An Evaluation of the Differences in HPV Vaccination Status and Providers Recommendation between Genders and Maternal Educational Levels

by

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Abstract

Human Papillomavirus (HPV) vaccination rates have remained low among adolescents in the United States over the last decade, persevering as a public health concern. The purpose of this study was to evaluate differences in HPV vaccination status and provider recommendation between genders and maternal educational levels. First, this study addressed if there were differences in HPV vaccination status between female and male adolescents 13-17 years of age. Secondly, this study sought to determine if there were differences in HPV vaccination status based on adolescents' mothers' educational levels (mothers of high vs. low educational levels). The study further examined the difference in provider HPV vaccine recommendations to adolescents based on adolescents' mothers' educational levels. Lastly, the study explored if there were differences in the likelihood of teens receiving the HPV vaccine in the next 12 months based on the adolescents' mothers' educational levels. This study employed a cross-sectional design using data from the 2018 National Immunization Survey-Teen (NIS-Teen). Chi-square tests of independence and an independent samples *t*-test were used to analyze the four research questions. The findings of this study determined a significant difference in HPV vaccination status between genders ($p = .002$). This study also identified a significant difference in provider recommendations between high and low maternal educational levels ($p = .001$). However, no difference was found in the likelihood of teens receiving the HPV vaccine in the next 12 months between adolescents whose mothers had high or low educational levels. Further research is needed to better understand reasons for lack of provider HPV recommendations.

Keywords: HPV vaccination status, providers recommendation, maternal educational levels, gender, likelihood of receiving HPV vaccination.

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Introduction

Overview of the Literature

Human Papillomavirus (HPV) is a common viral venereal disease in the United States (Tan & Gerbie, 2017). Annually, 14 million individuals, including teens, become infected with HPV (Centers for Disease Control and Prevention [CDC], 2019). HPV is a sexually transmitted infection spread through intimate skin to skin contact with an infected person (CDC, 2019). Although most HPV infections can be asymptomatic and resolve on their own, HPV has the potential to cause cervical, vulvar, vaginal, anal, oropharyngeal, and penile cancers (Printz, 2013; Markowitz et al., 2014). Nearly 35,000 females and males are affected by one kind of HPV related cancer yearly (CDC, 2019).

HPV Related Cancers

More than 150 HPV strains have been identified, including 40 types that infect the genital area (Doorbar et al., 2012; De Villiers et al., 2004). HPV strains have been categorized as high- or low-risk infections depending on their association with cancer. Studies have found that the majority of HPV-related cancers are associated with high-risk HPV serotypes 16, 18, 31, 33, 35, 45, 52, and 58 (Muñoz et al., 2003). HPV serotypes are assigned depending on their particular strain of the viral infection. In addition to causing most cervical cancers, high-risk HPV types can also lead to other anogenital cancers, such as penile, vulvar, vaginal, and anal (Muñoz et al., 2003; Markowitz et al., 2014). In the United States, approximately nine out of ten cervical cancer diagnoses have been attributed to HPV infections (CDC, 2019). Moreover, research showed that 70% of oropharyngeal cancers, 90% of anal cancers, 60% of penile cancers, 75% of vaginal cancers, and 70% of vulvar cancers have been caused by HPV (National Cancer Institute

[NIH], 2020). Recent studies have also found that rates of HPV-associated male cancers have increased for anal and oropharyngeal cancers (Van Dyne et al., 2018). Similarly, vaginal cancers in females have also increased but reduced or remained the same for cervical, penile, and vulvar cancers (Van Dyne et al., 2018). Globally, high-risk HPV types cause approximately 5% of all cancers, affecting 570,000 women and 60,000 men annually (NIH, 2020).

Low-risk HPV types are not identified as being associated with precancerous cells; however, they are linked to genital and respiratory infections. Research suggested that low-risk HPV serotypes 6 and 11 are associated with 90% of anogenital warts and respiratory papillomatosis (Lacey, Lowndes, & Shah, 2019). Studies also showed that sexually active teens and young adults have the highest incidence of anogenital infections related to HPV (International Agency for Research on Cancer, 2012). Despite HPV being a commonly sexually transmitted infection, it is highly preventable with the proper vaccinations.

HPV Vaccinations

To reduce the occurrence of HPV, the U.S. Advisory Committee on Immunization Practices (ACIP) recommended routine HPV vaccinations beginning at age 11 or 12 years for females and males (CDC, 2019; Markowitz et al., 2014). HPV vaccinations can also begin at an earlier time to protect children before becoming exposed to the disease (CDC, 2019). HPV vaccinations can begin as early as age nine for boys and girls with an intake of two doses and three doses for young adults who did not receive the vaccination at a young age (Petrosky et al., 2015; Markowitz et al., 2014; CDC, 2019). Moreover, HPV vaccinations have been classified as either 2vHPV, 4vHPV, and most recently

9vHPV, depending on the prevention coverage against the HPV diseases (Petrosky et al., 2015).

Vaccines against HPV were initially developed and licensed to target females before covering other forms of HPV-related cancers and infections in males. In 2006, the ACIP recommended a prophylactic quadrivalent HPV vaccine (4vHPV) for females ages nine to 26 years, which protects against HPV serotypes 6, 11, 16, and 18 (Markowitz et al., 2007; CDC, 2010). The same quadrivalent vaccine, however, was not approved until 2009 for males ages nine to 26 years to use as a prevention against genital warts (Tan, & Gerbie, 2017; Markowitz et al., 2014).

All HPV vaccinations have been authorized by the U.S. Food and Drug Administration (FDA), including Gardasil, Cervarix, and Gardasil 9 for assurance in evidence of the safety of the vaccine (Petrosky et al., 2015; CDC. 2019). Recent studies showed that Gardasil 9, or 9vHPV, defended against more HPV strains for females and males in comparison to Cervarix, which was recommended solely for the prevention against HPV-related cancers for females (Petrosky et al., 2015; FDA, 2008). Furthermore, Gardasil and Cervarix were later not made available for use in the United States, and Gardasil 9 became the only recommended HPV vaccination (CDC, 2019). Overall, even with the ACIP updating their recommendation of vaccine usage, a disproportion in the rate of HPV vaccine uptake across genders perseveres with male vaccination remaining relatively slow since its licensure for use (Tan & Gerbie, 2017).

HPV Female and Male Vaccination Rates

In 2016, the National Immunization Survey-Teen conducted randomized phone interviews of parents and guardians of eligible adolescents in the United States (Walker

et al., 2017). With consent from parents and guardians, adolescents' health care providers were identified and the vaccination history from the adolescents' medical records were obtained (Walker et al., 2017). Based on the results, it was reported that in the U. S., 60.4% of teens (65.1% females; 56.0% males) had initiated with one dose of the HPV vaccination coverage (Walker et al., 2017). Moreover, from those adolescents participating in the study, 43.4% (49.5% females; 37.5% males) had either received all injections in the HPV vaccination series or were expected to receive the HPV vaccination as recommended (Walker et al., 2017; CDC, 2019). In California, more specifically, 58.3% of female and 40.3% of male adolescents ages 13-17 received all HPV vaccine doses (Walker et al., 2017; CDC, 2019). Although adherence to vaccine-based HPV prevention recommendations continues to improve overall, HPV male vaccination remains low compared to rates for females (Reiter, Oldach, Randle, & Katz, 2014).

Previous literature illustrated that there has been more HPV research related to females due to prevalence and awareness of a large quantity of female cancers being associated with HPV, which has helped in higher female vaccine rates (Alexander et al., 2012). Literature also suggested that surveillance for HPV infections in males is not as prominent as it is for females, thus creating fewer interventions for males (Brotherton et al., 2016). Additional studies showed that HPV vaccine uptake in male adolescents is low due to several factors, including lack of proper provider recommendations, lack of parental education, parental perceived effectiveness, low involvement in parent and son decision-making, and lack of proper resources for minority groups due to their social economic status (Alexander, Best, Stupiansky, & Zimet, 2015; Reiter, McRee, Kadis, & Brewer, 2011; Alexander et al., 2012; Polonijo & Carpiano, 2013). All these factors have

been shown to play a significant role in adolescent males not receiving adequate HPV prevention, resulting in low male vaccination rates.

Maternal Education as a Factor

Studies have shown that parents and health care providers are key stakeholders associated with the likelihood of adolescent males obtaining the HPV vaccine and finishing with the HPV vaccine series (Lake, Kasting, Malo, Giuliano, & Vadaparampil, 2019; Tan & Gerbie, 2017). Lack of education about the vaccine, reluctance to acknowledge the sexual activity of teens, and the negative public perception about the vaccine's safety are some of the disabling factors in parents' understanding of their adolescent males needing the vaccine (Printz, 2013; Lake et al., 2019). Current literature demonstrated that, although there has been a high acceptance for parents to vaccinate their sons against HPV, there is still low knowledge about HPV which interferes with the parent and son decision-making for boys aging from nine to 18 years of age (Tan & Gerbie, 2017; Alexander et al., 2012). Additional studies also proposed that the gap of parental knowledge is larger within race and ethnic minority groups. Polonijo and Carpiano (2013) pointed out that racial and ethnic minority parents have a significantly lower likelihood of knowing less about HPV vaccines, which affects their children's vaccine uptake (Polonijo & Carpiano, 2013).

Furthermore, Polonijo and Carpiano (2013) described an association between parental knowledge of HPV and a parent's educational level, specifically focusing on mothers. The odds of having knowledge about HPV routine vaccinations were 73% lower for mothers with no high school diploma and 53% lower for mothers with high school diplomas in comparison to mother's with post-secondary education like a bachelor's

degree (Polonijo & Carpiano, 2013). In addition, further findings showed that lower maternal educational levels decreased the odds of a child/adolescent receiving the first HPV vaccination uptake and lessened the chances for completion of the HPV series (Polonijo & Carpiano, 2013).

Provider Recommendation as a Factor

Providers' recommendations on HPV vaccination has also proven to have a higher impact on preventing HPV-related diseases and are a strong predictor of vaccination uptake (Tan & Gerbie, 2017; Gilkey et al., 2016). A previous study of a national sample of parents of adolescent males identified that only 2% of adolescent males had received the vaccine and only 50% of those who received the vaccination showed that it was due to the recommendation of their primary doctor or a health provider (Reiter, McRee, Kadis, & Brewer, 2011). Similarly, Perkins and Clark (2012) found that since the vaccination licensure for males, only 12% of health care providers had recommended the HPV series to their adolescent male patients.

The likelihood of providers recommending the vaccine has also been associated with socioeconomic status, maternal education, and race/ethnic groups of the patients. In their repeated cross-sectional study, Polonijo and Carpiano (2013) found that receiving a recommendation from a provider was negatively associated with low socioeconomic groups. Moreover, the odds of having received a professional recommendation for the HPV vaccine series was lower for Hispanic adolescents by 14% and even lower for Black adolescents by 27% (Polonijo & Carpiano, 2013). Likewise, the odds of professional recommendation for the vaccine in households with low maternal educational levels were

24% lower for those with post-secondary education and 41% lower for those with less than a high school diploma (Polonijo & Carpiano, 2013).

Race and Ethnicity as a Factor

Burdette, Webb, Hill, and Jokinen-Gordon (2017) argued that while HPV vaccination intake has increased across all race and ethnic groups, HPV disparities continue to exist since some race and ethnic groups are receiving the vaccination at a faster rate than others. Consequently, inequality in HPV vaccination led to increased disparities in HPV-related diseases, preventing specific racial or ethnic groups from obtaining appropriate preventions and interventions (Burdette et al., 2017). Studies suggested that low socioeconomic status and Black adolescents have lower odds of obtaining the first dose of the recommended HPV vaccination series, while other minority groups have lower odds of completing all three doses of the HPV series (Polonijo & Carpiano, 2013). Other findings suggested that among male adolescents, non-Hispanic Whites have lower vaccination rates versus Blacks and Hispanics, even though Hispanic male adolescents continue to have low rates of provider recommendation and HPV vaccinations (Burdette et al., 2017). Overall, due to inequalities in HPV preventions, racial and ethnic disparities persist for HPV-related diseases (Spencer, Calo, & Brewer, 2019).

Additional program interventions are needed to increase overall rates of vaccination across gender, race, and ethnicity (Burdette et al., 2017). Because HPV prevention occurs during adolescent years, identifying interventions that increase adolescent male HPV vaccination uptake will be beneficial to the overall health of the population. High uptake in male adolescents vaccines can be achieved through programs

that increase parental awareness of HPV for males, interventions that use all opportunities for vaccination in male adolescents, and stronger provider recommendation on HPV vaccines (Farmar et al., 2016; Gilkey et al., 2016). By increasing male adolescent vaccine intake, Healthy People 2020's goal of increasing all adolescent's vaccine usage by 80% can be feasible (U.S. Department of Health and Human Services [DHHS], 2020).

Purpose of the Study

The purpose of this study was to determine if there are differences between Human Papillomavirus (HPV) vaccination rates and provider recommendations among female and male adolescents whose mothers have different education levels. This study evaluated differences in females and males and maternal educational levels separately as it related to provider recommendations and the likelihood of the adolescent obtaining the HPV vaccination. More specifically, the focus of the study was to determine if there were lower HPV vaccination rates among adolescent males in comparison to higher vaccination rates among adolescent females based on their mothers' educational levels. The results from this study were used to identify and enhance educational programs that focus on increasing HPV awareness and exposure for young males across all backgrounds.

Research Questions

There were four research questions addressed in this study:

1. Among adolescents ages 13-17, is there a statistically significant difference in HPV vaccination status between females and males?

2. Among adolescents ages 13-17, is there a statistically significant difference in HPV vaccination status based on an adolescent's mother's educational level (mothers of high vs. low education levels)?
3. Among adolescents ages 13-17, is there a statistically significant difference in HPV vaccination status based on provider recommendation and maternal educational levels (mothers of high vs. low education levels)?
4. Among adolescents ages 13-17, is there a statistically significant difference in the likelihood to have the vaccine in the next 12 months based on an adolescent's mother's educational level (mothers of high vs. low education levels)?

Hypotheses

H1: There is a difference in HPV vaccination status between gender categories.

H2: There is a difference in HPV vaccination status between adolescents whose mothers have high and low educational levels (mothers of high vs. low education levels).

H3: There is a difference in the patient reported provider recommendation based on adolescents' mothers' educational levels (mothers of high vs. low education levels).

H4: There is a difference in the likelihood to have the vaccine in the next 12 months based on adolescents' mothers' educational levels (mothers of high vs. low educational levels).

Method

Design

This study utilized a cross-sectional design to explore the difference by gender in HPV vaccination uptake among adolescents ages 13-17 based on their mothers' educational levels, provider recommendations categories, and the likelihood of receiving the HPV vaccine. Data from the National Immunization Survey-Teen (NIS Teen) was used for this study. NIS-Teen was implemented by CDC's National Center for Immunization and Respiratory Diseases (NCIRD) and CDC's National Center for Health Statistics (NCHS) in 2006 (CDC, 2019). Data for years 2017-2018 was analyzed for this study, which included demographic information from the participants as well as the adolescents' up-to-date HPV recommended vaccine doses and other immunizations (CDC, 2019).

Procedures

With assistance from the National Immunization Survey-Child (NIS-Child), NIS-Teen sampling was collected by random digit dialing (RDD) telephone surveys that identified households with adolescents between the ages of 13-17 years old. For households with more than one adolescent between that age group, a random adolescent was chosen and an adult (parent or guardian) was interviewed. The adult conducting the interview was one who had more knowledge about the adolescent's vaccination history (CDC, 2019). Following the consent of the parent or guardian, the adolescent's health care provider was identified and contacted via mail with an immunization history questionnaire (IHQ), which is a survey on the adolescent's vaccination history from their

medical records. The information collected through this survey was assigned in the NIS-Teen as the Provider Record Check. For providers not answering the questionnaire, a reminder was given via phone call. For cases in which a provider was unable to return the questionnaire, a provider-reported vaccination history of the adolescent was then completed over the phone. As with the data collected from parents and guardians, the data from IHQ was edited, entered, cleaned, and merged with the RDD data. NORC at the University of Chicago conducted NIS-Teen sampling, data collection, and overall operations of the study (CDC, 2019).

For each calendar quarter, telephone numbers were drawn independently based on geographical areas. For the 2018 NIS-Teen study, 59 geographical areas were used to estimate the vaccine coverage levels. Geographical areas included the 50 states, District of Columbia, and eight local estimation areas (areas that received federal section immunization grants). Data from Puerto Rico, U. S. Virgin Islands, and Guam were not included in the 2018 data file. Cell phone sampling frames were provided by Marketing Systems Groups (MSG) and were used in lieu of landline phone interviews since landlines were no longer available for the 2018 data collection. Household interviews were conducted beginning on January 11, 2018 and ending on January 31, 2019. Data collected from providers began February 2018 and ended April 2019 (CDC, 2019).

Participants

The 2018 NIS-Teen contained data for 38,706 adolescents who completed the interviews, and 18,700 adolescents with adequate provided data (APD). "*Adequate provided data*" refers to having enough information from the

adolescent's provider as it pertains to the adolescent's up-to-date recommended vaccination schedule (CDC, 2019). All participants had to be living in a household during the time of the interview. Data from the 2018 NIS-Teen had 136 unvaccinated adolescents who either did not receive the recommended vaccination and had no providers or had not received the recommended vaccination and had more than one provider. The target population in this study included non-institutionalized adolescents between the ages 13-17 in the United States who were born between January 2000 and January 2006 (CDC, 2019). The sample size used in this study included 1,000 randomized adolescents.

Independent Variable and Dependent Variable

Independent Variables

This study consisted of four research questions. The independent variable for the first research question asked about the adolescents' gender. The question was measured by asking the *"sex of the teen"* and followed by the answers of *"male"* and *"female"* (1 for male, 2 for female) depending on the participant's answer (CDC, 2019).

For research questions 2, 3, and 4, the independent variables asked about the teen's maternal educational level. This was measured by the question of *"What is the highest grade or year of school completed?"* and was followed by four categories of the education level of the adolescents' mothers. This question required the responses to be filled in depending on what the participants answered. The categories ranged from *Less than 12 years, 12 years, More than 12 years; non-college grad, and College graduate* (CDC, 2019). In order to allow for

comparisons between low and high education levels in this study, the mothers' educational levels were combined from four categories into two categories consisting of *1 = under High School or High School equivalent* and *2 = Some college and above.*

Dependent Variables

The dependent variable for the first two research questions was the teen's vaccination status. This was measured by the question of "*Has teen ever received any Human Papillomavirus shots?*" The options for this question were *"Yes,"* "*No," "Don't Know,"* and *"Refused"* (CDC, 2019). The dependent variable for research question 3 was provider recommendations in relation to HPV shots. This variable was measured by the question of *"Had or has a doctor or other healthcare professional ever recommended that teen receive HPV shots?"* Responses to this question included "*Yes," "No," "Don't Know," "Refused,"* and *"Missing"* (CDC, 2019). Lastly, the dependent variable for research question 4 was the likelihood that teens would receive an HPV vaccination within the next 12 months. This was measured by the question of *"How likely is it teen will receive HPV shots in the next 12 months?"* The answers to this question were as follows: *"Very likely," "Somewhat likely," "Not too likely," "Not likely at all," "Not sure/Don't know," "Refused,"* and *"Missing"* (CDC, 2019). Any missing responses throughout the questionnaire were recorded as "inapplicable," which when re-coded, were deleted from the dataset.

Data Analysis

Descriptive statistics were produced to show the demographics of the participants, including gender, race/ethnicity, and maternal educational level. Chi-square tests for independence were also conducted to answer research questions 1-3, which hypothesized that there are significant differences in vaccination status and providers' recommendation across gender and maternal educational levels. This test was used for this specific study as it contained two categorical variables for the independent and dependent variables: *"Yes"* and *"No"* for vaccination status and *"1 = Male, 2 = Female"* for sex of the teen.

Moreover, an independent samples *t*-test was also conducted to answer research question 4, which hypothesized that there is a difference in the likelihood of an adolescent receiving an HPV vaccination shot within the next 12 months based on their mothers' educational levels (high vs. low). This test was appropriate because there was a continuous dependent variable. The dependent variable for this question included options of *"Very likely," "Somewhat likely," "Not too likely," "Not likely at all," "Not sure/Don't know," "Refused,"* and *"Missing"* (CDC, 2019). The minimum sample size for the research questions was determined by G*Power Software, version 3.1.9.2. A medium effect size, alpha level of 0.5, and power of 80% were used to determine a minimal sample size of 88 for all Chi-square tests for independence and 102 for the independent samples *t*-test. However, due to a great deal of sub-samples across categories used in the analysis, a sample size of 1,000 was used to allow for a sufficient sample size in each category for all four research questions. By having a larger sample

size, the results were more reliable and investigated all research questions with greater precision.

Results

Participant Demographics

Secondary data from the National Immunization Survey-Teen (NIS Teen) between the years 2017-2018 were analyzed to evaluate the four research questions in this study. A sample size of 1,000 participants was used that included 511 (51.1%) female and 489 (48.9%) male adolescents. Participants were asked their race and ethnicity independently. Race and ethnicity were multiple choice questions in the survey, and participants self-reported their answers. Among the 1,000 participants, 743 (74.35%) self-reported as White Only, 106 (10.6%) as Black Only, and 151 (15.1%) as Other + Multiple Race. Additionally, participants reported their ethnicity as follows: 188 (18.8%) as Hispanic, 599 (59.9%) as Non-Hispanic White Only, 93 (9.3%) as Non-Hispanic Black Only, and 120 (12%) as Non-Hispanic Other + Multiple Race. Participants' demographics are shown in Table 1 below.

Table 1
Demographic Details of Participants

		n	%
Gender	Male	489	48.9%
	Female	511	51.1%
Race	White Only	743	74.3%
	Black Only	106	10.6%
	Other + Multiple Race	151	15.1%
Ethnicity	Hispanic	188	18.8%

Non-Hispanic White Only	599	59.9%
Non-Hispanic Black Only	93	9.3%
Non-Hispanic Other + Multiple Race	120	12.0%

Note: n = 1,000; % = percentage. Data Source: 2018 National Immunization Survey-Teen (NIS Teen)

Major Findings

Descriptive statistics and Chi-square tests of independence were calculated to test the hypothesis that there is a difference in HPV vaccination status across gender, between high and low maternal educational levels (mothers of high vs. low education levels), and difference in patient reported provider recommendation between high and low maternal educational levels. For this first research question, *"Among adolescents ages 13-17, is there a statistically significant difference in HPV vaccination status between females and males?"* the sample size was of 906 participants with 94 *"Missing"* responses. Out of this number of participants, 444 were males and 462 were females. A total of 254 males (57.2%) and 311 females (67.3%) had received any of the HPV immunization doses. However, 190 males (42.8%) and 151 females (32.7%) had not received any HPV immunization shots. The results indicate that there is a highly statistically significant difference in HPV vaccination status between genders ($X^2(1) = 9.86$, $p = .002$). Adolescent males were less likely to have received any HPV vaccination shots in comparison to adolescent females. As shown in Table 2, the teens receiving the HPV vaccination were 35% more likely to be females than males.

Table 2
Comparison of HPV Vaccination Status between Genders (n=906)

Gender of Teen	HPV Vaccination Status		Adjusted OR (95% CI)
	Yes	No	
Male	254 (57.2%)	190 (42.8%)	
			*.649 (.495 -.851)
Female	311 (67.3%)	151 (32.7%)	

Note: n = 906, % = Valid Percent; OR, odd ratio; CI, confidence interval. Chi-Square Test of Independence was used to assess the difference in HPV vaccination status between gender *p=.002

For the second research question of "*Among adolescents ages 13-17, is there a statistically significant difference in HPV vaccination status based on an adolescent's mother's educational level (mothers of high vs. low education levels*)?," a Chi-square test of independence was also used to compare adolescents' vaccination status and maternal educational levels. It was hypothesized that there is a difference in vaccination status between adolescents with mothers of high educational levels *(Some college and above)* and those with mothers of low educational levels *(under High School or High School equivalent).* Of the 906 participants, from those adolescents who had received any HPV vaccine shots, 435 (63.7%) had a mother with a high educational level and 130 (58.3%) had a mother with a low educational level. Moreover, teens who had not received any HPV vaccine shots consisted of 248 (36.3%) who had a mother with a high educational level and 93 (41.7%) who had a mother with a low educational level. No significant difference was found between vaccination status and maternal educational level ($X^2(1) = 2.08$, $p = .149$). As shown in Table 3, there is no difference in adolescent vaccination status between adolescents with mothers of high and low educational levels.

Table 3
Comparison of HPV Vaccination Status between High and Low Maternal Educational Levels (n=906)

Maternal Educational Levels	HPV Vaccination Status		Adjusted OR (95% CI)
	Yes	No	
Under High School or High School Equivalent	130 (58.3%)	93 (41.7%)	.797 (.585 -1.085)
Some College and above	435 (63.7%)	248 (36.3%)	

Note: n = 906, % = Valid Percent; OR, odd ratio; CI, confidence interval. Chi-Square Test of Independence was used to assess the difference in HPV vaccination status between maternal educational levels p=.149

An additional Chi-square test of independence was used for the third research question, "*Among adolescents ages 13-17, is there a statistically significant difference in HPV vaccination status based on provider recommendation and maternal educational levels (mothers of high vs. low education levels*)?," to analyze the difference in provider recommendations regarding HPV vaccination to adolescents with mothers of high and low educational levels. The individuals who answered this part of the survey consisted of 926 participants. Those who answered *"Yes"* to having had a doctor or healthcare professional ever recommend that their teen receive the HPV vaccine included 551 (79.5%) mothers with high educational levels and 151 (64.8%) mothers with low educational levels. Those who answered *"No"* to receiving a provider recommendation for their teen included 142 (20.5%) mothers with high educational levels and 82 (35.2%) mothers with low educational levels. Results indicated a highly statistically significant difference in provider recommendation between high and low maternal educational levels ($X^2(1) = 20.55$, p = .001). Mothers with high educational levels *(Some college and above),* have a

higher self-reported rate of HPV provider vaccine recommendations in comparison to mothers of low educational levels *(under High School or High School equivalent).* As shown on Table 4, the individuals who reported having HPV provider vaccine recommendations were 53% more likely to be an adolescent's mother with a high educational level.

Table 4
Comparison of Providers Recommendation between High and Low Maternal Educational Levels (n=926)

Maternal Educational Levels	Providers Recommendation Yes	No	Adjusted OR (95% CI)
Under High School or High School Equivalent	151 (64.8%)	82 (35.2%)	*.475 (.343-.658)
Some College and above	551(79.5%)	142 (20.5%)	

Note: n = 926, % = Valid Percent; OR, odd ratio; CI, confidence interval. Chi-Square Test of Independence was used to assess the difference between providers recommendation and maternal educational levels *p=.001

In addition to the test completed above, an independent samples *t*-test was used to answer the last research question, "*Among adolescents ages 13-17, is there a statistically significant difference in the likelihood to have the vaccine in the next 12 months based on an adolescent's mother's educational level (mothers of high vs. low education levels)?*" Based on the literature, it was hypothesized that adolescents with parents who have high educational levels are more likely to have the HPV vaccine in the next 12 months. However, the results indicated no significant difference ($t(2) = -1.60$, $p = .110$). The mean of the mothers with high educational levels ($M = 10.10$, $sd = 22.28$) was not significantly different from the mean of mothers with low educational levels ($M = 7.18$, $sd = 18.37$). Furthermore, there was no significant difference in the likelihood of adolescents

receiving the HPV vaccine in the next 12 months between high and low maternal educational levels (see Table 5).

Table 5
Results from Independent Samples T-Test for Likelihood of HPV Vaccination between Maternal Educational Levels (n=728)

	F	t	df	Sig. (2-tailed)	95% CI of the Difference	
Equal Variances Assumed	9.062	-1.601	726.000	0.110	-6.501	0.661

Note: n = 728, CI, confidence interval. The Independent Samples T-Test did not reveal a significant difference in the likelihood of receiving HPV vaccination status between maternal educational levels p=.110

Discussion

Summary of Major Findings

The first research question examined the difference in HPV vaccination status between female and male adolescents ages 13-17, using a Chi-square test of independence. The results showed that there was a statistically significant difference in HPV vaccination status between genders with females having higher HPV vaccination rates than males. The results are congruent to previous research identifying female adolescents as the primary individuals obtaining HPV vaccinations. According to Walker et al. (2017) more female adolescents received all doses of the HPV vaccination in comparison to male adolescents. This is also consistent with data from CDC's 2018 NIS-Teen (2019), which showed that male adolescents have lower percentages in receiving all HPV vaccine doses in comparison to female adolescents (CDC, 2019).

The second research question addressed the difference in adolescents' HPV vaccination status based on their mothers' educational levels, more specifically mothers of high vs. low educational levels. A Chi-square test of independence was used, which concluded that there were no differences in adolescent vaccination status between the two maternal educational levels. The results were, however, inconsistent with previous literature showing that mothers of low educational levels have lower chances of vaccinating their teens (Polonijo & Carpiano, 2013).

Research question three examined the difference between providers HPV vaccine recommendation to mothers of the same educational levels. A Chi-square test of independence was also used to analyze this difference. Results indicated a statistically significant difference between mothers of high vs. low educational levels. Mothers with

higher education reported a higher percentage of providers recommending their teen to get vaccinated against HPV. As mentioned by Polonijo and Carpiano (2013), providers recommendation had been linked to mothers' educational levels; higher levels of education are connected to higher chances of obtaining providers' HPV vaccine recommendation.

Lastly, research question four examined differences in the likelihood of teens receiving HPV vaccinations between maternal educational levels. An independent samples *t*-test was used to analyze this question, which showed that there was not a statistical significance difference in the likelihood of teens receiving HPV vaccinations between mothers of high educational levels and mothers of low educational levels. These results are also inconsistent with preceding literature, which found a relationship between higher parental (mothers) educational levels and higher odds of teens obtaining their HPV vaccination (Polonijo & Carpiano, 2013).

Because a large portion of literature focused mainly on addressing HPV uptake across female adolescents, this research served to switch the focus to some of the factors associated with lower HPV vaccination rates among male adolescents. Previous research suggested that socioeconomic status, race/ethnicity, gender, and maternal education as some of the components limiting male adolescents from obtaining HPV vaccines and proper medical recommendation. However, it would be beneficial for all factors to be studied further. Future research is needed in understanding the capacity by which maternal educational level, race/ethnicity, and economic status creates gaps in HPV prevention, providers' recommendations, and HPV uptake across adolescent males.

Public Health Implications

This research focused on examining discrepancies in teens receiving HPV vaccinations between gender, maternal educational levels, and providers HPV vaccine recommendation. The findings of this study revealed existing HPV vaccination gaps between genders with male adolescents receiving lower HPV vaccines in comparison to females. Findings also showed a prevalence of health care professionals not recommending the HPV vaccine to adolescents' mothers of lower educational levels (*High School Equivalent or Less*). Supporting these findings are previous studies that also identified providers and health care professionals as one of the most significant factors in teens receiving all of their HPV doses (Tan & Gerbie, 2017; Gilkey et al., 2016). The information from the research is beneficial for policymakers, public health agencies, community members, and parents to boost their male adolescents' HPV vaccination uptake by increasing the efficiency of health care professional's suggesting the HPV vaccine.

Although the CDC's Advisory Committee Immunization Practices (ACIP) is now recommending females and males to receive all adequate HPV doses during their adolescence, such policy and practice recommendations do not assure that health care providers will properly deliver the information and guidance for HPV vaccinations. To assure that HPV prevention is given to all patients equally, public health agencies should mandate that health providers follow a mandated approach incorporated into the Healthcare Effectiveness Data and Information Set (HEDIS) measures of proper care. HEDIS childhood immunizations measures have proven to be accurate and effective in guiding clinical care (Bundy, Solomon, Kim, & Miller, 2012). By including adolescent

immunizations into the HEDIS measures, it will assist in identifying any gaps in preventative care as it relates to HPV recommendations and vaccinations. The main goal of this measure is to improve providers' recommendations and ranking as it pertains to preventative care given to teens of vulnerable populations. Moreover, further research should also focus on measuring and monitoring doctors' and providers' HPV recommendation among the minority population, including those of a low socioeconomic status.

Additionally, to also address any unforeseen reasons as to why health care providers are not recommending HPV vaccinations to their male patients, public health agencies should also distribute and collect a survey for community providers. Findings from this survey will assist in understanding the reasons behind discrepancies in HPV vaccine intake. Through this tool, any barriers, including cost, language, race/ethnicity, education, and insurance coverage, can be addressed to reduce low HPV vaccination rates for adolescent males and improve the communication between providers and their patients. Furthermore, it would be beneficial for non-profit health agencies to properly educate, bring awareness, and promote HPV vaccination for all genders. From a public health perspective, this will help to address any stigmas associated with HPV, increase HPV knowledge for individuals living in low socioeconomic environments, and allow for resources to adequately impact the population in need.

Overall, increasing male adolescent vaccination will get us a step closer to Healthy People 2020's goal of raising all adolescent's vaccine usage (DHHS, 2020). It is of essence that teens, regardless of their demographic backgrounds, obtain the best information and options possible to fully complete all of their immunizations.

Study Limitations

This study consisted of some limitations. First, the 2018 NIS-Teen used cell phone interviews to collect the data needed for the study. Because the study allowed for parents to answer on behalf of their child(ren), some bias may have been recorded. Since some of the questions allowed for respondents to answer based on their best knowledge of their child, some questions may have not been truthfully answered to please the caller or to not mis-speak about their child (ren). Due to the possibility of misunderstanding the questions, some answers may not have reflected what the participant wanted to answer, especially because the survey was a lengthy one. Additionally, significant gaps in race/ethnicities many have been ignored as not all races were adequately represented in the data (White Only, Black Only, Other + Multiple Race). By limiting the options within the race categories and clustering the rest of the races (Asian, Pacific Islander, American Indian or Alaska Native), a true representation of the population was not depicted in this dataset. Moreover, the sample used for the study had a large representation of *"White Only"* race in comparison to the other races. This is also a limitation since accurate representation of all races was not equally achieved.

Another limitation was that participants had the option of refusing to answer or answering with "*Not Sure/Don't Know*," which resulted in "missing" responses in the data. A consequence of this was that although the sample size was 1,000, not all 1,000 participants responded to all questions in the survey. For example, in research questions 1 and 2, only 906 participants responded to having received HPV vaccinations, their gender, and maternal educational levels. For research question 3, only 926 participants responded to having a doctor or health care provider recommend the vaccine, and for

research question 4, only 728 participants responded to the likelihood of having their teen vaccinated within the next 12 months.

Furthermore, although the current literature showed strong associations with providers HPV recommendation, maternal education, race/ethnicity, and socioeconomic background, it is important to note that other factors are still not accounted for in the studies. This includes important areas of future research such as individuals of undocumented families, individuals with language barriers, institutionalized adolescents, as well as those who may have refused to participate in the studies.

Conclusion

This study examined HPV vaccination status among adolescents 13-17 years of age in the United States. The study also evaluated various factors, including gender, providers HPV vaccine recommendation, and adolescents' mothers' education level as they related to the adolescents' HPV vaccination status. The study demonstrated that there was a significant difference between genders, showing that male adolescents have received fewer HPV vaccination shots in contrast to female adolescents. Moreover, adolescents whose mothers had high educational levels (some college and above) had higher HPV vaccine recommendations from providers than adolescents whose mothers had low educational levels (under high school or high school equivalent). These findings are important to note since literature revealed that HPV prevention has been targeting females, which has resulted in more females getting and completing their HPV vaccination shots but neglected males' need for the vaccine. Literature also indicated that high maternal educational levels and providers' HPV vaccine recommendation are significant factors for adolescent obtaining any of the HPV vaccination doses. Therefore,

increasing providers' HPV vaccine recommendation is important to improve HPV vaccination uptake among adolescents. In addition, this study also found no difference in the likelihood of teens receiving their HPV vaccination within the next 12 months between mothers of high and low educational levels. This suggested that other additional factors need to be considered, aside from maternal education levels, to guarantee that adolescents will be receiving any of their HPV vaccination shots. Furthermore, it is fundamental to develop HPV program interventions that target male youth adolescents to slow down the spread of HPV infections.

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