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Maternal Socioeconomic Status and Human Papilloma Virus Vaccine Uptake

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Abstract

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by

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MPH, University of Oklahoma, 1999

BS, University of Oklahoma, 1993

Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

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Abstract

There are more than 79 million people in the U.S. currently infected with human papillomavirus (HPV), with an estimated 14 million new infections annually. There is a lack of knowledge about the maternal socioeconomic influences and uptake of the HPV vaccine series. Infection with HPV can cause cervical cancer in women, and there are over 11,000 cervical cancer diagnoses in the U.S. responsible for 4000 deaths annually. Vaccination coverage to prevent HPV infection does not meet the Healthy People 2020 goals of an 80% vaccination rate in the U.S. In this study, associations were tested between maternal SES variables and uptake of the HPV vaccine in male and female adolescents ages 13-17 from 1,125 participants who lived within the estimation areas of New York City, New York and Houston, Texas in 2014. The health belief model was used as the theoretical framework for the study. This was a cross-sectional quantitative study using multiple logistic regression analysis of 4 maternal predictor variables. It was found that 3 of the variables (income, $p > .05$, education $\beta = -.026$, $p > .05$, and age $\beta = -.096$, $p > .05$) were not significantly related to uptake of the HPV vaccine series, whereas ethnicity was found to be significant (Non-Hispanic White $\beta = .429$, $p = .029$, Non-Hispanic Black $\beta = .587$, $p = .002$, and Non-Hispanic Other $\beta = .586$, $p = .011$). Hispanics were nearly 2 times more likely to be vaccinated than other groups. The potential social change implications of this research are that public health workers can use the findings to develop targeted interventions to increase HPV vaccination uptake and reduce the incidence of cervical cancer.

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Dedication

This research is dedicated to my son, Donovan Edward Lockett (December 7, 2005 – 9 August 2013). Donovan's death at age 7 was my inspiration for returning to school to finish my long-term goal of completing a doctorate. I will always remember my son and his positive effect on my life from the day of his birth. I was proud to be his father.

To my other children, Kaitlynn, Veronica, and Alexander for their unconditional love and support through years of moving to different countries, meeting new friends and leaving old friends related to our transient lifestyle within the Department of State.

To my late grandmother, Henrietta Lockett who helped form my ethical compass and has been guiding me these last 17 years from Heaven.

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Section 1: Foundation of the Study and Literature Review

Introduction

The genital human papillomavirus (HPV) is the most common sexually transmitted disease in the United States (Centers for Disease Control and Prevention [CDC], 2013). There are more than 79 million people in the United States currently infected with HPV, and an estimated 14 million new infections occur every year (CDC, 2014a). Infection with HPV can cause cervical cancer in women and is the second leading cause of cancer deaths in women worldwide (CDC, 2013).

The first HPV vaccine, Gardasil, was a significant step forward in the fight against cervical cancer. Gardasil, introduced in June 2006, immunized against HPV serotypes 6 and 11, plus the oncogenic HPV serotypes 16 and 18 (CDC, 2015a). A second vaccine, Cervarix, introduced in 2007, also immunized against the oncogenic HPV serotypes 16 and 18 (CDC, 2013). Collectively, Gardasil and Cervarix, both of which are a three-shot vaccination series, immunized adolescent females to the serotypes that account for 70% of cervical cancers (van Keulen et al., 2013). As previously stated, Gardasil also immunized against non-oncogenic HPV serotypes 6 and 11, which cause genital warts and which can affect men as well as women. Because of its efficacy against genital warts and oncogenic strains of HPV, Gardasil has been the only vaccine approved for use in both adolescent males and adolescent females since 2009 (U.S. Food and Drug Administration, 2013). Cervarix is also approved for use in HPV infection and cervical cancer prevention, but its use was restricted for use in females only (CDC, 2013).

In 2013, there were more than 6.2 million new HPV cases reported in the United States, and HPV was responsible for over 11,000 new cases of cervical cancer contributing to 4,000 deaths (Nettleman & Garcia-Chen, 2013). In 2014, there were an estimated 14 million new HPV infections (CDC, 2014b). Furthermore, despite the release of a safe, efficacious HPV vaccine in 2006, cervical cancer remains the second largest killer of women worldwide (Crowcroft, Hamid, Deeks, & Frank, 2012; Union for International Cancer Control (UICC), 2015). There has been some success against cervical cancer as the incidences in the United States have significantly decreased since the introduction of the Papanicolaou (Pap) test, or "Pap smear," in 1941 (Techakehakij & Feldman, 2008).

The Pap smear test enabled clinicians to screen for early-stage cervical cancer and earlier detection of cervical tissue changes related to HPV infection. The result of the screening test was earlier identification, intervention, and improved overall outcomes as the mortality rate of cervical cancer in the United States decreased by 70% after the introduction of the screening test (Techakehakij & Feldman, 2008). However, even though there has been a significant improvement in the identification and treatment of cervical cancer, it is still a significant burden to those affected by the disease (National Institutes of Health, 2013). Both men and women can carry HPV, and together they equally contribute to an epidemic that accounts for the most prevalent sexually transmitted disease in the United States (Malkowski, 2014; Vanderpool, Van Meter Dressler, Stradtman, & Crosby, 2015).

There are significant health disparities associated with race, ethnicity, and SES(SES) regarding HPV vaccine uptake, which puts vulnerable groups at increased risk of contracting cervical cancer (Btoush, Brown, Fogarty, & Carmody, 2015; Daniel-Ulloa, Gilbert, & Parker, 2016). Researchers and public health officials have taken significant steps over the years to study these disparities and improve intervention programs, but the barriers remain, resulting in only a modest increase in the uptake of the HPV vaccine (Schmidt & Parsons, 2014).

The potential for significant social change related to this study is based on the evidence of an association between measurable maternal SES influences (maternal income, maternal education) and uptake of the HPV vaccine series. Public health officials and researchers could potentially use the results of the research to reduce the burden of cervical cancer in women through the enhancement of vaccination programs contributing to the decreased incidence of a significant health disparity for women.

Section 1 is an introduction to the subject of cervical cancer and its impact on morbidity and mortality. I introduce the HPV vaccine series and its role in decreasing the incidence of HPV infection, as HPV infection is a precursor to the development of cervical cancer. I then describe the study, beginning with a discussion of the problem addressed by the research, followed by a statement of the purpose of the study. I also introduce the research questions and demonstrate how this research filled the gap in the existing literature.

Problem Statement

There is a lack of knowledge about the maternal socioeconomic (SES) influences and the voluntary uptake of the HPV vaccine series. Due to multifactorial issues, there has been resistance to the uptake of the HPV vaccine (Navarro-Illana, Aznar, & Díez-Domingo, 2014). Apte, Pierre-Joseph, Vercruysse, and Perkins (2015) reported that in the United States, 57% of female adolescents and 34% of male adolescents initiated the HPV vaccine series in 2013. The percentage of vaccinated male and female participants has grown in recent years but does not meet the Healthy People 2020 goals of 80% (Savoy, 2014). Additionally, according to one study, over 30% of females and more than 50% of males did not complete the series of three vaccinations (Apte et al., 2015). Lastly, there was evidence of family influences decreasing the uptake of the HPV vaccine series for their adolescent children. Cullen, Stokley, and Markowitz (2014) concluded that increasing parent education could increase uptake of the vaccine. Attanasio and McAlpine (2014) reported that the mother's education level influenced the accuracy of recall of HPV vaccinations given to their children. The lack of acceptance and subsequent completion of the HPV vaccination series poses a continued public health threat, and more research was needed to improve intervention programs, remove barriers, and increase confidence in the safety and efficacy of the HPV vaccine (Savoy, 2014). Other than research performed by Musto et al. (2013), which analyzed school-based service delivery models based on the SES status of schools, there are limited studies in recent literature addressing the associations between maternal SES influences and the voluntary uptake of the HPV vaccine series. In my research, I tested for such associations to gain

knowledge that researchers and public health officials could use to potentially enhance educational programs designed to improve vaccination rates, increase prevention, and reduce the overall incidence of cervical cancer. The problem statement for this study is as follows: There is a lack of knowledge about the maternal socioeconomic influences and the voluntary uptake of the HPV vaccine series. In this study, I sought to identify an association between measurable maternal SES influences and uptake of the HPV Vaccine based on the responses by participants of the 2014 National Immunization Survey-Teen (NIS-Teen).

Purpose of the Study

In this cross-sectional quantitative research study, I investigated the association between maternal SES variables and uptake of the HPV vaccine in female and male adolescents, aged 13-17, based on postal codes within the city of Columbus, Ohio. I included additional variables to observe for associations with maternal age and ethnicity.

Research Question(s) and Hypotheses

The objective of this research study was to explore the association between maternal SES and uptake of the HPV vaccine series. The research questions were as follows:

RQ1: What is the association between maternal income and uptake of the HPV vaccine series in male and female adolescents aged 13-17 in communities with postal codes in the Columbus, Ohio metropolis?

$H_0$1: No association exists between maternal income and uptake of the HPV vaccine series in male and female adolescents aged 13-17 after controlling for

ethnicity and maternal age based on postal codes in Columbus, Ohio.

H_a1: An association exists between maternal income and uptake of the HPV vaccine series in male and female adolescents aged 13-17 after controlling for ethnicity and maternal age based on postal codes in Columbus, Ohio.

RQ2: What is the association between maternal education and uptake of the HPV vaccine series in male and female adolescents aged 13-17 in the postal codes within the Columbus, Ohio metropolis?

H_02: No association exists between maternal education and uptake of the HPV vaccine series in male and female adolescents aged 13-17 in the postal codes within the Columbus, Ohio metropolis.

H_a2: An association exists between maternal education and uptake of the HPV vaccine series in male and female adolescents aged 13-17 in the postal codes within the Columbus, Ohio metropolis.

RQ3: What is the association between maternal age and uptake of the HPV vaccine series in male and female adolescents aged 13-17 in communities with postal codes in the Columbus, Ohio metropolis?

H_03: There is no association between maternal age and uptake of the HPV vaccine series in male and female adolescents aged 13-17 in communities with postal codes in the Columbus, Ohio metropolis.

H_a3: There is an association between maternal age and uptake of the HPV vaccine series in male and female adolescents aged 13-17 in communities with postal codes in the Columbus, Ohio metropolis.

RQ4: What is the association between ethnicity and uptake of the HPV vaccine series in male and female adolescents aged 13-17 in the postal codes within the Columbus, Ohio metropolis?

$H_0$4: There is no association between ethnicity and uptake of the HPV vaccine series in male and female adolescents aged 13-17 in the postal codes within the Columbus, Ohio metropolis.

H_a4: There is an association between ethnicity and uptake of the HPV vaccine series in male and female adolescents aged 13-17 in the postal codes within the Columbus, Ohio metropolis.

Theoretical Foundation for the Study

The theoretical framework for this study was the health belief model (HBM). The HBM was developed in the 1950s by psychologists in the U.S. Public Health Service to determine the rationale of people to not participate in programs that prevent and detect disease (Skinner, Tiro, & Champion, 2015). In the 1950s, there was a widespread failure of people to participate in screening and preventative programs for the early detection of asymptomatic disease (Rosenstock, 1974). The HBM consists of five core constructs proposed in order to influence an individual to perform a particular healthy behavior: perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, and self-efficacy. The HBM has some limitations, most notably the low predictive capacity ($R2 < 0.21$ on average) of existing HBM variables coupled with the small effect size of individual variables (Orji, Vassileva, & Mandryk, 2012). The second

limitation of the HBM was the lack of clear guidance on its usage in combination and relationship between the individual variables being studied (Orji et al., 2012). In my study, I focused on the modifying factors that influence individual beliefs as defined within the constructs of the HBM. As applied to this research, under the HBM, I would evaluate my independent variables of maternal income, maternal education, and maternal age to see if they significantly influence the dependent variable of uptake of the HPV vaccine series through the constructs of the HBM. My rationale for using the HBM was based on the hypothesis that differences in maternal SES and maternal age may have an association with the uptake of the HPV vaccine series in communities defined by postal codes in the Columbus, Ohio metropolis. The HBM was used in this study to look for an association with measurable maternal modifying factors that may influence the uptake of the HPV vaccine series by way of the HBM. Low SES has been associated with many different disease processes (Goldberg, 2014). For example, research by Nicolai et al. (2013) showed that higher rates of the precursors of cervical cancer, cervical intraepithelial neoplasia grades 2, 2/3 and 3 (CIN2+) and adenocarcinoma in situ (AIS) were associated with higher levels of poverty and occurred disproportionately among Black residents. In this study, I focused on maternal SES factors by exploring potential associations based on maternal income, maternal education, and maternal age, as well as the ethnicity of the participants, through the analysis of secondary data derived from the 2014 NIS-Teen survey.

Table 1

Health Belief Model

Modifying Factors		Individual Beliefs	Action
Maternal Income	Perceived susceptibility and severity	Mother's belief that her child can get HPV and HPV can lead to cervical cancer	Uptake of HPV vaccine
Maternal Education	Perceived benefits	Mother's belief that vaccination of her child with the HPV vaccine series will prevent HPV infection and cervical cancer	Non uptake of the HPV vaccine series
Maternal Age	Perceived Barriers	Mother's personal barriers to vaccinate her children (i.e., insurance coverage, cost, knowledge about disease or vaccine)	
Ethnicity	Cues to Action	Strategies to activate mother's readiness to vaccinate	
	Self-Efficacy	Non-applicable after uptake of vaccine	

Nature of the Study

This was a cross-sectional quantitative study in which I investigated the association between maternal income, maternal education, maternal age and ethnicity, and the outcome of the uptake of the HPV vaccine series. I analyzed the categorical independent variables (maternal income, maternal education, maternal age and ethnicity) with the categorical dependent variable (uptake of the HPV vaccine series). The most appropriate method of statistical analysis for these variables was a multiple logistical

regression. My rationale for using multiple logistic regression was its appropriateness to explore for a functional association between the independent variables and the dependent variable. This statistical plan can be used to predict probabilities of an effect of multiple independent variables on a categorical dichotomous dependent variable, and in some circumstances multiple logistic regression can be used to make inferences about which independent variables have a larger effect or stronger association with the dependent variable (McDonald, 2014).

My study analyzed a secondary dataset that contains detailed information about the uptake of the HPV vaccine series, maternal income, maternal education, maternal age, and ethnicity by postal code. I defined the dependent variable, HPV vaccination uptake as a dichotomous (yes/no) response on whether the male of female adolescents received at least one dose of the vaccine. The independent variables were (a) maternal income defined as the income reported by the respondents living within certain postal codes within the Columbus, Ohio metropolitan area, (b) maternal education, (c) maternal age, and (d) ethnicity. Maternal income was defined by total reported combined family income, separated into the following groups: less than $20,000, $20,000 to $39,999, $40,000 to $59,999, $60,000 to $75,000, and more than $75,000. I defined maternal education by the highest level of education attained, separated into the following categories: no high school diploma; high school graduate or GED; completed a vocational, trade, or business school program; some college credit but no degree; associate degree (AA, AS); bachelor's degree (BA, BS, AB); master's degree (MA, MS, MSW, MBA); and doctorate (PhD, EDD) or professional degree (MD, DDS, DVM, JD).

Maternal age was measured by dividing the mothers' age into the following groups: less than 25 years old, 25-34 years old, 35-44 years, and 45+ years old. Ethnicity was measured by the following six categories: White, Black/African-American, Native American, Asian, Native Hawaiian, and Pacific Islander. The secondary dataset I used for the study was the 2014 NIS-Teen. The rationale for the dataset was that it surveys HPV vaccination, maternal education, and annual income. The 2013 NIS-Teen was an instrument that researchers used to record the responses of over 18,000 households across the United States (CDC, 2015c). For the purposes of my research, the 2014 NIS-Teen for participants in Columbus, Ohio needed to be at least 1,188 participants based on calculations using G*Power 3.1 Statistical Power Analysis for a logistic regression two-tailed analysis with 0.95 power (1-β err prob; Faul, Erdfelder, Lang, & Buchner, 2007). Since the NIS-Teen is an annual survey, there should be enough current information and, therefore, less risk of the research being duplicated. Researchers used the NIS-Teen to show at-risk groups for vaccine-preventable diseases (CDC, 2013).

Literature Review Search Strategy

I conducted a systematic literature search for pertinent research articles on the factors affecting HPV vaccine uptake in different populations. Searches of several databases, including Medline, Google Scholar, PubMed, Cinahl, and EBSCO resulted in 80 published articles relevant to the research. The keywords used in the search were *human papillomavirus vaccine, human papillomavirus vaccine and maternal income, human papillomavirus vaccine and communities, human papillomavirus vaccine and maternal education,* and *human papillomavirus vaccine and health belief model*. I used

the search terms in various order to gather as many relevant articles to satisfy an exhaustive search of literature that was less than five-years-old. The search for relevant books and journal articles ranged from January 2011 to January 2016 unless otherwise identified as an essential source for the development of the study.

Literature Review of Key Concepts

Key concepts noted during the exhaustive review of the literature concerning the uptake of the HPV vaccine series were centered on maternal income, maternal education, maternal age, and ethnicity. Below, I will highlight findings from previous research regarding these key concepts that show tendencies relevant to my research.

Maternal Income

Higher income has been associated with increased uptake of the HPV vaccine series. According to Link and Phelan (1995), money was a significant component of SES, and the more money a person has, the better their health, with some exceptions. Musto et al. (2013) investigated possible differences in HPV vaccine uptake in Calgary between in-school and community delivery models and also whether SES contributed to the phenomenon. Using 35,592 vaccination records the Calgary Zone Public Health immunization database for all grades 5th through 9th-grade females for school years 2008–2011, logistic regression methods were used to examine the delivery system and SES status on being vaccinated (Musto et al., 2013). The authors concluded that HPV vaccination completion rates were 75% (95% confidence interval = 74.7%, 75.8%) for females who received vaccination in school compared to 36% (95% confidence interval = 35.3%, 37.2%) for females who received the vaccination in the community (Musto et al.,

2013). Additionally, the researchers found that the participant's neighborhood SES was related to the likelihood of being HPV vaccinated depended on the delivery model available (Musto et al., 2013). Limitations of this study were that the authors used an area-based material deprivation index as an alternative measure for individual SES as individual SES reporting was not available (Musto et al., 2013). Based on the authors' admission, the usage of this index may have potentially misclassified SES, and there may be some misclassification bias (Musto et al., 2013). A strength of the research was the linkage of postal code with the SES data was over 99% reducing the risk of selection bias (Musto et al., 2013). Millen, Ginde, Anderson, Fang, & Camargo (2009) examined knowledge and attitudes about HPV vaccine among emergency department patients if the vaccine was mandatory. The researchers hypothesized that most women would be aware of HPV, but few would know its association with cervical cancer or support mandatory vaccinations (Millen et al., 2009). The researchers reported that one-third of those surveyed had no knowledge of HPV, which correlated with recent U.S. survey data concerning knowledge of HPV by women (Millen et al., 2009). Additionally, one-half of patients surveyed supported state-administered mandatory HPV vaccination programs. Participants were three times more likely to support mandatory programs based on the knowledge of HPV being a sexually transmitted disease whereas cervical cancer knowledge did not increase support for mandatory vaccinations (Millen et al., 2009). However, the limitation of the study was that it had been conducted in a higher status SES area within the Boston metropolis that was less ethnically diverse and more educated than the more urban emergency departments (Millen et al., 2009). The authors asserted

that that lower SES areas would have less knowledge of HPV but never tested the assertion (Millen et al., 2009). Another limitation was selection bias of the participants by the investigators and participants, as people with certain medical conditions, such as mental status changes were excluded from the study, as were non-respondents, which could have affected the results of the survey (Millen et al., 2009). Cowburn et al. (2014) tested for an association between insurance continuity and HPV vaccine use in a network of federally qualified health facilities. Using retrospective electronic health record (EHR) entries for females aged 9 to 26 from 2008 to 2010; the researchers categorized the participants' length of insurance in an ordinal fashion and studied HPV vaccine initiation prevalence across the range of insurance coverages. They found that participants were less likely to start the HPV vaccination series if they were insured less than 66% of the time of the study, were 13 years or older, and belonged to an ethnic minority (Cowburn et al., 2014). The authors concluded that disparities existed in the health facilities researched in the study despite the fact that HPV vaccines are available to many of the patients regardless of their ability to pay (Cowburn et al., 2014). Limitations of the research included the potential for incomplete vaccination records if patients had received immunizations outside of the network of facilities studied, which could have caused underreported vaccination status especially in older children (Cowburn et al., 2014). Btoush, Brown, Fogarty, and Carmody (2015) examined the prevalence and correlates of HPV vaccination initiation among adolescents in low-income urban areas using electronic health records from multisite community health centers in 2011. Their research indicated that 27.4% of the adolescents and the study initiated HPV vaccination (Btoush

et al., 2015). Of those vaccinated, initiation was higher among males and higher among Blacks than Hispanics (Btoush et al., 2015). HPV vaccination initiation was lower in older adolescents, non-English speakers, and those who had received care from non-pediatricians (Btoush et al., 2015). The limitations of the study are related to the 2009 inclusion of males in the U.S. Advisory Committee on Immunization Practices (ACIP) recommendations and the 2011 data analysis published by the researchers in 2015. An important finding was evidence of the lack of vaccination among patients of non-pediatricians. Smith et al. (2011) reviewed the usage of the HPV vaccine in Ontario where the government spent over 100 million dollars to offer free quadrivalent HPV vaccinations to young females. The researchers using administrative and immunization databases conducted a population-based retrospective study cohort study of females eligible to receive the vaccination in selected cities in the Ontario province of Canada. Of the females eligible for vaccination and living within the study boundaries, 1,425 (56.6%) received at least one dose of the HPV vaccination, and less than half (48.2%) completed the vaccination series (Smith et al., 2011). The researchers found no differences in health utilization between vaccinated and unvaccinated females, except that females in the lowest income quintile were less likely to receive HPV vaccine than the quintile above (Smith et al., 2011). Additionally, HPV-vaccinated females were more likely to have received other childhood vaccinations than their unvaccinated counterparts showing an association of parents' attitudes and vaccinations (Smith et al., 2011). HPV vaccine series initiation and completion were not associated with age, health services utilization, or medical history, although there was an association with low-income neighborhoods,

which were less likely to complete the vaccine series than the females living in middle-income neighborhoods (Smith et al., 2011). Females residing in rural areas were more likely to complete their series than females living in urban areas (Smith et al., 2011). A limitation of a study was that school grade was not always available for review in the databases, so the researchers used the birth year to identify eligible females. Another limitation was that investigators did not have vaccination information after December 31, 2009, meaning that females received their vaccinations after this date may have been misclassified (Smith et al., 2011). There was also the potential for misclassification of health systems usage because the database used in the research did not capture care received in clinics that did not update the database (Smith et al., 2011). Lastly, the validity of using neighborhood income as a proxy for household income has not been assessed (Smith et al., 2011). The researchers concluded that the females in the lower SES groups were least likely to complete the HPV vaccination series suggesting that future intervention programs be modified to enhance the delivery of the vaccine to this vulnerable population (Smith et al., 2011).

The following research provides evidence that some programs like the Vaccines for Children Program (VFC) may be having an impact in compensating for families lacking resources regarding the HPV vaccine. Bednarczyk, Curran, Orenstein, and Omer (2014) conducted a study of the atypical demographic patterns of HPV vaccine initiation phenomenon. The researchers used the NIS-Teen data from 2008-2011 and used regression analysis to calculate the average annual increase by sociodemographic characteristics. The researchers found that HPV series initiation increased overall 16%

during the time evaluated (Bednarczyk et al., 2014). The researchers also found that since 2008, adolescents living below the poverty level had higher HPV vaccination initiation than adolescents above the poverty level (Bednarczyk et al., 2014). There were also some variations in HPV initiation by ethnicity as Hispanic adolescents were consistently higher in initiation followed by Black and White adolescents (Bednarczyk et al., 2014). There were also consistent findings when you compared ethnicity and poverty status and HPV vaccination. All ethnic groups had higher initiation of the HPV vaccine series if they were below the poverty level than groups above the poverty line (Bednarczyk et al., 2014). The research was limited by the small samples of some ethnic groups (Bednarczyk et al., 2014). Additionally, the researchers used a 4-level race/ethnicity which may have overlooked some racial differences and poverty status (Bednarczyk et al., 2014). The researchers concluded that more research was needed to explore provider recommendation and sociodemographic factors. The researchers also found that the VFC program may have had a larger impact than previously thought as all adolescents below the poverty level were consistently higher initiators for the HPV vaccine series (Bednarczyk et al., 2014).

My study overcame the limits of previous studies by analyzing maternal income defined by postal code. Unlike the study by Musto et al. (2013) which used an area-based material deprivation index, this study established maternal SES by reported income within the boundaries of the postal codes of the participants. This method may provide evidence of a maternal influence on the uptake of the HPV vaccine series based on maternal income, a limitation found in the study by Musto et al. (2013). Additionally, this

study evaluated all postal codes within the Columbus, Ohio metropolis and provided a broader, temporal, and more complete evidence of an association between maternal income and uptake of the HPV vaccine series. My research examined maternal income in an ordinal fashion based on the responses on the 2014 NIS-Teen survey. By analyzing a broader range of maternal income and HPV uptake, this study overcomes the limitations of Millen et al. (2009) and Btoush et al. (2015) which examined communities of higher or lower income only. By examining more than only the polar extremes of income across communities in the same region, there may be some valuable associations with maternal income found that could enhance future HPV vaccine series intervention programs. Lastly, this was a secondary data research conducted by using responses from the 2014 NIS-Teen. There were no limitations associated with the reviewing medical records of a particular facility. As part of the NIS-Teen Survey, permission was obtained from parents to survey the primary provider's vaccination records, and NIS-Teen researchers had verified the vaccine administration, thus minimizing the risk of recall bias from parents on when and if their children received the HPV vaccine.

Maternal Education

Knowledge is a modifying factor of the HBM as knowledge can moderate individual beliefs as well as health literacy (Phelan & Link, 2013; Skinner, Tiro, & Champion, 2015). Health literacy can decrease the asymmetry of information given through access to care thus influencing the avoidance of disease (Phelan & Link, 2013). The following publications show some contradictory evidence of maternal education and uptake of the HPV vaccine series. My study analyzed maternal knowledge as the variable

maternal education as reported on the 2014 NIS-Teen to explore for an association with HPV vaccine series uptake.

Dorell et al. (2014) conducted research using the NIS-Teen data to correlate parents who refuse or delay the HPV vaccine series for their children with other vaccinations compared to parents who do not refuse or delay HPV vaccination. The researchers used the parental attitudes module of the 2010 NIS-Teen survey which included 1808 completed household interviews (Dorell et al., 2014). The researchers separated the respondents into four groups based on answers about delaying or refusing the HPV vaccination. The results showed that 10% delayed only 16.6% refused only, and 3.4% both delayed and refused (Dorell et al., 2014). The females in the delayed only group tended to be White, from higher income homes and have mothers with college degrees (Dorell et al., 2014). The major rationale for delaying or refusing the HPV vaccination found through the analysis of the responses was related to knowledge or vaccine necessity, vaccine safety, and access (Dorell et al., 2014). The research had some limitations related to the random digit dialing aspect of the survey, and it was limited to households with landlines. The study also had the risk of non-response bias, parental recall, and incomplete vaccination records may also have affected the outcome (Dorell et al., 2014). The researchers concluded that parental education about HPV might help improve acceptance of the vaccine.

Additionally, Feiring et al. (2015) studied the parental influence on HPV vaccine in Norway. In this research, the researchers examined parental education and income as a factor in the uptake of the HPV vaccine. The researchers used a national immunization

registry to study the uptake of the HPV vaccine and the income and education of parents of adolescent females. Norway offered the HPV vaccine to the public free of charge to all 12-year-old females since 2009 (Feiring et al., 2015). The researchers found an association with high maternal education with a lower probability of initiation of the vaccine series whereas lower education was associated was associated with the higher likelihood of the initiation of the vaccine series (Feiring et al., 2015). Conversely, high maternal income was found to be significantly associated with a higher probability of initiating the HPV vaccine than lower maternal income (Feiring et al., 2015). Paternal income and education were found to have the same associations with HPV vaccine initiation, but weaker association than of the mothers (Feiring et al., 2015). The researchers concluded that more research was needed to determine the factors responsible for the socioeconomic differences so that interventions could target these differences (Feiring et al., 2015). The limitations of this study included incomplete information on vaccinations, income and immigrant education obtained abroad may not be as precisely accounted for in the survey and may have affected results (Feiring et al., 2015). The strength of the study was that it was a national registry covering the entire population of Norway limiting selection bias (Feiring et al., 2015).

The previous studies showed an inverse association with education and acceptance of the vaccine, but the research by Feiring et al. (2015) reinforced the association between increased income and the uptake of the HPV vaccine while the study by Dorell et al. (2014) showed the opposite. The following studies showed a different association in regards to education and the uptake of the HPV vaccine. Yu et al. (2016)

examined the awareness, knowledge, and acceptability of the HPV vaccine in mothers of teenage daughters in Shandong, China. The goal to study was to examine the variables of awareness, knowledge, and acceptability of the vaccine in preparation for the introduction of the HPV vaccine rollout in China. The researchers wanted to gather information on attitudes regarding the HPV vaccine to provide evidence to inform health educators and improve programs targeting this population. Researchers used a cross-sectional approach using self-administered surveys on a population of 1850 mothers who had daughters aged 9 to 17 attending schools in the region of Weihai, Shandong, China (Yu et al., 2016). Researchers used 12 public schools grouped by school level and location for the research. The mothers were asked to complete the survey of which researchers collected 1592 surveys. Researchers excluded 14 questionnaires related to logic errors for a total of 1578 mothers, 85.3% of those initially invited finished the study (Yu et al., 2016). The findings of the research showed that 19.33% were aware of HPV before the investigation n=305 (Yu et al., 2016). For the mothers who were aware of HPV, 14.75% had no knowledge 58.69 % had low knowledge and 26.56% at higher knowledge (Yu et al., 2016). Additionally, 26.49% mothers voiced a willingness to accept the vaccination for their daughters n= 418. The authors used Chi-square tests for analysis and identified five variables that were significantly associated with the acceptance of the HPV vaccine. These areas found to be associated with acceptance of the vaccine were daughter's age, maternal education, maternal occupation, household income, and knowledge level (Yu et al., 2016). There was increased vaccine acceptability associated with older daughters, higher income, and knowledge score (Yu et al., 2016).

The prevalent reasons for the refusal of the HPV vaccination were that mothers felt their daughters were too young to have the risk of cervical cancer (30.95%); not sure about the use of a new vaccine on their daughters (24.91%); and worried about the safety of the vaccine (22.85%) (Yu et al., 2016). The limitations of the research were that the research was conducted and in an economically developed city in China, and not a multi-center study (Yu et al., 2016). Additionally, there was potential for response bias as the survey was completed by the mothers who may have been influenced to give socially desirable responses (Yu et al., 2016). The researchers concluded with the recommendation for the prioritization of education to raise awareness and knowledge about HPV and the HPV vaccine. As evidenced by the research, decreased knowledge was associated with poor acceptance of HPV vaccination which was contrary to the research in Norway which higher education was associated with decreased acceptance. However, the HPV vaccine in Norway was available at the time of the study whereas the HPV vaccine was unavailable in China and the research may not reflect the intentions of mothers once it is available in China.

Researchers in Botswana conducted a cross-sectional survey on the HPV vaccine with adults recruited from general medicine and HIV clinics in the capital of Botswana. The goal of the researchers was to study the intentions of parents and adults to get the HPV vaccine for their adolescent daughters. There were 376 participants in the study and the researchers reported that 77% of the respondents were female, and their median age was 37 years old (DiAngi, Panozzo, Ramogola-Masire, Steenhoff, & Brewer, 2011). The participants had varying levels of education. 31% of participants completed up to primary

school level (6th grade), 41% of the participants have a secondary school education (high school), and 28% of the participants had a tertiary education or above (DiAngi et al., 2011). The income of the respondents showed that many of the participants were poor. Many of the interviewees had no regular income (48%) or made less than 360 U.S. dollars a month (29%). Geographically, over two-thirds (65%) of the participants reported living within 30 kilometers of the capital. 83% of the respondents had children, and 77% of the children of the participants had one or more daughters (DiAngi et al., 2011). The results of the survey showed that in the population surveyed only 9% had ever heard of the HPV vaccine before the study (DiAngi et al., 2011). Additionally, 88% of the respondents said that they would definitely vaccinate their daughter, and they were more likely to vaccinate if they had a lower education level or if they lived more than 30 kilometers outside the capital (DiAngi et al., 2011). The researchers concluded that providing more information about HPV and a widely available HPV vaccine while minimizing barriers would improve uptake in Botswana (DiAngi et al., 2011). The limitations of the study were centered on the convenience sample of participants from adults with health care access, and the oversampling of HIV-positive patients in the sample may have confounded the results (DiAngi et al., 2011).

In South Africa, researchers studied the acceptability of the HPV vaccine in educated participants attending a masters-level program in KwaZulu-Natal South Africa. A cross-sectional self-administered anonymous survey was conducted on 146 participants to test their knowledge of HPV and cervical cancer and whether they would accept the HPV vaccination for their daughters. The researchers found that in this group that 74%

had heard of cervical cancer, but only 26.2% had ever heard of HPV (Hoque & Van Hal, 2014). The participants, after reading the information sheet on HPV and cervical cancer, the intention to vaccinate their daughters increased from 88% to 97.2% (Hoque & Van Hal, 2014). The majority of those surveyed (75.4%) believed that the vaccination should be given before their daughters were aware of sexual activity (Hoque & Van Hal, 2014). The group that declined to vaccinate tended to want more information on the safety of the vaccination. The limitations of the study are that it only surveyed one university and because of the education level of the participants, the results cannot be generalized to a larger population (Hoque & Van Hal, 2014). A strength of the study was that the participants, masters-level candidates and future leaders in their perspective fields, could initiate societal changes through their leadership and knowledge of HPV and cervical cancer (Hoque & Van Hal, 2014).

Markovitz, Song, Paustian, and El Reda (2014) also found that higher household education was positively associated with both initiation and completion of the HPV vaccination series but that higher household income was only positively associated with completion. This discovery was noted during research of an association between maternal preventive care utilization and HPV vaccine uptake by their adolescent daughters (Markovitz et al., 2014).

My analysis of maternal education could contribute to previous research and help deconflict some of the findings found in the past. This study could overcome some limits of previous studies by showing maternal income across the population defined by postal code. Additionally, because this research was on populations in areas within the same

metropolis, there may be some association with HPV vaccination uptake and maternal education based on the community surveyed because secondary education i.e. beyond high school education was not based on postal code, and the overlap of education and community could show a tendency with HPV uptake. Unlike the study by Dorell et al. 2014), my research attempted to show an association with maternal education and uptake across a defined area. My use of this method might provide some clearer evidence of a correlation between maternal education and community influence based on postal code and uptake of the HPV vaccine series. Feiring et al. (2015) researched a nationwide database for a correlation between education, income, and uptake of the HPV vaccine series. A major limitation in this research was incomplete vaccination information. My research uses the 2014 NIS-Teen which allows researchers to query participants' vaccination prescribers to verify vaccination information. Additionally, my research uses the HBM methodology and examines maternal tendencies delineated by maternal income delineated by postal code to search for an association between these variables.

Maternal Age

Maternal age could be a significant factor in the mother's decision-making process for the acceptance of HPV vaccine series in adolescent males and females. There were no studies found that directly examined this phenomenon, but the variable was discussed in a study conducted in Tanzania. Watson-Jones et al. (2012) conducted a case-control study of the characteristics of the receivers and non-receivers of the HPV vaccination in Tanzania as well as their rationale for not taking the vaccination. Researchers utilized a randomized trial of HPV vaccinations in 134 primary schools.

Researchers randomized 67 of the schools to an age-based strategy and the other 67 to a school-based strategy. A sample of 250 females who did not take the vaccine (cases) was compared to a sample of 250 females who did receive the vaccine (controls). An analysis of the responses the researchers determined that 53% did not get a dose of the vaccine because they were absent from school on vaccination day, 40% because a parent refused, and 1% because the girl refused (Watson-Jones et al., 2012). For the parent group that received the vaccination, the common reasons for accepting the vaccination was protection from cervical cancer (89%), health benefits (22%), and knowing someone who had cancer (13%) (Watson-Jones et al., 2012). For the pupil group that received the vaccination, the common reasons for accepting the vaccination was protection from cervical cancer (91%), health benefits (24%), and parental wishes (21%) (Watson-Jones et al., 2012). For the parent group that did not agree to the vaccination of their daughters, the common reasons for not accepting the vaccination was concern over side effects (40%), infertility (23%), or insufficient knowledge about the vaccine (22%) (Watson-Jones et al., 2012). For pupil group that had not received the vaccination, the common reasons for not accepting the vaccination was absent from school on vaccination day (33%), both parents refused (24%), and concerns about side effects (22%) (Watson-Jones et al., 2012). Further analysis of parents who refused vaccination of their daughters showed a tendency to be older household members with less education (Watson-Jones et al., 2012). In conclusion, Watson-Jones et al. (2012) recommended that sensitization messages targeted at older and poor parents are crucial for vaccine acceptance in Tanzania. The limitations of the study were related to potential selection bias as 60%

cases responded to the survey compared to more than 80% of the controls. This deficiency could confound results and might not be representative of the non-receivers of the HPV vaccine series.

Maternal age has not been adequately researched in recent literature. My study provided new information about tendencies of the acceptance of the HPV vaccine and mothers based on their age. This new information could provide insight for future researchers to tailor interventions that target mothers of adolescent children to increase HPV vaccination acceptance. Since this research was from secondary data obtained from the 2014 NIS-Teen Survey, the limitation of selection bias seen in the study by Watson-Jones et al. (2012) would not be a constraint because of the random digit dialing method used to recruit participants of the survey.

Ethnicity

Blackman et al. (2013) compared and contrasted the knowledge and attitudes toward the HPV and the vaccine within different cultures of African descent. The researchers conducted a cross-sectional survey of African-Americans and Afro-Caribbean's living in the US and the Bahamas. The evidence indicated that there was a significant difference between the two countries in knowledge about HPV and the HPV vaccine. People from the Bahamas were significantly less knowledgeable about HPV and the vaccine than African-Americans residing in the United States (Blackman et al., 2013). Attitudes related to the vaccine were similar although Bahamians tended not to support vaccination without parental consent versus African-Americans (80% to 57%) (Blackman et al., 2013). Limitations of this study included a low response rate from Bahamian

parents on the rationale for the unwillingness to vaccinate their children compared to the replies from African-Americans (Blackman et al., 2013). Luque, Raychowdhury, and Weaver (2012) examined the provider's perspectives of the VFC program for Hispanics in rural Southern Georgia. The researchers performed structured interviews with providers and focus groups with parents of Hispanic immigrant's parents to understand from the provider's perspective the barriers to access and compliance of the HPV vaccine. There were two focus groups of parents of females aged 9 to 18 years with mothers and fathers in separate panels. Predominate barriers gathered from VFC providers were related to: (1) low English proficiency of the parents; (2) Medicaid reimbursement shortfalls; (3) mobile population creating difficulty completing a 3-dose series over a 6-month span of time; (4) lack of transportation access; and (5) lack of knowledge of the HPV vaccine (Luque et al., 2012). The limitations of the study include a small sample size of parents for recruitment related to immigration status and Georgia's immigration law, and a media-driven controversy surrounding the HPV vaccine (Luque et al., 2012). There were also limitations in the recruitment of VFC providers related to contractual limitations on research participation (Luque et al., 2012). Ultimately, the researchers concluded that inadequate insurance coverage by the VFC program was a major barrier for not vaccinating adolescents with the additional reluctance to discuss sexuality and lack of education about HPV and the vaccine (Luque et al., 2012). Kumar and Whynes (2011) researched for an association between uptake, deprivation and ethnic background that had been established in pilot research. Based on national immunization programs in England, the HPV vaccine rates across the country were inconsistent and

varied by location, and the researchers sought to identify the factors explaining the variation (Kumar & Whynes, 2011). The researchers analyzed published data of HPV vaccination uptake, material deprivation, ethnic compositions of the different localities, primary care access, and quality, and preventative services such as usage of cervical screening and childhood immunization services. The analysis showed that ethnicity was associated with attitudes towards cervical screening and other childhood vaccinations while material deprivation and access to quality care were not significant (Kumar & Whynes, 2011). The researchers found that ethnicity, childhood immunizations, and usage of preventive and primary care and cervical screening were predictive of the uptake of the HPV vaccine (Kumar & Whynes, 2011). The researchers also found an association with increased material deprivation independent of race and lower access to quality care with the decreased uptake of the HPV vaccine. The limitations of the study were related to the data only tracked the first two doses of the HPV vaccine and the unavailability of the data to the boundaries within the localities researched (Kumar & Whynes, 2011). Lechuga, Swain, and Weinhardt (2011) performed a generalizability study to investigate the strongest predictors of the mother's intentions to vaccinate their daughters across three cultural groups: Hispanic, non-Hispanic White and African American. The researchers recruited a convenience sample of 150 mothers, 50 from each cultural group from public health clinics in Milwaukee, Wisconsin and assessed their personal and normative predictors of intentions to vaccinate their daughters (Lechuga et al., 2011). The convenience sample of 150 mothers was drawn from Women Infant and Children (WIC) federal program clinics at one of the four clinics in the Milwaukee, Wisconsin

metropolis. The research results indicated that the predictors of HPV vaccine intentions varied by cultural group and that culture moderated the influence of norms on intentions (Lechuga et al., 2011). Additionally, researchers discovered that in their attempt to control for demographic differences through the recruitment of mothers enrolled in the WIC program, that there was a significant amount of variability in insurance status (Lechuga et al., 2011). Hispanic mothers in the study were more likely to be uninsured and only have a high school education compared to both White and African American mothers (Lechuga et al., 2011). The perceptions about the vaccine varied based on each cultural group. For example, the non-Hispanic White mothers had the perception at the vaccine would lead to increased sexual risk-taking, African American mothers believed that the vaccine would cause a decrease in protective behaviors such as screening (Lechuga et al., 2011). Hispanic mothers were more influenced by social norms as it was a significant contributor to health decision-making (Lechuga et al., 2011). The limitations of the research stem from the use of a small convenience sample, thus limiting the generalizability of the results. Additionally, the varying levels of health insurance and education within the small sample of mothers may have confounded the results. Lastly, the intention to vaccinate was researched, not the initiation and completion of the HPV vaccination series (Lechuga et al., 2011).

As noted above, there was much research on racial differences and HPV vaccine series uptake. My research overcame some limitations of previous research because it was examining a cross-section of populations defined not by race or ethnicity, but socioeconomic status. Previous studies such as Blackman et al. (2013) and Luque,

Raychowdhury, and Weaver, (2012) examined specific ethnic groups for an association with HPV vaccine uptake. My study does not specifically seek racial or ethnic groups, but all social demographics confined to individual postal codes defined by maternal income in Columbus, Ohio. My research might add new information to the field concerning maternal influence via SES, regardless of race or ethnicity, and the uptake of the HPV vaccine series.

Decisional Influences

The overall premise of the HBM was that people are likely to adopt a health protective behavior if they believe: that they are susceptible to disease or condition; the condition could have serious consequences; the remedy for the problem could eliminate or reduce the susceptibility or severity of the problem; there are benefits to taking action; and that the perceived costs are outweighed by the benefit of the action (Skinner et al., 2015). These beliefs, shaped by modifying factors such as age, gender, ethnicity, personality, socioeconomics, and knowledge may moderate an individual's beliefs and subsequent actions (Skinner et al., 2015). The constructs of the HBM collectively affect behaviors, but precise relationships, weighting, or the combination of variables cannot be delineated into action in the individual (Skinner et al., 2015). In adult women under 26 years of age, the decision to initiate the HPV vaccination series depends on their personal choice to get the immunization. The forces that influence initiation or rejection of the vaccination series vary person to person but have been studied by several researchers. Harper et al. (2014) studied decisional satisfaction associated with HPV vaccination. Researchers performed a prospective survey of urban college women aged 18 to 26 years

old about their HPV vaccination experience. The result of the study showed personal satisfaction was very high regardless of the participant's decision to accept or reject the vaccination (Harper et al., 2014). There was variance in the initiation of the vaccine based on perceived value of the vaccination by the participants. Participants who saw the value of the vaccination as a method to prevent cervical cancer were more significantly associated uptake than those who perceived the vaccination as a preventive measure for genital warts (Harper et al., 2014). Additionally, the authors concluded that based the participant's responses targeting those who are neutral to HPV vaccination are a more effective group to engage than those with high satisfaction to reject vaccination (Harper et al., 2014). The limitations of the research are related to half the population had already made a choice to receive at least one dose of the HPV vaccine series (Harper et al., 2014). Additionally, within the decisional framework of the study, the researchers did not offer the choice of no vaccination to the participants, so it was unknown how not having that option might affect the results (Harper et al., 2014).

Knowledge and awareness of a disease process can influence parental choices to vaccinate their children. Trim et al. (2011) conducted a systematic review of critical surveys about HPV to understand how knowledge, attitudes, and behaviors were influenced before and after the FDA release of HPV vaccination. The authors compared the findings of previous research which studied parental knowledge attitudes and behaviors towards the HPV vaccine. Additionally, the authors studied the factors that influenced the decision to vaccinate their children. The authors used published articles printed between the years 2001 and 2011. The findings from the research showed some

knowledge trends that changed throughout the study. Researchers found that parental awareness of HPV increased in 2008 and 2009. Parental awareness of the HPV vaccine increased in 2007 from 14% aware of the HPV vaccine in 2006 to 59% aware of the HPV vaccine in 2007 and awareness continued to rise into 2008, but dropped slightly by 2010 (Trim et al., 2011). Behavior trends also fluctuated during the study as parents began vaccinating their children after the 2006 release of the quadrivalent HPV vaccine, reaching its peak in 2009 and 2010. For attitude trends, the highest percentage of parents who intended to vaccinate their children peaked at 86% in 2005, the year before the HPV vaccine release (Trim et al., 2011). Parental intent to vaccinate their children gradually rose from 67% in 2007, and 80% 2008, but declined slightly over the last three years of the study (Trim et al., 2011). There were also barriers for parents to accept the HPV vaccine for their children. Parental knowledge of the HPV vaccine was a significant factor in the acceptance of the vaccine for their children. In the review of the research, the authors found evidence that in 37% of the studies reviewed, concerns about the safety of the HPV vaccine were the parent's primary barrier with additional concerns about the potential for side effects (Trim et al., 2011). Parents wanted more information to make an informed decision was cited in 25% of the studies from the analysis. Conversely, parents who were concerned about the risk of cancer in their child were more likely to accept the HPV vaccination for their child (Trim et al., 2011). Parents differed in their attitudes on when the vaccine should be given. In 19% of the studies reviewed by the researchers showed a trend not to vaccinate if the parent believed that their child was too young for the HPV vaccination (Trim et al., 2011). Earlier initiation to sex in adolescents related to

the HPV vaccine was also a barrier for parents. In 25% of the studies, researchers examined parental concerns about increased risky sexual behaviors in adolescents after vaccination (Trim et al., 2011). Research performed by Smith, Kaufman, Strumpf, and Lévesque (2015) and Zimet et al. (2013) included in the review showed no evidence of increased sexuality post-HPV vaccination. The strengths of the research were that it included the knowledge, attitudes, and behaviors from a large number of parents from several countries (Trim et al., 2011). The limitation of the research was the lack of the ability to validate parental responses (Trim et al., 2011). The authors concluded based on their analysis that parents wanted more information and reassurance from their providers that the HPV vaccine was safe to give to their children (Trim et al., 2011). The parental decisional findings by Trim et al. (2011) were similar to the findings of the research conducted by Hofman et al. (2013). Hofman et al. (2013) studied parent's decision-making strategies through focus groups in the Netherlands. The researchers used four focus groups of primarily Dutch parents (one urban and two rural) and one group of Turkish parents, who represented the largest ethnic minority in the Netherlands. All of the parents in each group had at least one daughter between the ages of 8 and 15. The researchers concluded post analysis of the parental responses that many parents felt uneasy about HPV vaccination. The concern was related to the safety and the effectiveness of the HPV vaccine (Hofman et al., 2013). The common theme from the analysis was child protection motivation, and with some of the parents, the motivation was to vaccinate whereas there were also some parents who were motivated to protect their daughter by not vaccinating (Hofman et al., 2013). The strength of the research was

that it provided information about parental attitudes and decisional strategies about HPV uptake before the vaccine was discussed in the media. The limitations of the research were that most of the participants in the focus groups were mothers. The other limitation was related to the sample size of Turkish parents group as there were too few Turkish parents studied to compare to Dutch parents (Hofman et al., 2013).

My research provided new information concerning decisional influences for HPV vaccination based on the responses of parents in communities defined by postal code. The variables of maternal income, maternal education, and maternal age could provide additional insight of the decisional influences of parents in communities of various SES by way of the health belief model. Maternal SES and maternal age could be contributing influences for parent's decisions to vaccinate adolescent males and females with the HPV vaccine based on the core constructs of the health belief model.

Critics and Differing Opinions

Bresse, Goergen, Prager, and Joura (2014) researched the cost effectiveness and health impact of universal vaccination against HPV in Austria. The focus of the study was to note the cost savings of preventing cancers caused by HPV 16/18 in a cohort of 9-year-old males and females (Bresse et al., 2014). The authors concluded that with vaccination, the HPV-related cancer burden would decrease by 71% over 100 years (Bresse et al., 2014). This total includes not only cervical cancers but also anal, penile and oropharyngeal cancers (Bresse et al., 2014). Additionally, Crowcroft et al. (2012) concluded that high vaccine coverage improves communities, reduces absolute risk, and increase equity. Their research computed the comparative risks for invasive cervical

cancer in a population or subgroup before and after the implementation of a vaccination program. A simple static multi-sensitivity analysis was completed to compare the relative risk of HPV infections that would lead to invasive cervical cancers if they were not prevented or detected (Crowcroft et al., 2012). The researchers evaluated 3,793,902 scenarios and in 63.9% of the considered scenarios; HPV vaccination would lead to a better population outcome regardless of the effectiveness of the vaccine (Crowcroft et al., 2012). A limitation in the research by Crowcroft et al. (2012) was not estimating the prior probability distribution for their parameters as Bayesian methods require. A limitation of both these studies was that according to Ruiz et al. (2012) there are other prevalent strains of oncogenic HPV other than HPV 16/18 and would not be covered by the present vaccine. Currently, there are 12 known oncogenic strains of HPV (16/18/31/33/35/39/45/51/52/56/58/59) (Ruiz et al., 2012).

Usage of the HPV vaccine in males has been a recommendation in the United States since 2009, but usage in males had only recently achieved approval in Canada in 2015. The National Advisory Committee on Immunizations in Canada recommended that males aged 9-26 receive the HVP vaccination series (Smith et al., 2015). In 2009, the ACIP recommended that males receive the HPV vaccine aged 9-26 but subsequently modified the initiation age in males to ages 11-26 in 2011 (CDC, 2011). The current recommendation by ACIP for HPV vaccination is routine vaccination at age 11 or 12 years with HPV4 or HPV2 for females and with HPV4 for males; the vaccination series can be started beginning at age nine years (CDC, 2014a). There were additional studies using the NIS-Teen survey data for analysis,

A different approach for the prediction of HPV vaccine uptake was done by (Hechter et al., 2013), who studied the maternal use of preventative care and history of sexually transmitted disease as a predictor of uptake of HPV vaccine in adolescent males. This innovative study linked maternal information with electronic medical records of males aged 9-17 enrolled in a health maintenance organization (HMO) in Southern California. Based on the various criteria conducted during the study, the researchers found some interesting results useful for future research. For example, there was an association between the initiation of HPV vaccine in males if they received the seasonal influenza vaccine (Hechter et al., 2013). Additionally, males whose mothers received Pap testing were more likely to receive the HPV vaccine than males whose mothers without a history of genital papillomatosis were more likely to receive HPV vaccine (Hechter et al., 2013). The authors concluded that maternal use of preventive health services might influence HPV vaccination uptake in males (Hechter et al., 2013). Rahman, Laz, McGrath, and Berenson (2014) found a similar association with the uptake of the HPV vaccination in older adolescent females who received a seasonal influenza vaccination.

Some researchers argued that the disparity of HPV vaccinations may be related to underreporting due to parental recall. Attanasio & McAlpine (2014) implied that parental recall might inaccurately depict HPV uptake rates. The researchers evaluated parental recall of HPV vaccination compared to clinical records while also evaluating social characteristics of the accuracy by the parents surveyed. Researchers used data from the 2009-2010 NIS-Teen. The NIS-Teen survey consists of household interviews and a provider-completed immunization history to compare responses to patient records. The

results showed parental underreporting of HPV uptake associated non-White, lower household income, and lower education attained adolescent mothers (Attanasio & McAlpine, 2014). Limitations of the study were related to the timing of the change the ACIP recommendations for the HPV vaccination for males and the survey depended on households that participated that also had a complete provider report (Attanasio & McAlpine, 2014). This research showed that parental recall might cause a significant limitation in vaccine coverage studies because some parents based on multiple sociodemographic factors underreported the number of HPV vaccinations given to their adolescent teen (Attanasio & McAlpine, 2014).

Malkowski (2014) studied the gender impact of the rollout of the HPV vaccine by Merck Pharmaceuticals in 2006. The initial promotion of Gardasil presented a solution for a woman-only issue despite the evidence that HPV infected both men and women (Malkowski, 2014). The author implied that the initial advertisements for the vaccine focus were not on the soon to be released vaccine nor did it inform the public of anything related to the sexual transmission of HPV (Malkowski, 2014). The second advertisement campaign was more focused on the teenage target audience, this time; the focus of the ad campaign was on the vaccine and the disease without mentioning the mode of transmission of the virus or even the virus itself (Malkowski, 2014). The third advertisement campaign launched four years after the initial advertisement offering, and the target audience was women. Merck used personal testimonies of people infected with HPV a different tactic from previous campaigns where they targeted women not yet exposed to the virus. Women in this campaign were portrayed to be the guardians of

public health despite the fact that HPV virus infects both males and females (Malkowski, 2014). Through analysis of all three campaigns, the researcher concluded that Merck targeted a specific audience and persuaded them to assume a disproportionate burden for a public health problem that affects men and women (Malkowski, 2014). The author recommended a retooling of efforts to deconstruct parts of the message to repackage HPV and the disease process as a more inclusive disease that does not solely place the burden of protection on women (Malkowski, 2014). There are several theories in the field of HPV vaccine uptake research. Most of these theories have been used in research to determine the leading barriers to the uptake of the vaccine (Savoy, 2014). The most common reasons for decreased uptake are knowledge of the vaccine, cost of the vaccine, safety, efficacy, and risks of increased promiscuity. Savoy (2014) theorized that the infrequent visits to the doctor as adolescents than as toddlers for vaccinations to be a possible cause for the lack of vaccinations. Another rationale considered for decreased uptake was the parental fear the vaccination would lead to promiscuity which various researchers have evaluated (Savoy, 2014). Smith, Kaufman, Strumpf, and Lévesque (2015) evaluated a cohort of over 260,000 females and found no evidence of perceived promiscuity based on pregnancy and other sexually transmitted diseases. This study was limited because it only evaluated females up to age 17 and the high attrition rate of the survey as over 131,000 of the returned questionnaires was ineligible for the analysis (Smith et al., 2015). Two years before this research, Zimet, Rosberger, Fisher, Perez, and Stupiansky (2013) also investigated the promiscuity hypothesis and evaluated sexual risk compensation related to HPV vaccination. The researchers reviewed several selected

published behavioral and social science articles on HPV vaccine acceptance and attitudes and found no evidence of increased sexual risk-taking in adolescents taking the vaccine (Zimet et al., 2013). Brown, Blas, Heidari, Carcamo, and Halsey (2013) evaluated changes in sexual behavior and HPV knowledge after an education and vaccination intervention in Peruvian female sex workers. The researchers noted that the participants had a significant decrease in new clients over a 30-day period and utilized at least one preventative strategy against other sexually transmitted infection upon the seven-month follow-up survey (Brown et al., 2013). This evidence was corroborated by Zimet et al. (2013), who came to similar conclusions in a study reviewed that was done on 13 to 21-year-old females. Ruiz et al. (2012) hypothesized that proximity of first sexual experience to menarche or the start of menstruation was associated with increased risk of cervical intraepithelial neoplasia grade 2/3. In their research, they evaluated 1009 Colombian and 1012 Finnish females aged 16 to 23 that enrolled in an HPV vaccination trial that had accurate data concerning the onset of menstruation and their first sexual experience. Of the women included in the study, the statistics showed the mean age of menarche as 12.4 years, and the mean age of first sexual intercourse was 16 years (Ruiz et al., 2012). The results of this study showed that women who had their first sexual intercourse less than three years after menarche had a higher risk of cervical cytological abnormalities compared to women who waited beyond three years after menarche (Ruiz et al., 2012). Ruiz et al. (2012) concluded with the emphasis on the importance of primary prevention through early vaccination and sexual education of adolescent females. The perception of the HPV vaccine contributing to infertility was another hypothesis investigated by

researchers. Schuler, Hanley, and Coyne-Beasley (2014) researched parent's concerns about infertility as a barrier to accepting the HPV vaccine in adolescent males. 39% of respondents reported that they were concerned about vaccine acquired infertility (VAI) (Schuler et al., 2014). Additional analysis showed that this group had no less knowledge than other parents surveyed indicating an increased need for conversations concerning the side effects of the HPV vaccine to parents rather than having parents read the vaccine information sheet (VIS) (Schuler et al., 2014).

This study provided new information that could impact future HPV vaccination interventions. Based on the evidence discussed in the literature above, increasing the uptake of the HPV vaccine series decreases the overall cervical cancer risk. As stated in the research by Crowcroft et al. (2012) high HPV vaccination coverage improves community health, increases equity, and reduces the absolute risk of cervical cancer. This research added additional empirical evidence to support the development of future HPV vaccination intervention programs by way of predicting tendencies of parents of adolescent males and females to vaccinate their children with the HPV vaccine series based on the theoretical concepts of the health belief model. My research enhanced knowledge of decision-making based on maternal income, maternal education, and maternal age.

Definitions

Cervical cancer: A type of cancer that begins in the cells lining the cervix at the lower portion of the uterus (American Cancer Society, Inc., 2014). Cervical cancer is the second most common female cancer worldwide, and there are nearly 500,000 cases per

year contributing to >250,000 deaths each year (Union for International Cancer Control (UICC), 2015).

Human papillomavirus (HPV): Genital HPV is the most common sexually transmitted infection (CDC, 2014c). There are over 100 HPV types identified, and there are more than 40 HPV types that can infect the genital area (Hariri, Dunne, Saraiya, Unger, & Markowitz, 2011). HPV types are classified by their association with cancer. Non-oncogenic or low-risk strains of HPV can cause genital warts while oncogenic or high-risk HPV can cause cervical cancer (Hariri et al., 2011).

HPV vaccine: Two vaccines are available to prevent persistent infection with oncogenic strains of HPV. One vaccine is effective against four HPV strains, two high risk, and two low risk and both vaccines are effective at protecting against the types that cause 70% of cervical cancers (CDC, 2013; U.S. Food and Drug Administration, 2013).

Papanicolaou (Pap) test: A screening test for cervical cancer. The test looks for abnormal cells on your cervix that could potentially turn into cancer. Early identification of cancerous cells can improve the overall success of treatment. All women should start getting regular Pap tests starting at age 21 (Techakehakij & Feldman, 2008).

Gardasil: The first HPV vaccine released in the United States in 2006. Gardasil immunizes against HPV serotypes 6,11, 16 and 18 (U.S. Food and Drug Administration, 2013).

Cervarix: The second HPV vaccine released in the United States in 2009. Cervarix immunizes against HPV serotypes 16 and 18 (CDC, 2010).

Maternal income: The value of the participant's income reported on the NIS-Teen

survey by postal code.

Maternal education: The level of maternal educational reported by the 2014 NIS-Teen survey participants (Centers for Disease Control and Prevention [CDC], National Center for Immunization and Respiratory Diseases [NCIRD}, & National Center for Health Statistics [NCHS], 2015).

Race: The 2014 NIS-Teen Survey defines race as White, Black or African American, American Indian, Alaska Native, Asian, and Native Hawaiian (CDC, NCRID and NCHS, 2015).

Ethnicity: The 2014 NIS-Teen Survey defines ethnicity as participants of Hispanic or non-Hispanic origin (CDC, NCRID & NCHS, 2015).

Assumptions

This study was based on several assumptions. The most critical assumption was that the instrument for data collection is valid and reliable based on the previous use of the survey for HPV vaccination research. The NIS-Teen launched in 2006 provides the most current, household, population-based, state and local area estimates of vaccination coverage among children and teens using a standard survey methodology (CDC, 2016). Additionally, there was the assumption that the random digit dial [RDD] sampling method used to collect the NIS-Teen data resulted in a representative sample of telephone households in Columbus, Ohio metropolitan area. Another assumption was that surveyors collected data in a nonbiased manner and the participants provided the most honest and accurate responses on the survey. The target audience for the NIS-Teen were adolescents 13-17 years living in households in the United States at the time of the survey. Lastly, it

was assumed the questions in the NIS-Teen survey are reliable and valid measures of gathering information. This assumption was based on several years of use by the CDC and in multiple previously published research studies. These assumptions are necessary to conduct this research using this secondary data source. Due to the multiyear collection of data by the National Immunization Survey (NIS), it was assumed that this source of data was valid and reliable to be used in research. These assumptions are critical to the research and to the analysis of the data provided so that conclusions can be made on the population surveyed.

Scope and Delimitations

Scope and Delimitations

This study was limited to the analysis of selected SES variables and uptake of the HPV vaccine series by postal code in the Columbus, Ohio metropolitan area. The findings cannot be generalized to other vaccines. This survey data was limited by information recall of parents who participated in the study. The sample population interviewed for the 2014 NIS-Teen may not be generalizable to other populations. The study did not analyze the variants of insurance coverage plans, or the state-related variances in the VFC although some these variances may affect the conclusions and should be considered for future research. Eligibility of the survey participants was determined by the self-reporting by parents or guardians of adolescent children in the household ages 13-17 years old via random digit dialing phone interviews. The NIS-Teen is a large national representative sample that estimates vaccination coverage for the 50 States (CDC, 2016). Lastly, this research analyzed the responses from participants living

in the Columbus, Ohio metropolitan area and excluded postal codes not associated with this location.

Significance and Potential for Social Change

Significance of Study

The significance of this research was that it could add potentially valuable evidence that could contribute to the improvement of HPV intervention programs based on maternal income and other selected SES variables examined in this study. Potential evidence discovered through this research could enhance future researchers' methodological approach to the implementation of community intervention programs by tailoring HPV vaccination programs to fit selected communities based on maternal income, education, maternal age, and ethnicity. Additionally, evidence found in the analysis could potentially exclude some SES factors that were thought to influence the uptake of the vaccine.

This research is an original contribution to field as there are many research studies published exploring the barriers contributing to the decreased uptake of the HPV vaccine series. None of the published contributions have explored maternal income, maternal education and maternal age by community (defined by postal code) to explore for an association within a community's maternal SES status indicators and uptake of the HPV vaccine series in adolescent females and males ages 13-17.

Social Change

The potential for significant social change related to this study was based on the potential evidence of an association between uptake of the HPV vaccine series and

maternal influences as it relates to measurable maternal SES factors (maternal income and maternal education). Such results of the research could potentially be used to reduce the burden of cervical cancer in women through the enhancement of vaccination programs contributing to the decreased incidence of a significant health disparity for women. As a potential result of this research, more women could live longer and reach their full potential through the improvement and enhancement of HPV vaccine series interventions. Additionally, as a secondary result, this research could potentially change the recommended screening schedule for cervical cancer screening decreasing the frequency of exposure to invasive screening tests. Both men and women are reservoirs for the HPV virus, universal HPV vaccination of all adolescents could lower the incidence of HPV infection in women and the progression to cervical cancer.

Summary

HPV infection is the most common sexually transmitted infection (CDC, 2013). HPV can progress to cervical cancer, and cervical cancer is responsible for over 4,000 deaths in the United States annually and a much higher burden worldwide, especially for developing countries (American Cancer Society, Inc., 2014; Union for International Cancer Control (UICC), 2015). To prevent cervical cancer, the enhancement of HPV vaccination programs to meet the healthy people 2020 goal of 80% HPV infection is critical (Savoy, 2014). HPV infection reduction can be accomplished by the use of Gardasil, which is effective against HPV serotypes 6, 11, 16 and 18, and Cervarix, which protects women from HPV types 16 and 18 (CDC, 2013; U.S. Food and Drug Administration, 2013). The identification of additional barriers to HPV acceptance could

contribute to the continued improvement of vaccine intervention programs. The use of the health belief model as the framework for the study may bring to light additional measures to improve and enhance HPV vaccination programs. This study focused on maternal SES factors by exploring for a correlation based on maternal income, maternal education, as well as the maternal age of the participants through the analysis of the 2014 NIS-Teen survey data.

Conclusion

In conclusion, there was a gap in the literature for research exploring associations between maternal community-level SES influences and the voluntary uptake of the HPV vaccine series. Improving HPV vaccination rates among adolescents ages 13-17 was an issue that must be addressed (Moss et al., 2014). The protection offered by this vaccine can keep women from acquiring strains of oncogenic HPV that account for 70 % of all cervical cancers in the U.S.(Harper et al., 2014). As both men and women are reservoirs for the HPV virus, universal HPV vaccination of all adolescents could lower the incidence of HPV infection and the progression to cervical cancer. The following chapter provided the rationale behind the research design and data collection methods to reinforce the significance and need of this scholarly project.

Section 2: Research Design and Data Collection

Introduction

The purpose of this doctoral study was to assess if there was an association between maternal SES variables of income, education, age, and ethnicity and uptake of the HPV vaccine in adolescent females and males ages 13-17 in Columbus, Ohio. In this section, I explain my research design and the rationale for the choice of design. This section also provides a comprehensive explanation of the methodology used for the study in the event future researchers may want to replicate this research. Next, I elucidate my choice of instrumentation, its purpose, and how I operationalized the constructs. Lastly, I describe threats to validity and ethical procedures, to include the protection of data, and close by summarizing the pertinent details in this section.

Research Design and Rationale

This was a cross-sectional quantitative observational research study in which I explored associations between maternal socioeconomic influences based on income and education and uptake of the HPV vaccine series. Additional analyses covered the association between maternal age and ethnicity. The dependent variable in this study was uptake of the HPV vaccine series, which I defined as a dichotomous (yes/no) response to whether the adolescent (male or female) received at least one dose of the vaccine. The four independent variables were maternal income, maternal education, maternal age, and ethnicity. The first independent variable, maternal income, was defined as the income reported by the respondents living within a certain postal code within the Columbus, Ohio metropolitan area. The second independent variable, maternal education, was

defined by the highest level of education reported by the mother divided into the following categories: no high school diploma; high school graduate or GED; completed a vocational, trade, or business school program; some college credit but no degree; associate degree (AA, AS); bachelor's degree (BA, BS, AB); master's degree (MA, MS, MSW, MBA); and doctorate (PhD, EDD) or professional degree (MD, DDS, DVM, JD). The third independent variable, maternal age, was defined by the mother's age at the time of survey completion divided into the following categories: 18-22, 23-27, 28-31, 31-36, 37-41, 42-45, and 46 and above. Ethnicity was measured by the following six categories: White, Black/African-American, Native American, Asian, Native Hawaiian, and Pacific Islander.

I chose a cross-sectional research design for this study. Cross-sectional design is the predominate method for survey research and can be used sufficiently to examine associations between properties and dispositions (Frankfort-Nachmias & Nachimas, 2008). There were no time or resource constraints related to using a cross-sectional design approach, as the data analyzed was from a secondary analysis of the 2014 NIS-Teen survey. Cross-sectional design was an optimal choice for this study as it allowed an analysis of the dependent variables, uptake of the HPV vaccine series with multiple independent variables, maternal income, maternal education and maternal age. By using the cross-sectional design, the findings could be helpful in predicting outcomes based on the SES variables analyzed in the study. The information gathered could enhance intervention strategies based on any discoveries noted from the analysis of the SES variables. A cross-sectional design was the best option because I was trying to elicit a

pattern of a relationship between the SES variables and uptake of the HPV vaccine series.

The statistical plan for my study was multiple logistical regression, which is used when there is one categorical dependent variable and two or more independent variables (McDonald, 2014). I chose multiple logistic regression because of its appropriateness for seeking a functional association between the independent variables and the dependent variable. This statistical plan can be used to predict probabilities of an effect of multiple independent variables on a categorical dichotomous dependent variable and in some circumstances can be used to make inferences about which independent variables have a larger effect on or stronger association with the dependent variable (McDonald, 2014).

Methodology

In this section, I describe how I performed the research by defining the study population, sampling techniques, access to secondary data, instrumentation, operationalization of constructs, threats to validity, and ethical considerations.

Study Population

Columbus is the capital of the State of Ohio. The population of Columbus is approximately 850,106 (Department of Commerce, 2016b). The target population for the study was parents or guardians of adolescent teens who participated in the 2014 NIS-Teen survey and live in the Columbus, Ohio metropolitan area. Since the participants of the survey are asked specifically about HPV vaccine series uptake, I included all participants of the survey who live in the geographic region when conducting the analysis of the data. The sample size needed to be at least 1188 participants based on the calculations using G*Power 3.1 Statistical Power Analysis for a logistic regression two-

tailed analysis with 0.95 power (1-β err prob; Faul et al., 2007). Optimally, if participants resided across different postal codes, comparing uptake of the HPV vaccine series among multiple SES variables would have improved the analysis. The target population for the 2014 NIS-Teen was adolescents aged 13–17 years living in non-institutionalized households in the United States at the time of the interview (CDC, 2015b). Researchers conduct the 2014 NIS-Teen concurrently with the 2014 NIS. The 2014 NIS-Teen identified households containing one or more adolescents who was 13-17 years of age at the time of the survey. Interviews were conducted with the household adults who were the most knowledgeable about the teenager's record of vaccinations (CDC, 2015b). Upon completion of the survey and after obtaining consent from the parent or guardians of the teenagers surveyed, the 2014 NIS-Teen surveyors also contacted the teenager's vaccination providers to request information on their vaccination records (CDC, 2015b).

The criteria for inclusion in this research study were as follows:

- Being an adolescent male or female between 13-17 years of age by the time of the interview in 2014,
- Live in one of the Columbus, Ohio metropolitan postal codes
- The first HPV shot was received between 9 -17 years of age.

The ACIP recommends routine vaccination at age 11 or 12 years with HPV4 or HPV2 for females and with HPV4 for males, although the vaccination series can be started as early as age 9 (CDC, 2014b). For those unvaccinated at the routine age, the vaccine is recommended for males aged 13 through 21 years and females aged 13 through 26 years who have not been vaccinated previously or who have not completed

the 3-dose series (CDC, 2014b).

Sampling and Sampling Procedures

The 2014 NIS -Teen Survey was used by surveyors to collect data from households with adolescents 13-17 years and the teens' vaccination providers (CDC, 2015). The NIS-Teen survey was conducted in two parts. The first part of the survey was the random-digit-dialing (RDD) telephone survey of parents and guardians of randomly selected households in all 50 states and the District of Columbia and the second part of the survey was the survey of the teen's vaccination providers (CDC, 2015). The NIS-Teen surveyors obtained the consent to survey from the parents or guardians of eligible teenagers so that contact could be made with their vaccination providers (CDC, 2015). Researchers mailed a survey questionnaire to participants' vaccine providers to perform a check of their medical records (CDC, 2016). The goal of the mail survey of vaccination providers was to confirm the accuracy and recall from the parents as compared to the actual vaccination records and to assure the accuracy and precision of overall vaccination coverage estimate (CDC, 2015c). The 2014 NIS-Teen survey included 59 geographic strata for which vaccination coverage levels could be estimated, including seven mostly urban cities and county areas (including the District of Columbia). Lastly, the remaining 52 estimation areas were either entire states or territories (including U.S. Virgin Islands and Guam) or "rest of state" areas (CDC, NCRID & NCHS, 2015). According to CDC, NCRID and NCHS (2015), this design makes it feasible to produce yearly predictions of vaccine coverage levels for each state or territory (including U.S. Virgin Islands and Guam) and for each of the seven sub-state estimation areas with a specified degree of

precision (a coefficient of variation of approximately 7.5%). Additionally, using the same data collection methods and survey instruments researchers use the NIS-Teen to produce results that are comparable to predict vaccination coverage levels among estimation areas and through subsequent years (CDC, NCRID & NCHS, 2015). However, on the 2014 NIS-Teen survey, there was a change of the definition of adequate provider data (Reagan-Steiner et al., 2015). As of 2014 on the NIS-Teen survey, adequate provider data was achieved if the adolescent had vaccination history data from one or more of the named vaccination providers or if the parent reported that the adolescent was completely unvaccinated (Reagan-Steiner et al., 2015). Prior to 2014, there were more criteria associated with the definition of adequate provider data, and it was based on a comparison between provider reports of vaccination history and parental reports of vaccination history, either by shot record report or recall (Reagan-Steiner et al., 2015). This change means that future studies using the NIS-Teen survey data cannot be compared to the previously published vaccine coverage estimates (Reagan-Steiner et al., 2015).

Access to Secondary Data

The procedure to gain access to the 2014 NIS-Teen data was detailed at the CDC website. The 2014 NIS-Teen public-use secondary dataset can be downloaded from this website. In addition to the 2014 NIS-Teen dataset, users can download other pertinent documents such as the readme file, data user's guide, household interview questionnaire, provider-immunization history questionnaire data documentation, codebook and frequencies, SAS input statements, and R Input Statements (CDC, NCRID & NCHS,

2015).

Permissions to use the 2014 NIS-Teen are clarified in the readme file. The permissions for the use of data was strictly used only for the purpose of health statistical reporting and analysis and any attempts to ascertain the identities of the participants were prohibited by law (CDC, NCRID & NCHS, 2015). To comply with permissions for the usage of the 2014 NIS-Teen, users of the data must be in compliance with the following:

1. Use the data in these data files for statistical reporting and analysis only.
2. Make no use of the identity of any person or establishment discovered inadvertently and advise the Director, NCHS, of any such discovery (301-458-4500)
3. Not link these data files with individually identifiable data from other NCHS or non-NCHS data files (CDC, NCRID & NCHS, 2015).

Instrumentation and Operationalization of Constructs

Instrumentation

The NIS-Teen was launched in 2006. The target population for the NIS-Teen was adolescents 13-17 years living in the United States at the time of the interview (CDC, 2015b). The NIS, developed in 1994 are a group of phone surveys used to monitor vaccination coverage among children 19-35 months, teens 13-17 years, and flu vaccinations for children 6 months-17 years (CDC, 2015b). The first NIS survey began in April 1994 to examine vaccination coverage in the United States after measles outbreaks in the early 1990s (CDC, 2015b). Researchers at the NCIRD of the CDC developed the NIS by using a culmination of research experience using several different survey

methodologies (Zell et al., 2000). The NIS is an annual survey designed to provide current and continuous estimates of vaccine coverage, provide reliable and valid estimates of vaccination coverage in 78 separate areas (all 50 states, the District of Columbia and 27 urban areas considered to be at risk of under-vaccination), provide timely estimates, and produce estimates using reasonable resources (Zell et al., 2000).

Operationalization

Uptake of the HPV vaccine series: A person's receiving one or more vaccinations of the HPV vaccine series. This was the dependent variable. Based on the ACIP recommendation, all participants of the HPV vaccination series are eligible to accept the vaccine at 11-12 years of age but can be given as early as age 9 (CDC, 2014b). The recommended age of initiation of the vaccine is well within the parameters of the NIS-teen survey which gathers data of adolescents aged 13-17.

Maternal income: The household income reported based on the postal code of the survey participants. Maternal income was measured by the income reported income per postal code on the 2014 NIS-Teen survey. Maternal educational is measured by the reported level of maternal educational reported during the survey by postal code.

Maternal education: The level of maternal education based on the postal code of the survey participants, defined by the highest level of education attained, separated into the following categories: no high school diploma; high school graduate or GED; completed a vocational, trade, or business school program; some college credit but no degree; associate degree (AA, AS); bachelor's degree (BA, BS, AB); master's degree

(MA, MS, MSW, MBA); and doctorate (PhD, EDD) or professional degree (MD, DDS, DVM, JD).

Maternal age: The age of the mother at the time of survey participation. Maternal age was measured by dividing the mothers' age into the following groups: less than 25 years old, 25-34 years old, 35-44 years and 45+ years old.

Ethnicity: The grouping of the major divisions of humankind, having distinct physical characteristics. Ethnicity was measured by dividing participants into the following six categories: White, Black/African-American, Native American, Asian, Native Hawaiian, and Pacific Islander.

Data Analysis Plan

I analyzed the 2014 NIS-Teen secondary data using SPSS® version 21 (IBM Corp., 2016). I validated the analyses using the built-in validation functions in SPSS® v.21. I conducted simple descriptive analyses of the variables. I recoded the identified variables, categorized and manipulated them to fit the variables in line with the research questions. I conducted normality testing and performed binary analyses, bivariate analysis, followed by multiple logistic regression using SPSS® on the independent variables to search for statistically significant associations with the dependent variable.

Research Question(s) and Hypotheses

The objective of this research study was to explore the association between maternal SES and uptake of the HPV vaccine series. The research questions are as follows:

Q1: what is the association between maternal income and uptake of the HPV

vaccine series in adolescent males and females 13-17 in communities with postal codes in the Columbus, Ohio metropolis?

H_O: there is no association exists between maternal income and uptake of the HPV vaccine series in adolescent males and females 13-17 after controlling for ethnicity and maternal age based on postal codes in Columbus, Ohio.

H_A: There is an association exists between maternal income and uptake of the HPV vaccine series in adolescent males and females 13-17 after controlling for ethnicity and maternal age based on postal codes in Columbus, Ohio.

Q2: What is the association between maternal education and uptake of the HPV vaccine series in adolescent males and females 13-17 in the postal codes within the Columbus, Ohio metropolis?

H_O: There is no association between maternal education and uptake of the HPV vaccine series in adolescent males and females 13-17 in the postal codes within the Columbus, Ohio metropolis

H_A: There is an association between maternal education and uptake of the HPV vaccine series in adolescent males and females 13-17 in the postal codes within the Columbus, Ohio metropolis.

Q3: What is the association between maternal age and uptake of the HPV vaccine series in adolescent males and females 13-17 in communities with postal codes in the Columbus, Ohio metropolis?

H_O: There is no association between maternal age and uptake of the HPV vaccine series in adolescent males and females 13-17 in communities with postal codes in the

Columbus, Ohio metropolis

H_A: There is an association between maternal age and uptake of the HPV vaccine series in adolescent males and females 13-17 in communities with postal codes in the Columbus, Ohio metropolis.

Q4: What is the association between ethnicity and uptake of the HPV vaccine series in adolescent males and females 13-17 in the postal codes within the Columbus, Ohio metropolis?

H_O: There is no association between ethnicity and uptake of the HPV vaccine series in adolescent males and females 13-17 in the postal codes within the Columbus, Ohio metropolis.

H_A: There is an association between ethnicity and uptake of the HPV vaccine series in adolescent males and females 13-17 in the postal codes within the Columbus, Ohio metropolis.

A cross-sectional design study using multiple logistical regression analysis was performed to predict the most parsimonious model of HPV vaccine series uptake. The variables of the study were measured by using responses from the 2014 NIS-Teen. This research explored the association between SES variables of maternal income, maternal education, maternal age and ethnicity in communities within communities of Columbus, Ohio and uptake of the HPV vaccine series.

Threats to Validity

The data produced by the NIS are considered the gold standard for public health surveillance on immunization rates. The NIS is one of the largest telephone surveys and

produces high-quality estimates of vaccine coverage in the United States (NORC at the University of Chicago, 2016). Due to the method in which this survey was conducted, and the theoretical framework the analysis, there are several external and internal threats to validity involving the participants, location, and their reported income via postal code. The analysis was performed on participants who completed the 2014 NIS-Teen in communities within Columbus, Ohio metropolitan and the results are not generalizable to different populations. There also could be a temporal association between the effects of SES related to the length of time participants resided in the sampled postal codes. Newer residents may not have the full effect of access or lack of access to money, knowledge, prestige, power and supportive social networks where they were surveyed. This threat was addressed by the random digit dialing sampling of selected households during the survey. Additionally, there is evidence that parental reporting of vaccination statuses can be inflated as compared to provider records (Lu, Dorell, Yankey, Santibanez, & Singleton, 2012). The NIS-teen survey compares the vaccination status reports from parents to the reports from the adolescent's providers only when the parents or guardians have given consent (CDC, 2015c). Lastly, up-to-date vaccine information, individual or vaccine series was drawn from provider-reported data. There was no recheck of households or reconciliation of data that might be different from the report of parents or guardians, and the NIS-Teen surveyors do not re-contact households or providers to attempt to reconcile potential discrepancies in provider-reported vaccination dates or to resolve date-of-birth reporting errors (NORC at the University of Chicago, 2016).

Ethical Considerations

Human Subjects

I conducted the research using the 2014 NIS public-use data file for this secondary data analysis study. The 2014 NIS -Teen staff and contractors are subject to strict federal laws in regards to protecting the participants and the provider's privacy (CDC, 2015e). Employees working on the NIS are required to sign a legal document saying that they will keep all information private as well as details the consequences of the illegal disclosure of the information (CDC, 2015e). All information in the 2014 NIS-Teen was collected under strict confidentiality and can be used only for research as outlined in [Section 308(d) of the Public Health Service Act, 42 U.S. Code 242m(d), the Privacy Act of 1974 (5 U.S. Code 552a), and the Confidential Information Protection and Statistical Efficiency Act (5 U.S. Code)] (CDC, NCRID & NCHS, 2015). Prior to the release of the public-use data file, the contents of file go through extensive review by the NCHS Disclosure Review Board to ensure that participant privacy was protected as well as the protection of data confidentiality (CDC, NCRID & NCHS, 2015). The information collected in the NIS-Teen are used only for reporting of important statistical health information in the United States and its territories, and the organization has taken precautions to protect the privacy of individuals, families, and businesses participating in the survey (CDC, 2015e).

Ethical Issues

During the data collection phase, many of the telephone numbers are randomly selected by a computer so listed, and unlisted phone number receive phone calls

requesting permission to conduct the survey. Additionally, potential participants are mailed a letter from the Director of the National Center for Immunization and Respiratory Diseases, which describes the survey before a telephone interview was conducted (CDC, 2015c). These steps were taken to protect participants' confidentiality and to make certain they understand that their participation was voluntary (CDC, 2015c).

Summary

In summary, this research was a cross-sectional quantitative study that explored for a correlation between maternal socioeconomic influences and uptake of the HPV vaccine series in the communities within the cities of Columbus, Ohio metropolis. By using multiple logistic regression analysis, this study analyzed the dependent variables of uptake of the HPV vaccination series with the independent variable of maternal income measured by postal code. Additionally, the research analyzed the additional independent variables of maternal education, and maternal age as well as ethnicity. There are several threats to validity, but due to the RDD nature of gathering participants to be surveyed, the threats to validity should be minimal. The research was ethical and should satisfy the requirements of protecting the privacy of human subjects as all information in the 2014 NIS-Teen was collected under strict confidentiality and can be used only for research as outlined in [Section 308(d) of the Public Health Service Act, 42 U.S. Code 242m(d), the Privacy Act of 1974 (5 U.S. Code 552a), and the Confidential Information Protection and Statistical Efficiency Act (5 U.S. Code)]. Additionally, the employees collecting information for the 2014 NIS-Teen are under strict federal laws in regards to protecting

the participants and the provider's privacy. The next section of this doctoral study discussed the results and the findings of the research.

Section 3: Presentation of the Results and Findings

Introduction

The purpose of this study was to assess if there was an association between maternal SES variables of maternal income and maternal education as well maternal age and ethnicity and uptake of the HPV vaccine in adolescent males and females ages 13-17 based on postal codes within communities within the city of Columbus, Ohio. I provided evidence of an association between maternal SES influences and uptake of the HPV vaccine series. Four research questions were answered as a result of this study: (a) What is the association between maternal income and uptake of the HPV vaccine series in adolescent males and females 13-17 in communities with postal codes in the Columbus, Ohio metropolis, and (b) What is the association between maternal education and uptake of the HPV vaccine series in adolescent males and females 13-17 in communities with postal codes in the Columbus, Ohio metropolis, and (c) What is the association between maternal age and uptake of the HPV vaccine series in adolescent males and females 13-17 in communities with postal codes in the Columbus, Ohio metropolis, and (d) What is the association between ethnicity and uptake of the HPV vaccine series in adolescent males and females 13-17 in communities with postal codes in the Columbus, Ohio metropolis? The null hypothesis stipulated that there is no association between maternal socioeconomic factors of income and education and uptake of the HPV vaccination series, nor between the variables of age and ethnicity and uptake of the HPV vaccination series in adolescent males and females 13-17 in communities with postal codes in the Columbus, Ohio metropolis.

In this section, I present the results of a secondary data analysis. I analyzed the 2014 NIS-Teen secondary data using SPSS® version 21 (IBM Corp., 2016). I validated the analyses using the built-in validation functions in SPSS® v.21. I conducted simple descriptive analyses of the variables. I recoded the identified variables and categorized and manipulated them to fit the variables in the research questions. I conducted normality testing and performed binary analyses and bivariate analysis, followed by multiple logistic regression using SPSS® on the independent variables to search for statistically significant associations with the dependent variable. I conclude this section with a summary of the findings from the data analysis.

Data Collection of Secondary Data Set

The annual NIS-Teen survey is conducted as an adjunct to the NIS. The overall goal of the NIS is to estimate vaccination coverage rates among 19- to 35-month-old children in the United States. The NIS uses a random digit dialing (RDD) telephone survey to identify households with children aged 19 to 35 months and interviews the adult who was the most familiar with the child's vaccination history. When such a household was identified, and the NIS interview was completed, the household was further screened for the presence of 13- to 17-year-old adolescents. Households without 19- to 35-month-old children are not administered the NIS interview but are further screened for the presence of a 13- to 17-year-old adolescent. If a household containing one or more adolescents aged 13 to 17 years was identified, one of those adolescents was randomly chosen from within the household, and the adult who was most knowledgeable about the teen's vaccinations was interviewed. The household interviews for the 2014

NIS-Teen landline and cell-phone samples began on January 9, 2014, and ended on February 8, 2015 (CDC, National Center for Immunization and Respiratory Diseases, & National Center for Health Statistics, 2015). The samples were drawn independently from RDD phone numbers from within the 58 selected geographical regions of the annual NIS. Data obtained from the teen's vaccine provider were collected from February 2014 through April 2015 for both landline and cell-phone sample sources. The response rates for the 2014 NIS-Teen were as follows: resolution rate of 82.6%, screener completion rate 87.2%, interview completion rate 83.8%, CASRO response rate 60.3%, and teens with adequate provider data rate 57.1% (CDC, National Center for Immunization and Respiratory Diseases, & National Center for Health Statistics, 2015).

Discrepancies

There were some discrepancies from the use of this secondary data set. Upon review of the data, there were no specific methods to identify survey respondents by postal code for the Columbus, Ohio metropolis. Additionally, I noted that the State of Ohio (n = 754) did not have the required sample size to conduct multiple logistic regression analysis. Based on this discrepancy, I modified my location of research into two cities with differing levels of per capita income using the same methods I planned to use in the research on Columbus, Ohio. My revised research plan analyzed New York City, New York (n = 616) and Houston, Texas (n = 679). The combination of these cities gave me a sample size of 1,295, which was adequate to perform multiple logistic regression analysis. However, after reviewing the responses concerning HPV uptake for the cities selected, I found that 170 respondents were unaware of HPV vaccine series

uptake in their adolescent teen and those respondents were excluded from the analysis. The final sample size analyzed in this study was n = 1,125 which lowered the achieved power to 0.939 power (1-β err prob) based on calculations using G*Power 3.1 Statistical Power Analysis for a logistic regression two-tailed analysis from the original 0.95 power (1-β err prob)(Faul et al., 2007). My study examined two large metropolitan areas with vast differences in per capita income. In 2015, the per capita personal income (PCPI) in New York City was $ 63,196 (Department of Commerce, 2017), whereas the PCPI in Houston for 2015 was $36,913 (Department of Commerce, 2016a). The states that encompass these cities have comparable HPV-related cervical cancer rates: New York at 7.57 and Texas at 8.27 per 100,000 (CDC, 2017). Both New York and Texas have the highest cervical cancer rates for the United States. The change in my research plan prompted a necessary change of my research questions.

My revised research questions are as follows:

Q1: What is the association between maternal income and uptake of the HPV vaccine series in adolescent males and females 13-17 in communities within the cities of New York City, New York and Houston, Texas?

H_O: There is no association exists between maternal income and uptake of the HPV vaccine series in adolescent males and females 13-17 after controlling for ethnicity and maternal age within the cities of New York City, New York and Houston, Texas.

H_A: There is an association exists between maternal income and uptake of the HPV vaccine series in adolescent males and females 13-17 after controlling for ethnicity and maternal age within the cities of New York City, New York and Houston, Texas.

Q2: What is the association between maternal education and uptake of the HPV vaccine series in adolescent males and females 13-17 within the cities of New York City, New York and Houston, Texas?

H_O: There is no association between maternal education and uptake of the HPV vaccine series in adolescent males and females 13-17 within the cities of New York City, New York and Houston, Texas.

H_A: There is an association between maternal education and uptake of the HPV vaccine series in adolescent males and females 13-17 within the cities of New York City, New York and Houston, Texas.

Q3: What is the association between maternal age and uptake of the HPV vaccine series in adolescent males and females 13-17 in communities within the cities of New York City, New York and Houston, Texas?

H_O: There is no association between maternal age and uptake of the HPV vaccine series in adolescent males and females 13-17 in communities within the cities of New York City, New York and Houston, Texas.

H_A: There is an association between maternal age and uptake of the HPV vaccine series in adolescent males and females 13-17 in communities within the cities of New York City, New York and Houston, Texas.

Q4: What is the association between ethnicity and uptake of the HPV vaccine series in adolescent males and females 13-17 within the cities of New York City, New York and Houston, Texas?

H_O: There is no association between ethnicity and uptake of the HPV vaccine

series in adolescent males and females 13-17 within the cities of New York City, New York and Houston, Texas.

H_A: There is an association between ethnicity and uptake of the HPV vaccine series in adolescent males and females 13-17 within the cities of New York City, New York and Houston, Texas.

There were also some slight differences in my expectations in how the variables were listed in the 2014 NIS-Teen data. The differences of the listing of the variables were incorporated into the multiple logistic regression analysis. Maternal income was reported on the 2014 NIS-Teen as: $0-$7500, $7501-$10000, $10001-$17500, $17501-$20000, $20001-$25000, $25001-$30000, $30001-$35000, $35001-$40000, $40001-$50000, $50001-$60000, $60001-$75000, and over $75000. Ethnicity was reported on the 2014 NIS-Teen as Hispanic, non-Hispanic White only, non-Hispanic Black only, and non-Hispanic other + multiple race. Maternal education was reported on the 2014 NIS-Teen as: less than 12 years education, 12 years of education, more than 12 years non-college graduate, and college graduate. Maternal age was reported on the 2014 NIS-Teen as: less than 34 years old, 35-44, and over 45 years. Lastly, HPV acceptance was reported on the 2014 NIS-Teen as Yes, No or I don't know (CDC et al., 2015). The "I don't know" respondents were excluded from further analysis.

Additionally, there were other discrepancies from the use of this secondary data as the NIS-Teen is a telephone survey and the results are weighted to be representative of all children ages 19-35 months, and even with the statistical adjustments to account for non-response and households without telephones, there may be some residual bias.

National estimates of vaccination coverage are precise, but state and local estimates should be interpreted with caution because of limited sample size and widened confidence intervals than for national estimates of vaccination coverage (CDC et al., 2015).

The total sample, including the U.S. territory of Puerto Rico, contained approximately 8.1 million telephone numbers (5.0 million landline and 3.1 million cell-phone) and created household interviews for 38,703 teens (20,030 landline and 18,673 cell-phone), 21,057 of whom (11,353 landline and 9,704 cell-phone) had vaccine provider data adequate to conclude whether the teen was current with the recommended vaccination schedule (CDC et al., 2015). The NIS-Teen RDD telephone survey phase used independent, quarterly samples of telephone numbers. Sampling frames for the NIS were provided by Marketing Systems Group (MSG) and the target sample size of completed interviews in each estimation area was designed to approximately achieve the equal coefficient of 6.5% of the estimated vaccine coverage from provider reported histories, given a true coverage parameter of 50% (CDC et al., 2015).

In order to best represent the general population, the 2014 NIS-Teen survey weights for landline and cell-phone samples were combined in order to weight the full population of teens aged 13 to 17 years. Teens that resided in landline-only households (from the landline sample) and cell-phone-only households (from the cell-phone sample) within the estimation areas were weighted to represent teens in landline-only and cell-phone-only households. Additionally, because landline and cell-phone sampling frames sometimes overlap in coverage of teens in landline and cell-phone dual-use households,

dual-users from both samples are combined based on the most effective number of teens with completed household interview within each phone sample type (landline, cell-phone), and were weighted to represent teens in dual-use households within each estimation area. Lastly, teens who lived in houses without phones were excluded from the dual-frame sample but were accounted for by using controls derived from combining the 2013 census population estimates and the public-use single year 2011 and the 2011-2013 American Community Survey (ACS) data for the United States and Puerto Rico. The representation within the estimation areas was derived by using small area statistical modeling techniques used by Blumberg et al. 2012. The modeled telephone estimates were applied to the control total for the estimation area to approximate the control totals by detailed telephone status within each estimation area. Additionally, sampling variability was reduced, and precision of estimation was improved by trimming extreme weights within an estimation area. RDD sampling weight values that surpassed the median weight plus three times the interquartile range of the weights within an estimation area were truncated to that threshold. This weight trimming prevented teens with unusually large weights from having an unusually large effect on vaccination coverage estimates (CDC et al., 2015).

Univariate Analysis

Descriptive Characteristics of the Sample Population

A total sample of 1295 respondents in the estimation areas of New York City, New York (NYC) and Houston, Texas completed the 2014 NIS-Teen survey (NYC 522 and Houston 603). Of the 1,295 respondents, 170 responded that they did not know if the

teen had received any HPV vaccinations and were excluded from the analysis. Table 2-5 depict the sample sizes of the maternal SES variables that were evaluated in the study.

Table 2

Maternal Age

Age Groups	Frequency	Percent	Valid Percent	Cumulative Percent
<= 34 YEARS	80	7.1	7.1	7.1
35 TO 44 YEARS	410	36.4	36.4	43.6
>= 45 YEARS	635	56.4	56.4	100.0
Total	1125	100.0	100.0	

Table 3

Maternal Income

	Frequency	Percent	Valid Percent	Cumulative Percent
$0 - $7500	35	3.1	3.1	3.1
$7501 - $10000	40	3.6	3.6	6.7
$10001 - $17500	74	6.6	6.6	13.2
$17501 - $20000	56	5.0	5.0	18.2
$20001 - $25000	58	5.2	5.2	23.4
$25001 - $30000	51	4.5	4.5	27.9
$30001 - $35000	38	3.4	3.4	31.3
$35001 - $40000	44	3.9	3.9	35.2
$40001 - $50000	55	4.9	4.9	40.1
$50001 - $60000	37	3.3	3.3	43.4
$60001 - $75000	60	5.3	5.3	48.7
$75001+	436	38.8	38.8	87.5
DON'T KNOW	51	4.5	4.5	92.0
REFUSED	90	8.0	8.0	100.0
Total	1125	100.0	100.0	

Table 4

Maternal Education

	Frequency	Percent	Valid Percent	Cumulative Percent
LESS THAN 12 YEARS	213	18.9	18.9	18.9
12 YEARS	192	17.1	17.1	36.0
MORE THAN 12 YEARS, NON-COLLEGE GRAD	217	19.3	19.3	55.3
COLLEGE GRADUATE	503	44.7	44.7	100.0
Total	1125	100.0	100.0	

Table 5

Ethnicity

	Frequency	Percent	Valid Percent	Cumulative Percent
HISPANIC	352	31.3	31.3	31.3
NON-HISPANIC WHITE ONLY	409	36.4	36.4	67.6
NON-HISPANIC BLACK ONLY	231	20.5	20.5	88.2
NON-HISPANIC OTHER + MULTIPLE RACE	133	11.8	11.8	100.0
Total	1125	100.0	100.0	

Tables 6-8 depict the sample sizes of HPV vaccine series uptake, the sample size of the two communities sampled by the 2014 NIS-Teen survey and a summary depicting the number of the males and females who received or did not receive the HPV vaccine.

Table 6

HPV Vaccine Series Uptake

	Frequency	Percent	Valid Percent	Cumulative Percent
YES	610	54.2	54.2	54.2
NO	515	45.8	45.8	100.0
Total	1125	100.0	100.0	

Table 7

Estimation Area Of Residence

	Frequency	Percent	Valid Percent	Cumulative Percent
NYC	522	46.4	46.4	46.4
Houston	603	53.6	53.6	100.0
Total	1125	100.0	100.0	

Table 8

Gender of Child

	HPV YES	HPV NO	Total
Male	257	289	546
	47.1%	52.9%	100%
Female	353	226	579
	61%	39%	100%
Total	610	515	1125

Bivariate Analysis

A bivariate analysis of the respondents' four SES variables and uptake of the HPV vaccine series revealed a significant finding related to ethnicity. The other three variables, maternal age, maternal education, and maternal income were found to be non-significant. The complete results of all bivariate analyses are shown in the following tables. I conducted a bivariate Pearson $\chi 2$ test of the crosstabulation on the variables of HPV vaccination uptake and maternal age. HPV uptake and maternal age were not significantly related, Pearson $\chi 2$ (2, N = 1125) = .751, p = .69. For HPV uptake and maternal education, I also conducted a bivariate Pearson $\chi 2$ test of cross tabulation of the variables of HPV vaccination uptake and maternal education. HPV uptake and maternal education were also showed no significant relationship Pearson $\chi 2$ (2, N = 1125) = 4.06, p = .25. For HPV vaccination uptake and ethnicity, I conducted a bivariate Pearson $\chi 2$ test of the crosstabulation of the variables of HPV Vaccination Uptake and ethnicity. There was a significant pattern of association between HPV uptake and ethnicity, Pearson $\chi 2$ (2, N = 1125) = 8.37, p = .039. The results of the analysis showed that there was a significant relationship between uptake of the HPV vaccine series and ethnicity of the respondents living within the estimation areas analyzed in the study. Lastly, an independent-samples t-test was conducted to evaluate HPV vaccine uptake and maternal income. The test was non-significant, t(982) = -1.38, p = .17. The patterns of association between HPV vaccine uptake and the maternal demographic variables are seen below in Tables 9-12.

Table 9

Crosstabulation Ethnicity of Sample and HPV Vaccine Uptake

Ethnicity*		HPV Uptake		Total
		Yes	NO	
	Hispanic	213 (60.5%)	139 (39.5%)	
	White	213 (52.1%)	196 (47.9%)	409 (36.4%)
	Black	116 (50.2%)	115 (49.8%)	231 (20.5%)
	Other	68 (51.1%)	65 48.9%	133 (11.8%)
Total Responses to Survey for Maternal Ethnicity		610 (54%)	515 (46%)	

*Indicates p <.05

Table 10

Crosstabulation Maternal Age of Sample and HPV Vaccine Uptake

Maternal Age		HPV Uptake		Total
		Yes	NO	
	<= 34 YEARS	41 (51.2%)	39 (48.8%)	409 (36.4%)
	35 TO 44 YEARS	218 (53.2)	192 (46.8)	231 (20.5%)
	>= 45 YEARS	351 (55.3%)	284 (44.7%)	133 (11.8%)
Total Responses to Survey for Maternal Age		610 (54%)	515 (46%)	

Table 11

Crosstabulation Maternal Education of Sample and HPV Vaccine Uptake

Maternal Education		HPV Uptake		Total
		Yes	NO	
	LESS THAN 12 YEARS	123 (57.7%)	90 (42.3%)	213 (19%)
	12 YEARS	97 (50.5%)	95 (49.5%)	192 (17%)
	12 YEARS, NON-COLLEGE GRAD	109 (50.2%)	108 (49.%)	217 (19%)
	COLLEGE GRADUATE	281 (55.9%)	222 (44.1%)	503 (45%)
Total Responses to Survey for Maternal Education		610 (54%)	515 (46%)	

Table 12

Crosstabulation Maternal Income and HPV Vaccine Uptake

Maternal Income		HPV Uptake		
		Yes	No	Total
	$0 - $7500	20 (57.1%)	15 (42.9%)	35 (3.6%)
	$7501 - $10000	19 (47.5%)	21 (52.5%)	40 (4.1%)
	$10001 - $17500	54 (73%)	20 (27%)	74 (7.5%)
	$17501 - $20000	32 (57.1%)	24 (42.9%)	56 (5.7%)
	$20001 - $25000	32 (55.2%)	26 (44.8%)	58 (5.9%)
	$25001 - $30000	28 (54.9%)	23 (45.1%)	51 (5.2%)
	$30001 - $35000	18 (47.4)	20 (52.6%)	38 (3.9%)
	$35001 - $40000	27 (61.4%)	17 (38.6%)	44 (4.5%)
	$40001 - $50000	27 (49.1%)	28 (50.9%)	55 (5.6%)
	$50001 - $60000	18 (48.6%)	19 (51.4%)	37 (3.8%)
	$60001 - $75000	20 (33.3%)	40 (66.7%)	60 (6.1%)
	$75001+	245 (56.2)	191 (43.8%)	436 (44.3%)
Total Responses to Survey for Maternal Income		610 (54%)	515 (46%)	1125 (100%)

Logistic Regression Analysis

Multiple logistic regression was performed on all four variables simultaneously to analyze the predictors for uptake of the HPV vaccine series in the cities of New York City, New York and Houston, Texas. The parsimonious analysis of each predictor variable corresponds with each of the research questions reviewed later in the analysis. In addition, sex of the child (male/female) and city of residence (New York City/Houston) were included as control variables. The outcome variable was 'Ever received any HPV Vaccinations (yes/no).' The main goal of the logistic analysis was to determine the role of several critical predictors in explaining the dichotomous outcome (yes or no HPV vaccination). The critical predictors were: maternal education, maternal income, maternal age, ethnicity and uptake of the HPV vaccine series. City of residence and child sex were also included, as mentioned above. Linearity of the continuous variables with respect to the logit of the dependent variable was assessed via the Box-Tidwell (1962) procedure. Based on this assessment, the sole continuous independent variable, maternal income was found to be linearly related to the logit of the dependent variable. The model containing all four independent variables (maternal income, maternal education, maternal age, and ethnicity) as well as the two control variables (child sex and city of residence) was statistically significantly related to HPV vaccination uptake ($\chi^2(8) = 34.867$, $p = .0005$.

Pseudo- R^2 (Nagelkerke) was .047. Uptake of the HPV vaccine series was correctly classified for 58.1% of cases by the combination of variables in the logistic

regression equation. Sensitivity was 73.33%, specificity was 39.63%, positive predictive value was 59.64%, and negative predictive value was 55.00%. Of the six predictor variables, two were statistically significant: ethnicity and child sex. Non-Hispanic Whites, Non-Hispanic Blacks, and Non-Hispanic Others all had approximately half the odds to of being vaccinated than Hispanics (as shown in Table 13). Difference in odds ratio when comparing the racial groups indicated that an increase in one unit of the independent variable (0 for Hispanic to 1 for White patients, for example) decreases the odds of receiving the HPV vaccine series such that Whites were 1.535 times – Exp(B) - less likely to receive the HPV vaccine series than Hispanics. The reason that the comparison was seen as a decrease in odds of receiving the HPV vaccine series despite the fact that the beta value was positive was that the designation of the outcome variable was (arbitrarily) coded in the reverse direction, with the "yes HPV" category represented by a lower number ('1') than the "no HPV" category ('2'). When comparing Black teens to Hispanic teens, the odds of Blacks receiving the vaccine were 1.799 less likely than Hispanics to receive the vaccine, and teens who were identified as multi-race or "other" were 1.796 times less likely than Hispanics to receive the vaccine.

Maternal Income, Maternal Education and Maternal age were not significant predictors of uptake of the HPV vaccine series as their associations with the dependent variable were non-significant Maternal income $\beta = .013$, $p > .05$, Maternal Age $\beta = -.096$, $p > .05$, and Maternal Education, $\beta = -.026$, $p > .05$. City of residence was not a significant predictor of HPV vaccination, $\beta = .004$, $p > .05$.

Child sex was a significant predictor of HPV vaccination, $\beta = -.571$, $p > .0005$. Females were more likely (61 percent of females) than males (47 percent of males) to have received the HPV vaccination. The designation of female in the dataset was 2 and the designation of male was 1, which explains the negative beta coefficient for this result.

Table 13

Logistic Regression Results for Maternal Education, Maternal Age, Maternal Race/Ethnicity, and Maternal Income as Predictors of Teens' HPV Vaccine Series Uptake

Predictor Variable		B	SE	*p*	Odds Ratio	95 % Confidence Intervals for Odds Ratio	
						Lower	Upper
Ethnicity							
	White	.453	.194	.02	1.535	1.046	2.254
	Black	.534	.187	.004	1.799	1.239	2.612
	Multi-race/ Other	.509	.227	.025	1.796	1.141	2.827
Maternal Age		-.096	.112	.387	.908	.730	1.130
Maternal Education		-.026	.07	.734	.974	.839	1.132
Maternal Income		.013	.024	.595	1.013	.966	1.062
City of Residence		.004	.003	.170	1.004	.998	1.010
Child Sex		-.571	.131	.0005	.565	.437	.730

Note: For the categorical variable "ethnicity," Hispanic is the reference category. The outcome variable was coded as 1-yes, 2-no in the dataset; sex was coded 1-male, 2-female in the dataset.

Results

One logistic regression analysis was conducted that tested the specific associations between the variables in the research questions and the outcome variable, HPV vaccination. The results of the overall logistic regression are seen in Table 13. Each

component of the equation, corresponding to the individual research questions, is presented below.

Research Question 1

Logistic regression analysis was conducted to investigate the association between maternal income and uptake of the HPV vaccine series in adolescent males and females 13-17 in communities within the cities of New York City, New York, and Houston, Texas. The outcome variable of interest was uptake of the HPV vaccine series, and the possible predictor variable was maternal income. The predictor variable, maternal income was found to be non-significant $\beta = .013$, $p > .05$. Therefore, no statistically significant association was found between maternal income and uptake of the HPV vaccine series in adolescent males and females 13-17 in communities within the cities of New York City, New York and Houston, Texas.

The null hypothesis that there is no association exists between maternal income and uptake of the HPV vaccine series in adolescent males and females 13-17 after controlling for ethnicity and maternal age within the cities of New York City, New York, and Houston, Texas could not be rejected.

Research Question 2

A logistic regression analysis was conducted to investigate the association between maternal education and uptake of the HPV vaccine series in adolescent males and females 13-17 in communities within the cities of New York City, New York and Houston, Texas. The predictor variable, maternal education was found to be non-significant $\beta = -.026$, $p > .05$. Therefore, no statistically significant association was found

between maternal education and uptake of the HPV vaccine series in adolescent males and females 13-17 in communities within the cities of New York City, New York and Houston, Texas.

The null hypothesis that there is no association exists between maternal education and uptake of the HPV vaccine series in adolescent males and females 13-17 after controlling for ethnicity and maternal age within the cities of New York City, New York and Houston, Texas could not be rejected.

Research Question 3

A logistic regression analysis was conducted to investigate the association between maternal age and uptake of the HPV vaccine series in adolescent males and females 13-17 in communities within the cities of New York City, New York and Houston, Texas. The predictor variable, maternal age was found to be non-significant β = -.096, $p > .05$. Therefore, no statistically significant association was found between maternal age and uptake of the HPV vaccine series in adolescent males and females 13-17 in communities within the cities of New York City, New York and Houston, Texas.

The null hypothesis that there is no association exists between maternal age and uptake of the HPV vaccine series in adolescent males and females 13-17 within the cities of New York City, New York, and Houston, Texas could not be rejected.

Research Question 4

A logistic regression analysis was conducted to investigate the association between ethnicity and uptake of the HPV vaccine series in adolescent males and females 13-17 in communities within the cities of New York City, New York, and Houston,

Texas. The predictor variable, ethnicity was found to be significant: Non-Hispanic White β = .429, p = .029, Non-Hispanic Black β = .587, p = .002, and Non-Hispanic Other β = .586, p =.011. Therefore, the odds of Hispanic mothers reporting that their child had been vaccinated were 1.535, 1.799, and 1.796 times that of Whites, African-Americans, and those identified as multiracial or other race, was found between ethnicity and uptake of the HPV vaccine series in adolescent males and females 13-17 in communities within the cities of New York City, New York and Houston, Texas.

The null hypothesis that there is no association exists between ethnicity and uptake of the HPV vaccine series in adolescent males and females 13-17 within the cities of New York City, New York, and Houston, Texas was rejected. The evidenced displayed in the above table suggested that the existence of a relationship between the ethnicity and uptake of the HPV vaccine series was supported, hence rejecting the null (*Ho*) hypothesis.

Summary

In summary, I presented the results of the 2014 NIS-Teen survey as it pertains to uptake of the HPV vaccine series and maternal SES covariates. A total of 1125 respondents in the estimation areas of New York City, New York and Houston Texas completed the survey. I used logistic regression analysis to evaluate the relationship between the four variables of maternal income, maternal education, maternal age, and ethnicity, and uptake of the HPV vaccine series in adolescent males and females 13-17 in communities within the cities of New York City, New York and Houston, Texas. Based on the results of the analysis, I found a statistically significant relationship between the

ethnicity and HPV vaccination uptake such that Hispanic teens were approximately twice as likely to receive at least one dose of HPV vaccine series than teens from all other ethnicities. The association between ethnicity and HPV vaccination uptake was statistically significant; therefore, I rejected the null hypothesis. Bivariate analysis of these variables also showed a relationship between ethnicity and HPV vaccination uptake. Logistic regression analysis of the other three predictor variables (maternal income, maternal education, and maternal age) resulted in a non-significant relationship; therefore, I failed to reject the null hypotheses of these variables. In the next and final section of the study, I discussed the findings of my research, their potential application to professional practice, and the implications for social change.

Section 4: Application to Professional Practice and Implications for Social Change

Introduction

HPV vaccination coverage in the United States does not meet the Healthy People 2020 goals of an 80% vaccination rate. As a means to gather information that could improve vaccination programs, I investigated the association between maternal SES variables and uptake of the human papillomavirus (HPV) vaccine in male and female adolescents ages 13-17 within the estimation areas of New York City, New York, and Houston, Texas. The study was designed to provide evidence about maternal SES factors and their association with HPV vaccine series acceptance. I conducted an analysis of secondary data from the 2014 NIS-Teen public-use survey dataset. The analysis of the secondary data was done using SPSS version 21 where univariate, bivariate and multivariate analyses were done.

Concise Summary of Findings

By analyzing the 2014 NIS-Teen data, I found that ethnicity was a significant predictor of being vaccinated with the HPV vaccine series. HPV uptake and ethnicity were found to be significantly related, Pearson $\chi 2$ (2, $N = 1125$) = 8.37, $p = .039$. The results of the analysis showed a significant relationship between uptake of the HPV vaccine series and the ethnicity of the respondents living within the analyzed estimation areas. The odds of Hispanic mothers reporting that their child had been vaccinated were 1.535, 1.799, and 1.796 times that of Whites, African-Americans, and those identified as multiracial or other race, respectively. Additionally, a child's sex was a significant

predictor of HPV vaccination, β = -.571, $p > .0005$. Males had lower odds of being vaccinated compared to females.

Interpretation of the Findings

Ethnicity

Ethnicity was associated with HPV vaccination uptake in the cities of New York City, New York, and Houston, Texas. This evidence confirmed the findings of Bednarczyk et al. (2014), who noted that Hispanic adolescents were consistently higher in the initiation of the HPV vaccine. Additionally, Kumar & Whynes (2011) found that ethnicity, childhood immunizations, and usage of preventive and primary care and cervical screening were predictive of the uptake of the HPV vaccine. Lastly, Lechuga et al. (2011) indicated that the predictors of HPV vaccine intentions varied by cultural group and that culture moderated the influence of norms on intentions. The evidence discovered through my research illustrates a need for additional research to more clearly explain and find further evidence of the association of ethnicity and the initiation of the HPV vaccination series in order to improve HPV vaccination initiation across all racial/ethnic groups.

Maternal Age

Maternal age was not associated with HPV vaccination uptake in the cities of New York City, New York, and Houston Texas. This non-significant maternal age association with HPV vaccination uptake disconfirmed the findings of Watson-Jones et al. (2012), who found that parents who refused vaccination of their daughters tended to be older household members with less education. As there were not many studies in the

literature examining maternal age as a predictor for HPV vaccine uptake, my research results indicate a need for further research to elucidate the association or lack thereof between maternal age and HPV vaccine uptake.

Maternal Income

Maternal income was not associated with HPV vaccination uptake in the cities of New York City, New York, and Houston, Texas. This non-significant maternal income association with HPV vaccination uptake in my study disconfirms other research. For example, Musto et al. (2013) found that the participant's neighborhood SES was related to the likelihood of being HPV vaccinated. Additionally, Bednarczyk et al. (2014) found that since 2008, adolescents living below the poverty level had higher HPV vaccination initiation than adolescents above the poverty level. These previous studies showed an association with maternal income not found in my study but also conflicting maternal income associations in regards to level of SES. My research extends the knowledge of maternal income as a possible predictor variable of HPV vaccine uptake and justifies further research on this variable. As found in the above mentioned studies, maternal income was found to be inconsistently related to levels of HPV vaccine uptake.

Maternal Education

Lastly, maternal education was not associated with HPV vaccination uptake in the cities of New York City, New York, and Houston, Texas. This non-significant association between maternal education and HPV vaccine uptake disconfirms findings by Dorell et al. (2014), who noted that females that delayed HPV vaccination tended to be White, come from higher income homes, and have mothers with college degrees.

Similarly, Feiring et al. (2015) found an association between higher maternal education and a lower probability of initiation of the vaccine series, whereas lower education was associated with a higher likelihood of initiation of the vaccine series. Other studies, however, suggested that a higher level of education was associated with increased uptake of the HPV vaccine. Yu et al. (2016) found increased vaccine acceptability to be associated with older daughters, higher income, and higher level of education. Cullen, Stokley, and Markowitz (2014) also found that increasing parent education could increase uptake of the HPV vaccine. My research disconfirms the overall association of maternal education and HPV vaccine uptake found in these earlier studies. Based on these contradictory findings in the literature, combined with my finding of a non-significant association of maternal education and HPV uptake, I recommend further research to expand knowledge about the role of maternal education as a predictor of HPV vaccination uptake.

Conceptual Framework

Ethnicity, along with gender, age, personality, socioeconomics, and knowledge can influence or moderate relationships between health beliefs and health behaviors (Skinner et al., 2015). Applying the HBM to this study, I found evidence that ethnicity was more associated with HPV vaccination uptake than the other SES variables examined. According to the HBM constructs, the various sociodemographic variables of age, sex, race, education or socioeconomic issues possibly moderate relationships between health beliefs and health behaviors (Skinner et al., 2015). This concept seemed consistent in my research as the modifying factor; ethnicity was a significant predictor of

HPV vaccine uptake. As this was a secondary data analysis, indirect analysis showed that ethnicity could affect the perception of susceptibility to cervical cancer. More research is necessary to directly test the perception of susceptibility to cervical cancer and the potential moderation of the perception by ethnicity. According to (Skinner et al., 2015), perceived susceptibility was a major component for the adoption of preventative health behaviors. My study revealed that ethnicity was a significant factor predicting HPV vaccination uptake in New York City, New York, and Houston, Texas. The effective use of the HBM constructs during an HPV immunization program redesign could improve HPV vaccination coverage across different ethnic groups and across different regions in the United States. The effective tailoring of HBM construct-driven vaccination programs towards communities and regions based on ethnic/racial cultural considerations and barriers could provide a positive impact and enhance HPV vaccination coverage within the broad range of diverse communities across the United States.

Limitations of the Study

The data used for this study was secondary data originally obtained as part of the 2014 NIS-Teen survey for immunization coverage estimates of 13-17-year-old adolescent males and females in the United States. The findings of this study cannot be generalized to the entire U.S. population as the study sample populations were only in the estimation areas of New York City, New York, and Houston, Texas and not adequate to be fully representative of the entire U.S. population. Secondary data can create limitations to a study as well, as the data were not originally collected for the purpose of this research. Another limitation of the study was that it was based solely on parental recall and if the

teen received at least one HPV vaccination. This study did not analyze whether the respondent's teen completed the HPV vaccination series. Lastly, this study did not analyze responses from participants' vaccine providers to confirm the accuracy and recall from the parents as compared to the actual vaccination records and to assure the accuracy and precision of overall vaccination coverage estimate.

Recommendations

My current secondary data analysis only looked at two estimation areas in the states of New York, and Texas. To be more comprehensive in the research process, other estimation areas should be quantitatively researched to compare or provide additional information about maternal SES variables in different regions. Additionally, as this was a secondary data analysis, further research using an HPV vaccine tailored instrument grounded in the HBM constructs to analyze parents and medical providers' responses regarding maternal SES variables and uptake of the HPV vaccine is recommended. Another consideration for further research would be in-depth interviews and focus group discussions to qualitatively analyze participants' responses. Evidenced by the contradictions in maternal SES associations in previous research, more research is necessary to improve the knowledge of maternal SES associations and to minimize or even eliminate some of the contradictions. Lastly, a study using mixed methods, qualitative and quantitative with responses gathered by the primary researchers examining the same maternal SES variables could provide more information that could further advance the goals of this research.

Implications for Professional Practice and Social Change

The study has shown that ethnicity could have a positive or negative effect on HPV vaccination uptake in New York City, New York, and Houston, Texas. My study examined researchable modifying factors of the HBM via secondary data analysis to look at factors that may influence HPV vaccination uptake in large metropolitan areas in States with high levels of cervical cancer.

Professional Practice

This study provides valuable information gathered through the process of secondary data research. In regards to professional practice, the findings from this study could be used to develop and test strategies to improve the uptake of the HPV vaccine series across the different racial/ethnic groups. The findings of this research could also be used in the development or the enhancement of culturally-sensitive educational programs for parents and adolescent teens for use by primary care practitioners. The evidence found in this study could be used to target the evidenced-based predictors, such as race/ethnicity as seen in my study in HPV vaccine series educational programs. Lastly, the evidence found in this study could be used to enhance the knowledge of primary care health providers about the importance of race/ethnicity sensitive education and literature to improve the HPV vaccination uptake within their patient populations.

Implications for Research

Findings from this research study showed that future researchers should attempt to expand the knowledge of the impact of ethnicity on the uptake of the HPV vaccine series. The study results also indicated that future research should be performed to

improve the knowledge and strength of the relationship between ethnicity and uptake of the HPV vaccine series and to also examine possible regional influences as my study looked at two cities with different levels of per capita income in different locations in the United States. These results provided information that can further advance the field of HPV vaccination research. The study depicted secondary data analysis as a low cost, effective means of testing relevant hypotheses concerning HPV vaccination uptake and as a means to explore for associations that may act as facilitators or barriers to HPV vaccination. This analysis should be repeated to analyze other regions or States in the U.S. to test the hypotheses of this study. A strength of this study was it was a low-cost analysis of a public-use secondary data collected annually to check immunization coverage across the U.S. within the 58 selected geographical regions of the annual NIS.

Positive Social Change

The research was conducted to narrow the gap of previous research concerning maternal SES variables and their association with uptake of the HPV vaccine series. In this study, ethnicity was a significant predictor of uptake of the HPV vaccine series, and more predictive than maternal education, maternal age, and maternal income. As of a result of this research, this information could contribute to the improvement of HPV vaccination programs aimed at increasing the coverage to meet the Healthy People 2020 goals. Using these findings to redesign, supplement or enhance HPV vaccination programs could ultimately reduce overall morbidity and mortality from cervical cancer in the U.S.

Conclusion

The findings from this study revealed that: (a) there is an association between ethnicity and uptake of the HPV vaccine series in adolescent males and females 13-17 within the cities of New York City, New York, and Houston, Texas, (b) there is not an association between maternal income and uptake of the HPV vaccine series in adolescent males and females 13-17 within the cities of New York City, New York, and Houston, Texas, (c) there is not an association between maternal education and uptake of the HPV vaccine series in adolescent males and females 13-17 within the cities of New York City, New York, and Houston, Texas, and (d) there is no association between maternal age and uptake of the HPV vaccine series in adolescent males and females 13-17 within the cities of New York City, New York, and Houston, Texas. Vaccination to prevent HPV infection and subsequent cervical cancers should remain a public health priority, and more research is necessary to further enhance the knowledge gaps in the uptake of the HPV vaccine series associations within different communities in the U.S. Additionally, based on conflicting evidence found in previous research, there is a need for more research to decrease the contradictory evidence found in the literature on HPV vaccination acceptance. Although there have been significant improvements in the identification and treatment of cervical cancer, it is still a significant medical and financial burden for those affected with the disease. Cervical cancer is much more costly to treat than to prevent through the uptake of the HPV vaccine series. The evidence found in the study could be used to potentially enhance educational programs designed to improve vaccination rates, increase prevention, and reduce the overall incidence of

cervical cancer. The use of the results to enhance HPV vaccination programs have the potential for positive social change by way of improving the lives of individuals, families, and communities by increasing HPV vaccination and reducing cervical cancer in the U.S.

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