annually in the United States from diseases that had preventive vaccinations. Taking into account and the 36,000 figure previously mentioned, one could infer that most of the vaccine-preventable deaths are related to influenza. In areas where a high percentage of the region is not vaccinated, it places others in the area at higher risk of getting these vaccine-preventable diseases.

Racial and Ethnic Health Disparities

> In the next 50 years we expect the minority to become the majority (Berkman 2002).

The increasing diversity in the United States is changing the health needs in this country, and the health of minority groups is a primary concern. The Office of Minority Health (2011) claims that African Americans, Latino Americans, Native Americans, and other minority groups have poor health compared to other populations in the United States. Previous researchers have looked at the relationship between the attitudes of minorities and vaccination rates, and findings suggest that these attitudes explain health disparities consistently seen in the United States.

African Americans are less likely to receive flu vaccinations, have higher death rates related to heart disease, influenza, and asthma compared to the white population

(Office of Minority Health 2011). In regard to American Indians and Alaska Natives health compared to other racial/ethnic groups, they have the highest rate of two or more chronic conditions and rate of smoking. American Indians and Alaska Natives under 65 years of age have the lowest rate of private insurance compared to other racial and ethnic groups (James, Schartz, and Berndt 2009). Racial/ethnic minority populations are discussed in greater detail in the following sections.

African Americans

In 2010 the population of African Americans in the United States was 38,929,319 (Humes, Jones, and Ramirez 2011). The median household income of African Americans was $32,584 in 2009 compared to $54,461 for whites. In 2010, 25.8 percent of African Americans were in poverty compared to 9.4 percent of whites. The year 2009 had the highest poverty rates for all racial/ethnic categories in the United States since 1994. The highest rates of poverty were seen in the south and west with 15.7 and 14.8 respectively. The highest numbers of uninsured were seen in metro areas and especially principal cities. Poverty also increased for all types of families including those that were married for all racial/ethnic groups (Denvas-Walt, Proctor, and Smith 2010).

In 2009 16.7 percent (50.7 million) of the population in the United States was uninsured. Of those uninsured 21 percent were African American, and 26.6 percent of those uninsured had household incomes less than $25,000. In contrast in 2009 only 12 percent of whites were uninsured. Of those who did have health insurance in 2009, 30.6 percent was covered by government health insurance. This was the highest rate since 1987. In the population 15.7 percent (47.8 million) were on Medicaid and 14.3 percent (43.4 million) were on Medicare (Denvas-Walt et al 2010).

American Indian and Alaska Natives

In 2009 one third of American Indian and Alaska Native families had incomes less than the federal poverty level and had the lowest rates of private health insurance compared to other racial/ethnic groups. Large portions of these individuals rely on Medicaid, and the United States government is in charge of providing health services to American Indian/Alaska Native federally recognized tribes. The IHS facilities are most often located on reservations and it was estimated in 2009, 43 percent of the American Indian and Alaska Native population lives outside of reservations (James, Schwartz, and Berndt 2009).

In 2007 the white population was twice as likely to have a high school degree compared to the American Indian and Alaska Native population. In the American Indian and Alaska Native population 27 percent partook in smoking in 2008, 19 percent were self-reported in the 2008 BRFSS Survey as binge drinkers (James et al. 2009).

Latino

According to Ennis et al. (2011) 50.5 million or 16 percent of the U.S. population is Hispanic or Latino. DeNavas-Walt et.al (2010) found that in 2009 the Latino medium household income was $38,039 and 25.3 percent were Latino of those in poverty. Of the uninsured 32.4 percent were Latino, compared to 12 percent of whites. This population is also the fastest growing group with most of them from Mexican origin. In 2007, 67 percent had a high school diploma, and 12.5 percent had a bachelor's degree.

The numbers of each racial/ethnic group correspond with the factors previous studies have associated with poorer health. Minority groups have higher rates of poverty,

lower levels of education, and lower median household incomes compared to the white population in the United States.

Table 1: Racial/Ethnic Economic Profiles 2009

	% of Uninsured	% Poverty	Med Household Income
White	12%	9.40%	$54,461
Latino	32.40%	25.30%	$38,039
American Indian/Alaska Native	33% (2007)	25%	$33,627
African American	21%	25.80%	$32,584

Further studies of racial/ethnic health disparities are discussed in the following section. One of these studies focused solely on American Indian and Alaska Native's influenza and pneumococcal vaccinations compared to whites. Lindley, Groom, Wortley, and Euler's (2008) research sample consisted of American Indian and Alaska Native respondents and white respondents 65 years of age and older from the data collected by the 2003-2005 BRFSS surveys. Their findings suggested that American Indian and Alaska Native respondents were less likely than white respondents to have health insurance or a primary care physician. After aggregating the individual data into the regions of Alaska, Eastern United States, the Northern Plains, the Southern Plains, the Pacific Coast, and Southwest, these researchers found that the vaccination rate for American Indian and Alaska Native respondents and white respondents varied by region. The influenza vaccination rates for American Indian/Alaska Natives ranged from 63.7 percent to 77.6 percent, and white respondents had a range from 63 percent to 71.5 percent. The highest percentages for the influenza vaccine were found in the pacific coast for whites at 71.5 percent and the southern plains for American Indian and Alaska Natives at 77.6 percent.

Lindley et. al's (2008) pneumococcal vaccination findings were similar to the influenza vaccine rates by region, with whites in the sample ranging between 60.6 percent to 69.6 percent. The American Indian and Alaska Native respondents had a larger range from 45.1 percent to 70.6 percent. The white percentage for the pneumococcal vaccine was highest in the Southwest at 69.6 percent, while this region was lowest for American Indian and Alaska Natives at 45.1 percent.

Call, McAlpine, Johnson, Beebe, McRae, and Song (2006) also focused on comparisons between American Indians and whites. Their research looked at the main barriers reported by the respondents to health care services. The researchers used a stratified random sample of 1,281 Minnesota health care program enrollees with a mailed survey and a follow-up telephone survey between April and July 2003. The researchers looked at several barriers such as financial, access, cultural, trust, and discrimination. The findings suggested that American Indians cited most often racial discrimination, cultural misunderstandings, family/work responsibilities, and difficulty with transportation as the main barriers to their access of healthcare services. In contrast the researchers found that the white respondents in the sample most often reported not being able to see their preferred doctor.

Further research on racial/ethnic vaccination disparities was conducted by Straits-Tröster, Kahwaiti, Orelien, Burdick, and Yevich (2006) on 121,738 veterans receiving care from outpatient Veteran's Affairs (VA) clinics. This study differs from the two previously mentioned because it takes into account other racial/ethnic groups in addition to American Indian/Alaska Natives. The sample specifically included individuals older than 50 years of age during the 2003-2004 flu season. After mailing surveys and running

multivariate logistic regression models, the researchers found that African Americans, Latinos, and American Indian/Alaska Natives were significantly less likely to be vaccinated compared to whites. The percentages were 71 percent, 79 percent, 74 percent, and 82 percent respectively. After controlling for age, gender, marital status, education, employment, whether respondents had a primary care provider, and health status, African Americans were the only racial/ethnic group to remain significantly less likely than whites to receive a flu vaccine.

Another study that looked at the relationship between vaccinations and race/ethnicity was conducted by Norwalk, Patricia, Tabbarah, Terry, Raymund, Wilson, Fox, and Zimmerman (2009), who looked at 18 practices of inner-city, urban neighborhoods. They examined the vaccination rates between practices with a primary care physician, and patients of different race/ethnicities. These researchers specifically looked at the pneumococcal (PPV) and influenza vaccines among 2,021 patients who were less than 65 years of age. They observed characteristics of the practice, interviewed the physician, and looked at medical records. They took individual findings and used Hierarchical Linear Modeling (HLM) to examine panels of patients. The finding from this study found large variation between panels with different racial compositions. Panels with higher proportions of minorities were associated with lower vaccination rates, and in mixed race/ethnic panels, as the white percentage went up, so did the vaccination rates of minorities.

Chen, Fox, Cantrell, Stockdale, and Kagawa-Singer (2007) researched five different racial/ethnic groups' flu vaccination rates, perceived susceptibility, perceived severity of illness, and the main barriers reported for receiving an influenza vaccine. The

sample studied was of parishioners of congregations aged 50-75 years during 2004 in the cities of Honolulu and Los Angeles. The researchers used a telephone survey method, and in addition to looking at race/ethnicity they added control variables such as age, gender, education, annual household income, location, chronic medical conditions, and church attendance. They found that 45 percent of African Americans and 58 percent of Latinos reported not being concerned about getting the flu. In contrast 27 percent Japanese American respondents and 37 percent Filipino Americans reported being concerned of getting the flu. The researchers also found that 73 percent of Japanese Americans reported receiving the flu vaccine the previous year followed by 71 percent of whites, 58 percent Filipino Americans, 46 percent of African Americans, and 44 percent of Latinos. Four out of five of the racial/ethnic categories, excluding African Americans, reported "do not need influenza vaccine" as the most common reason for not getting vaccinated. African Americans (32 percent) reported "the vaccine causes the flu or causes serious side effects" as their main reason for avoiding the vaccine. In comparison only 18 percent of whites, 13 percent of Latinos, 11 percent of Japanese Americans, and 22 percent of Filipino Americans reported this response as the main reason for not receiving the influenza vaccine. African Americans do not trust the preventive benefits of the flu vaccination and the medical community that recommends it.

The studies in this section have advanced the understanding of racial/ethnic health disparities concerning vaccinations. They examined different factors such as the racial makeup of patients, barriers to healthcare, and vaccination rates. Chen et al. (2007) even used similar statistical methods to this study of hierarchical linear modeling.

While these previous studies have advanced knowledge in racial/ethnic differences and reasons for receiving vaccinations and healthcare, there are several noteworthy limitations. Lindley et al. (2008) focused on only two racial/ethnic categories consisting of American Indian/Alaska Natives and whites. The sample population was restricted to individuals over the age of 65 in the now data 2003-2005 BRFSS study. Call et al. (2006) had the limitation of a convenience sample of Minnesotans from two racial/ethnic categories. Norwalk et al. (2010) differed from this current study by focusing on only 18 inner-city practices, and looking at the racial makeup of patients and physicians. Straits-Tröster et al. (2006) limited their study to a sample of VA outpatients who were 50 years and older. Also, Chen et al. (2007) limited themselves to a two city sample that included 50-75 year olds. Wile many of these previous studies focused more on the senior population in our society, who are considered at greatest risk from death from influenza, their studies do not examine vaccinations across all age groups. This current study differs from those previously mentioned by using a sample of residents from all 50 states who represent all of the major racial and ethnic groups in the United States, including African American, Latino, American Indian/Alaska Native, and white respondents. Vaccination disparities have been examined, the data are approximately three years old, and the individual level data have been analyzed within the context of the 50 states.

Racial/Ethnic Differences in Vaccination Perceptions

Herbert, Frick, Kane, and McBean (2005) took a different approach than the studies previously mentioned by examining attitudinal differences towards vaccinations between racial/ethnic respondents. They looked at racial and ethnic attitudes relating to

resistance of getting a flu vaccine. They found that the Latino respondents most often reported a lack of knowledge, which prevented them from receiving the vaccine. In contrast white and African American respondents most often reported that receiving a flu vaccine could cause them to get the flu and mentioned the side effects associated with the vaccine.

In contrast to the above study, Bird and Bogart (2001) approached their study by examining perceptions by conducting research in Northeast Ohio on 76 African Americans using self-report questionnaires to examine whether the respondent perceived socioeconomic status and/or race-based discrimination when interacting with healthcare. The study found that 63 percent of respondents reported perceived discrimination based on race, and 58.9 percent based on socioeconomic status or social class when interacting with healthcare providers.

Blendon (1995) acknowledged that compared to whites, African Americans express more negative attitudes towards the healthcare system in the United States and this could be due to several factors such as historical disparities or current experiences that differ between racial/ethnic groups. He used data from the National Household Survey and the National Opinion Research Center. The sample consisted of 1,987 households and looked at health or health-related financial problems, public safety net programs such as Medicaid, and discrimination perceptions between white and African Americans. His research showed that compared to whites, African Americans perceive themselves to be in poorer health. African Americans had higher percentages of reporting having difficulty finding a job and less likely to have gone to college or graduate school. “Half of all African Americans sampled rated health care, education,

and police services in their community either fair or poor." He concluded from his findings that the everyday lives of African Americans do differ than whites, but that it might not all be due to race. It could be due to the burdens of living with lower income in the United States. This work coincides with variables that are being considered in this study such as education, which may influence whether an individual chooses to receive healthcare services such as receiving a vaccine. It also further explains various factors that African Americans account for when perceiving healthcare. Blendon's idea of multiple factors combined to affect health outcomes is further discussed in Andersen's (1995) Behavioral Model of Health Services.

Negative perceptions by racial/ethnic minorities are not new, and Gamble (1997) explained in a historical context the mistrust of African Americans towards healthcare that dated back before the Tuskegee study and inequality still seen today. She stated, "The Tuskegee Syphilis Study is frequently described as the singular reason behind African-American distrust of the institutions of medicine and public health (p. 1773)." In the forty year Tuskegee study 399 African American men from Macon County, Alabama were infected with syphilis and left untreated to observe the natural progression of the disease. She claims fear and inequality still exists today. She offers the contemporary example of the differences in treatment for heart disease between African Americans and whites in the 1980s. She cited a study by Wenneker and Epstein (1989), which claimed both groups had equal rates of hospitalization, but whites were a third more likely to be treated. She also goes on to claim that the Tuskegee study is a possible explanation as to why large numbers of African Americans do not support needle exchange programs.

Hammond (2010) researched medical mistrust among African American men in the United States. He sampled 216 African American men in barbershops and academic settings in the Midwest and Southeast United States. His aim was to look at what factors were associated with medical mistrust. A hierarchical regression was employed and age, education, and health status were used as control variables. The research found that more medical mistrust was reported in barbershops and those of older men. Hammond (2010) suggested the older men's higher levels of mistrust may be due to the fact they are closer in age to those who participated in the Tuskegee study. He also found men who held more traditional masculine values reported more medical mistrust, those who were discriminated in social environments had more mistrust, and African American men who expected to be treated different by physicians had more mistrust.

Voils, Oddone, Weinfurt, Friedman, Schulman, and Bosworth (2005) conducted a community based study to examine trust towards healthcare institutions by African Americans, whites, and Latinos. The sample consisted of data from a telephone survey of 549 respondents in Durham County, North Carolina. The researchers found that white and Hispanic/Latino respondents trusted physicians more than African Americans. Hispanic/Latinos trusted the health department, insurance companies, and state and federal governments more than African Americans and whites.

The studies in this section discussed various ways racial/ethnic minority perceptions towards healthcare have been studied. They varied greatly from a historical perspective, to perceived discrimination, and fear of side effects. This previous literature is important to understand the influence perceptions and beliefs have in whether an individual receives healthcare or even a vaccination in particular.

These studies further advance knowledge regarding racial/ethnic groups' perceptions of the efficacy of vaccinations and the healthcare industry in general. However, limitations exist within each one. Herbert et al. (2005) focused solely on the racial/ethnic groups of whites, African Americans, and Latinos. This current study also includes American Indian/Alaska Natives in comparison to whites. Bird and Bogart (2001) had a convenience sample of 76 respondents in Northeast Ohio, while their findings were informative, a larger sample that is representative of the nation may display different patterns and yield findings that are generalizable to the larger population in the United States. Blendon's (1995) research differs from the current study by specifically asking about variables related to attitudes and perceived health, and focusing solely on African Americans and whites. Hammond (2010) limited his study to a convenience sample of only African American men in the Midwest and Southeast United States. Voils et al. (2005) similarly had a convenience sample only located in Durham County, North Carolina. This current study uses a sample of individuals from all 50 states representing the African American, Latino, American Indian/Alaska Natives and whites population. The current study also uses a multi-level model to adjust for the clustering of respondents within states.

Health Coverage, Socioeconomic Status, and Education's link to Health

Previous research has found that low socioeconomic status and factors contributing to it such as low levels of education obtained and unemployment were correlated with whether or not an individual decided to receive care from a hospital (Mustard and Frolich 1995). Research shows higher levels of education and

socioeconomic status lead to higher rates of vaccine (Linn, Guaralink, and Patel 2010; Lindley et al. 2008)

Control variables that are being studied in this research such as education, income, and access to healthcare was previously studied by Bouye, Truman, Hutchins, Richard, Brown, Guillory, and Rashid (2009). They looked at various aspects of public housing, single parent families, and low income populations and how they influenced complications associated with the flu vaccination. These factors overlapped and after developing a framework they concluded that the individuals in these categories were more likely to get complications from the flu due to several issues. These issues were a lack of funds to get the proper medications and supplies needed, lack of adequate insurance, the inability to receive good healthcare with their government funded insurance, lack of stable employment, weak social support, unawareness of health interventions, and the inability to partake in health interventions because of the everyday tasks needed to survive.

Sex, Marital Status and Health

Differences between men and women's health has also been studied. Research has found that women compared to men were more likely to postpone medical care, skip checkups, not take medicine at recommended times, or refill prescriptions because of cost (The Kaiser Family Foundation, Kaiser Health Tracking Poll 2010). Women were also the highest percentage in every age category to be on Medicaid (Kaiser Commission on Medicaid and the Uninsured and Urban Institute analysis, 2004). American Indian, Alaska Natives, and white women respondents in research conducted by Lindley et al.

(2008) were less likely to receive a flu vaccine compared to men 65 years of age and older.

Contradicting statements from Courtenay (2000) reasoned why men tend to be in poorer health compared to women, such as having lower life expectancy rates and more chronic conditions. He went on to explain these disparities may be due to males having more pressure than females to conform to gender social perceptions, such as health beliefs of being tough and self-reliant. He also claimed variables such as ethnicity, socioeconomic status, and sexuality influence an individual's health behavior. After further discussion Courtenay (2000) concluded "men are more likely to demonstrate behaviors that increase the risk of disease, injury, and death (p.1386)." Also, "women in the United States adopt and practice healthier beliefs than men (p.1397)."

Married individuals tend to be healthier compared to those who are not married (Williams and Umberson 2004; Hemstrom 1996; Rogers 1995). Research conducted by Williams and Umberson (2004) found that the link between marriage and age differs between sex and age. A man older in age who divorces or becomes a widower experiences a quicker rate of decline when compared to a younger man who becomes divorced or a widower. However, they did find contradicting evidence that younger men's health worsened at a quicker rate the longer they were widowers compared to men older in age. The researchers were unable to find an effect on health by getting divorced or becoming a widow among women. Further socio-demographic variables are looked at in this current study, such as sex and marital status to see if these variables influenced the odds/ratios of an individual receiving an influenza vaccination.

Health Disparities across States

According to the National Vital Statistics System (2007) provided by the CDC the death rates per 100,000 from influenza and or pneumonia were highest in Tennessee, Arkansas, Wyoming, Louisiana, Kentucky, and Oklahoma. After further examination of data, several states were ranked at the top of the list for deaths in other areas such as cancer, heart disease, and diabetes. Kentucky is an example, being ranked as number one for cancer and nine for heart disease. Similarly, West Virginia is number one for diabetes and number five for heart disease. States such as Texas, Louisiana, Arkansas, Kentucky, West Virginia, Mississippi, and Alabama have the highest percentage of obese adults in the United States. These states are also located in the region of the United States (southeast) with the highest rates of deaths due to heart disease, Mississippi being the highest (Centers for Disease Control and Prevention 2010). These figures are beneficial to understanding this current study, because state variables are used in studying racial/ethnic disparities in receiving the flu vaccine. The environment is also a component of The Behavioral Model of Health Services discussed below.

The Behavioral Model of Health Services

The Behavioral Model of Health Services will be the theoretical framework for this research. It takes into account individual and environmental factors, both of which are examined in this study. The Behavioral Model of Health Services was originally developed in the late 1960s by medical sociologist Ronald Andersen. He created this model to understand and explain the use of health services by families, assist in the development of policies, and make healthcare access equal (Andersen 1995).

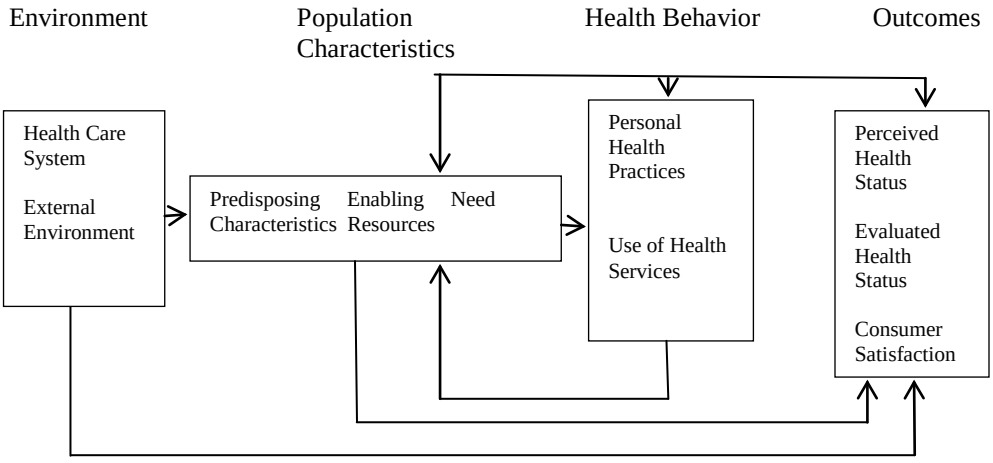
In the first phase of the model, Andersen emphasizes predisposing characteristics, enabling resources, and need. According to Andersen (1995) there are three types of predisposing characteristics. The first type is demographic. These include variables such as age and gender. The second type of predisposing characteristics are social structures. Andersen said social structures include education, ethnicity, and occupation. It may also include variables such as social interactions and culture. The final type of predisposing characteristic is health beliefs. These include knowledge about health and their access to care, attitudes, and values. Beliefs held by an individual may explain enabling resources and perceived need. Enabling resources, according to Andersen, are things such as access (availability of facilities), a way to get to these facilities, waiting times, income, and health insurance to be able to pay for these services. The final important component of the first phase is need. Andersen defines two types of need. The first is perceived need and the second is evaluated need. He says perceived need is a "social phenomenon" or how individuals view themselves and how important they view the need is. Evaluated need is the judgment from a professional on how serious the person's need is. It is important to note that Andersen argues that there are alternative ways to view this model. On one hand "each component might be conceived as making an independent contribution predicting use. On the other, the model suggests an explanatory process or causal ordering where the predisposing factors might be exogenous (p.2)"

With the assistance of Aday (1974) and others from the Center of Health Administration Studies, in the 1970s the model was restructured. This second phase of the model focused more on the individual as opposed to the family as a whole. It recognized the national health care system during this time period, resources available,

policy, and organization's influence on whether someone utilizes the system. This second phase of the model looked at the type, site, purpose, and time interval related to use of health services. The final addition to this phase was an examination of consumer satisfaction with the health care services they had received. Within consumer satisfaction, variables such as availability, financing, convenience, and quality were considered.

A third phase of the model, developed during the 1980s and 1990s, included a greater emphasis placed upon personal health. Personal health includes activities such as individual diet and exercise, perceived health status, and evaluated health status. It also took into consideration external factors that were outside of the individual's control such as the economy and politics. Phase four of the model is currently in development, yet, purportedly, it will take into account many environmental and personal factors that influence utilization of health care and as shown below in Figure 1 (Andersen 1995).

Figure 1: Phase 4 of the Behavioral Model of Health Services



This Behavioral Model of Health Services is applied to the present study of the individual's receipt of an influenza vaccination. Variables being examined such as race/ethnicity are part of Andersen's demographic consideration. Other variables herein

tested, such as gender, education, marital status, income level, health care coverage, and ability to see a doctor because of cost are all components of the Behavioral Model of Health Services and thus associated with health behavior and utilization from the health care system in receiving a flu vaccine. One's environment is additionally tested when individual level data is aggregated to the state level and states are used as control variables in least squares dummy variable modeling.

Research Methods

This study used data collected from the 2009 Behavioral Risk Factor Surveillance System (BRFSS) established by the Centers for Disease Control and Prevention. BRFSS originated in 1981 that consisted of monthly telephone surveys in 15 states. The aim of BRFSS is to look at health risk behaviors in adults 18 years of age and older (Centers for Disease Control and Prevention 2011).

The 2009 BRFSS was a cross-sectional survey that consisted of telephone interview surveys from all 50 states, the District of Columbia, Puerto Rico, Guam and the Virgin Islands. Every respondent was asked and responded to the same set of questions that BRFSS provided. However, every state was given the option to ask additional questions. If a large portion of the state spoke a language other than English, then the state had an option to provide the survey in other languages (Center for Disease Control and Prevention 2011).

The sample was selected using disproportionate stratified sampling in the 50 states and District of Columbia. Simple random sampling was used for the territories. The final sample size consisted of 432,607 respondents. The disproportionate stratified sample is determined by dividing telephone numbers into two groups, which are high density and medium-density strata. The determination of which group a number goes into is based on its hundred block. The CDC defines a hundred block as "a set of one hundred telephone numbers with the same area code, prefix, and first two digits of the suffix and all possible combinations of the last two digits." Each state is a single stratum most of the time, however smaller states in geographic size disproportionately stratify

from strata to get a large enough sample size (Centers for Disease Control and Prevention 2011).

Prior research has shown that self-reported vaccination data has a high degree of validity. MacDonald, Baken, Nelson, and Nichol (1999) examined the validity of self-reported vaccination of VA outpatients 65 years of age and older located in Minneapolis Veterans Affairs Medical Center and Group Health Managed Care Organization in Minneapolis-St. Paul. They found self-reported flu vaccine was on par when compared to medical records.

The current study examines the similarities and differences between different racial and ethnic groups in receiving the influenza vaccination in the United States in 2009. Specifically, this research studies if racial/ethnic minority groups have greater or lesser odds compared to whites of receiving a flu vaccine from the 2009 BRFSS data. Additional models explore these similarities and differences while controlling for demographic, economic, social, health care related, and environmental variables. And finally, a multilevel model assesses the similarities and differences in the odds of receiving the flu vaccination among different racial/ethnic groups nested with the 50 United States.

Hypotheses

Four hypotheses were tested in this research. The first three hypotheses specifically test the influence that race and ethnicity have on the odds of receiving the influenza vaccine at the individual level. The fourth hypothesis test the influence that race and ethnicity has on the odds of receiving the flu vaccine after adjusting/controlling for the clustering of respondents within the 50 states.

H1: Racial/ethnic minority groups will have lesser odds of receiving the flu vaccine compared to whites.

H2: Racial/ethnic minority groups will have lesser odds of receiving the flu vaccine compared to whites after controlling for each individual's access to health care.

H3: Racial/ethnic minority groups will have lesser odds of receiving the flu vaccine compared to whites after controlling for other socio-demographic factors.

H4: Racial/ethnic minority groups will have lesser odds of receiving the flu vaccine compared to whites after controlling for the clustering of respondents within states.

Dependent Variable

The dependent variable in this study measured whether or not the respondent received a flu shot in the past 12 months. The original question from BRFSS 2009 was "A flu shot is an influenza vaccine injected into your arm. During the past 12 months, have you had a flu shot? (BRFSS Codebook Report 2009 p.25)." Respondents who stated that they "Don't know" and those who "Refused" to answer the question were excluded from the analyses. The frequency distribution for the dependent variable is shown in Table 2. For the logistic regression analyses, the "yes" response was coded as "1" and the "no" response was coded with a "0".

Table 2: Influenza Vaccine Frequency Distribution from BRFSS 2009

Flu Shot in Past 12 Months	Freq	Percent
No	222,004	52.68
Yes	199,404	47.32
Total	421,408	100

For the individual and multilevel analyses, logistic regression analyses were used, Datyon (1992) explained that one would use logistic regression when the "outcome variable is categorical." In this study the outcome/dependent variable is dichotomous with a yes or no response to whether the respondent had received a flu vaccine in the past 12 months. The formula provided for a logistic regression is shown in figure 2 (Dayton 1992).

Figure 2: Logistic Regression Formula

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_p X_p + \varepsilon = \alpha + \sum_{j=1}^{p} \beta_j X_j + \varepsilon$$

Independent Variable

Race/Ethnicity

STATA 11.0 was used to perform the baseline analyses on the non-hierarchical data for this research. The core independent variable in this study was race with the following categories: white, African American, Latino, and American Indian/Alaska Native. The Latino category was a separate variable in the data set, but after further examination the Latino variable was equal to the multi-racial category in the original race variable. Therefore, for the purposes of this analysis, the multiracial category for the "race" variable was used as the measure for Latino. The categories of "Asian", "Hawaiian/Pacific Islander", "Other", "Don't Know", and "Refused to Answer" were removed from the data set due to the small number of cases or the invalid nature of some of these responses. Therefore, "African American" "Latino", and "American Indian/Alaska Native" are included in the multivariate logistic regression models with the racial/ethnic category of "white" serving as the excluded reference category. Results in all tables show the influence of being in one of these larger racial/ethnic minority groups

compared to whites. The frequency distributions for the independent and control variables are shown in Appendix A.

Control Variables

The baseline logistic regression model (Model 1) examines the differences between racial/ethnic groups on the odds of receiving the flu vaccine. Subsequent models add additional predictors to determine if the baseline results change. For example, Model 2 examined the differences between each racial/ethnic groups' odds of receiving the flu vaccine after controlling for the health coverage and medical costs of respondents. The original questions for these two variables from BRFSS 2009 are "Do you have any kind of health care coverage, including health insurance, prepaid plans such as HMO's, or government plans such as Medicare?" (BRFSS 2009 p.10), and "Was there a time in the past 12 months when you needed to see a doctor but could not because of cost?" (BRFSS 2009 p.10) For both these variables, the value of a "yes" was coded with a "1" and the value of the "no" was coded with a "0".

The third model of the multivariate analyses adds additional control variables, such as education, income, marital status, and sex. The original questions for these control variables are as follows: "What is the highest grade or year of school you completed (BRFSS 2009 p.19)", "What is your annual household income from all sources: (If respondent refuses at any income level, code "Refused") (BRFSS 2009 p.19)", "Are you (marital status) (BRFSS 2009 p. 18)" "Indicate sex of respondent. (BRFSS 2009 p.22)." The original values for each response are shown in Appendix B and the frequency of each category for each question is shown in Appendix A. The marital status variable was dummied and compared to the category of single. Dummy variables

were also created for education, with the category "never attended school" serving as the reference category. The income variable started as an ordinal variable and was changed into an interval/ratio variable by taking the midpoint of each ordinal category. The sex variable was recoded so that "0" represented "female" "1" represents "male" respondents.

As noted in the discussion above, the 2009 BRFSS data contains respondents nested within the 50 US States. Health care delivery and access is not uniform in the United States, and it is highly likely that access to vaccines and sources of distribution vary across the 50 United States. The first three models presented in this study examine the influence of race/ethnicity on the odds of receiving the influenza vaccine for all individuals in the dataset; these initial analyses do not control for the fact that these individuals are nested within different states. A straightforward and accepted practice for dealing with individual respondents clustered within larger aggregate units is to simply create a dummy variable for those aggregate units, and add this dummy variable (minus one category) to the regression model. This technique, known as Least-Squares Dummy Variable (LSDV) modeling allows one to examine the relationship of covariates while controlling for the nesting of respondents within social aggregates (Sayrs p.32). Given the categorical nature of the state variable, a set of 50 dummy variables were created, and in the multivariate analyses, the state of North Dakota is excluded and serves as the reference category. North Dakota was selected as the reference category because nearly 50 percent of the sample of North Dakota residents in the 2009 BRFSS dataset had received the flu vaccine. The LSDV technique was used in Model 4 of Table 3.

The final model employs the use of hierarchical logistic regression modeling. In traditional hierarchical models, data from the individual level is referred to as the level 1

model, and data from the larger aggregate units represents the level 2 model. In such an analysis, the level 1 units, such as individuals, must be nested within the aggregate level 2 units. This application has been used to measure such topics as socioeconomic status and academic achievement for students nested in schools (Raudenbush and Bryk 2002) and for the examination of offending by individuals residing within neighborhoods (Sampson, Raudenbush and Earls 1997).

Similar to the LSDV model discussed above, hierarchical modeling is used in this research to control for the fact that individual level respondents are nested within states. However, hierarchical modeling is considered to be a more robust means of estimating the relationship between a dependent variable and covariates at the individual level when there is nesting of these data. When individual level data are nested, it is possible to obtain deflated standard errors, which may ultimately yield a statistically significant relationship between a covariate and a dependent variable, when in fact, a relationship truly does not exist (Type 2 error). While LSDV model used in Model 3 helps to adjust for the clustering of data, invalid standard errors are still possible. Hierarchical modeling is considered more preferable because it provides more valid and robust standard error, and thus, more valid tests of statistical significance.

In the final analysis of this study, hierarchical modeling was conducted using the software program HLM 6.02 because it specifically controls for the fact that individual respondents are clustered within the 50 states in the BRFSS data. In this final analysis, the independent variables used in Model 3 of Table 3 were used to build a multilevel model in HLM 6.02 to determine if the results differed when the hierarchical nature of the data was taken into account and controlled. With the use of HLM 6.02, we can get a

clearer picture of the odds/ratios of receiving a flu vaccination of minority respondents compared to white respondents from the 2009 BRFSS dataset. Specifically, HLM 6.02 allows researchers to create a multilevel model where individual level predictors can be examined while controlling for the clustering of individual respondents within the larger aggregate units.

Analyses

Multivariate logistic regression models were created using the STATA 11.0 statistical software package. As discussed in the previous section, the baseline model for this research examines the odds of receiving a flu vaccine for African Americans, Latinos, and American Indian/Alaska Natives relative to whites. These results are presented in Model 1 of Table 3. The results clearly show that African Americans, American Indian/Alaska Natives, and Latinos had lesser odds of receiving the flu vaccine in 2009 compared to whites. African Americans had about 44 percent lesser odds of receiving the flu vaccine, American Indian/Alaska Natives had 10 percent lesser odds, and the Latino respondents had 51 percent lesser odds compared to whites. All of these differences were statistically significant.

Additional models assess whether these racial/ethnic differences hold after controlling for various demographic, socio-economic, and health care related variables. Model 2 in Table 3 displays the odds-ratios for the racial/ethnic variables after controlling for whether or not the respondent could see a doctor because of cost in the past 12 months and whether or not they had access to a health plan.

After controlling for these factors, odds-ratios increased for all racial/ethnic groups, suggesting that once these factors are controlled, the differences between racial/ethnic minority groups and whites subside slightly. African American and Latino respondents' odds/ratios remained having lesser odds of receiving the flu vaccine compared to whites after adding these two variables. However, after the two health related variables the significant differences between American Indian/Alaska Natives and whites presented in Model 1 disappear when these two medical variables were added to

Model 2. This means there are no significant differences in flu vaccinations between whites and American Indian/Alaska natives after controlling for medical costs and health plan access. As for the control variables themselves, those with healthcare had 203 percent greater odds of receiving the flu vaccine, while those who were unable to see a doctor because of cost had 37 percent lesser odds of being vaccinated. One can speculate that having healthcare coverage helps with the cost of health care, and therefore a greater ability to receive health care.

In Model 3 of Table 3, the variables income, marital status, education, and sex were added to the multivariate logistic models. After controlling for these factors, African Americans had 37 percent lesser odds and Latinos had 39 percent lesser odds of receiving the flu vaccine compared to whites. These were both increases in odds compared to Model 1 and 2, suggesting that the differences between these minority groups and whites decreased when these control variables were introduced. However, large differences remain, which means these differences of odds/ratios compared to whites remain beyond the influence of the control variables that were introduced. Unlike Model 2, American Indian/Alaska Natives now significantly differ from whites and have 14 percent greater odds of receiving the flu vaccine when these control variables are introduced. Those who were married, divorced, or widowed had greater odds compared to those who were single, and those who were unmarried or never married had lesser odds. Education did not exert a significant influence on the odds of being vaccinated. However, Model 3 displays that males and females significantly differ, with males having 8 percent lesser odds of being vaccinated compared to females.

Table 3: Odds/Ratios Comparisons of Three Models by the Gradual Addition of Medical and Demographic Variables

	Model 1		Model 2		Model 3	
	Odds-Ratio / (SE)	Conf. Interval	Odds-Ratio / (SE)	Conf. Interval	Odds-Ratio / (SE)	Conf. Interval
African American	.559***	.54 - .57	.625***	(.61-.64)	0.635***	(.62-.65)
	(0.01)		(0.01)		(0.01)	
American Indian/ Alaska Native	.896***	.85 - .95	1.111	(1.05-1.18)	1.142***	(1.08-1.21)
	(0.03)		(0.03)		(0.03)	
Latino	.499***	.49 - .51	.599***	(.58-.61)	.607***	(.59-.63)
	(0.01)		(0.01)		(0.01)	
Health Plan	---	---	3.035***	(2.95-3.12)	2.849***	(2.77-2.93)
	---		(0.04)		(0.04)	
Medical Costs	---	---	.635***	(.62-.65)	.629***	(.61-.65)
	---		(0.01)		(0.01)	
Income	---	---	---	---	.949***	(.94-.95)
	---		---		0.00	
Married	---	---	---	---	1.344***	(1.28-1.42)
	---		---		(0.04)	
Divorced	---	---	---	---	1.257***	(1.19-1.33)
	---		---		(0.03)	
Widowed	---	---	---	---	2.548***	(2.41-2.69)
	---		---		(0.07)	
Member of an Unmarried Couple	---	---	---	---	.901**	(.84-.97)
	---		---		(0.03)	
Never Married	---	---	---	---	.939*	(.89-.99)
Pseudo R2	0.0068		0.0318			

Table 3 Continued: Odds/Ratios Comparisons of Three Models by the Gradual Addition of Medical and Demographic Variables

	Model 1		Model 2		Model 3	
	Odds-Ratio / (SE)	Conf. Interval	Odds-Ratio / (SE)	Conf. Interval	Odds-Ratio / (SE)	Conf. Interval
Elementary	---	---	---	---	1.019	(.82-1.26)
	---		---		(0.11)	
Some High School	---	---	---	---	0.959	(.77-1.19)
	---		---		(0.11)	
High School Graduate	---	---	---	---	0.958	(.77-.19)
	---		---		(0.10)	
Some College	---	---	---	---	1.017	(.82-1.26)
	---		---		(0.11)	
College Graduate	---	---	---	---	1.234	(1.00-1.53)
	---		---		(0.14)	
Sex	---	---	---	---	.923***	(.91-.94)
	---		---		(0.92)	
Pseudo R2					0.0482	

The next set of analyses uses Least Squares Dummy Variable (LSDV) modeling to examine the differences between racial/ethnic groups and their odds of receiving the influenza vaccine. In the LSDV model, the state in which the respondents reside is being controlled through the use of a dummy variable. This required the creation of 50 unique dummy variables, one for each of the 50 United States. In the multivariate analyses, results show the odds of receiving the vaccine for different racial/ethnic groups after controlling for all of the covariates presented in Table 3 and 49 of the state dummy variables. The state of North Dakota was excluded from the analysis and serves as the reference category because 50 percent of the respondents in this state reported receiving

the vaccine while the other 50 percent did not receive it. This virtual 50/50 distribution makes it an ideal reference category. These analyses are presented in Table 4. For the simplicity of presentation, only the dummy variable for race/ethnicity and those states that significantly differed from North Dakota are presented in Table 4. It was found that 13 states were significantly less likely to receive the flu vaccine after controlling for all other factors that were included in the previous analyses compared to North Dakota and 13 states were significantly more likely to receive to receive the flu vaccine compared to North Dakota after controlling for the other factors previously run. Moreover, all of the other controls discussed above were included in the analyses presented in Table 4, but the specific odd-ratios and standard errors for these control variables are not presented in the table itself because these values are not relevant to the testing of hypotheses for this study.

Table 4. States with greater and lesser odds of being vaccinated compared to North Dakota

	Odds-Ratio (SE)	Confidence Interval
African American	0.649*** (0.01)	(.63-.67)
American Indian/Alaska Native	1.113 (0.74)	(1.05-1.18)
Latino	.738*** (0.01)	(.71-.76)
Arkansas	1.122*** (0.02)	(1.02-1.24)
Colorado	1.126*** (0)	(1.04-1.22)
Iowa	1.157*** (0)	(1.06-1.26)
Maryland	1.088*** (0.04)	(1.00-1.18)
Pseudo R2		0.0509

Table 4 Continued. States with greater and lesser odds of being vaccinated compared to North Dakota

	Odds-Ratio (SE)	Confidence Interval
Minnesota	1.469***	(1.35-1.60)
	(0.00)	
Nebraska	1.135***	(1.05-1.22)
	(0.00)	
New Mexico	1.121***	(1.03-1.22)
	(0.01)	
North Carolina	1.101***	(1.02-1.19)
	(0.01)	
Oklahoma	1.144***	(1.05-1.24)
	(0.00)	
Rhode Island	1.233***	(1.13-1.34)
	(0.00)	
South Carolina	1.127***	(1.04-1.22)
	(0.00)	
South Dakota	1.362***	(1.25-1.48)
	(0.00)	
Texas	1.102***	(1.02-1.19)
	(0.01)	
Alaska	0.734***	(.65-.82)
	(0.00)	
California	0.837***	(.78-.90)
	(0.00)	
Florida	0.788***	(.73-.85)
	(0.00)	
Georgia	0.907***	(.83-.99)
	(0.03)	
Hawaii	0.874***	(.79-.97)
	(0.01)	
Idaho	0.823***	(.79-.97)
	(0.01)	
Illinois	0.840***	(.77-.92)
	(0.00)	
Pseudo R2		0.0509

Table 4 Continued. States with greater and lesser odds of being vaccinated compared to North Dakota

	Odds-Ratio (SE)	Confidence Interval
Indiana	0.865***	(.80-.94)
	0.00	
Montana	0.890***	(.82-.97)
	(0.01)	
Nevada	0.783***	(.71-.86)
	0.00	
New Jersey	0.816***	(.76-.88)
	0.00	
Ohio	0.898***	(.83-.97)
	(0.01)	
Oregon	0.892***	(.81-.98)
	(0.02)	
Pseudo R2		0.0509

After controlling for the state in which the residents live, it is clear that the racial/ethnic disparities evident in Table 3 remain in Table 4. African Americans continue to have 35 percent lesser odds of receiving the flu vaccine compared to whites. This figure is just 1 percentage point less than the final model presented in Table 3 where states were not controlled in the analysis. In model 3 of Table 3, Latino respondents had 39 percent lesser odds of receiving the flu vaccine compared to white; when the states are added as control variables in Table 4, this percentage drops to just 26 percent. This clearly suggests that when states are controlled in the analysis, differences between whites and Latinos declines. Moreover, the differences detected between American Indian/Alaska natives and whites in Model 3 Table 3 disappear (i.e. becomes insignificant) when the states are added as control variables. These results show nation wide racial/ethnic differences in the odds of receiving the flu vaccination are partially explained by the concentration of Latinos and Native Americans in certain states.

The data in Table 4 also provide insight into those states where respondents have significantly greater or lesser odds of receiving the flu vaccine compared to the reference category in North Dakota. Residents of Arkansas, Colorado, Iowa, Maryland, Minnesota, Nebraska, New Mexico, North Carolina, Oklahoma, Rhode Island, South Carolina, South Dakota, and Texas had greater odds of receiving the flu vaccine compared to residents in North Dakota after controlling for all other factors previously analyzed. Minnesota had 47 percent greater odds and South Dakota had 36 percent greater odds compared to the reference category.

Table 4 also suggests that residents in the states of Alaska, California, Florida, Georgia, Hawaii, Idaho, Illinois, Indiana, Montana, Nevada, New Jersey, Ohio, and Oregon have lesser odds of receiving the flu vaccine compared to residents in North Dakota after controlling for all the variables previously analyzed such as medical cost, whether the person had a health plan, marital status, education, sex, and race/ethnicity. It appears that Alaskan residents have 27 percent lesser odds of getting vaccinated compared to residents of North Dakota. There is no clear pattern for which states are above or below the median North Dakota.

Following the LSDV analysis using STATA 11.0 a multilevel logistic regression model was created using HLM 6.02 to measure the influence of race/ethnicity on the odds of receiving the flu vaccination for respondents nested within each of the 50 states. As noted in the research methods section of this document, the hierarchical model compensates for the fact that respondents are clustered within the 50 states, and reports standard errors and subsequent tests of statistical significance that are more reliable and

unbiased. The same control variables cited above were used in this multilevel model as well.

Table 5 presents the results of the multilevel model generated in HLM 6.02. This model contains the same variables presented in Model 3 of Table 3. As one can see from the fixed effects hierarchical model, the odds/ratios of hierarchical logistic regression modeling are different than Model 3, which is a standard logistic regression in that regard. When using hierarchical modeling for this study fixed effects was selected and there are no random effects. Fixed effects assume constant variance. The African American variable remained significant in the hierarchical modeling, but the odds/ratio slightly changed from 0.635 to 0.649, showing that African Americans continue to have lesser odds of receiving the flu vaccine compared to whites. The American Indian/Alaska Native population was not significant, but the odds/ratios decreased from 1.142 to 1.11. In both Table 3 Model 3 and Table 5 American Indian/Alaska Natives have greater odds of being vaccinated compared to whites. This could be due to the large American Indian/Alaska Native populations being densely populated in a few areas of the United States. Latinos were statistically significant in both tables, with a slight increase in odds/ratios when clustering of individuals were taken into account. Overall, they still have lesser odds of receiving the flu vaccine compared to whites.

Table 5. Hierarchical logistic regression modeling replication of table 3 model 3 with clustering of individuals within states taken into account

	Odds-Ratio (SE)	Confidence Interval
African American	0.649***	(.60-.70)
	(0.00)	
American Indian/Alaska Native	1.11	(.98-1.26)
	(0.1)	

Table 5 Continued. Hierarchical logistic regression modeling replication of table 3 model 3 with clustering of individuals within states taken into account

	Odds-Ratio (SE)	Confidence Interval
Latino	0.737***	(.67-.82)
	(0.00)	

Table 5 above displays the odds/ratios and confidence intervals of the race/ethnicity variables in this study. The control variables were taken out for the sake of simplicity. These numbers account for clustering within states as opposed to the logistic regression shown in Table 3 Model 3. Table 5 shows that African Americans and Latinos have statistically significant lesser odds of being vaccinated compared to whites. It shows being married, divorced, or widowed have statistically significant greater odds of being vaccinated compared to being single, which was also seen in Table 3 Model 3. Education and never being married were not significant when accounting for clustering within states. After employing Hierarchical Logistic Regression Modeling in Table 5 there appears to be little difference in the odds/ratios of African Americans, American Indians, and Latinos compared to whites.

Conclusions

Influenza is associated with a large number of deaths and hospitalizations (Nichol, Wuorenmna, and Von Sternberg 1998) and the World Health Organization (2011) claims the best way to prevent influenza is through vaccination. This study has contributed to the knowledge on racial/ethnic differences on receiving the flu vaccination. This research is of great importance due to the increasing minority population in the United States. This research clearly showed minority populations of African Americans and Latinos have lesser odds of receiving the flu vaccine compared to whites, which was also seen in previous literature. If the fastest growing populations are not receiving the flu vaccination as much as the white population, it is important to understand why, and perhaps with this research others can use this to create a strategy to increase influenza vaccination rates in African Americans and Latino populations residing in the United States.

In particular this study contributes to previous literature by the methods that were used to assess the influence of race/ethnicity on the odds of receiving a flu vaccine. The statistical techniques that were used were multivariate logistic regression, least squares dummy modeling, and hierarchical logistic regression modeling. An effort was made to examine state level covariates to see how these level 2 variables (macro) influence odds of receiving a flu vaccine at level 1 (micro). When this analysis was attempted the output was not plausible and contained extremely large confidence intervals. After further examination trying to troubleshoot the problem and being unable to find a resolution, these analyses were discarded.

Previous literature has suggested that several different factors can influence whether someone receives a flu vaccination or not. A few of these previous ideas included cost, mistrust, beliefs, culture, and the region you live in. This research differs from previous studies in that it has taken into account variables at an individual level using logistic regression, least squares dummy variable modeling, but also at a macro level using hierarchical logistic regression modeling. These three levels of analysis were used to get a clear assessment of the odds/ratios of receiving a flu vaccine among minorities as compared to whites. With these three methods we were able to measure the respondents as independent and then take into account the nesting of individuals within states. This provided more accurate and valid standard errors and statistical significance.

The Behavioral Model of Health Services was used as the theoretical framework for this study. The results from this study coincide with Andersen's model to an extent. It was found that predisposing characteristics such as race/ethnicity were statistically significant in relation to vaccinations. Other controls were used which the model incorporates such as sex and marital status (social structures), and access were found to be significant as well. The results from this study suggest that Andersen's model coincided with the variables measured except for the influence of education. However, this study appears to be most applicable to the first phase of the model. This study did not examine variables such as the differences between perceived and evaluated health status or consumer satisfaction.

From analysis of this study's data from BRFSS 2009, hypothesis one was supported that racial/ethnic minorities have lesser odds of receiving the flu vaccine compared to whites, which is shown in Table 3 Model 1. However, hypothesis two was

only supported for African American and Latino groups when considering access to healthcare. Hypothesis three was partially supported in that as seen previously, African Americans and Latinos have lesser odds of getting a flu vaccine compared to whites when controlling for other demographic variables. The inverse was seen with American/Indian Alaska Natives, once all of the variables were controlled for, this minority group had greater odds of receiving a flu vaccine compared to whites. The reasons behind this are speculative. Perhaps it has something to do with policy for American Indian/Alaska Natives, or perhaps results would have differed with an increase number of respondents in this minority group, but further research is needed to draw conclusions.

Once states were used as control variables, examination of the states displayed 13 states having higher odds and 13 states having lower odds of receiving a flu vaccine compared to North Dakota. There was no clear pattern as to why this was this case. Once the states were controlled for African Americans and Latinos had lesser odds of receiving a flu vaccine compared to whites. This continues with the data presented in Table 3. American Indian/Alaska Natives showed greater odds of receiving a flu vaccine compared to whites, but lost statistical significance. Further examination of differences between states would be beneficial, such as cultural differences, climate, and access. The HLM data took into account clustering of respondents within states as previously mentioned. Again, similar to previous models African Americans and Latino respondents were less likely to receive the flu vaccine compared to whites. American Indian/Alaska Natives showed greater odds, but was not significant. The numbers shown with American Indian/Alaska Natives may be due to the dispersed populations of this

race/ethnicity in the United States. According to the United States Census Bureau (2009) the top five states with American Indian/Alaska Native populations are Alaska with 15.3 percent, New Mexico with 9.7 percent, South Dakota with 8.5 percent, Oklahoma with 8.0 percent, and Montana with 6.4 percent. Three of these states had significantly greater odds of receiving the flu vaccine compared to North Dakota and 2 had significantly lesser odds of receiving the flu vaccine compared to North Dakota. No clear pattern can be drawn with this racial/ethnic group. Further research is needed on what influenced their odds/ratios.

A pattern did emerge with African American and Latino respondents. Consistently through all three models of Table 3, the addition of states as control variables in Table 4, and Table 5, which took into account clustering of states these two minority populations had significant lesser odds of receiving an influenza vaccination compared to whites in BRFSS 2009. With this information it would be beneficial to further understand why this is the case and what can be done to increase vaccination rates. By increasing vaccination rates, individuals are preventing themselves from acquiring the flu, but also protecting others with herd immunity.

A few limitations to this study were that this was a self-reported telephone survey, and white respondents had the largest response frequency consisting of 82.76 percent. The year that this was conducted may have influenced the respondent's responses due to the H1N1 epidemic in 2009. Future researchers could expand on this study by considering more cognitive variables as to why a person receives a flu vaccine, examination at a county level, and examination of health policy at a national and state level. Other topics that could be examined are other countries strategies towards

vaccination, a comparison of different BRFSS years and if vaccination rates have increased or decreased.

It should also be noted that BRFSS has made some recent changes. According to the Centers for Disease Control and Prevention (2012) beginning with BRFSS 2011 telephone interviews will include cell phones. This is due to the 700 percent increase in between 2003 and 2009 with households only having a cell phone. Weighting has also recently changed from post-stratification to proportional fitting (raking). Future research could use this new sampling in a time series study. This new sampling may also increase the response frequency of minority racial/ethnic groups, and therefore possibly provide a better understanding to the self-reporting rate of receiving an influenza vaccination.

Overall, this research has provided further information onto racial/ethnic disparities compared to whites when receiving the influenza vaccine. Even with the control of several factors, such as not being able to see a doctor because of cost, whether one has a health plan, income, education, and other socio-demographic variables African Americans and Latinos had lesser odds of receiving the flu vaccine compared to whites. The opposite was seen for American Indian and Alaska Natives. As to why this is the case, one can speculate that it is a multitude of factors interacting. State and national policies, environment, beliefs, and access are all possible factors. There is not one reason that can be pinned down. We do know that these inequalities do exist. Sociology and public health need to continue to study these topics because of the ever-changing population and health status in the United States.

APPENDIX A: Frequency Distribution of Individual Level Data

Variable	N	%
Race		
White	339,059	82.76%
African American	34,609	8.45%
American Indian/Alaska Native	5,951	1.45%
Latino	30,075	7.34%
Hlthplan		
No	45,232	10.48%
Yes	386,310	89.52%
Medcost		
No	380,879	88.23%
Yes	40,805	11.77%
Marital Status		
Married	242,991	56.42%
Divorced	58,985	13.69%
Widowed	61,107	14.19%
Separated	8,715	2.02%
Never Married	49,602	11.52%
A member of an unmarried couple	9,318	2.16%
Education		
Never attended or Kindergarten	645	0.15%
Grades 1-8 Elementary	13,995	3.25%
Grades 9-12 Some High School	26,433	6.13%
Grade 12 or GED High School Graduate	129,173	29.96%
College 1-3 yrs/ Some college or tech school	115,550	26.80%
College 4 yrs or more/ college graduate	145,293	33.70%
Sex		
Female	268,646	62.10%
Male	163,961	37.90%
Income		
$5,000	20,353	5.44%
$12,500	22,717	6.07%
$17,500	29,805	7.97%
$22,500	36,494	9.76%
$30,000	45,414	12.14%
$42,500	57,703	15.43%
$63,500	61,055	16.32%
$75,000	100,520	26.87%

APPENDIX B: Original BRFSS 2009 Variables

"Which one of these groups would you say best represents your race?" (BRFSS 2009 p. 17)
Table 1: Race/Ethnicity

Value	Value Label
1	White
2	Black or African American
3	Asian
4	Native Hawaiian or Other Pacific Islander
5	American Indian, Alaska Native
6	Other
7	Don't Know/ Not sure
8	Multiracial but preferred race not asked
9	Refused

"Do you have any kind of health care coverage, including health insurance, prepaid plans such as HMOs, or government plans such as Medicare?" (BRFSS 2009 p.10)
Table 2: Health Plan

Value	Value Label
1	Yes
2	No
7	Don't know/Not Sure
9	Refused

"Was there a time in the past 12 months when you needed to see a doctor but could not because of cost?" (BRFSS 2009 p.10)
Table 3: Medical Cost

Value	Value Label
1	Yes
2	No
7	Don't know/Not Sure
9	Refused

"Are you: (marital status)" (BRFSS 2009 p.18)

Table 4: Marital Status

Value	Value Label
1	Married
2	Divorced
3	Widowed
4	Separated
5	Never Married
6	A member of an unmarried couple
9	Refused

Is your annual household income from all sources: (If respondent refuses at any income level, code “Refused.) (BRFSS 2009 p.19)

Table 5: Income

Value	Value Label
1	Less than $10,000
2	Less than $15,000
3	Less than $20,000
4	Less than $25,000
5	Less than $35,000
6	Less than $50,000
7	Less than $75,000
8	$75,000 or more
77	Don't know/Not sure
99	Refused

“Indicate sex of respondent.” (BRFSS 2009 p.22)

Table 6: Sex

Value	Value Label
1	Male
2	Female

“What is the highest grade or year of school you completed?” (BRFSS 2009 p.19)

Table 7: Education

Value	Value Label
1	Never attended school or only kindergarten
2	Grades 1 through 8 (Elementary)
3	Grades 9 through 11 (Some high school)
4	Grade 12 or GED (High school graduate)
5	College 1 year to 3 years (Some college or technical school)
6	College 4 years or more (College graduate)
9	Refused

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