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SEASONAL INFLUENZA VACCINATION DISPARITIES BETWEEN U.S. NON-HISPANIC WHITES AND HISPANICS, 2000-2009

by

Andrew E. Burger

A thesis submitted in partial fulfillment
of the requirements for the degree

of

MASTER OF SCIENCE

in

Sociology

Approved:

Dr. Eric Reither Major Professor	Dr. Michael B. Toney Committee Member
Dr. E. Helen Berry Committee Member	Dr. H. Reed Geertsen Committee Member

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Vice President for Research and
Dean of the School of Graduate Studies

UTAH STATE UNIVERSITY
Logan Utah

2011

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ABSTRACT

Seasonal Influenza Vaccination Disparities Between

U.S. Non-Hispanic Whites and Hispanics, 2000-2009

by

Andrew E. Burger, Master of Science

Utah State University 2011

Major Professor: Dr. Eric Reither
Department: Sociology

Seasonal influenza produces substantial disease within the United States every year. Despite the availability of safe and effective vaccines for influenza, millions of individuals go unvaccinated each flu season, with notable differences across racial/ethnic groups. Using the Behavioral Risk Factor Surveillance System (BRFSS), I examine vaccination rates among non-Hispanic whites and Hispanics during the 2000-2009 influenza seasons. After developing a new method that addresses shortcomings of BRFSS vaccination measures, I find that non-Hispanic whites exhibit higher vaccination rates than Hispanics. Through a series of logistic regression models I show that the disparities between non-Hispanic whites and Hispanics narrow after controlling for healthcare coverage and socioeconomic characteristics. This suggests that seasonal influenza vaccination may be improved among U.S. Hispanics by addressing structural barriers in receiving the vaccine, especially access to health care.

(83 pages)

PUBLIC ABSTRACT

Seasonal Influenza Vaccination Disparities Between
U.S. Non-Hispanic Whites and Hispanics, 2000-2009

by

Andrew E. Burger, Master of Science
Utah State University 2011

The seasonal flu is a deadly disease which infects millions of individuals within the United States annually. One of the leading causes of death in the United States, the seasonal flu claims more lives than liver disease, homicide, or HIV. While most individuals will not develop life-threatening symptoms due to the seasonal flu, millions of individuals become sick every year. Not only does this produce hundreds of thousands of hospitalizations annually, but also creates a drain on the economy as individuals are not able to attend their daily activities. This burden remains despite the presence of safe and effective seasonal influenza vaccines. Backed by numerous studies, the seasonal flu vaccine has been found to be the most effective means of preventing infection. The Centers for Disease Control and Prevention (CDC) recommends that everyone 6 months of age and older become vaccinated.

However, despite the effectiveness of the seasonal flu vaccine, the disease burden associated with the seasonal flu remains. Part of the reasons for the continuing costs of the seasonal flu is due to the consistent racial and ethnic gaps in the receipt of the seasonal flu vaccine. Previous studies have found that racial and ethnic minorities receive the influenza vaccine at lower rates than non-Hispanic whites. Since most of these studies look at vaccinations during a particular flu season, little is known about the overall trends in vaccination among the population.

This thesis looks specifically at trends in vaccination uptake among non-white Hispanics and Hispanics in the United States during the 2000-2009 flu seasons. Using data from the Behavioral Risk Factor Surveillance System (BRFSS), I present a new method of organizing respondents to more accurately track vaccination during a specific flu season. I then examine differences in non-Hispanic whites and Hispanics in their influenza vaccination behavior.

During this time period I find that while both groups experienced upward trends in vaccination uptake, non-Hispanic whites are doing so at a quicker pace than Hispanics leading to an increasing gap between the two groups. I find that Hispanics experience lower odds of receiving a vaccine than non-Hispanic whites. But when controlling for socioeconomic factors, odds of reporting a flu vaccine increase substantially. Having some form of healthcare coverage was found to be a powerful predictor increasing the odds of receiving a flu vaccine. This suggests that by increasing healthcare coverage among the U.S. Hispanic population, gains in influenza vaccination could occur.

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Andrew E. Burger

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CHAPTER I

INTRODUCTION

First recorded in 1504, the term influenza is most likely derived from the Italian word meaning "influence" (Quinn 2008). It was believed by the Italians at the time that influenza, or more commonly known as the "flu," was brought about by the "malevolent position of the stars at certain times" (40). The influenza virus has likely affected humans for our entire known history. As early as the 4th century BC, the famous Greek physician Hippocrates gave an account of perhaps the first recorded influenza epidemic. Hippocrates (whose oath of medical ethics still impacts physicians today) described a condition where many, especially children, experienced convulsions, fevers, coughs, and great pain (42).

The seasonal flu is dangerous not only in its ability to produce significant mortality and morbidity burdens within local populations, but also by its ability to mutate into novel (or new) strains of influenza, capable of spreading across the globe. It is generally agreed that the first influenza pandemic occurred in 1580 where, in a period of 6 months, an influenza strain spread through the "whole of Europe," with infection eventually spreading to the Americas (Potter 2001:574). While seasonal influenza epidemics continued, the next pandemic wave would not occur for almost another 80 years (Quinn 2008). The 1658 pandemic was of such serious proportions that it would be reported by "many writers and commentators, [and] not just physicians" (Quinn 2008:52). Dr. Willis, one such commentator of the time, wrote his account of the 1658 pandemic, describing patients who were "troubled with burning thirst, waking,

hoarseness, and coughing, almost continual" (52–53). Dr. Willis notes that while most of the younger men recovered, among those advanced in age "not a few died of it" (53).

As human mobility increased throughout the world and international trade stretched across the globe, so did the ability of influenza to spread and infect populations. The influenza pandemic of 1781 is considered by historians to be "among the greatest manifestations of the disease in all history" (Quinn 2008:71). The first outbreak was believed to have begun in China, then spreading through Russia, continued to encompass Europe in the space of 8 months (Potter 2001). It is estimated that at the peak of this pandemic "30,000 fell ill each day in St. Petersburg [and] two-thirds of the population of Rome became ill" (575). It should be noted that even without modern advances in transportation, influenza was able to spread quickly throughout most of the world.

The next serious outbreak of influenza occurred in 1830. Following the same path as the 1781 pandemic, the 1830 pandemic began in China and then spreading through Russia to Europe eventually spread through the Americas (Patterson 1986). Although quantitative data were rare during the pandemic of 1830, contemporary "observers consistently reported high morbidity and low case-mortality" (Patterson 1986:35). During the 1830 pandemic, medical treatment still relied on archaic medical practices such as bloodletting (Quinn 2008).

While these 18th and 19th century pandemics were devastating and killed millions, they pale in comparison to the damage inflicted by the most severe influenza pandemic recorded to date, the 1918 influenza pandemic commonly known as the "Spanish Flu." Health records were considerably more accurate during the 1918 pandemic than in past outbreaks, but much remains unknown as to its full effect on mortality. Considered an

example of the possible "upper bound on the number of deaths caused by [a] future pandemic", the 1918 influenza was devastating (Murray et al. 2007). Johnson and Mueller (2002) comment that while "it would seem unlikely that a truly accurate figure can ever be calculated," the total mortality caused by this pandemic "may fall in the range of 50 to 100 million" (115).

Fortunately, since 1918 the world has not experienced another influenza pandemic of similar magnitude. However, every year in the United States seasonal influenza epidemics cause thousands of deaths, even more hospitalizations, and drain billions of dollars from the economy. Fortunately, medical advances have produced effective treatments to counter the symptoms of seasonal influenza, as well as the means to prevent it altogether through vaccinations. However, because many do not receive seasonal vaccinations, a substantial disease burden attributable to the flu is experienced within the United States every year.

Racial and Ethnic Disparities in Influenza Vaccination

Consistently, racial and ethnic disparities in receipt of the seasonal influenza vaccine have been observed especially among Hispanics (Lu et al. 2008). Reduction in these disparities could provide substantial health benefits not only to racial and ethnic minorities, but to the entire population. This thesis will focus on influenza vaccination disparities between non-Hispanic whites and Hispanics in the United States. Given that Hispanics are now the largest and fastest growing ethnic minority group in the United States (Pew Hispanic Center 2011a), understanding public health challenges in this population is of great importance. However, much attention has been given to the

"Hispanic paradox" where Hispanics, even with their average lower socioeconomic status, experience a mortality advantage over other similarly disadvantaged racial/ethnic minority groups (Markides and Coreil 1986).

The Hispanic Paradox

First documented in 1986, the Hispanic Paradox proposed that Hispanics experienced similar health outcomes to non-Hispanic whites despite their lower socioeconomic status (Markides and Coreil 1986). This discovery was viewed as a "paradox" since lower socioeconomic status has traditionally been viewed as a predictor of poorer health, as is often observed among disadvantaged African Americans. Despite research questioning the existence of a "Hispanic paradox" (Smith and Bradshaw 2006), evidence does suggest that a mortality advantage exists at least for some Hispanic groups (Markides and Eschbach 2005). Questioning biological explanations for a mortality advantage among Hispanics, Palloni and Arias (2004) present evidence that the "Hispanic paradox" was not really attributable to all Hispanics, but may rather be a characteristic found only among foreign-born individuals from Mexico. Explaining the paradox among foreign-born Mexican nationals in the United States, Palloni and Arias (2004) emphasize a "salmon-bias" effect where return migration of ill foreign-born Mexicans artificially deflates Hispanic mortality. If the Hispanic mortality advantage is explained through such factors as the return migration of its sick members or the selective emigration of healthy individuals, then future health concerns arise given the shift from migration to natural birth as the main driver in Hispanic population growth (Suro and Passel 2003).

A recent report from the Pew Hispanic Center (2011b) notes 58 percent of the growth experienced by U.S. Hispanics came from natural births rather than immigration. It is likely that this proportion will increase with studies showing rates of migration into the United States slowing from countries such as Mexico (Passel and Cohen 2010). This shift in growth from immigration to natural increase should be noted by public health officials given that "U.S-born Hispanics tend to be less healthy than Hispanic immigrants" (Livingston, Minushkin, and Cohen 2008:10). Even if a mortality advantage does exist among Hispanics, Markides and Eschabach (2005:74) note that

> […] it would be unfortunate if public health policy overlooked the presence of clear and remediable disparities in health care access and the burden of infectious diseases, diabetes, and disability that clearly do disadvantage Hispanics, even should it prove that some compensating factors create offsetting advantages in other morbidity and mortality processes.

With the growth among U.S. Hispanics changing from immigration to natural increase, the observed "Hispanic paradox" may disappear as a greater number of Hispanics are U.S. born, revealing poorer health among this population. Furthermore, supporting evidence of health *disadvantages* among Hispanics was found during the 2009 H1N1 influenza pandemic; the CDC noted that even though Hispanics represent 15 percent of the U.S. population, nearly 30 percent of A(H1N1) cases during the early spring wave were among Hispanics (CDC 2010g). Further evidence of a possible Hispanic health disadvantage during the 2009 A(H1N1) pandemic is found in a study which, following a group of infected individuals admitted into an intensive care unit (ICU) in Utah for A(H1N1), found that Hispanics were disproportionally affected by the disease suggesting perhaps a "genetic predisposition for a more severe manifestation of A(H1N1) infection" (Miller et al. 2010:756). These disturbing trends suggests that

Hispanics may actually experience higher risks of infection for certain strains of influenza. Whether those risks are attributable to biological or sociodemographic factors has yet to be fully determined. Essentially, "the need to address observed health disparities concerning Hispanics does not turn on how the Hispanic paradox is finally explained" (Markides and Eschabach 2005:74). Given the relative ease with which influenza vaccinations can be produced and administered, it is one such "clear and remediable" health disparity that should be addressed.

Outline of Thesis

To evaluate seasonal influenza vaccination disparities between non-Hispanic whites and Hispanics, it is important to monitor trends in vaccination rates. While previous research has identified disparities within particular flu seasons (Jones et al. 2004; Link et al. 2006), few studies have tracked disparities across multiple influenza seasons (see Lu et al. 2008). In order to emphasize the need for tracking influenza vaccination coverage and the potential health gains vaccination could have on society, a review of the mortality, morbidity, and economic burden of seasonal influenza will be presented in Chapter II. Following, a brief review of the literature detailing the effectiveness of the seasonal influenza vaccine in preventing disease will be given. To help explain the mechanisms behind racial and ethnic disparities in seasonal influenza vaccinations, this study utilizes the Fundamental Cause Theory (FCT), which proposes a central relationship between socioeconomic status (SES) and health outcomes, as outlined in Chapter III. A detailed description of the method used to estimate seasonal vaccination rates with the Behavioral Risk Factor Surveillance System (BRFSS) will be

given in Chapter IV with a subsequent comparison utilizing the National Health Interview Study (NHIS). This method, which utilizes the respondent's month of interview to more accurately calculate seasonal vaccination, will be compared with previously employed methods. Using this method, seasonal vaccination rates among non-Hispanic whites and Hispanics will be estimated. This and other descriptive results will be presented in Chapter V. To test the propositions set forth by FCT, a series of logistic regression analyses will be performed to control for SES and its influence on the odds of reporting receipt of a seasonal influenza vaccination between non-Hispanic whites and Hispanics. Chapter VI presents the results of these analyses, along with my interpretation. Additionally, the academic and policy implications of this research are discussed.

CHAPTER II

DISEASE BURDEN OF SEASONAL INFLUENZA

Given the potential for seasonal influenza to infect large portions of society every year, its burden is often substantial in terms of mortality, morbidity and related economic costs. Influenza is a leading cause of death in the United States with an estimated 263,887 cumulative deaths occurring during the 1999 through 2006 influenza seasons (CDC 2010a). This mortality estimate places influenza above deaths caused by liver disease (245,869), hypertension (192,290), homicide (161,747), and HIV (120,222) during the same time period (CDC 2011b). A brief description of the mortality, morbidity, and economic burden of seasonal influenza is provided to emphasize the destructive nature of this common virus, and to stress the need for more effective seasonal vaccination programs of the population.

Mortality Burden of Seasonal Influenza

In a recent publication on mortality trends due to seasonal influenza from 1976 to 2007, the Centers for Disease Control and Prevention (CDC) estimates that, on average, seasonal influenza is responsible for 23,607 deaths each flu season (CDC 2010a). However, this average masks variability in the virulence of seasonal influenza and the dramatic variation in mortality that can occur based on virus type (CDC 2010a). Consistently, in flu seasons where the influenza A(H3N2) virus is present, mortality is 2.7 times higher than when that particular virus type is absent (CDC 2010a). It is not surprising, then, to learn that the 2003 influenza season (in which A(H3N2) virus was present) is estimated to have the highest impact on mortality in the 30 year period of

observation, with an estimated 48,614 deaths attributable to the A(H3N2) influenza virus (CDC 2010a). In contrast, the 1986 influenza season was estimated to have the lowest number of influenza related deaths with 3,349 (CDC 2010a). Molinari et al. (2007), in examining mortality from 2001 through 2003 (years dominated by the more virulent type A(H3N2) virus), estimate that 610,660 life-years are lost per annum in the United States due to seasonal influenza.

Morbidity Burden of Seasonal Influenza

Given the substantial mortality burden associated with seasonal influenza, it is not surprising that the morbidity burden is also large. However, unlike mortality associated with seasonal influenza, which is measured by number of deaths, the morbidity burden is more difficult to calculate. A useful gauge to help understand the severity of seasonal influenza in producing morbidity is to approximate the number of hospitalizations attributed to seasonal influenza. While not providing an approximation for the total number of illnesses caused by influenza, calculating the number of hospitalizations attributable to seasonal influenza does provide an insight to its virulence. In Thompson et al. (2004), the annual number of hospitalizations caused by seasonal influenza is estimated for the 1979 through 2000 flu seasons. During the time period, it was projected that on average 226,000 individuals were hospitalized per flu season (Thompson et al. 2004). However, just as is the case with mortality estimates, this average masks variability that can exist in the virulence of influenza. For example, during the 1997 flu season (in which an influenza type A(H3N2) virus was dominant) approximately 430,960 hospitalizations were attributed to influenza-related illnesses, while the 1990 flu season

experienced an estimated 157,911 hospitalizations due to seasonal influenza (Thompson et al. 2004). Also, seasonal influenza can aggravate chronic health conditions, such as cardiovascular disease, producing further hospitalizations (Madjid et al. 2007).

Hospitalizations caused by influenza may be a useful way to gauge morbidity burden, but they certainly underrepresent the full effect of seasonal influenza on the health of a population. The vast majority of individuals infected by seasonal influenza will not develop life threatening complications requiring hospitalization, but rather mild symptoms including fever, coughing/sore throat, runny nose, and body aches (U.S. Department of Health 2011). While these symptoms may be minor and the effect on the individual temporary, the sheer number of people infected by seasonal influenza can create disruptions throughout society. Given the large mortality and morbidity burden associated with seasonal influenza, the economic burden of influenza is also substantial.

Economic Burden of Seasonal Influenza

Molinari et al. (2007) calculate that, on average, seasonal influenza is responsible for an annual economic burden of nearly $87.1 billion (in 2003 dollars). Of this estimated economic burden, nearly 88 percent is attributable to indirect costs of illness (e.g., lost wages due to illness or death), while the remaining 12 percent is associated with medical treatments for seasonal influenza. Furthermore, an estimated 44 million days of work are lost each year because of influenza-related illnesses (Molinari et al. 2007). This seasonal absenteeism can have substantial effects in terms of cost for employers and employees resulting in an overall drain on the economy (Akazawa, Sindelar, and Paltiel 2003).

It is interesting to note that the average economic burden of one year of seasonal influenza (when adjusted for inflation to 2011 dollars), as presented in Molinari et al. (2007), is greater than the total economic damage caused by major natural disasters (including floods, hurricanes, fires, droughts, tornados and tropical storms) from 2006 through 2009 (National Climatic Data Center 2011). However, unlike hurricanes, the large mortality, morbidity, and economic burdens of seasonal influenza can easily be reduced through an effective vaccine.

Effectiveness of Influenza Vaccination

In the 2010 flu season, the CDC began recommending that everyone over 6 months of age should receive a seasonal influenza vaccine (CDC 2010a). This change reflects a shift in policy emphasizing the need for universal influenza vaccination coverage. The modification in policy is based in research showing the health benefits individuals, and the population as a whole, can achieve through vaccination (CDC 2010e). The CDC recommends that receiving a seasonal influenza vaccine should be the first step in preventing the flu (CDC 2010d). In fact, substantial efforts have been taken by the United States government to promote general knowledge regarding seasonal influenza and the benefits of vaccination. For instance, the internet website, *www.flu.gov*, provides information regarding the seasonal flu and where individuals can obtain an influenza vaccination.

The recommendation comes from strong evidence showing the effectiveness of the influenza vaccine in preventing illness (Bridges et al. 2000; Hak et al. 2005). Despite a minority of reports questioning the efficacy of the seasonal influenza vaccine (Jefferson

2006; Simonsen et al. 2005), the majority of studies have found that influenza vaccination in general is a highly effective means of preventing influenza-related illness. Influenza vaccination has been shown to reduce disease among mothers and young infants (Zaman et al. 2008) and in healthy children (Jefferson et al. 2005; Manzoli et al. 2007). Benefits are also available for healthy working adults, with the influenza vaccine reducing upper respiratory illness by an estimated 25 percent and further reducing work absenteeism due to upper respiratory illness by another 43 percent (Nichol et al. 1995). Seasonal vaccination also provides benefits to the elderly population, who may be more at risk of infection than the general populace (Gross et al. 1995, Nichol et al. 2007). Even when the influenza vaccine, which is prepared before the onset of the flu season, is a poor antigenic match for a particular strain of seasonal influenza, some level of protection can still be acquired through vaccination (Herrera et al. 2007; CDC 2010d).

Yet reaching the new levels of vaccination recommended by the CDC will prove difficult. Prior to the 2010 flu season, the CDC recommended influenza vaccination for those members in the population at particular risk for influenza related complications, such as the elderly or those with chronic health conditions (Lu et al. 2008). However, in a study of vaccination uptake from 1988 through 2004, even for those high-risk groups, estimated vaccinations were lower than their established goals sometimes by as much as an absolute value of 30 percent (Lu et al. 2008).

Disparities in Receipt of Seasonal Influenza Vaccination

An important force in sustaining the large mortality, morbidity, and economic burden of seasonal influenza in the United States is the scope of racial and ethnic

disparities in the receipt of seasonal influenza vaccines. Consistently, lower proportions of racial and ethnic minorities report influenza vaccination relative to non-Hispanic whites (Egede and Zheng 2003; Rangel et al. 2005; Link et al. 2006; Chen et al. 2007; Logan 2009; Linn, Guralnik, and Patel 2010; Burger et al. forthcoming).

Racial and ethnic disparities are so great that Fiscella (2005) suggests that if elderly Hispanic and African Americans were vaccinated at the same rates as elderly non-Hispanic whites, it would result in an additional 1 million elderly racial/ethnic minority persons being vaccinated each year. Furthermore, Fiscella et al. (2007) estimate that an average of 33,000 years of life could be saved each year among elderly racial and ethnic minorities by eliminating disparities in seasonal influenza vaccination.

The reasons for such disparities are likely to be complex. Among the explanations for racial and ethnic differences in influenza vaccination are theories regarding "attitudes toward vaccination and preventative care" (Lu et al. 2008:1791), differences in exposure, susceptibility and treatment (Blumenshine et al. 2008), and structural barriers such as lack of health insurance (Chen et al. 2007). Racial and ethnic minorities may also have less access to information regarding seasonal influenza and the benefits of vaccination (Hebert et al. 2005). In analyzing the reasons cited by racial and ethnic minorities for not receiving an influenza vaccination, Chen et al. (2007) found that one of the most common explanations was lack of concern about contracting the seasonal flu. This lack of concern regarding the receipt of a seasonal influenza vaccine comports with additional research showing racial and ethnic minorities may be less likely to go to a health care facility with the sole intent of receiving an influenza vaccination (Link et al. 2006).

Influenza Vaccination among U.S. Hispanics

Particularly large and persistent disparities in the receipt of seasonal influenza vaccinations have been observed between Hispanics and non-Hispanic whites in the United States (Rangel et al. 2005; Linn, Guralnik, and Patel 2010; Burger et al. forthcoming). Lu et al. (2008:1791) found that non-Hispanic whites were "persistently more likely to be vaccinated than […] Hispanics among persons aged ≥65 years, high-risk persons aged 18 through 64 years, health care workers, and household contacts." These observations indicate that this potentially vulnerable population may face significant barriers to acquiring adequate levels of vaccination. In addition to the previously mentioned barriers to vaccination often experienced by racial and ethnic minorities, language barriers can also deter vaccination among Hispanics (Chen et al. 2007). Supporting evidence toward a language barrier in vaccination, Fiscella et al. (2002) finds that English-speaking Hispanics with health insurance did not differ significantly from their non-Hispanic white counterparts in terms of receiving an influenza vaccination. However, they found that Spanish-speaking Hispanics with health insurance received flu vaccinations at lower rates than non-Hispanic whites with insurance, emphasizing possible language barriers in vaccination.

In addition, preventive healthcare services, such as the seasonal flu vaccine, are often underutilized by Hispanics (Kang-Kim et al. 2008; Logan 2009). Chen et al. (2007) found that Hispanics often cite structural barriers to flu vaccination, such as insufficient access to healthcare services, lack of transportation, and economic costs. Insurance is also found to be a factor that influences preventive care among Hispanics (Chen et al. 2007; DuBard and Gizlice 2008; Burger et al. forthcoming).

Given the magnitude of the disparity among racial and ethnic minorities (especially among Hispanics) in receiving a seasonal influenza vaccine, it will be useful to examine these inequalities through a theoretical lens. To help explain the observed disparity in influenza vaccination between Hispanics and non-Hispanic whites in the United States, this study will utilize the concepts and propositions as set forth in the Fundamental Cause Theory (FCT) as presented by Link and Phelan (1995). The FCT not only provides a useful theoretical framework for explaining Hispanic inequalities in influenza vaccination, it also establishes propositions that are easily testable. In the following chapter, a detailed description of FCT is given, as well as an explanation for influenza vaccination patterns among U.S. Hispanics.

CHAPTER III

THEORY

In 1995, Link and Phelan presented their seminal theory explaining health disparities in their article entitled, “Social Conditions as Fundamental Causes of Disease.” This article provides the groundwork for what would come to be known as Fundamental Cause Theory (FCT). FCT grew out of a reaction from social epidemiologists and sociologists alike to the popular “blame the victim” approach of addressing health inequalities in the United States during the 1980s (Link and Phelan 1995). During this time period, medical and social researchers more commonly looked for proximate causes of disease and sought ways to address disease through those causes rather than recognizing the underlying structural issues. For example, with the knowledge that lung cancer was associated with cigarette smoking, public and private campaigns urging individuals to quit smoking emerged. Since smoking was seen as controllable at the individual level, it “resonates with the value and belief system of Western culture that emphasize[s] both the ability of the individual to control his or her personal fate and the importance of doing so” (Link and Phelan 1995:80). However, this approach fails to recognize that behind smoking, a proximate cause of lung cancer, are various socioeconomic conditions that promote the behavior. Barbeau, Krieger, and Soobader (2004) found that class plays a significant role in rates of smoking and cessation, with higher socioeconomic status individuals being able to utilize more resources to help them quit smoking or avoid it altogether.

Given the focus on personal health behaviors, broader social explanations of health fell out of favor. Link and Phelan (1995) emphasize that societal explanations of health, such as a SES-health association, have been re-contextualized to minimize their importance. First, researchers may disregard societal forces as being merely proxies of disease. Citing evidence of this belief, Phelan et al. (2004:266) note that in the widely read *Modern Epidemiology* (1986) by Kenneth J. Rothman, socioeconomic status was considered to be "casually related to few if any diseases but is a correlate of many causes of disease" (90). Other times, researchers ignore social forces and rather "focus on mechanisms that mediate between socioeconomic status and mortality in the hopes of reducing mortality disparities by intervening on those mechanisms" (Phelan et al. 2004). Furthermore, the role of socioeconomic status is diminished by researchers considering it merely a "starting point" from which they could pursue the more proximate causes of disease.

As the name of the theory states, FCT posits that social conditions may be the "fundamental cause" of disease (Link and Phelan 1995). By fundamental cause, Link and Phelan refer to the social conditions that influence health outcomes, and "cannot be eliminated by addressing the mechanisms that appear to link them to disease" (86). This point is often demonstrated by using a simple path diagram (Figure 1), which shows the purported relationships between SES, proximate risk factors, and health outcomes.

According to Phelan and Link (2005), traditional epidemiology suggests that if the proximate risk factors were held constant, the association between socioeconomic status and health would be greatly diminished, if nonexistent.

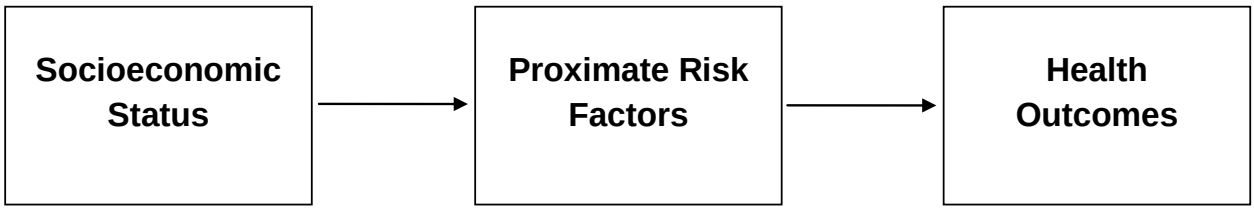

FIGURE 1. Causal Diagram Outlining Relationship Between Socioeconomic Status and Health Outcomes.

However, as Phelan and Link (2005) describe, history provides examples of when proximate risk factors have been addressed, yet the association between socioeconomic status and health remains. During the 19th century, the major causes of death were primarily related to infectious diseases such as cholera, smallpox, and tuberculosis. Also during this period, intense industrialization and urbanization occurred resulting in population centers which were often overcrowded and lacked sanitary means of providing clean water and disposing of waste. As Szreter (1988) notes, these health hazards were addressed, as adequate housing and clean water were provided. As a consequence, mortality from infectious diseases diminished. Phelan and Link (2005) note that with the disappearance of those proximate causes of disease (i.e., poor housing and contaminated water), the link between SES and health should have also disappeared. Still, the association between SES and health continued. Phelan and Link (2005) propose that the failure of eliminating poor health outcomes by addressing their proximate causes was due to the fact that

> new risk factors (such as chemical pollutants) arose, new knowledge about risk factors (such as smoking) emerged, and new treatment technologies (such as medicines that reduce cholesterol) were developed, and those possessing the most resources were best able to avoid the new risks and take advantage of the new protective factors, resulting in the emergence of a socioeconomic gradient in these factors. (29)

Indeed, if "no new diseases emerged (such as AIDS), [and] no new risks developed (such as pollutants), no new knowledge about risks emerged […]" then "the concept of fundamental social causes [of disease] would not apply" (Link and Phelan 1995:87). Essentially, fundamental causes of disease "involve access to resources that can be used to avoid risks or to minimize the consequences of disease once it occurs" (87).

Link and Phelan (1995) also make the case that race and ethnicity is often "so closely tied to resources like money, power, prestige, and/or social connectedness that they should be considered as potential fundamental causes of disease […]" (87). According to FCT, because health risks are constantly emerging, economically advantaged individuals, who may be stratified by race/ethnicity, will be better able to utilize resources to experience a more favorable social condition from which to address health risks.

Flexible Resources

The concept of "flexible resources" is important in FCT and is conceptualized broadly as "money, knowledge, power, prestige, and the kinds of interpersonal resources embodied in the concepts of social support and social network" (Link and Phelan 1995:81). These resources include relationships with friends, family, coworkers, and to those whose roles fall within broader societal structures. It is the relationship between such flexible resources and fundamental causes of disease that prevent health disparities from being eliminated by addressing only the proximate causes of disease. In an environment of competition for scarce resources (such as health), those with the most

knowledge and power will be advantaged in acquiring those resources. Furthermore, FCT also proposes that the use of flexible resources is for the benefit of its members and is done so in a "purposeful" manner (Phelan et al. 2004:268). Examples of such actions or resources used intentionally to promote health among the socioeconomically advantaged include, "asking for beneficial health procedures; quitting smoking; getting flu shots; wearing seat belts and driving a car with airbags; eating fruits and vegetables; exercising regularly and taking restful vacation" (Phelan et al. 2004:267). Since the use of such resources is purposeful, better health outcomes are not merely a "coincidental side-effect of 'the good life'" (Phelan et al. 2004:268).

Fundamental Causes of Disease

In summarizing the fundamental social causes of disease, Phelan et al. (2004) describe first the fundamental causes' ability to "influence multiple disease outcomes" (280). Indeed, the social causes of morbidity and mortality are not limited to a single disease. For example, Everson et al. (2002) found low SES to be related to higher risk of depression, obesity, and diabetes. Secondly, fundamental causes can also affect disease outcomes through a variety of risk factors. Thirdly, the "association between the fundamental cause and mortality is reproduced over time via the replacement of intervening mechanisms" (Phelan et al. 2004: 268). As mentioned previously, if new risks to human health do not emerge, then the economically advantaged would not be able to use their flexible resources to reduce risks of negative health outcomes.

Finally, the "essential feature" of fundamental causes in disease is that they "involve access to resources that can be used to avoid risks or to minimize the

consequences of disease once it occurs" (Phelan et al. 2004:268). An excellent example of this utilization of resources by the socioeconomically advantaged to offset health risks can be found in Victora et al. (2000). In analyzing differences in infant mortality rates (IMR) among Brazilian children, disparities were observed between the socioeconomically advantaged and the poor. In two different cities, it was found that the economically advantaged were better able to utilize public-health programs designed to reduce infant mortality. The remarkable decline in infant mortality rates among the economically advantaged led Victora et al. (2000:1098) to conclude that "an increasing proportion of the rich were making use of newer technologies that were still unavailable to most of the poor."

Important in understanding the implications of the fundamental cause perspective in describing racial and ethnic disparities is the ability of a given society to control a disease. Phelan and Link (2005) argue that the ability of a society to control disease and death is just as important for the creation of health disparities as the unequal distribution of resources. This "core" proposition of FCT posits that "It is our enormously expanded capacity to control disease and death in combination with existing social and economic inequalities that create health disparities by race and SES" (29). So, new techniques or knowledge in promoting health are "distributed according to resources of knowledge, money, power, prestige, and beneficial social connections" (29). This means that health "disparities by SES and race should emerge when new health enhancing information or technology is developed" (30).

Following the FCT perspective, disparities in flu vaccinations are likely to be observed between non-Hispanic whites and Hispanics; given that non-Hispanic whites

may be better able to utilize their higher socioeconomic status in applying flexible resources to maximize health benefits. However, controlling for flexible resources that encourage vaccination should attenuate this ethnic disparity in vaccination for seasonal influenza. This is an expected outcome since there is nothing fundamental about race or ethnicity *per se* that leads to poorer health outcomes; instead, race and ethnicity tend to predict disease because of the flexible resources associated with it. Before analyzing 2001 through 2010 BRFSS data for these possible disparities, I will discuss my strategy to manipulate BRFSS data in a manner that yields accurate seasonal influenza vaccination estimates.

CHAPTER IV

METHODS AND ANALYSES

The ability to monitor a population's health is of critical importance in maintaining a healthy and productive society. Without proper health information, addressing health issues to reduce mortality and morbidity burdens within a population is extremely difficult – even impossible. In order to properly address public health concerns, adequate and accurate data are essential. The manner in which a population obtains such information is typically through various health surveillance surveys and public records.

While such information plays a vital role in gauging the health of society, it is important to remember its limitations. Much of the information derived from survey research regarding health behaviors is taken from cross-sectional data. While providing a picture, or "slice" of information regarding the health of society at any particular moment, cross-sectional research cannot evaluate health trends over time.

The ability to track long-term trends in health behaviors and outcomes is important in adequately addressing concerns to public health. By observing long-term trends in health behaviors, a clearer picture of the nature of health issues and their impact can be assessed. Thacker and Berkelman (1988), in their commentary on the modern day conception of public health research, advise that "one-time surveys or sporadic studies do not constitute surveillance" (164). Rather, for health surveillance research to assess population health adequately, it must be conducted in a manner that tracks health behaviors and/or outcomes over a period of time.

Thacker and Berkelman (1988) also note that surveillance is not enough if health data are not "integrated into the conduct and evaluation of specific public health programs [...]" (164). Failing to connect the data that are collected through health surveillance surveys to potential or present remedial health policies limits the utility of public health research. Organizations that influence public health policies have a vested interest in tracking health related measures over time in order to evaluate the effectiveness of public health programs.

Unfortunately, limitations sometimes arise with data that are used to track public health behaviors. A certain question may not be asked a certain year, or measures used to evaluate particular health issues may be ineffective. Certainly, great care and work is involved in creating the surveys which help monitor the public's health, but it is essential to detect limitations and devise strategies to overcome them. Many times those limitations are corrected in subsequent surveys; for instance, health measures may be revised or added. While this may resolve data limitations for future survey waves, it cannot address past limitations, and may also lead to inconsistent measurement between waves, creating difficulties in assessing long-term health trends. If public health surveillance is dependent on the continual monitoring of public health data, then the inability to utilize past survey waves limits the public health researcher in addressing important health-related issues.

One such issue is the receipt of the seasonal influenza vaccine. Tracking seasonal influenza vaccinations through the BRFSS provides both state and national estimates in vaccination coverage. To reduce the disease burden of the seasonal flu in the United States., it is important to provide accurate seasonal estimates that detect at-risk groups,

possible disparities, and trends in vaccination coverage over time. In order to address such disparities this research will utilize the 2001 through 2010 BRFSS.

The Behavioral Risk Factor Surveillance System (BRFSS)

The BRFSS is the longest ongoing telephone-based health surveillance survey in the world (CDC 2008). Throughout the year, surveys are administered in all 50 states (as well as the District of Columbia, Guam, the U.S Virgin Islands and Puerto Rico), gathering information on the health status of non-institutionalized adults over the age of 18. The BRFSS is important because of its ability to "identify emerging health problems, establish and track health objectives, and develop and evaluate public health policies and programs" (CDC 2008). Given that the BRFSS is administered by individual states and compiled by the CDC to be nationally representative, it is an important means of monitoring health on a national as well as state level.

Beginning in 2001, the BRFSS included new measures of seasonal influenza vaccination behavior in its core questionnaire. Respondents were asked if they had received a seasonal flu vaccination in the past 12 months. Beginning in 2004, the BRFSS also asked if the respondent received a flu vaccination via nasal spray within the last 12 months. While providing information regarding whether the respondent has recently received an influenza vaccine, the questions fail to specify during which flu season (which typically begin during late October or November of a given year and last through the summer of the next year; *see* CDC 2010b) the respondent reported his or her vaccination. Given the retrospective nature of the question and the fact that the BRFSS is administered throughout the year, the respondent could potentially report vaccination for

any of three possible influenza seasons. This limitation means that precise seasonal influenza vaccination estimates are not readily available.

Not until the 2009 BRFSS was a follow-up question introduced, ascertaining the month and year of the respondents' most recent reported vaccination. The addition of this question allowed more accurate categorization of vaccinations into particular influenza seasons. Despite this improvement, the question does not identify the appropriate influenza season for respondents who did *not* receive a vaccination. Without a question asking if the respondent did or did not receive an influenza vaccination specifically during a particular flu season, it is not possible to estimate flu vaccination rates with exact precision. This issue in estimating seasonal flu vaccinations has been observed by other researchers (Lu, Euler, and Callahan. 2009; Linn et al. 2010; Setse et al. 2011), who have articulated various methods to account for the problem. This thesis presents a summary of those methods and utilizes an alternative method, first presented in Burger et al. (forthcoming), which allows for an accurate estimation of seasonal influenza vaccinations while retaining as many respondents as possible. After describing the method to be employed in this research, a brief comparison of these alternative approaches will be presented.

Filtering Respondents by Month of Interview

The 2009 and 2010 waves of the BRFSS were the first to report when the respondent received his or her seasonal influenza vaccination; data from these waves can be used to examine the distribution of reported influenza vaccinations for each flu season. As shown in Table 1, the 2009 BRFSS contains influenza vaccination data (either

through the traditional flu shot or nasal spray) for the 2007, 2008, and 2009 flu seasons. Similarly, in Table 2 it is observed that the 2010 BRFSS contains vaccination data for the 2008, 2009, and 2010 flu seasons. Of those reporting a flu vaccination in the 2009 BRFSS, most reported that their vaccination was for the 2008 flu season (77.3 percent). However, more than a fifth these respondents (22.7 percent) reported that their vaccination was for either the 2007 or 2009 flu seasons. Similarly, of those reporting vaccination in the 2010 BRFSS, a majority reported vaccination for the 2009 flu season (75.8 percent) and about a quarter (24.2 percent) reported vaccination for either the 2008 or 2010 flu seasons.

Given the seasonal nature of influenza epidemics and the regularity at which they occur, Burger et al. (forthcoming) propose that restricting respondents by month of interview will yield substantial improvements in the accuracy of estimates for seasonal vaccination rates. The logic used in restricting respondents by month of interview is illustrated through the following example. If a respondent is interviewed during January of any particular survey year, that individual cannot report receipt of a flu vaccination for the upcoming flu season since it would not begin until later, in the fall of that year. Given this fact and considering that vaccination for seasonal influenza typically begins in the last quarter of the year, respondents interviewed from January through September should be more likely to report the receipt of an influenza vaccination for the previous year's flu season.

Since the 2009 and 2010 BRFSS include information regarding the month and year of the respondent's last reported flu vaccination, these data are ideal for testing the method I have just outlined. As shown in Tables 1 and 2, significant gains in accuracy are

achieved by restricting respondents by interview months January through September. Restricting respondents in such a manner produced samples within the 2009 and 2010 BRFSS where 97.9 percent and 97.4 percent of reported flu vaccinations correspond to the 2008 and 2009 influenza seasons, respectively. It is expected that the application of this method would produce similar gains in accuracy for previous years of the BRFSS, which would allow public health researchers to estimate past vaccination rates more accurately; this in turn facilitates better depictions of population trends in influenza vaccination (Burger et al. forthcoming).

Previous Methods

While the method presented in Burger et al. (forthcoming) produces samples that are more representative of the prior year's flu season than is possible by utilizing the survey wave as a whole, other methods have also been proposed to address the issue of estimating seasonal influenza vaccinations within the BRFSS. Three of these approaches will be discussed in regard to their strengths and weaknesses and how they compare to the method that I advocate in this study.

Linn et al 2010. In Linn et al. (2010) an analysis of disparities in seasonal influenza vaccinations is presented for the 2007 flu season using data from the 2008 BRFSS. In their estimates, Linn et al. (2010) include all vaccination responses from the 2008 BRFSS. While recognizing that this method is likely to include responses from flu seasons other than the season of interest, Linn et al. (2010) justify their methodology since "when the sample was restricted to the first quarter of 2008 to avoid respondents

referencing different influenza seasons, the overall prevalence and disparities were essentially the same" (1339).

However, just as mortality rates can differ depending on the flu season, so can vaccination uptake among the population. For example, increased media coverage of the flu and the importance of vaccination could increase vaccination rates (Ma et al. 2006). Also, problems in producing or administering influenza vaccines could result in lower seasonal estimates. For example, during the 2004 flu season a contamination problem led to the temporary shutdown of one of the two major pharmaceutical plants that produced influenza vaccines for the United States, causing a massive shortage in vaccinations (Schleicher 2004). This shortage resulted in a 50 percent reduction of vaccination supplies for the 2004 flu season (Zimmerman et al. 2006), which led to sharply lower rates of vaccination coverage.

Therefore, the approach advocated by Linn et al. (2010) may be susceptible to inaccurate estimation of influenza vaccination rates. When applying the Linn et al. (2010) methodology to the 2009 and 2010 BRFSS (i.e., the entire survey wave is used to estimate the prior year's influenza season), some problems are observed. As shown in Table 1 and Table 2 nearly a quarter of the respondents during each survey year reported receipt of a vaccine for a flu season other than the one of interest. Including such a large proportion of respondents reporting vaccination for other flu seasons is likely to produce inaccuracies in subsequent analyses.

Lu et al. 2009. Lu et al. (2009) estimate seasonal influenza vaccination rates for individuals 18 through 64 with asthma during the 2006 influenza season using data from the 2007 BRFSS. To produce their estimates, Lu et al. (2009) use respondents

interviewed from February through August of 2007. This method recognizes that many respondents within the BRFSS report influenza vaccinations for flu seasons other than the one of interest, and that limiting respondents by time of interview improves the accuracy of seasonal vaccination estimates. While this does indeed improve accuracy, the choice of survey months is somewhat restricted, limiting sample size and potentially compromising statistical power. Limiting respondents by interview months February through August of the 2009 and 2010 BRFSS retains only 77.1 percent and 73.1 percent of the original respondents who reported a vaccination during the 2008 and 2009 influenza seasons, respectively.

Adopting the technique introduced in Burger et al. (forthcoming) (i.e., including BRFSS respondents interviewed from January through September) improves retention to 94.6 percent and 91.7 percent of the respondents who received a vaccine for the 2008 and 2009 flu seasons. This maximizes the number of respondents included in each wave of the BRFSS, ensuring that a representative sample is obtained and that statistical power is optimized.

Setse et al. 2011. In Setse et al. (2011) seasonal vaccination estimates are provided for the United States for the 2000 through 2009 influenza seasons. Using the 2001 through 2010 survey waves of the BRFSS, Setse et al. (2011) examine racial/ethnic disparities in influenza vaccination within the United States. Following a similar approach as found in Lu et al. (2009), Setse et al. (2011) instead limit respondents in each wave of the BRFSS by interview months March through August to estimate seasonal. When applying the method as proposed in Setse et al. (2011) to the 2009 and 2010 BRFSS, samples are produced where 98.5 percent and 98.2 percent of those interviewed

represent the 2008 and 2009 influenza seasons. While miniscule gains in accuracy can be achieved by restricting the sample to these interview months, they are overshadowed by the fact that this method excludes more than a third of the original respondents who reported a flu vaccination for either the 2008 or the 2009 influenza seasons.

Comparison using the National Health Interview Survey (NHIS)

In order to ensure that the benefits of using interview months January through September are not anomalous to the 2009 and 2010 waves of the BRFSS, similar analyses are performed using data from the 2005 through 2010 National Health Interview Survey (NHIS) sample adult file. Sponsored by the CDC, the NHIS has been conducted annually since 1957. Similar to the BRFSS, the NHIS provides health information on non-institutionalized adults in the United States. The NHIS is considered the "principle source of information" for that population (CDC 2011a). However, the NHIS differs significantly from the BRFSS in that data are collected using a completely different collection procedure. While the BRFSS provides data acquired through telephone based surveys, the NHIS data are gathered via face-to-face interviews.

Since the logic which allows gains in accuracy to be made within the BRFSS can also apply to the NHIS (i.e., that individuals interviewed prior to October of the survey year generally cannot report a flu vaccination for the upcoming flu season), it should be possible to improve the accuracy of NHIS estimates of seasonal influenza vaccination rates, as it was for the BRFSS. It should be noted that instead of month of interview (as in the BRFSS) the NHIS records when the respondent was interviewed into four interview quarters (January through March, April through June, July through September, and

TABLE 1. Comparison of Methods of Estimating Seasonal Influenza Vaccination Within the 2009 Behavioral Risk Factor Surveillance System (BRFSS).

Entire Sample Interview Month: January ´09 – January ´10 *Linn et al. 2010*			Restricting Vaccinations by Interview Month: January ´09 – September ´09 *Burger et al.(forthcoming)*			Restricting Vaccinations by Interview Month: October ´09 – January ´10 *Lu et al. 2009*			Restricting vaccination by Interview Month: March ´09 – August ´10 *Setse et al. 2011*		
Flu Season	*n*	*%*	*Flu Season*	*n*	*%*	*Flu Season*	*n*	*%*	*Flu Season*	*n*	*%*
2007[a]	2,341	1.24%	2007[a]	2,341	1.64%	2007[a]	1,909	1.66%	2007[a]	1,448	1.50%
2008[b]	146,263	77.32%	2008[b]	138,337	97.13%	2008[b]	112,720	98.30%	2008[b]	95,162	98.46%
2009[c]	40,568	21.45%	2009[c]	1,743	1.22%	2009[c]	45	0.04%	2009[c]	44	0.05%
Total	189,172	100%	Total	142,421	100%	Total	114,674	100%	Total	96,654	100%

a. Received flu vaccination from 01/07–08/07.
b. Received flu vaccination from 09/07–08/08.
c. Received flu vaccination from 09/08–12/09.

TABLE 2. Comparison of Methods of Estimating Seasonal Influenza Vaccination Within the 2010 Behavioral Risk Factor Surveillance System (BRFSS).

Entire Sample Interview Month: January ´09 – January ´10 *Linn et al. 2010*			Restricting Vaccinations by Interview Month: January ´09 – September ´09 *Burger et al. (forthcoming)*			Restricting Vaccinations by Interview Month: October ´09 – January ´10 *Lu et al. 2009*			Restricting vaccination by Interview Month: March ´09 – August ´10 *Setse et al. 2011*		
Flu Season	*n*	*%*	*Flu Season*	*n*	*%*	*Flu Season*	*n*	*%*	*Flu Season*	*n*	*%*
2008[a]	2,752	1.36%	2007[a]	2,752	1.91%	2007[a]	2,276	2.00%	2007[a]	1,763	1.81%
2009[b]	152,988	75.75%	2008[b]	140,246	97.42%	2008[b]	111,791	97.99%	2008[b]	95,427	98.17%
2010[c]	46,212	22.88%	2009[c]	965	0.67%	2009[c]	17	0.01%	2009[c]	16	0.02%
Total	201,952	100%	Total	143,963	100%	Total	114,084	100%	Total	97,206	100%

a. Received flu vaccination from 01/08–08/08.
b. Received flu vaccination from 09/08–08/09.
c. Received flu vaccination from 09/09–12/10.

October through December). This allows a convenient comparison of the effectiveness of restricting respondents by interview months January through September in the BRFSS to the first three quarters (January through September) of the NHIS. Tables 3 through 8 shows during which flu season the respondent reported the influenza vaccination (either through the traditional flu shot or nasal spray) for the 2005 through 2010 waves of the NHIS. First, all reported vaccinations are placed in their respective flu seasons, and then vaccinations are shown while restricting respondents to the first three quarters of the survey wave.

For each wave of the NHIS from 2005 to 2010, gains in the accuracy of estimates for seasonal flu vaccination rates can be achieved by limiting respondents to the first three quarters of the survey wave. Compared to using the entire survey wave, restricting respondents in this manner improved my ability to isolate a specific flu season among respondents who received an influenza vaccine; specifically, the percentage of respondents who received their flu shot in the previous flu season increased from 77.4 percent to 97.4 percent, on average. This improvement in the ability of the NHIS to represent a specific flu season is accomplished while still retaining, on average, 91.3 percent of all respondents who reported receiving a flu vaccine in the year prior to the NHIS interview. The improved ability to isolate vaccinations to specific flu seasons means that providing seasonal influenza vaccination estimates or performing seasonal analyses can be performed with greater confidence.

The approach advocated in Burger et al. (forthcoming) of filtering respondents by interview months January through September works equally well for two methodologically different surveys, which is indicative of the general applicability and

usefulness of this method. Even in flu seasons where dramatic disruptions occurred in the distribution of flu vaccinations throughout society, such as during the shortage experienced during the 2004 influenza season, restricting respondents by interview months January through September produces samples which allow for a more accurate estimation of seasonal influenza vaccinations.

TABLE 3. Reported Seasonal Influenza Vaccination by Flu Season, 2005 National Health Interview Survey (NHIS)

Entire Sample Interview Quarter: Q1-Q4			Restricting Vaccination by Interview Quarter: Q1-Q3			Restricting Vaccination by Interview Quarter: Q4		
Flu Season	*n*	*%*	*Flu Season*	*n*	*%*	*Flu Season*	*n*	*%*
2003[a]	96	1.39%	2004[a]	96	1.91%	2004[a]	0	0.00%
2004[b]	5,516	79.78%	2005[b]	4,925	97.99%	2005[b]	591	31.30%
2005[c]	1,302	18.84%	2006[c]	15	0.10%	2006[c]	1,297	68.70%
Total	6,914	100%	Total	5,026	100%	Total	1,888	100%

a. Received flu vaccination from 01/03-08/03.
b. Received flu vaccination from 09/03-08/04.
c. Received flu vaccination from 09/04-12/04.

TABLE 4. Reported Seasonal Influenza Vaccination by Flu Season, 2006 National Health Interview Survey (NHIS)

Entire Sample Interview Quarter: Q1-Q4			Restricting Vaccination by Interview Quarter: Q1-Q3			Restricting Vaccination by Interview Quarter: Q4		
Flu Season	*n*	*%*	*Flu Season*	*n*	*%*	*Flu Season*	*n*	*%*
2004[a]	95	1.43%	2004[a]	95	2.03%	2004[a]	0	0.00%
2005[b]	5,102	76.64%	2005[b]	4,572	97.75%	2005[b]	530	26.77%
2006[c]	1,460	21.93%	2006[c]	10	0.21%	2006[c]	1,450	73.23%
Total	6,657	100%	Total	4,677	100%	Total	1,980	100%

a. Received flu vaccination from 01/04-08/04.
b. Received flu vaccination from 09/04-08/05.
c. Received flu vaccination from 09/05-12/05.

TABLE 5. Reported Seasonal Influenza Vaccination by Flu Season, 2007 National Health Interview Survey (NHIS)

Entire Sample Interview Quarter: Q1-Q4			Restricting Vaccination by Interview Quarter: Q1-Q3			Restricting Vaccination by Interview Quarter: Q4		
Flu Season	*n*	*%*	*Flu Season*	*n*	*%*	*Flu Season*	*n*	*%*
2005[a]	68	0.97%	2005[a]	68	1.37%	2005[a]	0	0.00%
2006[b]	5,361	76.44%	2006[b]	4,887	98.45%	2006[b]	474	23.13%
2007[c]	1,584	22.59%	2007[c]	9	0.18%	2007[c]	1,575	76.87%
Total	7,013	100%	Total	4,964	100%	Total	2,049	100%

a. Received flu vaccination from 01/06-08/06.
b. Received flu vaccination from 09/06-08/07.
c. Received flu vaccination from 09/07-12/07.

TABLE 6. Reported Seasonal Influenza Vaccination by Flu Season, 2008 National Health Interview Survey (NHIS)

Entire Sample Interview Quarter: Q1-Q4			Restricting Vaccination by Interview Quarter: Q1-Q3			Restricting Vaccination by Interview Quarter: Q4		
Flu Season	*n*	*%*	*Flu Season*	*n*	*%*	*Flu Season*	*n*	*%*
2006[a]	101	1.40%	2006[a]	101	1.64%	2006[a]	0	0.00%
2007[b]	6,326	87.46%	2007[b]	6,032	97.99%	2007[b]	294	27.30%
2008[c]	806	11.14%	2008[c]	23	0.37%	2008[c]	783	72.70%
Total	7,233	100%	Total	6,156	100%	Total	1,077	100%

a. Received flu vaccination from 01/07-08/07.
b. Received flu vaccination from 09/07-08/08.
c. Received flu vaccination from 09/08-12/08.

TABLE 7. Reported Seasonal Influenza Vaccination by Flu Season, 2009 National Health Interview Survey (NHIS)

Entire Sample Interview Quarter: Q1-Q4			Restricting Vaccination by Interview Quarter: Q1-Q3			Restricting Vaccination by Interview Quarter: Q4		
Flu Season	*n*	*%*	*Flu Season*	*n*	*%*	*Flu Season*	*n*	*%*
2007[a]	102	1.08%	2007[a]	102	1.73%	2007[a]	6	0.20%
2008[b]	6,147	64.87%	2008[b]	5,586	94.77%	2008[b]	561	15.64%
2009[c]	3,227	34.05%	2009[c]	206	3.50%	2009[c]	3,021	84.20%
Total	9,476	100%	Total	5,894	100%	Total	3,588	100%

a. Received flu vaccination from 01/08-08/08.
b. Received flu vaccination from 09/08-08/09.
c. Received flu vaccination from 09/09-12/09.

TABLE 8. Reported Seasonal Influenza Vaccination by Flu Season, 2010 National Health Interview Survey (NHIS)

Entire Sample Interview Quarter: Q1-Q4			Restricting Vaccination by Interview Quarter: Q1-Q3			Restricting Vaccination by Interview Quarter: Q4		
Flu Season	*n*	*%*	*Flu Season*	*n*	*%*	*Flu Season*	*n*	*%*
2008[a]	125	1.37%	2008[a]	125	1.81%	2008[a]	0	0.00%
2009[b]	7,252	79.38%	2009[b]	6,617	95.97%	2009[b]	635	28.18%
2010[c]	1,759	19.25%	2010[c]	153	2.22%	2010[c]	1618	71.82%
Total	9,136	100%	Total	6,895	100%	Total	2,253	100%

a. Received flu vaccination from 01/09-08/09.
b. Received flu vaccination from 09/09-08/010.
c. Received flu vaccination from 09/10-12/10.

In fact, creating samples by restricting respondents by month of interview, or quarter of interview, seems to be a viable option in improving the usefulness of the BRFSS and the NHIS in accurately estimating seasonal vaccination rates. Utilizing this approach will produce more accurate estimates of long-term trends in seasonal influenza vaccinations in the United States, which will result in better evaluations of health policies that affect vaccination coverage.

While not perfect, limiting respondents to those interviewed from January through September retains more BRFSS respondents than alternative approaches, thus including as much data as possible for analysis. Due to smaller samples, retention of respondents is especially important when producing state-based estimates using BRFSS data. Given these advantages, all analyses in this study will consider only those respondents interviewed from January through September, which strikes the best balance between statistical power and the accuracy of flu season estimates. Those interviewed in October through December of each wave of the BRFSS will be excluded from subsequent analyses.

Measures

Dependent Variable. In the BRFSS, influenza vaccination is measured by asking respondents if they received an influenza vaccine in the last 12 months. The informants were then coded as having responded "Yes," "No," "Don't Know," or "Refused." Beginning in 2004, the BRFSS introduced an additional question asking if the respondent had received an influenza vaccination through a nasal spray. Given the small number of respondents reporting a nasal flu vaccine and the possibility of complicating the analysis by double counting vaccination, only respondents reporting an influenza vaccination administered through a shot will be considered, consistent with the approach advocated in Lu et al. (2008). Respondents who responded "Don't Know" or "Refused" are excluded from analyses.

It should be noted that the analyses presented in this study are solely limited to the seasonal influenza vaccination and do not include information referring to the 2009 H1N1 pandemic influenza vaccination which was administered separately.

Independent Variables. In the BRFSS, race is measured separately from Hispanic ethnicity. Since the principal racial and ethnic groups of interest in this investigation are non-Hispanic whites and Hispanics, these two mutually exclusive groups are created by combining the race and Hispanic ethnicity variables. For reasons of simplicity, the term white will be used interchangeably with non-Hispanic white. Individuals who refused to report their race/ethnicity or did not know were excluded from analysis. Analyses are limited to white and Hispanic respondents from the fifty United States as well as the District of Columbia. Respondents from Puerto Rico, Guam, and the U.S. Virgin Islands are not included.

Key Covariates. Other independent variables of interest include age, sex, level of education, household income, period of observation, and healthcare coverage. Age is collapsed into six categories including: 18 through 24, 25 through 34, 35 through 44, 45 through 54, 55 through 64, and ≥65. Educational attainment is recoded into five categories including: "Less than High School," "High School Graduate," "Some College or Technical School," and "College Graduate." To create the "Less than High School" category the following responses are combined: "Never Attended School or Only Kindergarten," "Elementary School (grades 1 through 8)," and "Some High School (grades 9 through 11)." Household income is collapsed into seven different categories, <$14,999; $15,000 through $24,999; $25,000 through $34,999; $35,000 through $49,000; $50,000 through $74,999 and <$75,000.

Whether or not the respondent had some form of healthcare coverage was assessed through the question, "Do you have any kind of health care coverage, including health insurance, prepaid plans such as HMOs, or government plans such as Medicare?" to which the respondent replied "Yes," "No," "Don't Know," or "Refused." Individuals replying "Don't Know" or "Refused" to the age, sex, level of education, household income, or presence of healthcare coverage were excluded.

Analyses

All statistical analyses were performed using PASW 18 (formerly known as SPSS) and Microsoft Excel 2007. Given the complex design of the BRFSS sample, the Complex Sample Module was used in conjunction with PASW 18 to provide appropriate point and variance estimates. Overall trends in influenza vaccination were observed for

white and Hispanic males and females during the 2000 through 2009 influenza seasons. Linear regression trend lines were also added to summarize trends in seasonal vaccination during the 2000 through 2009 seasons.

In addition, vaccination rates were estimated for whites and Hispanics by specific sociodemographic characteristics for the 2000 through 2009 influenza seasons. Difference of proportion tests were used to determine if statistically significant differences in seasonal vaccination exist between whites and Hispanics within these sociodemographic subgroups.

Finally, a series of binary logistic regression models were estimated for males and females to test the propositions set forth by FCT – namely that whites secure health benefits (influenza vaccinations) through the use of flexible resources. When flexible resources such as education and health care coverage are held constant, the magnitude of racial/ethnic disparities is expected to lessen. These models should provide insight into mechanisms underlying racial and ethnic disparities while also providing a critical assessment of the fundamental cause explanation for disparities in seasonal influenza vaccinations. Three models are estimated that control for key covariates: Model 1 includes race/ethnicity, age, and period of observation, showing the effect of Hispanic ethnicity on the odds of reporting an influenza vaccination, net of these potential confounders. Model 2 includes the previously used variables while introducing healthcare coverage. Model 3 controls for the previously mentioned variables while adding household income and the respondent’s highest level of education.

CHAPTER V

RESULTS

Seasonal Trends in Influenza Vaccination

In Figures 2 and 3, estimated seasonal vaccination rates are presented for white and Hispanic males and females. As observed in previous research, substantial disparities in the receipt of the seasonal influenza vaccination are observed by race/ethnicity and sex. Among all four groups examined in this study – Hispanic females, Hispanic males, non-Hispanic white females and non-Hispanic white males – increases in vaccination rates were observed. However, large differences between whites and Hispanics were detected among both males and females. For white males, the rate of seasonal influenza vaccination increased from 31.5 percent (95 percent CI, 30.8 through 32.1) during the 2000 influenza season to 39.5 percent (95 percent CI, 39.0 through 40.1) during the 2009 influenza season, resulting in a relative increase of 25.4 percent over the 10 flu seasons. Hispanic males experienced a smaller relative increase of around 12.5 percent over the same time period —from 22.3 percent (95 percent CI, 20.3 through 24.4) during the 2000 influenza season to 25.1 percent (95 percent CI, 23.3 through 27.0) during the 2009 influenza season.

White females experienced even greater gains in relative terms (34.9 percent), with vaccination rates rising from 34.4 percent (95 percent CI, 33.9 through 35.0) during the 2000 influenza season to 46.4 percent (95 percent CI, 46.0 through 46.9) during the 2009 influenza season. Hispanic females experienced a relative increase of 29.8 percent during the period of observation, increasing from 23.5 percent (95 percent CI, 21.6

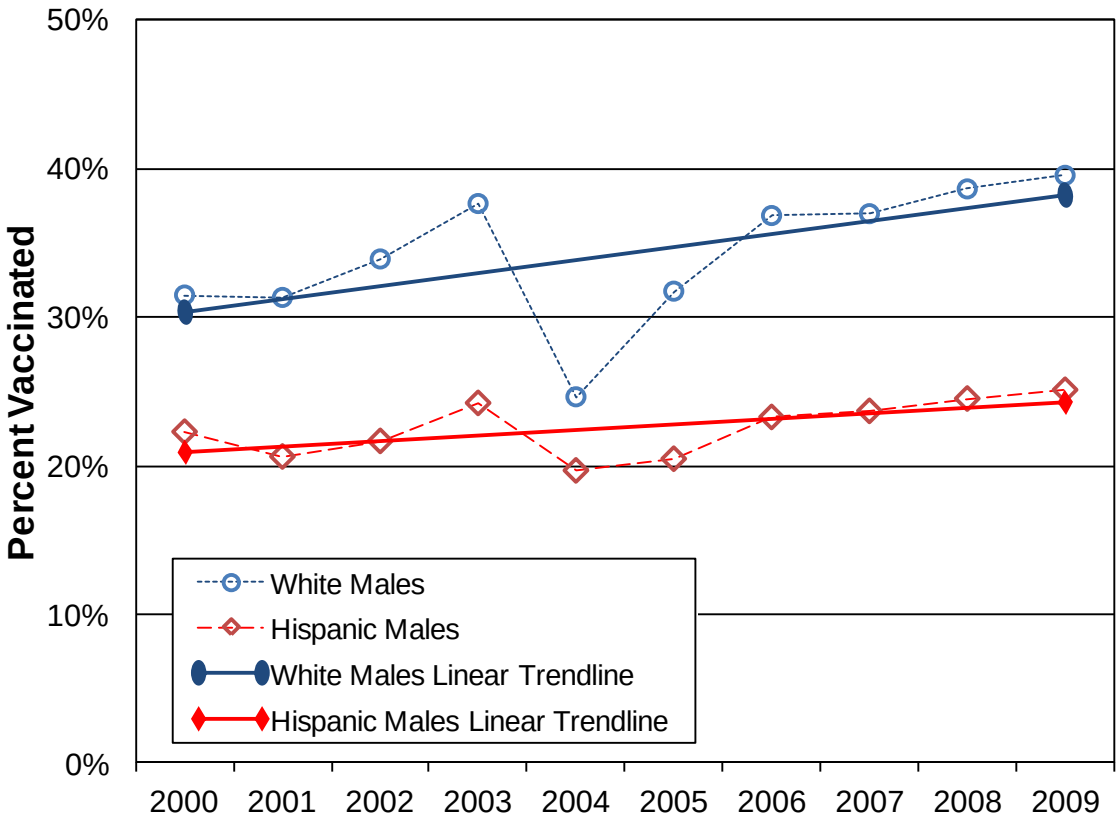

FIGURE 2. Estimated Trends in Influenza Vaccination Rates for White and Hispanic Males Age ≥18 in the United States, 2000-2009 Influenza Seasons.

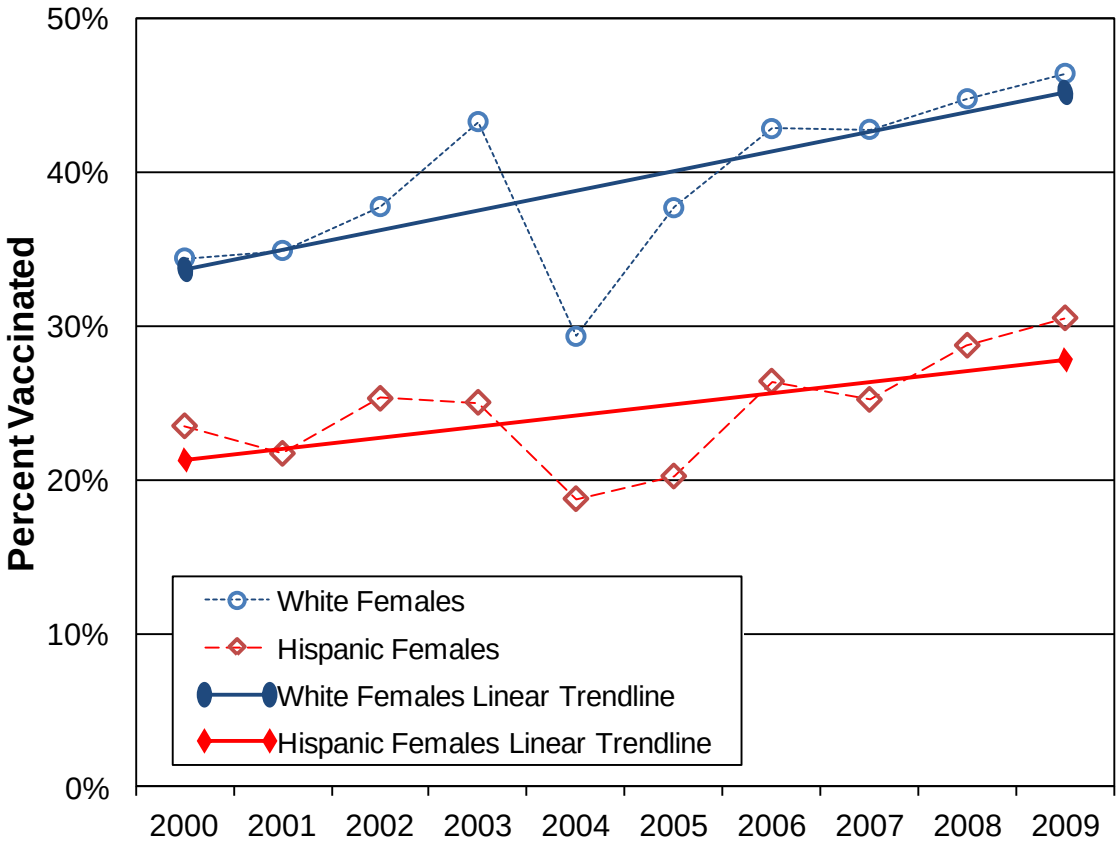

FIGURE 3. Estimated Trends in Influenza Vaccination Rates for White and Hispanic Females Age ≥18 in the United States, 2000-2009 Influenza Seasons.

through 25.5) during the 2000 influenza season to 30.5 percent (95 percent CI, 29.2 through 31.9) during the 2009 influenza season.

Although Hispanics experienced upward trends in seasonal influenza vaccinations during these ten flu seasons, they increased at a somewhat slower pace than their white counterparts. It is disconcerting to note that while influenza vaccinations are rising for both groups overall, the gap between whites and Hispanics widened during the time period. The evidence shows that the gap in seasonal vaccinations between whites and Hispanics during the 2009 influenza season is actually greater than what was present during the 2000 influenza season.

However, it is important to remember the difference age can play in receipt of an influenza vaccination, with the elderly often experiencing higher rates of vaccination (Simonson et al. 2005). Given this fact, the dramatic differences between whites and Hispanics as observed in Figures 2 and 3 could be a result of whites, on average, being older than Hispanics. Considering that the Hispanic demographic is considerably younger than non-Hispanic whites it is important to examine seasonal influenza vaccinations according to specific age categories as well as by other sociodemographic characteristics.

Tables 9 and 10 compare vaccination rates for non-Hispanic whites and Hispanics over ten consecutive flu seasons, by various sociodemographic characteristics. Seasonal influenza vaccination rates are presented for whites in Table 9, and vaccination rates are presented for Hispanics in Table 10. For nearly all sociodemographic subgroups, the proportions of Hispanics vaccinated were statistically lower than their white counterparts.

In nearly every age category across the ten seasons of observation, Hispanics report significantly lower rates of influenza vaccination than whites. However, it is

interesting to note that in seven of the ten seasons, Hispanics in the youngest age group (18 through 24) experienced vaccination rates that were not significantly different than whites of similar age. Also of note is that during the 2004 influenza season (in which there were large shortages of influenza vaccination supplies), Hispanics 25 through 34, 35 through 44, and 55 through 64 experienced vaccination rates on par with their white counterparts.

One of the most dramatic differences between whites and Hispanics in influenza vaccination coverage was observed among the oldest respondents, those ages ≥65. Over the ten-season period, 56.5 percent of Hispanics ≥65 received a flu vaccine, compared to 71.5 percent of non-Hispanic whites in the same age group.

When examining flu vaccination by sex, white females consistently exhibited higher vaccination rates than white males over the ten-season period. This finding confirms prior research showing that females are more likely than males to receive preventive health care services (Pinkhasov et al. 2010). In contrast, while Hispanic females also tend to receive the flu vaccination at higher rates than Hispanic males, they do not seem to experience the same gender-based advantages as white females. For example, during the 2004 and 2005 flu seasons, which were seasons in which vaccination materials were in short supply, Hispanic males actually tended to have slightly higher vaccination rates than Hispanic females.

In every income category, vaccination rates were higher among whites than Hispanics. During most flu seasons, with the exception of the 2000 and 2004 influenza seasons, income seems to play a positive role in influencing vaccinations. Similarly, rates of influenza vaccination tend to increase with level of education.

For both whites and Hispanics, substantial absolute differences in vaccination rates exist between those with or without some form of healthcare coverage. Vaccination rates were often more than 20 percent higher among insured whites than uninsured whites. While differences are also observed between insured and uninsured Hispanics, they are less dramatic. On average, insured Hispanics experience absolute vaccination rates 12.7 percent higher than uninsured Hispanics. Between insured whites and Hispanics, statistically significant differences were found in every flu season (p <.001). However, while statistically significant differences between uninsured whites and Hispanics were obtained for six of the ten flu seasons; those absolute differences are often small, averaging about 2 to 3 percent.

While Tables 9 and 10 provide ample evidence of substantial disparities in reported flu vaccination between whites and Hispanics, it does little to provide insight as to the effect of social conditions (as described in FCT) on receiving the vaccine. In Tables 11 and 12, results of logistic regression models are presented estimating the effect of race/ethnicity and SES on the odds of receiving a flu vaccination. Table 11 presents a series of logistic regression models for white and Hispanic males, and Table 12 presents the same series of logistic regression models for white and Hispanic females.

Odds of Reporting Influenza Vaccination: Males

As shown in Model 1 of Table 11, Hispanic males, in absolute terms, experience 25.3 percent (p < .001) lower odds of reporting a flu vaccination than white males when controlling for age and period of observation. The model exhibits the known positive association between age and receipt of the seasonal flu vaccination.

TABLE 9. Influenza Vaccination Coverage for Whites Age ≥18 in the United States, 2000-2009 Flu Seasons.

Characteristics	2000 Flu Season			2001 Flu Season			2002 Flu Season			2003 Flu Season			2004 Flu Season		
	n	%	C.I.	*n*	%	C.I.	*n*	%	C.I.	*n*	%	C.I.	*n*	%	C.I.
Age															
18-24	9,060	18.7	17.5-20.0	9,613	18.6	17.4-20.0	9,363	20.1	18.8-21.4	9,394	21.3	19.9-22.8	9,136	15.3	14.1-16.6
25-34	18,726	16.1	15.3-16.9	21,354	15.0	14.2-15.8	21,323	18.1	17.3-19.0	22,883	23.0	22.1-24.0	24,230	13.5	12.7-14.2
35-44	24,657	18.6	17.9-19.4	28,742	19.5	18.8-20.3	29,681	21.1	20.3-21.8	31,573	26.5	25.6-27.3	35,772	13.3	12.7-13.9
45-54	23,435	27.0	26.1-28.0	29,428	28.5	27.6-29.3	32,675	30.3	29.4-31.1	36,401	36.7	35.8-37.6	43,684	17.5	16.9-18.2
55-64	15,917	41.5	40.3-42.8	21,726	42.6	41.6-43.6	25,975	45.6	44.6-46.7	30,567	52.3	51.3-53.3	39,644	29.7	28.9-30.4
≥ 65	24,336	68.7	67.7-69.6	32,061	70.3	69.5-71.2	35,773	73.0	72.2-73.8	42,890	75.7	75.0-76.5	55,234	66.3	65.6-67.0
Sex															
Male	47,743	31.5	30.8-32.1	57,868	31.3	30.7-31.9	62,203	33.9	33.3-34.5	68,145	37.6	37.0-38.3	80,526	24.6	24.1-25.2
Female	69,419	34.4	33.9-35.0	86,005	34.9	34.4-35.4	93,636	37.8	36.2-38.3	106,409	43.3	42.8-43.8	128,512	29.3	28.9-29.7
Household Income															
< $14,999	10,208	36.2	34.6-38.0	12,321	36.7	35.1-38.2	13,444	39.4	37.9-40.9	15,559	41.3	39.8-42.9	18,154	32.1	30.8-33.5
$15,000-$24,999	17,317	37.7	36.5-39.0	21,186	36.8	35.8-37.9	22,950	39.1	38.0-40.2	25,617	41.9	40.8-43.1	30,015	33.0	32.0-34.0
$25,000-$34,999	15,596	32.7	31.6-33.9	18,715	34.5	33.4-35.6	19,208	37.5	36.3-38.8	21,162	40.4	39.2-41.6	24,497	30.9	29.9-31.9
$35,000-$49,999	19,441	30.1	29.1-31.1	23,833	30.2	29.3-31.1	25,469	33.3	32.3-34.3	27,553	38.8	37.8-39.8	31,977	26.0	25.1-26.8
$50,000-$74,999	18,203	27.8	26.8-28.8	22,895	28.6	27.7-29.5	24,823	32.5	31.5-33.4	27,729	37.3	36.3-38.3	33,410	22.5	21.7-23.2
≥ $75,000	19,627	30.1	29.1-31.1	25,291	30.6	29.7-31.5	29,752	32.6	31.7-33.4	34,024	39.1	38.2-40.0	43,290	21.6	21.0-22.3
Education															
< High School	11,000	36.6	35.2-38.1	12,776	34.9	33.6-36.2	12,833	38.2	36.8-39.6	14,017	40.6	39.1-42.2	16,781	31.0	29.8-32.3
HS or GED	36,884	32.6	31.8-33.3	45,780	32.8	32.2-33.5	47,293	35.3	34.6-36.1	53,363	38.5	36.7-39.3	64,316	27.6	27.0-28.3
1-3 Years College	32,171	31.2	30.4-32.0	38,986	31.7	31.0-32.5	43,155	34.2	33.4-35.0	47,291	39.2	38.4-40.1	56,005	25.1	24.5-25.8
≥ 4 Years College	36,834	34.0	33.3-34.8	46,091	34.3	33.6-35.0	52,289	37.2	36.5-37.9	59,566	43.4	42.7-44.1	71,562	27.2	26.7-27.8
Healthcare Coverage															
Yes	104,915	35.2	34.7-35.6	128,418	35.6	35.2-36.0	139,098	38.5	38.0-38.9	155,782	43.4	42.9-43.8	187,781	29.0	28.7-29.4
No	11,993	14.0	13.0-15.1	15,121	14.0	13.1-15.0	16,392	15.5	14.5-16.5	18,376	19.1	18.1-20.2	20,800	11.5	10.7-12.3

n= unweighted sample size.
CI = confidence interval.
% and CI are calculated from weighted values.

TABLE 9 *continued*. Influenza Vaccination Coverage for Whites Age ≥18 in the United States, 2000-2009 Flu Seasons

Characteristics	2005 Flu Season			2006 Flu Season			2007 Flu Season			2008 Flu Season			2009 Flu Season		
	n	%	C.I.	*n*	%	C.I.	*n*	%	C.I.	*n*	%	C.I.	*n*	%	C.I.
Age															
18-24	7,334	17.2	15.4-19.1	7,451	21.1	19.6-22.6	6,444	21.5	19.9-23.2	6,140	23.5	21.8-25.3	5,589	24.6	22.9-26.3
25-34	21,107	20.0	19.1-21.0	22,638	24.9	24.0-24.9	19,786	24.6	23.6-25.6	18,702	27.1	26.1-28.2	16,745	31.5	30.4-32.6
35-44	33,304	21.3	20.4-22.1	37,074	27.2	26.5-28.0	33,601	27.4	26.7-28.2	32,412	29.8	29.0-30.7	30,078	33.1	32.2-34.0
45-54	42,431	28.0	27.2-28.9	51,049	33.6	32.9-34.3	48,441	33.5	32.8-34.2	49,935	36.1	35.4-36.8	47,440	36.7	36.0-37.4
55-64	40,991	43.4	42.5-44.3	53,132	48.7	47.9-49.4	52,482	49.5	48.8-50.2	57,124	50.7	50.0-51.4	58,670	50.3	49.6-50.9
≥65	56,808	71.6	70.9-72.3	76,185	73.9	73.4-74.4	76,030	73.5	73.0-74.0	84,070	72.6	72.1-73.1	89,842	69.2	68.7-69.7
Sex															
Male	78,134	31.7	31.1-32.4	94,300	36.8	36.3-37.4	90,391	36.9	36.4-37.5	95,769	38.6	38.0-39.2	95,608	39.5	39.0-40.1
Female	125,386	37.7	37.1-38.2	154,999	42.8	42.4-43.3	148,041	42.8	42.3-43.3	154,257	44.8	43.3-45.3	154,526	46.4	46.0-46.9
Household Income															
≤$14,999	16,903	35.8	34.2-37.4	19,130	40.2	38.8-41.7	18,305	38.6	37.2-40.1	19,214	38.1	36.6-39.6	20,425	35.5	34.2-36.9
$15,000-$24,999	27,355	38.5	37.3-39.8	33,649	42.5	41.5-43.5	31,841	42.1	41.0-43.1	34,918	41.2	40.1-42.3	35,700	40.7	39.7-41.7
$25,000-$34,999	22,456	36.7	35.5-38.0	26,796	40.9	39.8-42.0	24,976	42.3	41.1-43.5	26,019	42.7	41.6-43.9	25,691	43.0	41.9-44.1
$35,000-$49,999	30,263	33.7	32.7-34.8	36,540	38.5	37.6-39.5	33,584	39.2	38.2-40.2	35,244	40.7	39.7-41.7	34,269	42.6	41.6-43.6
$50,000-$74,999	32,520	31.7	30.7-32.7	39,408	37.5	36.7-38.4	38,219	37.7	36.9-38.6	38,526	40.4	39.5-41.3	36,588	42.2	41.3-43.1
≥$75,000	46,806	32.4	31.5-33.3	60,876	38.9	38.2-39.6	61,812	39.0	38.3-39.7	64,663	42.2	41.5-42.9	63,468	45.4	44.7-46.1
Education															
< High School	15,473	35.5	33.9-37.1	18,947	38.4	37.1-39.7	16,888	37.3	35.8-38.8	16,971	38.2	36.7-39.7	17,248	35.4	34.0-36.8
HS or GED	61,514	33.9	33.1-34.8	76,464	38.2	37.5-38.8	71,854	37.5	36.8-38.2	74,793	39.3	38.6-40.0	74,769	39.1	38.4-39.7
1-3 Years College	55,090	32.7	31.9-33.5	66,800	37.7	37.0-38.4	64,639	38.5	37.8-39.2	68,583	39.7	39.0-40.4	68,034	41.1	40.4-41.8
≥ 4 Years College	71,121	37.0	36.3-37.7	86,566	43.3	42.7-43.9	84,714	43.6	43.0-44.2	89,324	45.9	45.2-46.5	89,711	48.5	47.9-49.1
Healthcare Coverage															
Yes	184,067	37.5	37.0-37.9	225,993	42.7	42.4-43.1	218,417	42.8	42.4-43.2	228,866	44.9	44.5-45.3	228,935	46.3	45.9-46.7
No	19,021	13.8	12.8-14.8	22,757	16.9	16.0-17.8	19,553	16.2	15.3-17.2	20,680	16.9	16.0-17.9	20,677	17.5	16.6-18.5

n= unweighted sample size.
CI = confidence interval.
% and CI are calculated from weighted values.

TABLE 10. Influenza Vaccination Coverage for Hispanics Age ≥18 in the United States, 2000-2009 Flu Seasons

Characteristics	2000 Flu Season			2001 Flu Season			2002 Flu Season			2003 Flu Season			2004 Flu Season		
	n	%	C.I.	*n*	%	C.I.	*n*	%	C.I.	*n*	%	C.I.	*n*	%	C.I.
Age															
18-24	1,738	19.7	16.8-23.0	1,795	15.3***	13.0-17.9	1,749	20.4	17.4-23.9	1,913	18.5**	15.7-21.7	1,999	17.9**	14.8-21.5
25-34	3,068	17.6*	15.5-19.9	3,179	15.3	13.0-17.8	3,515	14.4***	12.6-16.5	3,976	18.4***	16.2-20.8	4,441	13.8	11.9-15.8
35-44	2,964	17.1*	14.3-20.2	2,961	16.2***	13.9-18.8	3,384	19.4*	17.0-22.1	3,895	19.5***	17.4-21.7	4,441	12.9	11.2-14.8
45-54	2,128	19.0***	16.1-22.3	2,191	21.0***	17.9-24.5	2,394	21.5***	18.4-25.0	2,885	25.4***	22.2-29.0	4,256	15.5***	13.2-18.1
55-64	1,374	35.2***	29.7-41.1	1,462	32.3***	27.4-37.5	1,665	33.4***	28.8-38.4	1,937	35.1***	30.6-39.9	3,250	30.2	26.1-34.7
≥65	1,599	54.6***	49.5-59.7	1,713	55.7***	49.8-61.5	1,868	61.5***	56.3-66.5	2,287	63.0***	58.1-67.6	2,238	52.1***	47.1-57.0
Sex															
Male	5,019	22.3***	20.3-24.4	5,264	20.6***	18.7-22.6	5,583	21.7***	19.7-23.7	6,476	24.2***	22.3-26.3	6,959	19.7***	17.9-21.6
Female	7,903	23.5***	21.6-25.5	8,087	21.7***	20.0-23.6	9,057	25.3***	23.5-27.1	10,471	25.0***	23.4-26.7	11,702	18.8***	17.4-20.2
Household Income															
≤$14,999	3,371	25.3***	22.3-28.6	3,166	20.3***	17.7-23.3	3,504	22.4***	19.7-25.2	4,033	22.7***	20.1-25.5	3,843	20.5***	17.8-23.5
$15,000-$24,999	3,004	22.8***	20.2-25.5	3,219	19.5***	17.1-22.3	3,642	22.4***	19.9-25.2	4,138	23.7***	21.3-26.3	4,812	18.0***	15.8-20.6
$25,000-$34,999	1,663	20.8***	17.6-24.5	1,834	17.9***	15.0-21.3	1,816	21.4***	18.1-25.2	2,116	24.4***	20.9-28.3	2,373	19.5***	16.3-23.1
$35,000-$49,999	1,445	20.0***	16.8-23.7	1,479	22.2***	18.5-26.5	1,578	27.0***	22.6-32.0	1,741	23.3***	19.8-27.1	1,961	19.4***	16.1-23.3
$50,000-$74,999	905	22.9**	17.9-28.8	1,031	20.8***	17.1-25.1	1,116	21.8***	17.8-26.4	1,294	26.1***	21.3-31.6	1,470	18.3***	15.0-22.1
≥$75,000	664	19.9***	15.4-25.3	833	23.5***	18.2-29.8	1,033	25.5***	20.8-30.8	1,208	32.7***	27.7-38.1	1,456	15.1***	12.4-18.3
Education															
< High School	3,960	23.2***	20.6-26.0	3,959	22.5***	20.0-25.2	4,574	22.5***	20.3-24.8	5,550	23.6***	21.5-25.9	5,967	19.9***	17.8-22.1
HS or GED	3,884	21.9***	19.5-24.4	4,016	20.5***	18.4-22.9	4,259	25.1***	22.4-27.9	4,958	24.2***	21.9-26.7	5,620	19.0***	16.9-21.2
1-3 Years College	2,866	24.0***	21.2-27.0	2,925	18.8***	16.3-21.7	3,091	22.6***	19.9-25.4	3,417	25.1***	22.1-28.4	3,837	17.8***	15.6-20.2
≥ 4 Years College	2,171	22.6***	19.5-25.9	2,416	22.5***	19.7-25.5	2,676	23.7***	21.0-26.8	2,964	27.8***	24.9-31.0	3,160	20.3***	17.5-23.3
Healthcare Coverage															
Yes	9,996	26.0***	24.3-27.8	10,000	25.2***	23.5-27.0	10,817	27.4***	25.7-29.1	12,171	29.2***	27.5-30.9	12,944	22.2***	20.7-23.7
No	2,895	15.5*	13.4-17.8	3,304	12.8	11.0-14.8	3,770	15.6	13.7-17.7	4,707	16.0***	14.2-17.9	5,648	13.9***	12.1-15.8

* $p < 0.05$; **$p < 0.01$; ***$p < 0.001$.
†=p value from difference of proportion test (non-Hispanic white vs. Hispanic).
n= unweighted sample size.
CI = confidence interval.
% and CI are calculated from weighted values.

TABLE 10 *continued*. Influenza Vaccination Coverage for Hispanics Age ≥ 18 in the United States, 2000-2009 Flu Seasons

Characteristics	2005 Flu Season			2006 Flu Season			2007 Flu Season			2008 Flu Season			2009 Flu Season		
	n	%	C.I.	*n*	%	C.I.	*n*	%	C.I.	*n*	%	C.I.	*n*	%	C.I.
Age															
18-24	1,716	17.9	14.3-22.2	1,879	21.8	18.4-25.7	1,582	20.7	17.2-24.7	1,491	21.7	18.3-25.5	1,491	23.0	18.9-27.7
25-34	4,031	12.8***	11.1-14.8	4,396	17.5***	15.4-19.9	3,834	16.4***	14.3-18.7	3,638	19.1***	17.0-21.4	3,435	21.7***	19.4-24.2
35-44	4,031	15.7***	13.3-18.4	4,724	20.4***	18.3-22.7	4,456	19.5***	17.5-21.6	4,545	20.6***	18.6-22.7	4,626	24.7***	22.7-26.8
45-54	4,249	17.6***	15.2-20.4	4,141	24.1***	21.5-26.8	3,940	25.0***	22.5-27.7	4,164	27.3***	24.9-29.8	4,425	27.5***	25.4-29.8
55-64	3,377	30.2***	26.4-34.4	3,214	35.3***	31.8-39.0	3,129	34.7***	31.6-38.1	3,472	39.4***	36.2-42.6	3,746	38.3***	35.5-41.1
≥65	2,716	55.8***	51.5-60.0	3,734	55.1***	51.3-58.8	3,807	59.1***	56.0-62.2	4,243	58.0***	55.1-60.9	4,650	50.1***	47.4-52.8
Sex															
Male	6,971	20.5***	18.4-22.7	7,873	23.3***	21.4-25.2	7,555	23.7***	21.9-25.6	7,760	24.5***	22.8-26.3	7,943	25.1***	23.3-27.0
Female	12,190	20.2***	18.8-21.7	14,333	26.4***	25.0-27.9	13,305	25.2***	23.8-26.7	13,875	28.7***	27.3-30.2	14,472	30.5***	29.2-31.9
Household Income															
≤$14,999	4,215	20.0***	17.0-23.3	4,328	24.0***	21.1-27.1	4,325	25.2***	22.4-28.2	4,819	26.1***	23.5-28.9	4,979	23.6***	21.5-25.9
$15,000-$24,999	4,763	19.5***	16.9-22.4	5,208	22.9***	20.6-25.3	5,178	22.2***	19.9-24.8	5,053	24.5***	22.4-26.8	5,160	24.3***	22.3-26.5
$25,000-$34,999	2,320	17.1***	13.9-20.7	2,694	24.1***	20.6-27.9	2,516	23.0***	20.1-26.2	2,508	22.7***	20.0-25.7	2,536	27.9***	23.4-32.8
$35,000-$49,999	1,916	19.7***	16.5-23.3	2,502	22.3***	19.2-25.8	2,236	24.0***	20.7-27.5	2,226	28.8***	25.3-32.7	2,334	29.7***	26.2-33.4
$50,000-$74,999	1,494	19.9***	16.5-24.0	1,929	24.4***	20.2-29.1	1,785	26.7***	22.9-30.9	1,821	27.1***	23.8-30.7	1,820	31.1***	27.4-35.1
≥$75,000	1,711	23.3***	19.4-27.7	2,258	28.9***	25.5-32.5	2,112	26.0***	22.9-29.3	2,417	31.3***	28.2-34.6	2,487	37.9***	34.7-41.1
Education															
Less than HS	6,106	19.0***	16.7-21.4	6,844	22.3***	20.2-24.6	6,712	23.9***	21.8-26.1	6,531	26.3***	24.2-28.5	6,917	25.0***	22.8-27.3
HS or GED	5,571	19.8***	17.7-22.2	6,526	25.6***	23.4-28.0	6,104	24.5***	22.3-26.9	6,182	23.7***	21.7-25.8	6,343	26.4***	24.3-28.5
1-3 Yrs. College	3,825	21.8***	18.8-25.0	4,582	24.2***	21.6-26.9	4,227	22.8***	20.4-25.3	4,707	28.7***	26.2-31.3	4,661	28.1***	25.8-30.6
4(+) Yrs. College	3,595	22.3***	19.5-25.4	4,135	28.5***	25.8-31.3	3,761	27.5***	24.9-30.3	4,154	29.0***	26.6-31.5	4,423	34.0***	31.6-36.5
Healthcare Coverage															
Yes	13,842	24.9***	23.4-26.6	15,757	28.6***	27.1-30.2	15,458	29.4***	27.9-30.8	16,301	31.8***	30.4-33.2	16,591	32.4***	31.0-33.8
No	5,257	12.1**	10.0-14.5	6,370	16.8	15.0-18.7	5,353	14.7**	12.8-16.7	5,276	15.5**	13.8-17.3	5,761	17.6	15.8-19.6

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.
†=p value from difference of proportion test (non-Hispanic white vs. Hispanic).
n= unweighted sample size.
CI = confidence interval.
% and CI are calculated from weighted values.

Odds of vaccination steadily increase with advancing age, with a dramatic jump being observed among males ≥65. In this age group, males experience nearly 70 percent (p <.001) absolute higher odds of reporting a flu vaccination than those aged 55 through 64, and nearly 87 percent (p < .001) absolute greater odds of reporting a vaccination than the youngest age category, 18 through 24. Model 1 also indicates that vaccination rates are increasing throughout the period of observation.

In Model 2, the presence of some form of healthcare coverage is added into the regression model. The inclusion of healthcare reduces the disparity between Hispanic and white males considerably, with Hispanic males now experiencing 15.2 percent (p <.001) absolute lower odds of vaccination than white males. Healthcare coverage is found to double the odds of reporting an influenza vaccination (p <.001). As observed in Model 1, the odds of reporting a vaccination continue to have a strong association with increasing age, regardless of healthcare coverage or race/ethnicity.

In Model 3, education and household income are introduced into the logistic regression model. When controlling for healthcare coverage, education, and household income, Hispanic males experience only 11 percent absolute lower odds of vaccination than white males (p <.001). Age continues to play a similar role as exhibited in Models 1 and 2.

Health care coverage continues to have the most influence in affecting odds of reporting a received flu vaccination, with odds being more than double for those with healthcare coverage than without (p <.001).

TABLE 11. Logistic Regression Estimates of the Effect of White and Hispanic Race/Ethnicity and Sociodemographic Factors on Reported Influenza vaccinations for US Males Age ≥ 18, 2000-2009 Flu Seasons.

Characteristics	Model 1			Model 2			Model 3		
	AOR‡	95% CI‡		AOR	95% CI		AOR	95% CI	
Race/ethnicity									
White	1.000			1.000			1.000		
Hispanic	0.747***	0.719	0.777	0.848***	0.815	0.882	0.891***	0.854	0.930
Age									
≥65	1.000			1.000			1.000		
55-64	0.299***	0.292	0.307	0.315***	0.307	0.324	0.307***	0.298	0.316
45-54	0.156***	0.152	0.160	0.166***	0.161	0.170	0.160***	0.155	0.165
35-44	0.115***	0.112	0.118	0.124***	0.120	0.127	0.120***	0.116	0.124
25-34	0.100***	0.096	0.103	0.112***	0.108	0.116	0.109***	0.105	0.113
18-24	0.112***	0.107	0.117	0.132***	0.125	0.138	0.134***	0.127	0.142
Healthcare Coverage									
No				1.000			1.000		
Yes				2.139***	2.057	2.224	2.048***	1.960	2.139
Education									
< High School							1.000		
High School							1.101***	1.050	1.156
1-3 Years College							1.204***	1.146	1.264
≥ 4 Years College							1.469***	1.400	1.540
Household Income									
≤ $14,999							1.000		
$15,000-$24,999							1.034	0.977	1.095
$25,000-$34,999							0.965	0.911	1.022
$35,000-$49,999							0.921**	0.872	0.972
$50,000-$74,999							0.918**	0.870	0.969
≥ $75,000							1.006	0.954	1.060
Period									
2000-2009	1.036***	1.033	1.040	1.037***	1.034	1.041	1.037***	1.033	1.041
Valid *n*.§	834,633			832,314			752,672		

* *p* <0.05; ***p* <0.01; ****p* <0.001.
‡ AOR, adjusted odds ratio; CI, confidence interval.
§ Unweighted sample size.

Statistically significant differences by education are also observed, with odds of reporting a vaccination increasing with education. Males with ≥4 years of college experienced significantly higher odds of reporting an influenza vaccination than those reporting an education level of less than high school. Interestingly, income appears to

have a weak and counterintuitive effect on vaccination among males, where higher levels of household income fail to provide any benefit. Rather, four of the six income categories do not differ statistically in their impact on vaccination than the reference group (≤$14,999), while the other two ($35,000 through $49,000 and $50,000 through $74,999) experienced significantly lower odds of receiving a flu vaccination than those households with an income of ≤$14,999.

Odds of Reporting Influenza Vaccination: Females

When performing the same series of logistic regressions among white and Hispanic females, similar findings were obtained as males, with some notable exceptions. First, in Model 1 of Table 12, when controlling for race/ethnicity and age, Hispanic females experienced 34.6 percent (p <.001) lower odds of reporting an influenza vaccination than white females. This is a considerably wider disparity than the 25.3 percent lower odds of vaccination reported by Hispanic males. Age appears to have a similar effect for females as for males, with higher vaccination rates being associated with advancing age.

After introducing healthcare coverage into the logistic regression in Model 2, disparities between white and Hispanic females narrowed considerably. Having some form of healthcare coverage among females has similar effects in influencing the odds of reporting an influenza vaccination as with males, with healthcare more than doubling a woman's odds of reporting an influenza vaccination (p < .001). Age continues to have a similar effect as in Model 1, with odds of reporting vaccination increasing across all age groups.

Model 3 retained the previous variables and introduced education and household income into the analysis. In this model the disparity in odds ratios between white and Hispanic females narrowed even further. Education among females had similar effects as with males; as the respondent acquired more education, the odds of reporting a flu vaccination also increased. Females with ≥4 years of college experienced 38.3 percent higher (p <.001) odds of reporting an influenza vaccination when compared to females with less than high school. Income among females appears to increase the odds of vaccination along a gradient, with the odds of reporting a flu vaccine increasing with household income. It is interesting that among females, increasing household income did have the expected effect of increasing the odds of vaccination. This effect was not observed among males, which suggests that while household income may be an important determinant of vaccination among females it is less so for males. Females reporting some form of healthcare coverage in this model reported 89.3 percent higher absolute odds of receiving an influenza vaccination than females without some form of healthcare coverage (p <.001). As with all previous models, age continues to have a statistically significant effect in the odds of receiving a flu vaccination, with females ≥65 experiencing, in absolute terms, 63.9 percent higher odds of reporting a vaccination than females 55 through 64 and 88.3 percent higher than females aged 18 through 24.

TABLE 12. Logistic Regression Estimates of the Effect of White and Hispanic Race/Ethnicity and Sociodemographic Factors on Reported Influenza vaccinations for US Females Age ≥ 18, 2000-2009 Flu Seasons.

Characteristics	Model 1			Model 2			Model 3		
	AOR‡	95% CI‡		AOR	95% CI		AOR	95% CI	
Race/ethnicity									
White	1.000			1.000			1.000		
Hispanic	0.654***	0.635	0.674	.731***	0.709	0.754	0.806***	0.780	0.833
Age									
≥ 65	1.000			1.000			1.000		
55-64	0.373***	0.365	0.380	0.396***	0.388	0.404	0.361***	0.353	0.370
45-54	0.205***	0.201	0.209	0.217***	0.213	0.222	0.193***	0.188	0.198
35-44	0.142***	0.138	0.145	0.151***	0.148	0.155	0.132***	0.128	0.135
25-34	0.124***	0.121	0.127	0.136***	0.133	0.139	0.119***	0.116	0.123
18-24	0.109***	0.105	0.113	0.124***	0.119	0.129	0.117***	0.112	0.123
Healthcare Coverage									
No				1.000			1.000		
Yes				2.126***	2.062	2.192	1.893***	1.829	1.960
Education									
< High School							1.000		
HS or GED							1.028	0.991	1.067
1-3 Years College							1.160***	1.117	1.204
≥ 4 Years College							1.383***	1.331	1.437
Household Income									
≤ $14,999							1.000		
$15,000-$24,999							1.083***	1.046	1.121
$25,000-$34,999							1.108***	1.069	1.149
$35,000-$49,999							1.103***	1.065	1.143
$50,000-$74,999							1.123***	1.084	1.164
≥ $75,000							1.249***	1.204	1.295
Period									
2000-2009	1.057***	1.055	1.060	1.058***	1.055	1.061	1.057***	1.054	1.060
Valid *n*.§	1,325,609			1,323,345			1,123,506		

* $p < 0.05$; **$p < 0.01$; ***$p < 0.001$.
‡ AOR, adjusted odds ratio; CI, confidence interval.
§ Unweighted sample size.

CHAPTER VI

DISCUSSION

As demonstrated through the analyses, statistically significant differences in vaccination uptake among whites and Hispanics were present in the United States during the 2000 through 2009 flu seasons. Consistently, Hispanics reported lower rates of influenza vaccination than their white counterparts. While influenza vaccinations have been increasing for both groups, the difference in the rate of increase has led to a widening disparity between whites and Hispanics during the period of observation. Findings from this study lend support to the proposition set forth by FCT that whites are better able to utilize flexible resources to obtain better health. Specifically, the presence of some form of healthcare is very influential in predicting the odds of reporting a seasonal influenza vaccination. During the ten-season period of observation, 89.1 percent (95 percent CI, 89.0 through 89.2) of whites reported some form of healthcare coverage compared to 66.8 percent (95 percent CI, 66.3 through 67.3) of Hispanics, highlighting the considerable gap in healthcare coverage between the two groups. This large disparity in healthcare coverage indicates that whites may be able to utilize more medical resources than Hispanics to obtain influenza vaccinations, supporting the claim of FCT that racial and ethnic minorities may be disadvantaged in the utilization of flexible resources to improve health. Even though flu vaccinations are relatively inexpensive without insurance and increasingly available in non-traditional locations (such as shopping centers), the effect of healthcare coverage on the odds of reporting vaccination was relatively stable even when controlling for the possible confounding effects of

household income and education. While not explaining the entirety of the difference in adjusted odds ratios, socioeconomic factors such as healthcare coverage, education, and household income explained 56.9 percent and 43.9 percent of the absolute difference in odds ratios for Hispanics males and females, respectively, relative to their white counterparts in reporting a seasonal influenza vaccination.

Importantly, the presence of healthcare coverage had a dramatic effect on the receipt of an influenza vaccination. As shown in the analyses, both whites and Hispanics reporting some form of health care coverage experienced dramatically higher rates of influenza vaccination than those without. Given the differences between those with or without some form of healthcare coverage, it is no surprise that it produced the largest effect in the logistic regression models. This finding is encouraging as programs aimed at increasing healthcare coverage among Hispanics may be influential in reducing disparities in flu vaccination.

Between whites and Hispanics one of the most important gaps in coverage appears in the ≥65 age group. On average, Hispanics ≥65 experienced vaccination rates nearly 15 percent lower than their white counterparts, with the disparity being its widest during the 2009 influenza season. Seasonal influenza vaccination is an important step in preventing both illness and mortality, especially among older individuals (Thompson et al. 2004). Given that individuals ≥65 experience the highest mortality rates due to seasonal influenza, addressing racial/ethnic vaccination disparities in this age group should be a critical public health concern. Also, the large disparity between whites and Hispanics in this vulnerable age group support the argument presented in Fiscella et al.

(2007) that eliminating vaccination disparities among older Americans would result in more than 33,000 years of life saved among racial and ethnic minorities.

However, optimistically, it should be noted that for all four demographic groups considered in this paper (e.g., white females); the odds of reporting a seasonal influenza vaccination were highest among those ≥65. This could be due to the success of public health information campaigns informing individuals ≥65 of the risks of the seasonal influenza and the benefits of vaccination. Another explanation could be that Medicare coverage, which begins at age 65 and covers the cost of the seasonal influenza vaccine, increases odds of vaccination. Furthermore, by having some form of healthcare coverage (such as Medicare), individuals ≥65 may have greater access to healthcare knowledge, increasing their ability to utilize flexible resources to improve health.

Limitations

While FCT does provide a useful theoretical perspective in explaining health inequalities, controlling for SES as measured in this study did not completely eliminate disparities between whites and Hispanics. However, it should be recognized that there are more characteristics and attributes than healthcare coverage, education, and household income that could be included in measuring flexible resources as defined by FCT (Link and Phelan 1995). For example, primary language, proximity to health care facilities, and social connections could all be measures of flexible resources as described by FCT that could affect seasonal influenza vaccination rates (Phelan et al. 2004), but are not included in this thesis due to data limitations.

An important flexible resource mentioned in FCT that is not included in the analyses is “knowledge” and “beneficial social connections” (Link and Phelan 1995). As mentioned in Chen et al. (2007), among Hispanics the most common explanation given for not receiving the flu shot was that it was not needed. Employing a Health Belief Model (HBM) approach to explaining vaccination disparities, it would seem that the perceived susceptibility and perceived severity of seasonal influenza is not great enough among Hispanics to warrant vaccination (Champion and Skinner 2008). The lack of information within the BRFSS regarding attitudes towards seasonal influenza prevents the test of an HBM explanation of vaccination disparities. Even without including the respondents’ attitudes toward vaccination, sociodemographic characteristics did help explain much of the gap between non-Hispanic whites and Hispanics in the odds of reporting receipt of a vaccine. Nevertheless, because Hispanic attitudes toward vaccination are potentially important in generating ethnic disparities, this issue merits additional consideration in future research.

Another notable limitation is the methodology used in gathering data for the BRFSS. For nearly all waves of the BRFSS, data were primarily collected through landline telephone numbers. It was not until the 2009 BRFSS that a dual-frame design was introduced to help capture both landline telephone respondents and cellular phone users (ABT Associates 2011). It has been noted that landline telephone surveys may artificially inflate influenza vaccination rates due to selection biases that favor the inclusion of advantaged socioeconomic groups (Blumberg and Luke 2007). Given the high percentage of Hispanics with lower incomes, actual influenza vaccination rates are likely to be somewhat lower than the estimates generated through this investigation.

CHAPTER VII

CONCLUSION

Seasonal influenza produces serious epidemics that cause substantial economic, mortality, and morbidity burdens in the United States every year. Tens of thousands of deaths, hundreds of thousands of hospitalizations, and billions of dollars lost is the typical result of seasonal influenza (Thompson et al. 2004; Molinari et al. 2007; CDC 2010a). Through effective vaccination, these burdens can be significantly reduced (Nichol 2008). However, substantial disparities in influenza vaccination rates have been observed between disadvantaged racial/ethnic and socioeconomic groups, and their more advantaged counterparts (Lu et al. 2008). Addressing such disparities is an important step toward reducing the disease burden of seasonal influenza.

In order to create effectual programs in eliminating disparities in seasonal influenza vaccinations, accurate information regarding long-term seasonal influenza vaccination trends must be obtained. Unfortunately, somewhat imprecise language in the measure of influenza vaccination status in the BRFSS (asking if in the last 12 months the respondent received a vaccination) limits the accuracy of seasonal estimates. Even with the addition of a follow-up question asking the specific month and year of the last reported vaccination, information regarding the non-vaccination behavior of respondents is unavailable, limiting the analysis of possible disparities.

However, this thesis finds that substantial gains in accuracy can be made when estimating seasonal influenza vaccination rates by restricting respondents to those interviewed from January through September. By doing so, a more accurate sample is

produced whereby rates of vaccination for the previous year's flu season can be estimated. The effectiveness of this method can be seen when observing both the Behavioral Risk Factor Surveillance System (BRFSS) and the National Health Interview Survey (NHIS). While differing substantially in their survey methodology, restricting respondents by survey months January through September in the BRFSS or first quarter through third quarter in the NHIS proved effective in producing samples which were not only more representative of the previous year's flu season, but also retained a higher percentage of respondents than previous methods. The technique first presented in Burger et al. (forthcoming) and elaborated in this thesis could be used by health agencies at the local, state, and national level to track influenza vaccination coverage by sociodemographic subgroups, helping to identify potential disparities. This information would prove valuable in focusing public health policy to increase vaccination among disadvantaged groups.

Utilization of the method elaborated upon in this thesis provides a reliable framework to examine seasonal trends in influenza vaccination by known and possible risk factors (such as obesity, diabetes, and chronic disease) and other sociodemographic characteristics (such as urban/rural differences in vaccination). Furthermore, the Burger et al. (forthcoming) method is a viable solution for tracking seasonal influenza vaccinations within the BRFSS and the NHIS, opening more avenues for future research.

However, it should be noted that such data manipulation would be unnecessary if the way in which the BRFSS and NHIS measured seasonal influenza vaccination were changed. Following an approach found in the National Flu Survey (CDC 2010h), asking

respondents if they have received an influenza vaccination during a specific flu season could yield more accurate results.

Policy Implications

This thesis shows that from the 2000 through 2009 flu seasons, Hispanics often reported receiving influenza vaccinations at lower rates than whites. In nearly every sociodemographic category (age, sex, presence of healthcare coverage, education, and household income) statistically significant disparities existed between the two groups during each period of observation. However, the analyses in this thesis suggest that sizable reductions in racial/ethnic disparities in influenza vaccination rates can be achieved by improving access to health care coverage, as well the education and household income levels of Hispanics. The role of some form of healthcare coverage was found to produce the greatest gains in improving the odds of reporting an influenza vaccination. This research suggests that by addressing the issue of low healthcare coverage among Hispanics, an increase in reported flu vaccinations could occur. Citing the Massachusetts healthcare reform passed in 2006, the CDC (2010f) notes that after the legislation (which provided nearly universal healthcare coverage for state residents) dramatic increases were observed among segments of the population that traditionally reported low levels of coverage. These increases included gains among Spanish-speaking Hispanics (30.3 percent increase) and Hispanics overall (14.2 percent increase), "persons with less than a high school diploma (12.0 percent increase), and persons with annual household incomes <$25,000 (11.9 percent increase)" (263). Given that all of these subgroups experienced lower vaccination rates within and between white and Hispanic

race/ethnicity, increasing healthcare coverage is likely to increase the odds of receiving a seasonal influenza vaccination for each group. It is expected that similar results could be seen throughout the United States with national healthcare reform or a reduction in the cost of adequate health care coverage. Future research comparing influenza vaccination rates among these groups in Massachusetts with the rest of the United States could reveal the actual impact of such legislation.

Addressing racial/ethnic disparities in influenza vaccination coverage could potentially reduce the disease burden of seasonal influenza in the United States, while also contributing to the achievement of prominent public health objectives. By focusing on policies aimed at providing and improving access of healthcare coverage (and improving the overall socioeconomic condition of Hispanics in the United States), elimination of the fundamental causes of health disparities could produce significant gains in seasonal influenza vaccinations, reducing the disease burden of seasonal influenza.

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