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Predictors of Human Papillomavirus Vaccination in Georgia

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Abstract

Predictors of Human Papillomavirus Vaccination in Georgia

by

Ashley Leeann Satterfield-Nash

Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

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Abstract

Although the human papillomavirus (HPV) vaccine has been approved by the Federal Drug Administration (FDA) and is available for males and females, completion of the 3-shot series in Georgia remains relatively low. The purpose of this study was to examine the predictors of HPV vaccination initiation and completion for male and female adolescents, ages 13 to 17 years old, in Georgia between 2013 and 2015. The theoretical foundation of the study was the structural model of health behavior which is an ecological model. Logistic regression was performed to determine if there was any relationship between the independent variables of parental knowledge, providers' recommendation, and physical access to vaccination sites, and the dependent variables of vaccination initiation and completion while controlling for and separately testing the impact of age, race, and gender. The data sets from the Centers for Disease Control and Prevention, *National Immunization Survey-Teen* from 2013–2015 were used. There was no significant difference in HPV vaccination initiation or completion for any of the 3 years that were analyzed related to parental knowledge, as indicated by a p-value <0.005. For all 3 years, participants who received a provider's recommendation were less likely to initiate and complete the vaccine series. There was a significant relationship between gender and initiation in 2014 (p-value <0.005); otherwise, age, gender, and race did not significantly impact vaccine initiation and completion. The findings from this study could contribute to positive social change by indicating that patient and physician distrust may exist for this population in Georgia. Encouraging public health providers to intervene in this process could produce increased vaccination rates and prevent future cancers among this population, which would improve the lives of individuals, families, and communities.

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Section 1: Foundation of the Study and Literature Review

Introduction

Human papillomavirus (HPV) is a group of more than 150 viruses, each of which is given a number, referred to as its HPV type (Centers for Disease Control and Prevention [CDC], 2015d). HPV can cause genital warts (papillomas) and cancer, especially cervical cancer (CDC, 2015d). HPV can be transmitted sexually, and is the most common sexually transmitted infection (STI; CDC, 2015d). Anyone that is sexually active can get HPV (CDC, 2015d). In fact, most sexually active men and women have had it at some point in their lives; most times, the body clears itself of the infection and the individual never knows he or she has had it (CDC, 2015d).

There are several ways in which a person can lower the chance of getting HPV, including vaccination, cervical cancer screening, using condoms, and being in a monogamous relationship (CDC, 2015d). There are two different HPV vaccines, Cervarix (females only) and Gardasil (males and females), that are recommended for preteen boys and girls at age 11 or 12 to ensure protection against HPV before ever being exposed (CDC, 2015d). The HPV vaccine is given in a three-shot series. After initiation of the vaccine, the second shot is given 1 to 2 months after the initial shot, and the third shot is given 6 months after the first shot (CDC, 2015d). Young men and women can receive the vaccine through the age of 26 (CDC, 2015d).

Problem Statement

Although the HPV vaccine has been approved by the Food and Drug Administration (FDA) and is available for both males and females, completion of the 3-

shot series remains relatively low (Georgia Department of Public Health, 2015). Cervical cancer is the fourth leading cancer in women in the United States (Wang, et. al., 2015, p. 2570). The HPV vaccine is approved by the FDA to prevent the high-risk HPV types that have been linked to cervical cancer and other genital cancers (CDC, 2015d). According to the CDC (2015d), an estimated 80 million people have HPV in the United States, and around 14 million new cases are reported annually. In Georgia, between the years of 2009 and 2013, approximately 1,265 cancers were associated with HPV (CDC, n.d.). It is important for adolescents to receive the vaccine early, before they become sexually active, which is before they would be exposed to HPV (CDC, 2015d). The CDC and the Advisory Committee on Immunization Practice (ACIP) recommend that adolescent males and females, ages 11 or 12 years old, receive the HPV vaccine before ever being exposed (CDC, 2015d). According to Wang et al. (2015), people's attitude toward the HPV vaccine influences promotion and acceptance of the vaccine. Wang et al. found that families of low income that had single mothers with only female children were more likely to accept the HPV vaccine. Schiffman and Wacholder (2012) suggested that more emphasis on geographical areas of low vaccination should be considered in order to promote HPV vaccination. According to Gilkey et al. (2016), a provider's recommendation is highly influential on parents' decisions to vaccinate their children against HPV. For a nationally representative sample, Gilkey et al. found that more than 70% of adolescents who receive a provider's recommendation for HPV vaccination actually initiate the vaccine series. However, researchers do not know if this is applicable to Georgia specifically. It is important to understand reasons for parents' decisions not to vaccinate or to vaccinate their teens against HPV in order to develop effective health initiatives and vaccine promotion programs (Fontenot et al., 2015). Rural Ohio health department personnel noted that the most common barrier to HPV vaccination was parental knowledge (Oldach & Katz, 2012). Oldach and Katz (2012) found that lack of parental knowledge may result in vaccination initiation differences between male and female adolescents in Appalachia Ohio. Spleen et al. (2011) noted that knowledge about the HPV vaccine was an important predictor of HPV vaccination in a national sample. Based on evidence of this literature review, there is a gap in the literature related to what predictors contributed to HPV vaccination up-take or completion in Georgia and whether this is due to lack of regular wellness visits and/or provider access, lack of knowledge, or lack of the primary care physician recommending the vaccine? To effectively establish an intervention, the predictors of uptake and completion of the HPV vaccine in Georgia must first be determined.

Purpose

The purpose of this quantitative study was to examine the predictors of HPV vaccination initiation and completion for male and female adolescents, ages 13 to 15 years old, living in Georgia between 2013 and 2015.. Polonijo and Carpiano (2013) suggested further research was needed on the uptake of HPV vaccination in countries that have routine vaccination programs funded by public sources to determine uptake that occurred as a result of removing barriers to vaccination. They asserted that it is necessary to determine if disparities in uptake of vaccination practices are perpetuated by factors such as location, parent belief, or lack of understanding of HPV infection (Polonijo &

Carpiano, 2013). Further indicating the need for my study, was Seven et al.’s (2015) finding that many parents appear to lack knowledge and awareness regarding HPV vaccination. Fazekas, Brewer, and Smith (2008) reported that to eliminate disparities in cervical cancer, further research is needed to understand the barriers to vaccination and to ensure that physicians are recommending and implementing HPVvaccination.

The independent variables of this study were parental knowledge, provider’s recommendation, and access to health care services. The dependent variables of this study were HPV vaccine initiation and completion. However, the main outcome of the study was HPV vaccine series completion. The covariates for this study were age, gender, and race.

Research Questions

RQ1: Is there any association between parental knowledge and HPV vaccination initiation and completion among adolescents in Georgia?

RQ2: Is there any association between providers’ recommendation and HPV vaccination initiation and completion among adolescents in Georgia?

RQ3: Is there any association between access to health care services and HPV vaccination initiation and among adolescents in Georgia?

RQ4: Is there any association between age, race, and gender at initiation of vaccination and the percentage of adolescents that initiate the HPV vaccination and complete the HPV vaccine series among adolescents in Georgia after controlling for parental knowledge, provider recommendation, and access to health care services?

Theoretical Foundation

The theoretical framework for the study was the structural model of health behavior, which is a form of the ecological theory. HPV vaccination is recommended by the CDC (2015a), but is not required. The foundation of ecological thinking is that there is a relationship between health, behavior, and their determinants (Crosby, Salazar, & DiClemente, 2011). Ecological theory has had considerable influence on public health and promotion (Crosby et al., 2011). The structural model of health focuses on four factors that influence health behavior: (a) availability, (b) physical structures, (c) social structures and policy, and (d) media and cultural influence (Crosby et al., 2011).

Ferrer et al. (2014), carried out a school-based vaccination study in which they observed female adolescents during the vaccination session. During these sessions, the researchers took detailed field notes and conducted thorough interviews to collect information on vaccination-related beliefs of parents, reason for initiating the vaccine, and sexual mores or concerns about sexual activity (Ferrer et al., 2014). After collecting data on parental beliefs and feelings toward the HPV vaccine, Ferrer et al. (2014) used the socio-ecological model to identify the pathway to a young person's receiving the vaccine. The model demonstrated that social norms and beliefs at the community level may influence decision making related to receipt of the HPV vaccine (Ferrer et al., 2014). Parental consent was referred to as the organizational level and interpersonal level of the model, and the adolescent participating in the vaccine program was referred to as the intrapersonal level of the social ecological model (Ferrer, et al., 2014).

The structural model of behavior is an ecological model that focuses on the environmental influences of behavior, which include: availability/accessibility, physical structures, social structures and policy, and media/cultural influence (Crosby et al., 2011). Availability and/or accessibility influences behavior because the greater the access is, the more likely a behavior is to occur (Crosby et al., 2011). For example, physically limiting access of a product affects availability, as does modifying price (Crosby et al., 2011). Physical limitation success was demonstrated in the reduction tobacco use and consumption for underage users and teens (Crosby, et al., 2011). Physical structures and environment likewise can influence behaviors and health outcomes (Crosby et al., 2011). For example, in the 1960s and 70s, New York had several apartment buildings with wide windows that were low to the floor. As a result, many children were falling through windows and getting injured (Crosby et al., 2011). The community began providing window guards, which ultimately reduced childhood falls and injuries (Crosby et al., 2011). Social structures refers to laws or rules that shape how we live our lives (Crosby et al., 2011). Enforcing social structures has been effective in increasing seat belt use, and in reducing tobacco use among adolescents and teens (Crosby et al., 2011). Media and cultural influence have a profound influence on health behavior (Crosby et al., 2011). Media and advertisements can and have been used to shape norms and behaviors about certain health behaviors by appealing to certain targeted audiences (Crosby et al., 2011).

This model was useful for capturing the information that I sought in this research, which included accessibility (reasons why parents/guardians are not having their children vaccinated), social structures (parents' knowledge and acceptance), and physical structures (doctor's office and provider). Ferrer et al. (2014) found that access to the HPV vaccine is shaped by interactions at the different levels of the social ecological model. Healthcare providers' decisions to recommend HPV vaccination and parental consent to vaccinate are influential stages in improving HPV vaccination uptake (Ferrer et al., 2014). I used the structural model of behavior in this study because it has proven to be successful in many health-related interventions, as described above, but has not been applied to HPV vaccination, although other ecological models (such as the social ecological model) have been (Ferrer et al., 2014).

Nature of the Study

The nature of this study was quantitative secondary data analysis, using archived data from the *National Immunization Survey–Teen* (NIS-Teen), to determine the predictors of initiation and completion of the HPV vaccine among adolescents, ages 13 to 17 years old in Georgia. Maintaining focus on determining the predictors of HPV vaccine initiation and completion in Georgia should be consistent with the structural model of behavior. To determine the correlates to HPV vaccination initiation and completion among adolescents in Georgia, I examined data from the 2013-2015 NIS-Teen on parental knowledge of the vaccine, providers' recommendations, and access to health care services. This cross-sectional, quantitative analysis determined the physical and perceived relationships among predictors to HPV vaccination initiation and completion.

Methodology

The NIS-Teen is a national survey that was implemented by the National Center for Immunization and Respiratory Diseases (NCIRD) and the National Center for Health Statistics (NCHS) of the CDC (2013). The target population of the NIS-Teen is adolescents between the ages of 13 and 17 years old living in the United States at the time of the interview (CDC, 2013). Data were collected via a randomized telephone survey (CDC, 2013). In 2013, 55.8% of those households randomly selected to participate in the survey completed the survey and were determined to have adequate data (CDC, 2013). The entire sample size for the United States in 2013 was 20,811,907; of this total, 696,071 participants were from Georgia (CDC, 2013).

Data Analysis Plan

The data for this study were taken from the NIS-Teen data set. The main dependent variables included vaccination initiation and vaccination completion. Vaccine initiation was measured by whether or not the adolescent had received any of the three vaccinations in the HPV shot series (CDC, 2013). Vaccination completion was measured by whether or not the adolescent had received 3 or more shots, or indicated that they completed the HPV vaccine series (CDC, 2013). The independent variables included parental knowledge, providers' recommendation, and access to health care services. Lack of parental knowledge was be measured as a reason for the teen not receiving the HPV shot(s) (CDC, 2013). Provider's recommendation was measured as a reason for the teen receiving or not receiving the HPV vaccination as answered in the NIS-Teen household survey (CDC, 2013). Access to health care services was measured as a reason for the teen not receiving the HPV shot(s) as answered in the NIS household survey (CDC, 2013). Model covariates included age (13-17 years old), race, and gender of adolescent.

I compared the state estimates of the sample's sociodemographics for male and female adolescents who have received one or more doses of the HPV vaccine (uptake/initiation) and those who have completed the vaccine series (3 shots). I compared estimates of the sample's sociodemographics for race (white/other and Hispanic/not Hispanic), for adolescents who have received one or more doses of the HPV vaccine (uptake), and those who have completed the vaccine series (3 shots). Logistic regression analysis was performed for each dependent variable. I used vaccine initiation and completion as the main dependent variables, and adjusted for race, age, and gender of the adolescent. I carried out data analysis in this way because other researchers have used this technique to analyze NIS-Teen HPV data for national samples and other geographically-specific HPV vaccination data.

Literature Search Strategy

I carried out the literature review using the Walden University's collection of peer reviewed journals and articles. The following journals were searched for relevant studies: Vaccine (via Elsevier 2007 to 2016); Gynecology and Obstetrics (via Science Direct 2013 to 2016); Preventive Medicine (Via Science Direct 2007 to 2016); Pediatric and Adolescent Gynecology (via Elsevier 2014 to 2016); Public Health (via Science Direct 2010 to 2016); Papillomavirus Research (via Science Direct 2016); Community Health (via Springer 2011-2016); American Academy of Pediatrics (via Science Direct 2011 to 2016); Women's Health (via BioMed Central 2014-2016); Adolescent Health (via Elsevier 2013 to 2016); Social Science and Medicine (via Science Direct 2016); Clinical Therapeutics (via Elsevier 2013-2016); Women's Issues (via Elsevier 2016); Human Vaccines and Immunotherapeutics (via T and F Online 2016); Lower Genital Tract Disease (via American Society for Colposcopy and Cervical Pathology 2014 to 2016);

Cancer Education (via Springer 2012 to 2016); and Social Science and Medicine (via SciVerse Science Direct 2013 to 2016). I also searched the CDC (www.cdc.gov) and Georgia Department of Public Health (www.dph.georgia.gov) websites. In the literature review I show, from many perspectives, the public health problems resulting from the lack of HPV vaccination initiation and completion. I also demonstrate what is known about HPV vaccination in national and geographically-specific contexts. I also demonstrate a gap in literature regarding the predictors of HPV vaccination specifically for Georgia.

Literature Review Related to Key Variables

HPV is one of the most common sexually transmitted infection in the United States (CDC, 2015). Some types of HPV can cause cancer and genital warts (CDC, 2015). There are two vaccines that protect against HPV, Ceravarix and Gardasil (CDC, 2015). Ceravarix has been available in the United States for females since June, 2006, and Gardasil has been available in the United States for both males and females since October, 2009 (CDC, 2015). HPV vaccination completion has remained relatively low in the United States, with 34% of girls 13-17 years old receiving the vaccine, and 21% of boys ages 13-17 receiving the complete vaccine series in 2014 (CDC, 2015). Vaccination uptake has also remained poor in Georgia, with only 44% of females receiving all 3 doses of the vaccine, and only 18% of males receiving all 3 doses of the HPV vaccine in 2014 (CDC, 2015). These vaccination rates are significantly lower than the Healthy People 2020 target of 80% vaccination coverage of male and female adolescents, ages 13 to 15 years old (CDC, 2015).

Polonijo and Carpiano suggested further research is needed on the uptake of HPV vaccination in countries that have routine vaccination programs funded by public sources to determine uptake that occurred due to the removal of vaccination-related barriers (2013). They asserted that this information is necessary to determine if disparities in uptake of vaccination practices are perpetuated by factors such as location, parental beliefs, or lack of understanding of HPV infection (Polonijo & Carpiano, 2013). The need for this study is further supported by findings from Seven, et al., said that there appears to be a lack of knowledge and awareness regarding the HPV vaccination in parents (Seven, et. al., 2015, p. 386). Parents' acceptability played an important role for the implementation of vaccination to be successful (Seven, et al., 2015). Seven et al. (2015) conducted a questionnaire-based survey in an elementary school, and found that among parents of 10 to 13-year-old children and adolescents, few reported having prior knowledge of the HPV vaccine, and even fewer intended to vaccinate their children. Since they found a gap in parental knowledge of the HPV vaccine, Seven et al. (2015) suggested further research regarding parental knowledge of the HPV vaccine because it is an important obstacle in implementation of vaccination uptake.

Fazekas, Brewer, and Smith (2008) found that to eliminate disparities in cervical cancer, further research is needed to understand the barriers to vaccination and to ensure that physicians are recommending vaccination and implementing HPV vaccination. In an attempt to address this disparity, Fazekas et al. (2008) surveyed over 100 women in rural North Carolina to identify predictors of HPV vaccination in themselves and their daughters. They found that predictors of their daughters' receiving the vaccine were associated with the mothers' knowledge about their own health care needs (Fazekas, et al., 2008). Women who had lower perceived barriers, such as cost, were more likely to have their daughters vaccinated, suggesting that efforts to increase HPV vaccination in rural North Carolina should reduce the perceived barriers of receiving the vaccine (Fazekas et al., 2008).

The findings reported in most of the literature I reviewed were mostly from national surveys, and tend to note different barriers and predictors of HPV vaccination than do state-specific survey findings. I address these differences in the following literature review sections. Fazekas et al.'s (2008) North Carolina HPV vaccination study showed that cost was a major barrier to adolescents receiving the vaccine, whereas, many national surveys showed that parental knowledge and provider recommendation are key to HPV vaccination coverage. To develop and implement an intervention in Georgia to increase HPV vaccination coverage among male and female adolescents, I must first understand the predictors of 13- to 17-year-old males and females receiving the HPV vaccination. The purpose of this study was to examine the predictors of Human Papillomavirus (HPV) vaccination initiation and completion for male and female adolescents, ages 13 to 15 years old, living in Georgia between 2013 - 2015, depending on provider's recommendation, parental knowledge, and access to health care.

Influence of Providers' Recommendation on HPV Vaccination

Vaccination recommendation from a provider is highly influential, and in a nationally represented sample, researchers found it to be a stronger predictor of HPV vaccination than race/ethnicity, insurance, and knowledge and/or perception of safety

(Gilkey et al., 2016). Gilkey et al. (2016) found that a provider's recommendation is highly influential on vaccination uptake, and that over 70% of parents who received a provider's recommendation had their child vaccinated for HPV. Findings from Gilkey et al. (2016) indicated that increasing the frequency of provider recommendations for HPV vaccination is important, as is the quality of the providers' recommendation. Increasing uptake of the HPV vaccine requires understanding and acceptance for the parents, and research has indicated that parents are more likely to accept the vaccine if a provider recommends it (Smith et. al., 2016). Smith et al. (2016) used data from the 2010 to 2014 NIS-Teen survey and found that, of the female teens vaccinated, parents who were positively influenced by a provider were 48% more likely to have completed the HPV vaccination series.

Differences among male and female provider recommendations for HPV vaccination may add to the significantly lower uptake of HPV vaccination among males (Oldach & Katz, 2012). Providers found it more difficult to explain the need for HPV vaccination to parents of male adolescents, which made their recommendation weak or seemingly unnecessary (Oldach & Katz, 2012). Many health departments in the Ohio Appalachia area indicated that parents were not aware of an HPV vaccine for males and did not understand why it is necessary for males to receive the vaccine (Oldach & Katz, 2012). Explaining the need for male HPV vaccination is complex, therefore, parents may be dissuaded by a weak provider recommendation that does not convey a strong message for the vaccine in males (Oldach & Katz, 2012). The findings from Oldach and Katz (2012) indicated that the informational needs of parents of males and females making the decision to vaccinate are different. Oldach and Katz (2012) identified barriers to HPV vaccination in rural Appalachia Ohio using a survey carried out by 32 county health departments in order to identify the best method for increasing initiation and completion. They found that 93.3% of the health departments used a reminder system to improve completion rates. The findings from this study indicated the need for further research into perceived barriers faced by parents of male and female adolescents to develop targeted educational tools and interventions appropriate for increasing HPV vaccination (Oldach & Katz, 2012).

The quality of the provider recommendation is also a factor in HPV vaccination acceptance and uptake (Gilkey et al., 2016). Strong provider recommendation was a predictor of HPV vaccination in national data samples, after controlling race/ethnicity, insurance status, knowledge, or vaccine effectiveness/safety (Gilkey et al., 2016). However, although there was strong evidence to support providers' influence on uptake, less than half of girls aged 13-17, and less than 25% of boys aged 13-17, received HPV vaccination (Gilkey et al., 2016). Gilkey, et al. (2016) suggested that not only does provider recommendation increase uptake, but also that the quality of the recommendation has a strong influence on parental decision. Providers who offered weak recommendations framed the HPV vaccine as less important (Gilkey et al., 2016). According to Gilkey et al. (2016), parents who received a weak provider recommendation for the HPV vaccine were less likely to have their child vaccinated against HPV. Specifically, Gilkey et al. noted that 52% of the parents in their sample reported receiving a provider's recommendation, and many noted a lack of urgency in the recommendation.

Gilkey et al. also found that high quality recommendations were directly correlated with vaccination initiation.

Provider recommendation was a strong facilitator in increasing HPV vaccination rates among males and females (Oldach & Katz, 2012). This research is consistent with findings from national surveys, but not Georgia specifically. Therefore, data for Georgia needed to be analyzed to determine if the same predictors of vaccination exist before an intervention can be implemented to increase vaccination coverage and completion for the Georgian population.

Parental Knowledge as a Predictor of HPV Vaccination

Knowledge of HPV is an important correlate of parental acceptance of and intent to vaccinate their children (Spleen et al., 2012). Spleen et al. (2012) found that parents who had their child receive the HPV vaccine had higher levels of knowledge about HPV and the approved vaccines than parents who chose not to have their child vaccinated. Spleen et al. (2012) conducted a community-based educational intervention to increase parental knowledge of the HPV vaccinations in rural Appalachian Pennsylvania, and conducted pre- and post-tests with the parents to compare their attitudes toward vaccination before and after the intervention. Parents of vaccine-eligible females were more likely to vaccinate their child after receiving the intervention (Spleen et al., 2012). Of the parents who completed the final interview after the intervention, 44% reported that they had begun the HPV vaccination series (Spleen et al., 2012).

Gaps in knowledge and misunderstanding of the benefits of HPV vaccination may account for the lack of uptake of the HPV vaccine, especially for males (Fontenot et al., 2015). Fontenot, et al. (2015) noted that many parents did not know there was an HPV vaccine for males and did not understand the need to vaccine their son against a sexually transmitted infection that is known for causing cervical cancer. According to Fontenot et al. (2015), the results of this national convenience sample focus group showed that many parents rely heavily on providers' recommendation, and that interventions should focus on educating parents through providers. Oldach and Katz (2012) found that the most common barrier to HPV vaccination reported by nurses was lack of knowledge about the available vaccines, concerns associated with side effects, the newness of the vaccines, parents believing their child is too young or not sexually active, and negative feedback from media or community members. Oldach and Katz (2012) conducted a survey of 48 public health departments in Ohio Appalachia and noted that over half of the health departments reported that parents of female adolescents were more receptive to the HPV vaccine. This suggests that informational needs differ between parents of males and parents of females (Oldach & Katz, 2012).

The most common difference between vaccination barriers was that parents of male adolescents were not aware of an HPV vaccine for males (Oldach & Katz, 2012). According to Lindley et al. (2016), there was a difference between reasons for vaccination and non-vaccination among parents of males and females. Lindley et al. (2016) carried out a data analysis using the 2013 NIS-Teen results to examine differences among male and female adolescents' vaccine receipt and reasons for not receiving the vaccine. Providers' recommendation was more likely to have been the reason for vaccination in females, whereas parents of males less frequently reported provider recommendation (Lindley et al., 2016). Lindley et al. (2016), noted that a reason for providers recommending HPV vaccination less frequently in males could be a misconception that the vaccination has fewer health benefits for males than for females. Several factors played a role in parent's decision to vaccinate their children such as considering the potential benefit of protecting their son's future female partners (Schuler, DeSousa, & Coyne-Beasley, 2014). Schuler et al. (2014) carried out a meta-analysis of parents from a pediatric clinic in North Carolina to examine parents' consideration of future-partner protection in the decision to vaccinate their adolescent. They noted that more often HPV is transmitted from infected males to females than the reverse (Schuler et al., 2014). Most parents of males reported that the decision to vaccinate was to protect their son's future female partners (Schuler, DeSousa, & Coyne-Beasley, 2014). Schuler, et al. (2014) suggested further efforts to improve HPV vaccination in North Carolina include benefits of protecting future female partners. This information is useful to better understand reasons for HPV vaccination in males, or reasons why parents chose to vaccinate their adolescent sons, since male HPV vaccination is typically significantly lower among males (Lindley et al., 2016).

Trends in HPV Vaccination Considering Demographics

HPV is pervasive throughout the U.S. population; however, cervical cancer disproportionately affects poor minority women (Jeudin, et al., 2014). In the United States, HPV incidence is twice as high in the US counties that are predominantly poor when compared to counties that are predominantly middle or upper class as it relates to income (Jeudin, et al., 2014). Locations within the US that have large populations of minorities have higher rates of cervical cancer because rates of cervical cancer are inversely related to screening and health care access (Jeudin, et al., 2014). Holman, et al. (2015) carried out a literature review comparing HPV vaccination among white non-Hispanic and Hispanic girls and found that age of initial sexual intercourse, parent discussions about gender, and social norms on vaccination was varied among different race/ethnicity. African American and Latina parents expressed concern about their child becoming more sexually active after receiving the vaccine (Holman, et al., 2015). For example, one study noted that effects of first intercourse, parent and daughter communication about ex, and social norms related to the HPV vaccine was differed by ethnicity (Holman, et al., 2015). Holman, et al. (2015) found that black and Hispanic females are less likely to have received all three doses of the HPV vaccine compared with white females. Barriers such as lack of knowledge about HPV and vaccination were found to be more common among black women than other races (Holman, et al., 2015). Rates of HPV vaccination initiation and completion were reported to be lower among black and Latina girls than white girls (Jeudin, Liveright, Del Carmen, & Perkins, 2014). Geographic disparities in HPV vaccination have emerged, indicating lower vaccination rates in Southern states, poor neighborhoods, and rural areas (Kulczycki, et al., 2016). Kulczycki, et al. (2016) surveyed 301 primary care physicians in Alabama and Mississippi to assess their personal beliefs and attitudes towards recommending and administering the HPV vaccine. They found that HPV vaccination coverage rates in Mississippi and Alabama, which are Southern, rural states, were significantly lower than other states (Kulczycki, et al., 2016). Their research indicated that personal beliefs of physicians may drive their behavior toward recommending and administering the vaccine more so than the professional guidelines set by the Advisory Committee on Immunization Practices (ACIP) (Kulczycki, et al., 2016). Although Kulczycki, et al. (2016) found that personal beliefs of physicians may drive their recommendation of HPV vaccination in Mississippi and Alabama, it is not known whether this is a factor for Georgia physicians. This further demonstrates the need to determine whether providers' recommendation is a predictor of HPV vaccination in Georgia because this must first be determined before recommending studies that determine qualitative information around beliefs of physicians and recommending the HPV vaccine.

Differences in Gender and Race/Ethnicity HPV Vaccination Initiation and Completion

Although the Advisory Committee on Immunization Practices (ACIP) recommends vaccination among males and females, in a three-dose series, a difference in vaccination initiation and completion existed between males and females (Choi, et al., 2016). Choi, et al. (2016) assessed data from the 2012 and 2013 NIS-Teen to determine factors that may explain the differences in HPV vaccination rates form male and females. In 2013, about 55% of female adolescents and only 27% of male adolescents received the HPV vaccine (Choi, et al., 2016, p. 48). Among those vaccinated, females are 66% more likely to complete the vaccine series than males (Choi, et al., 2016, p. 48). Reasons for this difference could be due to parents' belief or feelings toward the vaccine and provider's recommendation (Choi, et al., 2016). According to Choi, et al. (2016), the main reasons for not vaccinating males were that parents felt it was not necessary, providers did not recommend the vaccine, lack of knowledge, and parents believing their child was not sexually active, therefore the vaccine was not necessary. The main reasons for not vaccinating females were parents felt it was not necessary, providers' did not recommend the vaccine, lack of knowledge, and parental concerns for safety or unintended side effects (Choi, et al., 2016). Choi, et al. (2016) found that although vaccination rates increased slightly, they still remained lower for male adolescents when compared to females. They suggested that this could be due to the later recommendation of the vaccine for males (Choi, et al., 2016). This research indicates that differences in HPV vaccination rates exist between males and females at a national level, data from the Georgia Department of Public Health also suggests this difference, however, due to the lack of research for Georgia specifically, we do not know why these differences exist.

HPV Vaccination Completion

HPV vaccination completion is higher among non-Hispanic, white females when compared to black and Hispanic females (Galbraith, et al., 2016). Polonijo and Carpiano (2013) found a positive association between completion of series vaccination and mother's education. Black females have a 34% lower odds of not completing vaccination series than white, non-Hispanic females (Galbraith, et al., 2016). Holman, et al. (2015) suggested that barriers to completion of the 3-dose vaccine to be knowledge, health care access, physician specialty, and age of vaccine initiation. Nearly two-thirds of parents with partially vaccinated children reported they were not aware of the vaccine having 3 doses for completion (Lindley, et al., 2016). Lindley, et al. (2016) found that a majority of parents of partially vaccinated children had plans on fully vaccinating their children in the future. However, reasons for partial completion of the HPV vaccination series did not differ among gender (Lindley, et al., 2016). The most common report from parents of partially vaccinated adolescents was that they had plans to complete the series, but have not done so (Lindley, et al., 2016). Also, the most common response to reasons why parents had not fully completed the vaccine series was due to lack of knowledge that there was more than one shot (Lindley, et al., 2016). This information is important because it demonstrates that interventions may need to be targeted toward physicians to ensure that when they provide a recommendation, they make it clear that there are three shots to be completely protected against the types of HPV intended to be prevented. Again, this data was analyzed from the national sample collected by NIS-Teen, therefore, it may not be applicable to adolescents in Georgia. It is for this reason, data from Georgia specifically should be analyzed to determine reasons for and against HPV vaccination of adolescents in parents.

Vaccination completion was significantly declined with a later initiation (Richards, et al., 2016). Older adolescents and young adults are less likely to receive regular care, therefore, have a decreased change of HPV vaccine continuation and/or completion (Richards, et al., 2016). This is a problem because delaying vaccination initiation and completion risks the change of exposure to HPV (Richards, et al., 2016). According to Richards, et al. (2016), infection typically occurs between vaccine doses due to the lack of knowledge about the efficacy offered by incomplete vaccination series. Richards, et al. (2016) completed an electronic health record review of women from three

Colorado clinics to assess the opportunities for HPV vaccination that were missed by providers when older adolescents came in for care. Black and younger adolescents were less likely to receive vaccine initiation at these clinics, which could be due to lack of knowledge on the part of parents or self-and/or lack of confidence in the vaccine (Richards, et al., 2016). This demonstrates a common reason which is lack of knowledge, but also introduces a possibility of lack of trust or confidence in the vaccine as a reason to not receive the HPV vaccine, which is slightly different than the national data. Reasons could be largely different for Georgia, which provided another reason Georgia immunization data needs to be analyzed.

Summary

There is a gap in the literature related to what barriers are associated withlack of HPV vaccination initiation and completion in Georgia and whether this is due to lack of regular wellness visits, lack of parental knowledge, or lack of the primary care physician recommending the vaccine? To effectively establish an intervention, the reasons for the lack of initiation and completion of the HPV vaccine in Georgia must first be determined. Therefore, the purpose of this study was to examine the predictors of Human Papillomavirus (HPV) vaccination initiation and completion for male and female adolescents, ages 13 to 15 years old, living in Georgia between 2012 - 2015, depending on provider's recommendation, parental knowledge, and access to health care services.

The independent variables of this study were parental knowledge, providers' recommendation and access to health care services. The dependent variables of this study were HPV vaccine initiation and completion. However, the main outcome of the study is

HPV vaccine series completion. The covariates for this study are age, gender, and race.

Vaccination uptake has remained poor in Georgia, with 44% of females receiving all 3 doses of the vaccine and only 18% of males receiving all 3 doses of the HPV vaccine in 2014 (CDC, 2015). These vaccination rates were significantly lower than the Healthy People 2020 target of 80% vaccination coverage of male and female adolescents, ages 13 to 15 years old (CDC, 2015). We know from the literature review that common predictors of HPV vaccination initiation and completion for a select states range from parental knowledge, provider's recommendation, to insurance status. However, this information is not available specifically for Georgia adolescents. To develop and implement an intervention for Georgia to increase HPV vaccination coverage among male and female adolescents, we must first understand the predictors of 13 to 17-year-old males and females receiving the HPV vaccination. Findings from this study may serve as an impetus for future interventions to target specific variables, such as, providers and/or parents to increase HPV vaccination uptake and completion, which will lead to prevention of cervical cancer, potentially saving lives, reducing healthcare costs associated with care, and eliminating emotional strain associated with a HPV diagnosis.

Section 2: Research Design and Data Collection

Introduction

The purpose of this study was to examine the predictors of Human Papillomavirus (HPV) vaccination initiation and completion for male and female adolescents, ages 13 to 17 years old, living in Georgia between 2013 and 2015. The dependent variables in this study were HPV vaccine initiation, completion, and access to health care. The independent variables in this study were parental knowledge, geographic location, and providers' recommendation. The covariates for this study were age, gender, and race.

In this section, I discuss the design and rationale for this study. I also thoroughly discuss the methodology, target population, and sample size, which I justified by using a power analysis to determine that the sample size was appropriate and applicable to the adolescent population of Georgia. The data were collected through the NIS-teen household survey, which was developed by the CDC (2013). In this section, I describe the data analysis plan including the applied statistical tests, procedures I used to analyze the NIS-Teen data, test rationale, and how the results were interpreted. Beyond the data analysis plan, in this section I also detail threats to validity and ethical procedures as defined by the secondary dataset (NIS-Teen).

Research Design and Rationale

The dependent variables in this study were HPV vaccine initiation, HPV vaccination series completion, and access to health care. The independent variables in this study were parental knowledge, geographic location, and providers' recommendation. The covariates for this study were age, gender, and race. Most of the studies I synthesized in the literature review were quantitative in nature and utilized a survey method. The most typical survey method was non-experimental, meaning that there was not a control group and the design consisted of single observations (Trochim, 2006). Dorell et al. (2016), used this type of study design to analyze HPV vaccine coverage among female adolescents and their associated demographic characteristics. Among others, Smith et al. (2016) examined parental beliefs regarding the HPV vaccine and HPV immunization status using the 2010 NIS-Teen national dataset, which incorporated both the household survey and the primary care physician survey, both developed and administered by the CDC. Survey research has become an important domain in social science research (Trochim, 2006).

The survey design I used in this study provided non-experimental, cross-sectional, quantitative information that I used to determine the predictors of HPV vaccination among 13-17 year olds in Georgia. The survey design provided me a numeric description of the knowledge, providers' recommendations, and access to health care services of the study population, which may be generalizable to other male and female adolescents in Georgia (CDC, 2013). There are advantages to using this survey design, including quick data collection turnaround. The research questions were:

RQ1: What is the association between parental knowledge and HPV vaccination initiation and completion among adolescents in Georgia?

RQ2: What is the association between providers' recommendation and HPV vaccination initiation and completion among adolescents in Georgia?

RQ3: What is the association between access to health care services and HPV vaccination initiation and among adolescents in Georgia?

RQ4: What is the association between age, race, and gender at initiation of vaccination and the percentage of adolescents that initiate the HPV vaccination and complete the HPV vaccine series among adolescents in Georgia after controlling for parental knowledge, provider recommendation, and access to health care services?

To better understand the predictors of HPV vaccination in Georgia, I analyzed the 2013-2015 NIS-Teen data. NIS-Teen is a national survey implemented by the NCIRD and the NCHS of the CDC (2013). NIS-Teen seeks to estimate vaccine coverage rates among 13 to 17-year-old adolescents in the United States by using a random-digit dialing telephone survey that identifies households containing adolescents and interviews the adult who is most knowledgeable about the adolescent's medical history (CDC, 2013). The household survey asks questions about vaccines adolescents have received or not received, and why. It also collects detailed demographic data (CDC, 2013).

Population and Sample

Target Population

The NIS-Teen has a target population of male and female adolescents aged 13 to 17 years old, living in the United States. However, for this study, a subsection of the population, Georgia adolescents, was the target population. In 2013, approximately 429 participants had completed household interview surveys (CDC, 2013). Approximately 704,533 teen's households were interviewed and 657 teens had complete household interviews in 2014 (CDC, 2014). In 2015, approximately 599 participants had completed household interviews (CDC, 2015).

Sampling Procedures

In 2013-2015, adolescents aged 13-17, living in a non-institutionalized household in the United States were randomly selected and administered a household survey (CDC, 2014). NIS-Teen had two data collection phases: (a) a random digit dialing (RDD) survey, and (b) a provider record check. The RDD telephone interview phase used independent, quarterly samples of telephone numbers provides by Marketing Systems Group (MSG; CDC, 2014). MSG provided both landline and cell-phone numbers (CDC, 2014). The RDD sample of landline numbers used a random list of numbers from telephone number banks that contained at a minimum one residential telephone number (CDC, 2014). The cell-phone numbers were RDD without list assistance, and were selected from all banks (CDC, 2014). An automated procedure removed non-working and non-residential numbers, and numbers that were on the NIS do-not-call list from the land-line sample before interviewers have access to the numbers (CDC, 2014). Since 2014, an automated process has removed non-working and non-residential cell-phone numbers from the cell-phone sample (CDC, 2014).

Access to the Data Set

The NIS-Teen data set is a public use data file (PUF; CDC, 2005). All of the data are aggregate, meaning that there is not any individually identifiable data included in the PUF (CDC, 2005). Each year, the CDC makes available the dataset, a data user's guide, and a readme file (CDC, 2005). Researchers do not need to have an institutional review board (IRB) review the research project because the CDC holds documentation indicating that a HIPAA waiver was approved by IRB for this survey (CDC, 2015). However, Walden University does require IRB approval and can verify that the documentation provided by CDC adheres to HIPAA Privacy Rules (IRB applications in Appendix). Obtaining the PUF is simple because it is available on the CDC.gov website. The CDC provides a document that lists the steps for downloading NIS public-use data files.

Sample Size and Power

I used a power analysis to determine the appropriate sample size for this research project. Power refers to the probability of rejecting the hypothesis (Boslaugh, 2013). Boslaugh (2013), suggested that a standard power should be at least 80%, which refers to an 80% chance of finding results that are significant within the study population. Several factors affect power, including: alpha level, difference in outcome, variability, and sample size (Boslaugh, 2013). The standard alpha level is usually 0.05 or less because a larger value of alpha increases power (Boslaugh, 2013). Boslaugh (2013) said that increased differences in outcome can occur by improving the intervention to have a stronger effect, or by increasing expected differences in outcomes between chosen study groups. Reducing variability increases power and can be achieved by improving measurement or subject selection, such as by placing age restrictions or enforcing income level criteria (Boslaugh, 2013). However, in this study I could not control these factors. Sample size is the one factor that the researcher or experimenter does have control over. However, since I used a secondary data source, I had no control over this factor either.

The formula used to determine the sample size for an independent samples *t* test is below.

$$n = \frac{2(Z_{1-\alpha/2} + Z_{1-\beta})^2}{\delta^2}$$

Source: Boslaugh, 2013, p.158.

The *z* values were both calculated using a 95% confidence interval for a two-tailed test, so, the *z* values were 1.96 and 0.84 respectively. The effect size was 0.5, which was obtained by determining the difference between the two populations divided by the appropriate measure of variance. The sample size needed for an independent samples *t* test was determined to be 62.72 or 63 subjects per group to have an 80% probability of a significant difference between the groups with the effect size being 0.5.

Instrumentation and Operationalization of Published Instrument

The NIS-Teen household interview questionnaire was published in 2014 by the CDC, National Center for Immunization and Respiratory Diseases, and the National Center for Health Statistics (CDC, 2014). The NIS-Teen questionnaire was appropriate for this study because the target population was adolescents aged 13-17 living in the United States at the time of the interview, and because the questionnaire collects information down to the state-level on HPV vaccination (CDC, 2014). The data collected in this dataset are contained in a PUF, making them available to the public (CDC, 2014). Information regarding use of this data can be found in Appendix A. The publishers of this dataset run many quality assurance checks on the data, including online interview monitoring, provider look-ups database system, automated range-edits, and consistency checks (CDC, 2014). The error rate after the verification processes was less than 1% in

2014 (CDC, 2014). The NIS was one of the first national surveys, launched in 1994. Later the NIS-Teen was launched to monitor vaccination coverage among 13 to 17-year-old adolescents living in non-institutionalized households in the United States (CDC, 2015d).

Operationalization

The PUF consists of ten sections. However, I only used sections 1 (ID), 2 (household-reported vaccination history), 3 (demographics), and 4 (geographic variables). Variables and definitions from Sections 1, 2, 3, and 4 that I used in this survey are listed in Table 1 below.

Table 1

NIS Teen Public Use Data File Variables and Definitions Used in This Study

	PUF Variable Name	Definition
SECTION 1	HPVI_ANY_SC	HH report: Has teen ever received any HPV shots?
	HPVI_NUM_TOT	Number of HH-reported HPV shots received
SECTION 2	HPVI_ANY_REC	Does parent / guardian recall the teen getting any HPV vaccinations
	HPVI_NUM_REC	If teen has received any HPV vaccinations, how many of the shots does the parent/guardian recall teen receiving
	HPVI_REAS_28 HPVI_REAS_3	If parent/guardian reports that teen will not receive the HPV vaccine, what are the reason(s) why the teen won't receive the HPV vaccinations in the next 12 months
	HPVI_RECOM	If teen has received the HPV vaccinations, did a doctor or other health care professional recommend the teen receive the HPV vaccinations
SECTION 3	AGE	Age of the selected teen in years based on date of birth
	SEX	Gender of selected teen
	I_HIPS_K RACE_K	Race/Ethnicity
SECTION 4	STATE	True state of residence

Note.: Adapted from *National Immunization Survey-Teen: A user's guide for the 2014 public-use data file*, 2014, by the CDC.

Each variable was collected via a RDD survey, under the control of the CDC (CDC, 2014). People in the call center have a script they read from, and they move through the survey questions based on the respondent's answer to each question (CDC, 2014). Most of the questions have categorical answers that are listed out for the interviewer; if the respondent has an answer that does not match one of the responses, the interviewer can either try to further clarify the response or mark "other," "don't know," or "refused" (CDC, 2014).

After the data were collected, several steps were performed to clean the dataset (CDC, 2014). The computer-assisted telephone interviewing system (CATI) allows the interviewer to resolve errors in the collected data while the respondent is on the telephone (CDC, 2014). After the CATI stage, a broad review of the data values, cross tabulations, and response recoding took place (Centers for Disease Control and Prevention, 2014). After the dataset was cleaned, imputations were implemented for non-response variables and weights were calculated (CDC, 2014). Variables were renamed following a systematic pattern; for example, in Section B, the question referring to providers' recommendation for the HPV vaccine is coded as BHPV_RECOM (CDC, 2014). Missing value codes in the household interview survey were coded as "77 for don't know and 99 for refused" (CDC, 2014). Imputation was used to replace missing values that were used in weighting (CDC, 2014). Sampling weights were calculated using the dual-frame RDD-phase weight variable to produce estimates for the household interview (CDC, 2014). Sample weights provided the approximate numbers of teens that the sample of the target population represents (CDC, 2014). For example, the estimate of the total number of teens within the target population that will not receive the HPV vaccine is calculated by the sum of sampling weights of teens that are not going to receive the HPV vaccine; then the sum of these sampling weights are divided by the total of the sampling weights for all teens (CDC, 2014).

Data Analysis Plan

I analyzed the data using SPSS 21.0 for Mac. Descriptive statistics were performed on the following demographics: race, age, and gender. Statistical tests were based on the alpha level ($\alpha = 0.5$) for statistical significance. The decision to reject the null hypothesis was based on the *p* value. If a *p* value of less than or equal to 0.05 was obtained, the null hypothesis was rejected. If a *p* value of greater than 0.05 was obtained, the null hypothesis was retained.

Statistical Analysis for Research Question 1

The first research question and related hypotheses were:

RQ1: Is there any association between parental knowledge and HPV vaccination initiation and completion among adolescents in Georgia?

H_o1: There is an association between parental knowledge and HPV vaccination initiation and completion among adolescents in Georgia?

H_a1: There is no association between parental knowledge and HPV vaccination initiation and completion among adolescents in Georgia?

I used logistic regression to test the extent to which parental knowledge related to the reason for vaccinating or not vaccinating a teen.. Logistic regression was used to determine the significance of the results obtained and to decide whether to reject or retain the null hypothesis.

Statistical Analysis for Research Question 2

The second research question and associated hypotheses were:

RQ2: Is there any association between providers' recommendation and HPV vaccination initiation and completion among adolescents in Georgia?

H_o2: There is an association between providers' recommendation and HPV vaccination initiation and completion among adolescents in Georgia?

H_a2: There is no association between providers' recommendation and HPV vaccination initiation and completion among adolescents in Georgia?

I used logistic regression to test the extent to which providers' recommendation related to the reason for vaccinating or not vaccinating a teen. Logistic regression was used to determine the significance of the results obtained and to decide whether to reject or retain the null hypothesis.

Statistical Analysis for Research Question 3

The third research question for this study is:

RQ3: Is there any association between access to health care services and HPV vaccination initiation and completion among adolescents in Georgia?

H_o3: There is an association between access to health care services and HPV vaccination initiation and completion among adolescents in Georgia?

H_a3: There is no association between access to health care services and HPV vaccination initiation and completion among adolescents in Georgia?

I used logistic regression to test the extent to which access to health care services related to the reason for vaccinating or not vaccinating a teen. Logistic regression was used to determine the significance of the results obtained and to decide whether to reject or retain the null hypothesis.

Statistical Analysis for Research Question 4

The fourth research question for this study was:

RQ4: Is there an association between age, race, and gender at initiation of vaccination and the percentage of adolescents that initiate the HPV vaccination and complete the HPV vaccine series among adolescents in Georgia after controlling for parental knowledge, provider recommendation, and access to health care services?

H_o4: There is an association between age, race, and gender at initiation of vaccination and the percentage of adolescents that initiate the HPV vaccination and complete the HPV vaccine series among adolescents in Georgia after controlling for parental knowledge and provider recommendation?

H_a4: There is no association between age, race, and gender at initiation of vaccination and the percentage of adolescents that initiate the HPV vaccination and complete the HPV vaccine series among adolescents in Georgia after controlling for parental knowledge and provider recommendation?

I used logistic regression to test the extent to which age, gender, and race related to the reason for vaccinating or not vaccinating a teen. Logistic regression was used to determine the significance of the results obtained and to decide whether to reject or retain the null hypothesis.

I am aware that data cleaning could drastically improve data quality because unclean data could potentially threaten reliability and correctness of the study. Data cleaning refers to a process used to identify inaccurate, incomplete, or improbable data, then correcting these errors if and when possible (CDC, 2013). Data cleaning is typically performed in a two-step process including: detection and correction (CDC, 2013b). The NIS-Teen dataset is put through a rigorous cleaning process, as described earlier, to ensure that the data are free of entry errors, duplication, and missing information (CDC, 2014). The data was cleaned before analysis to remove cases that had missing data or if the participant noted 77/I don't know. Cases that were given 77, were treated as missing data.

Threats to Validity

Validity refers to the accuracy of data, meaning that the research instrument measured what it was intended to measure (Yilmaz, 2013). Internal validity is referred to as a causal relationship between the independent and outcome variables (Yilmaz, 2013). External validity refers to whether or not the research findings are generalizable (Yilmaz, 2013). Construct validity refers to the degree to which conclusions can be ascertained from the operationalization of the study to the theoretical model that the study is based upon (Yilmaz, 2013).

This study investigated the extent to which parental knowledge, provider's recommendation, and access to health care services affects HPV vaccination initiation and completion among adolescents, aged 13 to 17 years old, living in Georgia. The NIS-Teen was a cross-sectional study, which may be disposed to recall bias due to the self-reporting survey data collection method used to collect immunization histories. Validity of telephone interviews can be suspect due to respondents providing inaccurate or untrue responses that could lead to over reporting (Mickalide, 1997). Face validity could be threatened due to questions not yielding measureable information (Mickalide, 1997). Surveys with low face validity typically have many "don't know" responses to questions (Mickalide, 1997). Survey questions could be intrusive, forcing choices for answers that are yes/no, rather than offering categorical or ordinal choices (Mickalide, 1997). Surveys with questions such as these may force respondents to give untrue answers, especially, when answering questions about their children (Mickalide, 1997). Mickalide (1997) said that parents want to see themselves as protectors of their children and if a question is asked that may make a parent come off as careless, he or she may be forced to give an untruthful answer. Inconsistency in respondent answers could also threaten validity, which can be examined through trend analysis (Mickalide, 1997).

This study used the NIS-Teen, an established database with a sample that represents non-institutionalized adolescents, ages 13 to 17 living in Georgia and principal source of data of health information sponsored by the Centers for Disease Control and Prevention through the National Center for Immunization and Respiratory Disease. Pre-tested standardized survey questions were administered by trained personnel, limiting threats to validity of the survey (Centers for Disease Control and Prevention, 2014). To validate early NIS results, estimates of demographic and immunization estimates were compared to other source data, including: The National Health Interview Survey (NHIS), The Current Population Survey (CPS), The National Immunization Provider Record Check Study (NIPRCS), and Vital Statistics (Centers for Disease Control and Prevention, 2002).

Ethical Procedures

The trained interviewers obtain oral consent to assure confidentiality to the respondent. The National Center of Health Statistics (NCHS) has set and implemented standards for release of all survey data to ensure privacy of respondents. Certain items from the questionnaires are not included in the PUF to prevent participant identification (Centers for Disease Control and Prevention, 2014). Some of the variables are coded or have collapsed categories to ensure participant confidentiality (Centers for Disease Control and Prevention, 2014).

The NIS-Teen data set is a public use data file (PUF) (Centers for Disease Control and Prevention, 2005). All of the data are aggregate, meaning that there is not any individually, identifiable data included in the PUF (Centers for Disease Control and Prevention, 2005). Each year, CDC makes available the dataset, a data user's guide, and a readme file (Centers for Disease Control and Prevention, 2005).

Summary

This was a cross-sectional, quantitative study using a secondary data source. I analyzed data from the NIS-Teen survey, collected and managed by the Centers for Disease Control and Prevention for the years 2013 – 2015. I examined the predictors of Human Papillomavirus (HPV) vaccination initiation and completion for male and female adolescents, ages 13 to 17 years old, living in Georgia between 2013 - 2015, depending on provider's recommendation, parental knowledge and access to health care services. The data was analyzed using SPSS 21.0 for Mac to examine the relationship among providers' recommendation, parental knowledge, and access to health care and HPV vaccination initiation and completion. A description of how the data were collected and analyzed can be found below.

Section 3: Presentation of the Results and Findings Section

Introduction

The purpose of this study was to analyze data from the NIS-Teen survey, collected and managed by the CDC, for the years 2013–2015. I examined the predictors of HPV vaccination initiation and completion for male and female adolescents, ages 13 to 17 years old, living in Georgia between 2013 and 2015, depending on providers' recommendation, parental knowledge, and access to health care services. The research questions were:

RQ1: Is there any association between parental knowledge and HPV vaccination initiation and completion among adolescents in Georgia?

RQ 2: Is there any association between providers' recommendation and HPV vaccination initiation and completion among adolescents in Georgia?

RQ 3: Is there any association between access to health care services and HPV vaccination initiation and completion among adolescents in Georgia? and

RQ:4: Is there an association between age, race, and gender at initiation of vaccination and the percentage of adolescents that initiate the HPV vaccination and complete the HPV vaccine series among adolescents in Georgia after controlling for parental knowledge and provider recommendation? In this section, I describe the data collection process and timeframe used by the CDC in the NIS-Teen dataset, discuss the results from statistical analyses I performed on the data, and provide a summary of the findings.

Data Collection of the Secondary Data Set

NIS-Teen is a RDD telephone survey that uses independent, quarterly samples of telephone numbers obtained from MSG of both landline and cell-phone numbers within estimation areas during each annual survey period (CDC, 2014). Every year four sets of numbers are provided by MSG, one set per quarter throughout the year (CDC, 2014). The RDD method is used to select random telephone numbers from telephone number banks of 100 consecutive numbers (CDC, 2014). The sampling banks contain a minimum of one directory-listed residential number, meaning that the landline sample is list-assisted (CDC, 2014). However, there is not a directory listing of cell phone numbers, so the cell phone sample is RDD, but not list-assisted (CDC, 2014).

The target sample size of telephone interviews aims to achieve approximately 6.5% coefficient of variation for an estimator of vaccination coverage, which was derived from vaccination histories reported by providers, meaning that 6.5% of the data should be equal to the mean. The screener completion rate in 2013 was 71.1% (CDC, 2013). *Screener completion rate* describes the percent of participants who were successfully screened, or those who completed the entire telephone interview (CDC, 2013). In 2014, the screener completion rate was 72.9% (CDC, 2011). In 2015, the screener completion rate was 82.6% (CDC, 2015).

In 2013, the estimated population of teens in Georgia was 696,071 CDC, 2013). Four hundred twenty-nine teens had completed household interviews in 2013 (CDC, 2013). Of the 429 completed surveys, 144 had complete data that I used in the analyses for 2013. In 2014, the estimated population of teens in Georgia was 704,533 (CDC, 2014). Six hundred fifty-seven teens had completed household interviews in 2014 (CDC, 2014). Of the 657 completed surveys, 230 had no missing data and were used in my analyses. In 2015, the estimated population of teens in Georgia was 708,217 (CDC, 2015). Seven hundred seventy teens had completed household interviews in 2015 (CDC, 2015). Of the 770, 253 had no missing data and were used in my analyses.

Data from the NIS-Teen data sets can be used to produce state estimates of vaccination coverage using the weighted estimates (CDC, 2014). Data from these files can also be used to calculate standard errors of estimated vaccination coverage rates by state and estimation area (CDC, 2014). Demographic variables can be used to obtain national vaccination coverage rates, however these rates may have high standard error for some state and/or estimation areas, therefore CDC (2015) recommends the standard error to the estimate should be less than or equal to 0.03, and should contain a minimum of 30 respondents.

The NIS-Teen data sets use sampling weights to reflect the stratified sample design and to adjust for non-response, number of telephone lines in a household, combining landline and cell-phone samples, and for post-stratification to population control totals (CDC, 2014). Reagan-Steiner, Yankey, Jeyarajah, et al. (2016) reported that 54.4% of female adolescents in Georgia had received the initial shot of the HPV vaccine series, 38.7% received the second dose, and 32.3% received the final dose or completed the HPV series. They also reported that 51.0% of male adolescents in Georgia received the initial shot of the HPV vaccine series, 42.5% received the second dose, and 27.5% received the final dose or completed the HPV vaccine series (Reagan-Steiner, Yankey, Jeyarajah, et al., 2016). These authors reported that there was a statistically significant decrease in the percentage of females who received the second and final doses of the vaccine, and statistically more males received the second dose of the vaccine (Reagan-Steiner, Yankey, Jeyarajah, et al., 2016). Although much success has been seen in HPV vaccination initiation, Georgia still remains among the lowest of all states and the District of Columbia for vaccination among female adolescents, and among the middle of the national average for male HPV vaccine initiation (Reagan-Steiner, Yankey, Jeyarajah, et al., 2016).

Statistical Assumptions

Logistic regression requires the researcher to make several assumptions. The first assumption is that there is one dichotomous dependent variable (Laerd Statistics, 2016). The dependent variables of this study are consistent with this assumption because there are two possible outcomes for the dependent variables: Vaccine initiation (yes/no) and vaccine completion (yes/no). The second assumption to consider when running logistic regression is that you must have one or more continuous or nominal variables (Laerd Statistics, 2016). The independent variables of this study are consistent with this assumption, as they are: lack of knowledge, provider's recommendation, and access to health care services. The third assumption is that you should have independence of observations and the categories of the dichotomous dependent variables and all nominal independent variables should be mutually exclusive and exhaustive (Leard Statistics, 2016). Independence of observations is described as having no relationship between observations in dependent variable categories or in any of the nominal independent variables (Leard Statistics, 2016). In this study, teens could have either initiated the HPV vaccine series or completed the vaccination series. Also, parents could not have answered "yes" and "no," both for lack of knowledge, provider's recommendation, and access to health care services. The fourth assumption is that you should have 15 cases per independent variable at a minimum (Laerd Statistics, 2016). This condition has not been met as access to health care was not indicated as a reason to not vaccinate for the data. To meet this assumption, this variable was not analyzed. Assumption five is that there should be a linear relationship between the continuous independent variables and the logit transformation of the dependent variable (Laerd Statistics, 2016). The sixth assumption is that there should be no multicollinearity (Leard Statistics, 2016). Multicollinearity was tested for all of the data by running logistic regression and looking for VFI numbers above 2. This assumption was met, as none of the data indicated multicollinearity. The final assumption is that there should be no significant outliers, leverage or influential points (Laerd Statistics, 2016). Assumptions five, six, and seven were tested in SPSS by using the casewise list table where the cases with studentized residuals greater than +/- 3 standard deviations, if indicated by residual values greater than 2.5 were further inspected and removed if necessary.

Results

Research Question 1 was: Is there any association between parental knowledge and HPV vaccination initiation and completion among adolescents in Georgia? To answer this question, I performed a binomial logistic regression on NIS-Teen 2013 data for Georgia to ascertain the effects of parental knowledge on the likelihood that participants would initiate HPV vaccination. Linearity of the continuous variable with respect to the logit of the dependent variable was assessed using the Box-Tidwell (1962) procedure. A Bonferroni correction was applied using all seven terms in the model, resulting in a statistical significance being accepted when $p < 0.007143$ (see Tabachnick & Fidell, 2007). Based on this assessment, I found the continuous independent variable to be linearly related to the logit of the dependent variable. The logistic regression model was statistically significant, $X^2(7) = 134.624$, $p < 0.0005$. The model explained 41.6% (Nagelkerke R^2) of the variance in initiating HPV vaccination and correctly classified 73.1% of cases. Sensitivity was 66.2%, specificity was 77.4%, positive predictive value was 64.8%, and negative predictive value was 78.5%. Lack of parental knowledge did significantly impact HPV vaccination initiation. However, I did not accept this interpretation due to a low number of respondents, indicating that lack of knowledge was indeed a reason for not vaccinating their child. Out of the 368 respondents, only 19 indicated lack of knowledge as a reason for not vaccinating; therefore, this was not accepted. A binomial logistic regression could not be performed on NIS 2013 data for Georgia to ascertain the effects of parental knowledge on the likelihood that participants would complete the HPV vaccine series. This could not be performed due to the organization of data collection. Data were only collected on lack of knowledge if a respondent indicated they would not or had not vaccinated their teen for HPV.

Table 2

Logistic regression predicting HPV vaccine initiation based on Lack of Parental Knowledge, 2013

	B	S.E	DF	Significance	95% CI	
					Lower	Upper
Lack of Parental Knowledge	2.303	0.860	1	0.007	1.852	54.024

I performed a binomial logistic regression on NIS-Teen 2014 data for Georgia to ascertain the effects of parental knowledge on the likelihood that participants would initiate HPV vaccination. Linearity of the continuous variable with respect to the logit of the dependent variable was assessed using the Box-Tidwell (1962) procedure. A Bonferroni correction was applied using all eight terms in the model resulting in a statistical significance being accepted when $p < 0.00625$ (see Tabachnick & Fidell, 2007). Based on this assessment, I found the continuous independent variable to be linearly related to the logit of the dependent variable. The logistic regression model was statistically significant, $X^2(8) = 227.272$, $p < 0.0005$. The model explained 43.2% (Nagelkerke R^2) of the variance in initiating HPV vaccination and correctly classified 77.5% of cases. Sensitivity was 86.4%, specificity was 70.0%, positive predictive value was 70.7%, and negative predictive value was 86.1%. Lack of parental knowledge did significantly impact HPV vaccination initiation. However, I did not accept this interpretation due to a low number of respondents indicating that lack of knowledge was indeed a reason for not vaccinating their child. Out of the 582 respondents, only 29 indicated lack of knowledge as a reason for not vaccinating; therefore, this was not accepted. A binomial logistic regression could not be performed on NIS-Teen 2014 data for Georgia to ascertain the effects of parental knowledge on the likelihood that participants would complete the HPV vaccine series. This could not be performed due to the organization of data collection. Data were only collected on lack of knowledge if a respondent indicated they would not or had not vaccinated their teen for HPV.

Table 3

Logistic regression predicting HPV vaccine initiation based lack of Parental Knowledge, 2014

	B	S.E.	DF	Sig.	95% CI	
					Lower	Upper
Lack of Parental Knowledge	2.580	1.682	1	0.000	3.643	47.823

I performed a binomial logistic regression on NIS-Teen 2015 data for Georgia to ascertain the effects of parental knowledge on the likelihood that participants would initiate HPV vaccination. Linearity of the continuous variable with respect to the logit of the dependent variable was assessed using the Box-Tidwell (1962) procedure. A Bonferroni correction was applied using all seven terms in the model resulting in a statistical significance being accepted when $p < 0.007143$ (see Tabachnick & Fidell, 2007). Based on this assessment, I found the continuous independent variable to be linearly related to the logit of the dependent variable. The logistic regression model was statistically significant, $X^2(7) = 231.198$, $p < 0.0005$. The model explained 42.7% (Nagelkerke R^2) of the variance in initiating HPV vaccination and correctly classified

77.0% of cases. Sensitivity was 93.3%, and specificity was 62.3%. Lack of parental knowledge did significantly impact HPV vaccination initiation. However, I did not accept this interpretation due to a low number of respondents, indicating that lack of knowledge was indeed a reason for not vaccinating their child. Out of the 599 respondents, only 27 indicated lack of knowledge as a reason for not vaccinating, therefore, this was not accepted. I could not perform a binomial logistic regression on NIS-Teen 2015 data for Georgia to ascertain the effects of parental knowledge on the likelihood that participants would complete the HPV vaccine series. This could not be performed due to the organization of data collection. Data were only collected on lack of knowledge if a respondent indicated they would not or had not vaccinated their teen for HPV.

Table 4

Logistic regression predicting HPV vaccine initiation based on Lack of Parental Knowledge, 2015

	B	S.E.	DF	Sig.	95% CI	
					Lower	Upper
Lack of Knowledge	2.239	0.795	1	0.005	1.975	44.595

Research question 2 was: Is there any association between providers' recommendation and HPV vaccination initiation and completion among adolescents in Georgia? A binomial logistic regression was performed on NIS Teen 2013 data for Georgia to ascertain the effects of providers' recommendation on the likelihood that participants would initiate the HPV vaccine series. Linearity of the continuous variable with respect to the logit of the dependent variable was assessed using the Box-Tidwell (1962) procedure. A Bonferroni correction was applied using all 7 terms in the model resulting in a statistical significance being accepted when $p < 0.007143$ (Tabachnick & Fidell, 2007). Based on this assessment the continuous independent variable was found to be linearly related to the logit of the dependent variable. The logistic regression model was statistically significant, $X^2(7) = 134.624$, $p < 0.0005$. The model explained 41.6% (Nagelkerke R^2) of the variance in initiating HPV vaccination and correctly classified 73.1% of cases. Sensitivity was 66.2%, specificity was 77.4%, positive predictive value was 64.82% and negative predictive value was 78.48%. Participants that received a provider's recommendation were 3 times less likely to initiate the HPV vaccine series. A binomial logistic regression was performed on NIS 2013 data for Georgia to ascertain the effects of provider's recommendation on the likelihood that participants would complete the HPV vaccine series. Linearity of the continuous variable with respect to the logit of the dependent variable was assessed using the Box-Tidwell (1962) procedure. A Bonferroni correction was applied using all 6 terms in the model resulting in a statistical significance being accepted when $p < 0.00833$ (Tabachnick & Fidell, 2007). Based on this assessment the continuous independent variable was found to be linearly related to the logit of the dependent variable. The logistic regression model was statistically significant, $X^2(6) = 71.634$, $p < 0.0005$. The model explained 26.3% (Nagelkerke R^2) of the variance in completing the HPV vaccine series and correctly classified 76.4% of cases. Sensitivity was 24.2%, specificity was 93.5%. Provider's recommendation did significantly impact HPV vaccine completion. Those that received a provider's recommendation were 2 times less likely to complete the vaccine series.

Table 5

Logistic regression predicting HPV vaccine initiation based on Provider's recommendation, 2013

	B	S.E	DF	Significance	95% CI	
					Lower	Upper
Provider Recommended	-3.014	0.363	1	0.000	0.024	0.100

Table 6

Logistic regression predicting HPV vaccine completion based on Provider's recommendation, 2013

	B	S.E.	DF	Sig.	95% CI	
					Lower	Upper
Provider Recommended	-2.361	0.418	1	0.000	0.042	0.214

A binomial logistic regression was performed on NIS Teen 2014 data for Georgia to ascertain the effects of provider's recommendation on the likelihood that participants would initiate HPV vaccination. Linearity of the continuous variable with respect to the logit of the dependent variable was assessed using the Box-Tidwell (1962) procedure. A Bonferroni correction was applied using all 8 terms in the model resulting in a statistical significance being accepted when $p < 0.00625$ (Tabachnick & Fidell, 2007). Based on this assessment the continuous independent variable was found to be linearly related to the logit of the dependent variable. The logistic regression model was statistically significant, $X^2(8) = 227.272$, $p < 0.0005$. The model explained 43.2% (Nagelkerke R^2) of the variance in initiating HPV vaccination and correctly classified 77.5% of cases. Sensitivity was 86.4%, specificity was 70.0%, positive predictive value was 70.7% and negative predictive value was 86.1%. Provider's recommendation was statistically significant. Participants that received a provider's recommendation were two times less likely to initiate the HPV vaccine series. A binomial logistic regression was performed on NIS Teen 2014 data for Georgia to ascertain the effects of provider's recommendation on the likelihood that participants would complete the HPV vaccine series. Linearity of the continuous variable with respect to the logit of the dependent variable was assessed using the Box-Tidwell (1962) procedure. A Bonferroni correction was applied using all 6 terms in the model resulting in a statistical significance being accepted when p < 0.008333 (Tabachnick & Fidell, 2007). Based on this assessment the continuous independent variable was found to be linearly related to the logit of the dependent variable. The logistic regression model was statistically significant, $X^2(6) = 86.804$, $p < 0.0005$. The model explained 20.4% (Nagelkerke R^2) of the variance in completing the HPV vaccine series and correctly classified 74.7% of cases. Sensitivity was 16.1%, specificity was 94.9%. Provider's recommendation did significantly impact HPV vaccine completion. Those that received a provider's recommendation were less likely to complete the HPV vaccination series.

Table 7

Logistic regression predicting HPV vaccine initiation based on Provider's recommendation, 2014

	B	S.E.	DF	Sig.	95% CI	
					Lower	Upper
Provider Recommended	-2.621	0.230	1	0.000	8.754	21.594

Table 8

Logistic regression predicting HPV vaccine completion based on Provider's recommendation, 2014

	B	S.E.	DF	Sig.	95% CI	
					Lower	Upper
Provider Recommended	-1.808	0.263	1	0.000	0.098	0.275

A binomial logistic regression was performed on NIS Teen 2015 data for Georgia to ascertain the effects of provider's recommendation on the likelihood that participants would initiate HPV vaccination. Linearity of the continuous variable with respect to the logit of the dependent variable was assessed using the Box-Tidwell (1962) procedure. A Bonferroni correction was applied using all 7 terms in the model resulting in a statistical significance being accepted when $p < 0.007143$ (Tabachnick & Fidell, 2007). Based on this assessment the continuous independent variable was found to be linearly related to the logit of the dependent variable. The logistic regression model was statistically significant, $X^2(7) = 231.198$, $p < 0.0005$. The model explained 42.7% (Nagelkerke R^2) of the variance in initiating HPV vaccination and correctly classified 77.0% of cases. Sensitivity was 93.3%, specificity was 62.3%. Provider's recommendation was statistically significant. Participants that received a provider's recommendation were three times less likely to initiate the HPV vaccine series (Table 4). A binomial logistic regression was performed on NIS Teen 2015 data for Georgia to ascertain the effects of provider's recommendation on the likelihood that participants would complete the HPV vaccine series. Linearity of the continuous variable with respect to the logit of the dependent variable was assessed using the Box-Tidwell (1962) procedure. A Bonferroni correction was applied using all 6 terms in the model resulting in a statistical significance being accepted when $p < 0.008333$ (Tabachnick & Fidell, 2007). Based on this assessment the continuous independent variable was found to be linearly related to the logit of the dependent variable. The logistic regression model was statistically significant, $X^2(6) = 105.250$, $p < 0.0005$. The model explained 23.8% (Nagelkerke R^2) of the variance in completing the HPV vaccine series and correctly classified 74.8% of cases. Sensitivity was 10.5%, specificity was 96.6%. Provider's recommendation did significantly impact HPV vaccine completion. Those who received a provider's recommendation were two times less likely to complete the HPV vaccination series in 2015.

Table 9

Logistic regression predicting HPV vaccine initiation based on Provider's recommendation, 2015

	B	S.E.	DF	Sig.	95% CI	
					Lower	Upper
Provider Recommended	-3.148	0.280	1	.0000	0.025	0.074

Table 10

Logistic regression predicting HPV vaccine completion based on Provider's recommendation, 2015

	B	S.E.	DF	Sig.	95% CI	
					Lower	Upper
Provider Recommended	-2.698	0.380	1	0.000	0.032	0.142

Research Question 3 was: Is there any association between access to health care services and HPV vaccination initiation and completion among adolescents in Georgia? A binomial logistic regression could not be performed on NIS Teen 2013 data for Georgia to ascertain the effects of access (does not have a doctor or no doctor's visit scheduled) on the likelihood that participants would initiate and or complete the HPV vaccine series. This could not be performed due to zero respondents indicating having no doctor or no doctor's visit scheduled as a reason for not vaccinating.

A binomial logistic regression could not be performed on NIS Teen 2014 data for Georgia to ascertain the effects of access (does not have a doctor or no doctor's visit scheduled) on the likelihood that participants would initiate and or complete HPV vaccination. This could not be performed due to zero respondents indicating having no doctor or no doctor's visit scheduled as a reason for not vaccinating.

A binomial logistic regression could not be performed on NIS Teen 2015 data for Georgia to ascertain the effects of access (does not have a doctor or no doctor's visit scheduled) on the likelihood that participants would initiate and or complete HPV vaccination. This could not be performed due to zero respondents indicating having no doctor or no doctor's visit scheduled as a reason for not vaccinating

Research question 4 was: Is there an association between age, race, and gender at initiation of vaccination and the percentage of adolescents that initiate the HPV vaccination and complete the HPV vaccine series among adolescents in Georgia after controlling for parental knowledge and provider recommendation? A binomial logistic regression was performed on NIS Teen 2013 data for Georgia to ascertain the effects of age, race, and gender on the likelihood that participants would initiate the HPV vaccine series. Linearity of the continuous variable with respect to the logit of the dependent variable was assessed using the Box-Tidwell (1962) procedure. A Bonferroni correction was applied using all 7 terms in the model resulting in a statistical significance being accepted when $p < 0.007143$ (Tabachnick & Fidell, 2007). Based on this assessment the continuous independent variable was found to be linearly related to the logit of the dependent variable. The logistic regression model was statistically significant, $X^2(7) = 134.624$, $p < 0.0005$. The model explained 41.6% (Nagelkerke R^2) of the variance in initiating HPV vaccination and correctly classified 73.1% of cases. Sensitivity was 66.2%, specificity was 77.4%, positive predictive value was 64.8% and negative predictive value was 78.5%. Although the model was significant, the variables age, gender, and race did not significantly impact initiation of HPV vaccine series. A binomial logistic regression was performed on NIS 2013 data for Georgia to ascertain the effects of age, race, and gender on the likelihood that participants would complete the HPV vaccine series. Linearity of the continuous variable with respect to the logit of the dependent variable was assessed using the Box-Tidwell (1962) procedure. A Bonferroni correction was applied using all 6 terms in the model resulting in a statistical significance being accepted when $p < 0.008$ (Tabachnick & Fidell, 2007). Based on this assessment the continuous independent variable was found to be linearly related to the logit of the dependent variable. The logistic regression model was statistically significant, $X^2(6) = 71.634$, $p < 0.0005$. The model explained 26.3% (Nagelkerke R^2) of the variance in completing the HPV vaccine series and correctly classified 76.4% of cases. Sensitivity was 24.2%, specificity was 93.5%. Although the model was significant, variables age, gender, and race did not significantly impact initiation of HPV vaccine series.

Table 11

Logistic regression predicting HPV vaccine initiation Age, Race, and Gender, 2013

	B	S.E	DF	Significance	95% CI	
					Lower	Upper
Age	-9.649	9.002	1	0.284	0.000	2965.032
Hispanic	-1.015	0.432	1	0.019	0.155	0.845
Race	0.709	0.287	1	0.014	1.157	3.565
Gender	0.081	0.268	1	0.761	0.642	1.833

Table 12

Logistic regression predicting HPV vaccine completion based on Age, Race, and Gender, 2013

	B	S.E.	DF	Sig.	95% CI	
					Lower	Upper
Age	-0.579	9.157	1	0.004	0.000	34934210.3
Hispanic	0.596	0.496	1	0.230	0.686	4.799
Race	-0.185	0.291	1	0.525	0.469	1.471
Gender	0.675	0.279	1	0.015	1.137	3.393

A binomial logistic regression was performed on NIS Teen 2014 data for Georgia to ascertain the effects of age, race, and gender on the likelihood that participants would initiate HPV vaccination. Linearity of the continuous variable with respect to the logit of the dependent variable was assessed using the Box-Tidwell (1962) procedure. A Bonferroni correction was applied using all 8 terms in the model resulting in a statistical significance being accepted when $p < 0.00625$ (Tabachnick & Fidell, 2007). Based on this assessment the continuous independent variable was found to be linearly related to the logit of the dependent variable. The logistic regression model was statistically significant, $X^2(8) = 227.272$, $p < 0.0005$. The model explained 43.2% (Nagelkerke R^2) of the variance in initiating HPV vaccination and correctly classified 77.5% of cases. Sensitivity was 86.4%, specificity was 70.0%, positive predictive value was 70.7% and negative predictive value was 86.1%. Of the variables tested, gender was statistically significant ($p < 0.0005$). Males were more likely than females to initiate the HPV vaccine. A binomial logistic regression was performed on NIS Teen 2014 data for Georgia to ascertain the effects of age, gender, and race on the likelihood that participants would complete the HPV vaccine series. Linearity of the continuous variable with respect to the logit of the dependent variable was assessed using the Box-Tidwell (1962) procedure. A Bonferroni correction was applied using all 6 terms in the model resulting in a statistical significance being accepted when $p < 0.00833$ (Tabachnick & Fidell, 2007). Based on this assessment the continuous independent variable was found to be linearly related to the logit of the dependent variable. The logistic regression model was statistically significant, $X^2(6) = 86.804$, $p < 0.0005$. The model explained 20.4% (Nagelkerke R^2) of the variance in completing the HPV vaccine series and correctly classified 74.7% of cases. Sensitivity was 16.1%, specificity was 94.9%. Although the model was significant, variables age, gender, and race did not significantly impact completion of HPV vaccine series.

Table 13

Logistic regression predicting HPV vaccine initiation based on Age, Race, and Gender, 2014

	B	S.E.	DF	Sig.	95% CI	
					Lower	Upper
Age	9.660	6.872	1	0.160	0.022	1.108 E+10
Hispanic	-0.094	0.384	1	0.806	0.429	1.931
Race	0.213	0.223	1	0.340	0.799	1.915
Gender	0.873	0.209	1	0.000	1.590	3.607

Table 14

Logistic regression predicting HPV vaccine completion based on Age, Race, and Gender, 2014

	B	S.E.	DF	Sig.	95% CI	
					Lower	Upper
Age	3.280	6.807	1	0.630	0.000	16537423.4
Hispanic	0.803	0.449	1	0.073	0.927	5.381
Race	-0.378	0.223	1	0.091	0.442	1.062
Gender	0.532	0.212	1	0.012	1.124	2.577

A binomial logistic regression was performed on NIS Teen 2015 data for Georgia to ascertain the effects of age, gender, and race on the likelihood that participants would initiate HPV vaccination. Linearity of the continuous variable with respect to the logit of the dependent variable was assessed using the Box-Tidwell (1962) procedure. A Bonferroni correction was applied using all 7 terms in the model resulting in a statistical significance being accepted when $p < 0.007143$ (Tabachnick & Fidell, 2007). Based on this assessment the continuous independent variable was found to be linearly related to the logit of the dependent variable. The logistic regression model was statistically significant, $X^2(7) = 231.198$, $p < 0.0005$. The model explained 42.7% (Nagelkerke R^2) of the variance in initiating HPV vaccination and correctly classified 77.0% of cases. Sensitivity was 93.3%, specificity was 62.3%. Although the model was significant, variables age, gender, and race did not significantly impact initiation of HPV vaccine series. A binomial logistic regression was performed on NIS Teen 2015 data for Georgia to ascertain the effects of age, gender, and race on the likelihood that participants would complete the HPV vaccine series. Linearity of the continuous variable with respect to the logit of the dependent variable was assessed using the Box-Tidwell (1962) procedure. A Bonferroni correction was applied using all 6 terms in the model resulting in a statistical significance being accepted when $p < 0.00833$ (Tabachnick & Fidell, 2007). Based on this assessment the continuous independent variable was found to be linearly related to the logit of the dependent variable. The logistic regression model was statistically significant, $X^2(6) = 105.250$, $p < 0.0005$. The model explained 23.8% (Nagelkerke R^2) of the variance in completing the HPV vaccine series and correctly classified 74.8% of cases. Sensitivity was 10.5%, specificity was 96.6%. Although the model was significant, variables age, gender, and race did not significantly impact HPV vaccination series completion.

Table 15

Logistic regression predicting HPV vaccine initiation Age, Race, and Gender, 2015

	B	S.E.	DF	Sig.	95% CI	
					Lower	Upper
Age	3.966	6.703	1	0.554	0.000	26782954.3
Hispanic	-0.325	0.338	1	0.337	0.373	1.402
Race	0.121	0.213	1	0.570	0.743	1.716
Gender	0.008	0.203	1	0.346	0.010	1.501

Table 16

Logistic regression predicting HPV vaccine completion Age, Race, and Gender, 2015.

	B	S.E.	DF	Sig.	95% CI	
					Lower	Upper
Age	10.192	6.851	1	0.137	0.039	1.811E +10
Hispanic	-0.782	0.317	1	0.013	0.246	0.851
Race	-0.161	0.218	1	0.459	0.555	1.305
Gender	-0.081	0.205	1	0.694	0.618	1.378

Summary

Based on the results of the statistical analyses, I failed to reject the null hypothesis for the first research question: There is no association between parental knowledge and HPV vaccination initiation and completion among adolescents in Georgia? There was no significant impact on HPV vaccination initiation or completion for any of the three years that were analyzed (2013-2015) related to parental knowledge.

I rejected the null hypothesis for the second research question: There is no association between provider's recommendation and HPV vaccination initiation and completion among adolescents in Georgia. There was significance in all three years, 2013-2015, associated with a provider's recommendation for HPV vaccine initiation. For all three years, participants that received a provider's recommendation were, in most cases less likely to initiate and complete the vaccine series.

For 2013-2015 data, I failed to reject the null hypothesis for the third research question: There is no an association between access to health care services and HPV vaccination initiation and completion among adolescents in Georgia. For all three years of data there was no significant impact on access to health care services and vaccine initiation and completion.

For 2013 data, I failed to reject the null hypothesis for the forth research question: There is no association between age, race, and gender and initiation and completion the HPV vaccine series among adolescents in Georgia after controlling for parental knowledge and provider recommendation. There was no significant relationship between age, race and initiation and completion for the 2014 data; there was a significant relationship between gender and vaccine initiation for this data set; participants that were male were more likely to initiate the vaccine. For 2015 data, I did not reject the null hypothesis. There was no significant impact on HPV vaccine initiation and completion by age, race, or gender.

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

Introduction

The purpose of this study was to examine the predictors of HPV vaccination initiation and completion for male and female adolescents, ages 13 to 17 years old, living in Georgia between 2013 and 2015. I aimed to determine if there was any relationship between the independent variables of parental knowledge, provider's recommendation, and access to health care, and the dependent variables of vaccination initiation and completion. In this section I discuss important findings from my study, which I believe support the use of the structural model of health behavior for adolescents living in Georgia as a framework for explaining the relationship which predicts HPV vaccine initiation and completion. As I previously noted in Sections 1 and 2, the structural model of health behavior focuses on four factors that influence health behavior: availability, physical structures, social sutures and policy (Crosby et al., 2011). In this study, I used the model to better understand the relationship between HPV vaccination initiation and completion and predictors.

I found that there was no significant relationship between parental knowledge and vaccine initiation and completion; however, in most cases there was a statistically significant relationship between provider's recommendation and vaccine initiation. These findings confirm that provider's recommendation was related to vaccine initiation. However, participants who received a recommendation from their physician were less likely to have initiated the HPV vaccine series. I also found that in 2014, males were more likely to initiate the HPV vaccine series than females. Finally, the results confirmed that in most cases age, race, and gender did not significantly impact HPV vaccine initiation and completion in Georgia for years 2013 through 2015. However, in 2014, gender significantly impacted HPV vaccination initiation as males were more likely to initiate than females.

The structural model of health behavior is an ecological model that aims to describe a relationship among health, behavior, and their determinants (Crosby et al., 2011). The model specifically focuses on availability/accessibility, physical structures, social structures/policy, and media/cultural influence (Crosby et al., 2011). Availability and/or accessibility influence behavior in that the more accessible and available a resource is the more likely a behavior is to occur (Crosby et al., 2011). Social structures shape how we live in the way of rules or laws (Crosby et al., 2011). Media and culture profoundly influence health behavior through advertisements of appealing behaviors, targeted at specific audiences (Crosby et al., 2011). Physical structures, such as the surrounding environment, can influence behavior and health outcomes (Crosby et al., 2011). In this study, I used this model to better understand the relation of HPV vaccination initiation and completion to provider's recommendation, lack of parental knowledge, and access to health care services among non-institutionalized adolescents, ages 13-17 years old living in Georgia in 2013-2015.

For all three years of data, findings indicated that participants who received a provider's recommendation were less likely to initiate and complete the series. This finding disagreed with previous research by Gilkey et al. (2016), who found that provider's recommendation is highly influential on HPV vaccination uptake. According to Smith et al. (2016), increasing HPV initiation requires parents' acceptance, which is more common among those who receive a recommendation to vaccinate from their provider. There was no significance indicated between vaccine initiation and completion, and lack of parental knowledge. This finding was uncharacteristic of the literature, which indicated knowledge of HPV is an important correlate of parental acceptance and intent to vaccinate (Spleen et al., 2012). Fontenot et al. (2015), indicated that lack of knowledge accounted for a lack of HPV vaccine uptake, especially for males. There was little variability in these findings across all three years, 2013-2015.

I used binary logistic regression for data analysis and found that lack of parental knowledge was not a predictor of HPV vaccine initiation. However, in most cases provider's recommendation, age, gender, and race were not predictive of HPV vaccine initiation. I found that age, gender, and race in most cases were predictive of vaccine series completion. These findings were not supportive of the literature, except for lack of parental knowledge predicting non-vaccination.

Interpretation of Findings

Influence of Providers' Recommendation

Gilkey et al. (2016) the providers' recommendation to be a strong predictor of HPV vaccination—stronger than race/ethnicity, insurance, knowledge, and/or perception of safety. These findings were based on a nationally representative sample (Gilkey et al., 2016). These findings were also a characteristic of predicting HPV vaccination initiation in Georgia. In years 2013 through 2015, a provider's recommendation decreased the likelihood of HPV vaccine initiation in my study.

Smith, et al. (2016) used data from 2010 to 2014 from the NIS-Teen survey and found that of female teens vaccinated, parents who were positively influenced by a provider were 48% more likely to have completed the HPV vaccination series. This was not the case in my study. In my study, the provider's recommendation did significantly impact vaccine initiation and completion; however, those who indicated they received a provider's recommendation were less likely to initiate or complete the HPV vaccine series. These findings were opposite of those in the literature I reviewed, which indicated a provider's recommendation increased vaccine initiation and completion. This could be an indication of distrust in providers; however, this information could not be ascertained through the NIS-Teen data sets.

Parental Knowledge as a Predictor

Spleen, et al. (2012) found that knowledge of HPV is an important correlate of parental acceptance of and intent to vaccinate their children, and that parents who had their child vaccinated with the HPV vaccine had higher levels of knowledge about HPV than parents who did not have their child vaccinated. The findings from my study were not consistent with those of my literature review. Lack of parental knowledge was not a predictor of HPV vaccination initiation and completion. Gaps in knowledge and misunderstanding of the benefits of HPV vaccination have been noted to account for the lack of uptake in the HPV vaccine, especially for males (Fontenot et al., 2015). This discrepancy could be due to the data collection procedure on this variable in NIS-Teen data. As mentionedin Section 3, lack of parental knowledge was only indicated as a reason to not vaccinate. Also, since the NIS-Teen data were collected as a national data set, splitting this data into a Georgia-only sample could have contributed to the lower number of responses on this variable.

Differences in Gender and Race/Ethnicity

Choi et al. (2016) reported a difference in vaccination initiation and completion between males and females. In 2014 in Georgia, males were more likely than females to have initiated the HPV vaccine. This finding is not consistent with the literature review. According to Choi et al. (2016), reasons that parents of males did not vaccinate their sons included feeling it was not necessary, a lack of provider recommendation, a lack of knowledge, and the parents' belief that their child was not sexually active. They also found that later recommendation of the vaccine for males could have contributed to lack of initiation in males.

Holeman et al. (2015) found that black and Hispanic females were less likely to have completed the HPV vaccine when compared with white females. The findings from my study were not consistent with these findings. However, Galbraith et al. (2016) found that HPV vaccination completion was higher among non-Hispanic, white females when compared to black and Hispanic females. The differences in findings of my study could have been due to a small population of Hispanic/Latino participants. Also, since the NIS-Teen data were collected as a national data set, splitting this data into a Georgia-only sample could have contributed to a lower number of indications on this variable.

Accessibility and Availability

Richards et al. (2016) found that older adolescents and young adults were less likely to receive regular care and were therefore more likely to have a decreased change of HPV vaccine continuation and/or completion. In my study, accessibility and availability were measured by number of visits to a provider in the past 12 months. I was not able to analyze this variable due to the low number of respondents who indicated this as a reason for not vaccinating. I removed the variable from analyses in order to keep from violating the fourth assumption of the study—no variable shall have less than 15 respondents.

Limitations of Study

Generalizing the findings based on data from the NIS-Teen survey may have excluded participants who do not have access to a land line or cellular phone due to low socioeconomic status. NIS-Teen used date from individuals who are non-institutionalized in the general population, thereby excluding individuals in institutions such as juvenile detention centers and hospitals, and/or those who are a ward of the state. Excluding these individuals may have affected the outcome of the study and/or my interpretation of the findings. The use of secondary data from the NIS-Teen may represent a limitation because of self-report measures. Furthermore, because of barriers such as language and translation, the participants' understanding of the questionnaires may have affected their responses. Using self-reported data may have also posed a limitation to my study. Self-reported data is limited by the inability to verify the data, meaning that the sources may have a selective memory, poor or inadequate recall of information, attribution, and exaggeration (University of Southern California, 2017). Another limitation of my study could be due to the generalizability of variables. Generalizability refers to making predictions base on observations (Institute for Work and Health, 2006). Since the data set

I used was from a secondary source, I did not have the ability to ensure the population was equally represented as it relates to age, gender, and race. This could have potentially affected the internal validity (Rockinson-Szapkiw & Knight, 2012). However, the CDC aimed to control for threats to internal validity in the NIS-Teen data by randomly selecting participants for the database. Generalizability can also be threatened by lack of external validity, which refers to the extent to which the study results can be generalized, meaning that the results accurately represent the population (Rockinson-Szapkiw & Knight, 2012). As I mentioned in the results section, the number of participants for some variables, such as lack of knowledge and race, were very small compared to the entire sample; therefore, findings for these variables are not generalizable for the Georgia population.

Recommendations

Findings from this research study showed that future studies could focus on the impact of the quality of the provider's recommendation. These findings also indicated that further research should be carried out to better understand the relationship between providers and patients. Policy makers and other stakeholders may consider requiring HPV vaccination for adolescents in the public-school system, which may help increase the initiation and completion of the HPV vaccine series. In the long run, this may help in reducing the morbidity and mortality rates of cervical cancer in Georgia. Future studies should include examination of the extent of association between social values/beliefs, health seeking behaviors, and compliance with HPV vaccination among adolescents in Georgia.

Implications

Determining the extent to which provider's recommendation quality and trustworthiness of provider as viewed by the patient in Georgia could help improve compliance with HPV vaccination and possibly decrease the consequences of spreading and contracting the human papillomavirus, even further decreasing the possibility of cervical cancer and other genital cancers associated with HPV. The findings of this research study could assist public health providers and governmental agencies with the promotion of guidelines and interventions that may improve the uptake of HPV vaccination among adolescents in Georgia, thereby potentially leading to positive social change. Learning more about the relationship between patients and their perceived quality of recommendation in Georgia that could have prevented low HPV vaccine uptake in Georgia could be beneficial for researchers and public health providers with development of programs and interventions that could focus on delivery of recommendation and relationship building among patients and providers. The study findings could also be used as a foundation for future studies on HPV vaccination uptake which could lead to an increase in HPV vaccination practices among adolescents in Georgia. The outcome of this research may lead to positive social change by indicating the possibility of lack of trust between providers and patients, especially as it relates to HPV vaccination through development of provider education in delivery of a recommendation.

Conclusion

Although the HPV vaccine has been approved by the FDA and is available for both males and females, completion of the 3-shot series remains relatively low (Georgia Department of Public Health, 2015). Cervical cancer is the fourth leading cancer in women in the United States (Wang, et. al., 2015, p. 2570). This study obtained data from the NIS-Teen from 2013-2015 to examine the predictors of human papillomavirus (HPV) vaccination initiation and completion for male and female adolescents, ages 13 to 17 years old, living in Georgia between 2013 - 2015, depending on providers' recommendation, parental knowledge, and access to health care services. The findings from this study could contribute to positive social change by indicating that patient and physician distrust may exist for this population in Georgia and encouraging public health providers to intervene in this process to produce more positive results. Parental mistrust of their physician could be contributing to low vaccination rates. Future studies should focus on the impact of variables such as quality of providers' recommendation and trust in provider on compliance with HPV vaccination initiation and completion among adolescents in Georgia.

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Appendix A: Public Use Data File

2014 National Immunization Survey - Teen (NIS-Teen)
Public-Use Data File (PUF)

WARNING - DATA USE RESTRICTIONS - READ CAREFULLY BEFORE USE!

The Public Health Service Act (Section 308(d)) provides that the data collected by the National Center for Health Statistics (NCHS), Centers for Disease Control and Prevention (CDC), may be used only for the purpose of health statistical reporting and analysis.

Any effort to determine the identity of any reported case is prohibited by this law.

NCHS does all it can to ensure that the identity of data subjects cannot be disclosed. All direct identifiers, as well as any characteristics that might lead to identification, are omitted from the data files. Any intentional identification or disclosure of a person or establishment violates the assurances of confidentiality given to the providers of the information.

Therefore, users will:

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.

By using these data, you signify your agreement to comply with the above requirements

(CDC, 2014)