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Factors Impacting College Students' Receipt of Human Papillomavirus Vaccination

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This is to certify that the doctoral dissertation by

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Walden University
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Abstract

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by

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MBA, Our Lady of the Lake, 1997

MS, The University of Texas Health Science Center at Houston, 1992

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Public Health

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Abstract

Less than half of U. S. students entering college have had a human papillomavirus (HPV) vaccination, placing them at risk for HPV-related cancers. This study's purpose was to identify predictors of HPV vaccination initiation in college students. Andersen's behavioral model of health services use was used to examine the differences in predisposing, enabling, and need factors in U.S. college students ages 18–26 years who received an initial HPV vaccination in college compared to those who never received an HPV vaccination. The study was a quantitative, cross-sectional survey design using multivariable logistic regression for data analyses. Data were collected through an online survey of 403 college students. Predisposing factors, including lack of influence from religious beliefs ($p = .027$) and lack of communication with parents about sexual matters ($p = .033$), predicted not having an HPV vaccination. Enabling predictors of initiating HPV vaccination in college were student education level (years 2–4); receiving a vaccine recommendation by a parent ($p = .002$), health care provider ($p = .016$), or other person ($p = .016$); having prior knowledge of HPV vaccinations ($p < .001$); and belief that the vaccination is safe ($p = .008$). Need factor predictors of HPV vaccination initiation were use of the student health clinic ($p = .004$), sexual activity ($p = .049$), and use of preventive health services (hepatitis B [$p < .001$] and influenza vaccination [$p < .008$]). Implications for positive social change include understanding predictors of HPV vaccination initiation in college students may be used to develop interventions to increase HPV vaccination rates.

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Dedication

I dedicate this work to the college students who participated in my study, and to people worldwide who have suffered an HPV- related cancer. You inspire me to do more.

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Table of Contents

List of Tables v

List of Figures vi

Chapter 1: Introduction to the Study 1

Background 2

Problem Statement 5

Purpose of the Study 7

Research Questions and Hypotheses 8

Conceptual Framework 9

Nature of the Study 10

Definitions 12

Assumptions 14

Scope and Delimitations 14

Limitations 15

Significance 16

Summary 17

Chapter 2: Literature Review 18

Literature Search Strategy 18

Conceptual Framework: BMHSU 21

Justification for Using the Behavioral Model of Health Services Use 26

Introduction to HPV, Related Cancers, and Available Vaccines 26

Literature Review 28

HPV Vaccination Status 28
Predisposing Factors 29
Enabling Factors 36
Need Factors 49
Summary 57
Chapter 3: Research Methods 62
Research Design and Rationale 62
Research Questions and Hypotheses 64
Population 66
Sampling, Sampling Procedures, and Recruitment 66
Sample Size Calculation 67
Collection Methods 69
Instrumentation 70
Instrument Development 70
Instrument Reliability and Validity 71
Operationalization of Variables 72
Data Analysis Plan 76
Statistical Assumptions 79
Threats to Validity 79
Ethical Considerations 80
Summary 81
Chapter 4: Results 83

Study Instrument 85
Pilot Study 85
Reliability 85
Validity 86
Data Collection 86
Data Cleaning 87
Results 89
Power Analysis 89
Demographics 90
Statistical Analysis 96
Research Question1 97
Research Question 2 102
Research Question 3 115
Summary 120
Chapter 5: Interpretation of the Findings 122
Summary of Key Findings 123
Predisposing Factors 124
Enabling Factors 127
Need Factors 133
Key Findings Summary 136
Limitations of the Study 138
Recommendations 139

Implications....142
Conclusion....143
References....144
Appendix A: Predict HPV Vaccination Survey....163
Appendix B: Do Not Qualify Notification....176
Appendix C: Variable Coding....177

List of Tables

Table 1. Variables Categorized Based on BMHSU 25

Table 2. Key Sample Demographics 92

Table 3. Key Sample HPV Vaccination Statistics 93

Table 4. Participants' U.S. Region Compared to U.S. Population Census 93

Table 5. Participants' Gender Compared to U.S. College Population Gender 93

Table 6. Participants' Race Compared to U.S. College Population Race 94

Table 7. Predisposing Factor Variables in the Regression Model 99

Table 8. Enabling Factors: Variables in the Regression Equation 106

Table 9. Need Factors: Variables in the Regression Equation 117

List of Figures

Figure 1. Behavioral Model of Health Services Use: Phase 5 23

Figure 2. G*Power Logistic Regression Power Analysis Calculation 68

Figure 3. Post-Hoc G*Power Logistic Regression Power Analysis Calculation..... 90

Chapter 1: Introduction to the Study

Human papillomavirus (HPV) is a group of more than 200 related viruses. Fourteen high-risk subtypes have been identified that may lead to six HPV-related cancers in humans, all of which are preventable with HPV vaccination (Centers for Disease Control and Prevention [CDC], 2021b). The HPV vaccination series is recommended for males and females age 11 or 12 years, and initiation of the vaccination can start as early as 9 years of age (Meites et al., 2019). Uptake of HPV vaccination has been slow in the United States, and the Advisory Committee on Immunization Practices recommends HPV vaccination for males and females through age 26 years (Meites et al., 2019). Sixty percent of people 18–26 years of age in the United States have not initiated HPV vaccination (Boersma & Black, 2020). Students enrolled in college who have not been vaccinated in childhood are of prime age to receive HPV catch-up vaccinations to prevent HPV-related cancers from developing (Markowitz et al., 2014).

Recent evidence revealed a number of characteristics of college students' intent to be vaccinated for HPV, such as knowledge of HPV, an HCP's recommendation to get the vaccine, and family income (D'Errico et al., 2020; Preston & Darrow, 2019; Ragan et al., 2018). The literature focused on intent to be vaccinated and not on actualization of HPV vaccination while in college, leaving a gap to fill to better understand the factors that lead to initiation of HPV vaccination by college students. The purpose of the current study was to examine the characteristics of college students in the United States who received an initial HPV vaccination while in college compared to those who never received an HPV vaccination. Understanding these factors could assist with the development of

appropriate interventions to increase HPV vaccination rates, leading to herd immunity in the U.S. population and positive social change.

Background

HPV infection is the most common sexually transmitted disease in the United States, and the vaccination rate in adults 18–26 years of age is about 40%, which is half of the U.S. national goal of 80% recommended for achieving herd immunity and improving health (Boersma & Black, 2020; CDC, 2021d; Office of Disease Prevention and Health Promotion, 2021). Unvaccinated sexually active young adults entering college, and their sexual partners, are at risk of HPV infection and possibly HPV-related cancers. College provides an opportunity for 18–26-year-old students who are not appropriately vaccinated to catch up on HPV vaccinations and prevent HPV-related cancers. The literature provided evidence on factors associated with intention to be vaccinated and on HPV vaccination uptake but did not address the factors associated with the actualization of HPV vaccination in college. Andersen's (1995, 2008) behavioral model of health services use (BMHSU) guided variable selection in this study and the organization of the literature review by predisposing factors, enabling factors, and need factors in association with HPV vaccination intent and/or uptake in college students.

Predisposing factors are social, biological, and cultural, and are harder to alter than other factors (Andersen, 1995, 2008). The evidence supported significant differences in vaccination initiation and completion rates in people, with men being vaccinated less often than women, indicative of the HPV vaccine first being marketed for prevention of cervical cancer (Meites et al., 2019). The evidence related to race and ethnicity and HPV

vaccine uptake is conflicting among studies with reports that Whites have both increased and decreased odds of HPV vaccination compared to Asians (Hollins et al., 2021; Kellogg et al., 2019; LaJoie et al., 2018).

There have been discrepant results for religiosity and HPV vaccination uptake and for intention to be vaccinated based on sexual orientation (Preston & Darrow, 2019; Quinn & Lewin, 2020; Shah et al., 2021; Thompson et al., 2016). Religiosity has been shown to have both influence and no influence on the receipt of HPV vaccination in college students (Hollins et al., 2021; Quinn & Lewin, 2020; Shah et al., 2021). Data on sexual attitudes indicated strong preferences for vaccinated people to prefer their partners to be vaccinated against HPV (LaJoie et al., 2018). A key predictor of international student HPV vaccination status is increased time in the United States (Kim et al., 2019).

Enabling factors, more malleable than predisposing factors, have been shown to accelerate or impede the use of health care services (Andersen, 1995, 2008). Parent education level has been associated with student HPV vaccination uptake; however, in Latino/Hispanic populations, lower level parent education was predictive of vaccination uptake (Kellogg et al., 2019). Income is a predictor of vaccination with moderate incomes (over $60,000) being more predictive compared to higher incomes (Kellogg et al., 2019). Evidence indicated that having health insurance is positively associated with HPV vaccination uptake (Cooper et al., 2018). Recommendations to obtain the HPV vaccination by HCPs, parents, and others (friends, spouses) are predictive of both HPV uptake and intention to be vaccinated (D'Errico et al., 2020; LaJoie et al., 2018; McLendon et al., 2021; Richards, 2016). The strongest predictor of HPV vaccination

status, with consistency in the literature, is HCP recommendation. The real or perceived ability to meet with an HCP has been related to vaccination status. One of the most often assessed variables, showing mixed association with HPV vaccination uptake and intention, is HPV and HPV vaccine knowledge. In most studies reviewed, the majority of students heard of HPV and HPV vaccines prior to participating in a study (Grace-Leitch & Shneyderman, 2016). Knowledge deficits were highlighted in the studies, such as students not knowing that the HPV vaccine was a cancer prevention vaccine, and most were unclear of the vaccine benefits.

Need factors are variables associated with the need for an individual to seek out and use health care, such as when they are ill (Andersen, 2008; Li et al., 2016). An evaluated health issue or risk is one that has been assessed and diagnosed by an HCP. There have been mixed results, with college students reporting sexually transmitted infections (STIs) showing no association with HPV vaccination uptake, and those with an increased number of lifetime STI tests being associated with vaccination uptake (Thompson et al., 2016; Wilkinson et al., 2018). Conversely, associations with HPV vaccination intent have been found in students diagnosed and treated with urinary tract infections (Thompson et al., 2016). Perceived health risks have been discussed but rarely as related to HPV vaccine uptake. Many students reported low perception of HPV infection risk; however, women in dating relationships perceived their risk to be higher than women in committed relationships (Klasko-Foster et al., 2020).

Knowledge of HPV and the HPV vaccine, worry about HPV, and general health perception have been strongly associated with HPV vaccine uptake, intention, or

acceptance. Many college students reported they had been sexually active and had had one to more than five sexual partners (Rohde et al., 2018). HPV vaccination associated with sexual activity has been assessed in limited studies, and mixed results have been reported. Although sexual activity has been reported to influence HPV vaccination and has been positively associated with male vaccination uptake, data have indicated no relationship between sexual activity and HPV vaccination uptake in a mixed-sex student population (Winger et al., 2016). Finally, the use of preventive health services by college students has been positively associated with HPV vaccination intention. For women, a gynecological examination in the past year has positively predicted HPV vaccine uptake while the lack of a visit has negatively predicted HPV vaccine uptake (Thompson et al., 2016).

Most HPV vaccination research has addressed the intention of people to be vaccinated and not actualization of HPV vaccination. In an effort to identify the factors associated with HPV vaccination actualization in college students, I examined these variables in my study. The study was needed to identify factors that lead to college students seeking HPV vaccinations. With implementation of appropriate interventions, the results may be used to increase vaccination rates in the United States and decrease the morbidity and mortality caused by HPV infections.

Problem Statement

HPV is the most common sexually transmitted disease in the United States, affecting 79 million Americans. HPV-related cancers cause 3% of all cancers in women and 2% of all cancers in men in the United States (National Cancer Institute, 2021).

High-risk HPV subtypes cause six types of cancers with about 46,143 HPV-related cancers occurring annually in the United States. Based on data from 2014 to 2018, the incidence of HPV-related cancers was 25,719 among women and 20,424 among men, with cervical cancers being the most common in women and oropharyngeal cancers being the most common in men (CDC, 2021b). There are approximately 44,000 new HPV-related cancers in the United States every year (CDC, 2021a; Meites et al., 2019).

HPV vaccinations can prevent HPV-related cancers and protect the population from HPV infections and are recommended by the CDC for people age 11–26 years (Meites et al., 2019). Despite the recommendation, only 51.1% of U.S. adolescents, (17 years of age and younger) have completed the recommended vaccination series (Walker et al., 2019). Additionally, recent data indicated that, except for cervical cancer, the incidence of HPV-related cancers has been increasing in both men and women over the past 16 years (Liao et al., 2021). Unvaccinated young adults entering college and their sexual partners are at risk of HPV and HPV-related cancers because only 39.9% of people 19 years of age and older have received one or more HPV vaccine injections of the recommended series, leaving 60.1% of this age group vulnerable to HPV infection and HPV-related cancers (Boersma & Black, 2020).

The literature provided evidence regarding factors associated with intention to be vaccinated and on HPV vaccination uptake but did not address the factors associated with the actualization of HPV vaccination while in college (LaJoie et al., 2018; McClendon et al., 2021; Thompson et al., 2016). Identifying factors related to HPV vaccination receipt in college students is critical to understanding the influencers of HPV vaccination in this

age group (LaJoie et al., 2018). Understanding the factors that influence HPV vaccination actualization could lead to programs to increase vaccination rates and protect 18–26-year-old men and women from HPV infection and HPV-related cancers. HPV Vaccination of 80% of the population has been proposed as the rate of vaccination needed for herd immunity and focusing on catch-up vaccinations in 18–26-year-old college students is critical to the positive social change needed to protect the population from HPV infections and HPV-related cancers (Meites et al., 2019).

Purpose of the Study

The purpose of this quantitative study was to examine the distinguishing characteristics of college students who received their initial HPV vaccination while in college compared to those who never received an HPV vaccination. Variables measured were HPV vaccination status (dependent variable) and predisposing, enabling, and need factors (predictor variables) defined by the BMHSU and the literature review. To advance knowledge of the initiation of HPV vaccination in college students 18–26 years of age, I examined the characteristics of students who initiated the vaccination while in college compared to students who never received an HPV vaccination.

The dependent variable in this study was dichotomous and included the initial receipt of an HPV vaccination while in college or never having received an HPV vaccination. Predisposing factors are social, biological, or cultural factors that predict the use of health services (Anderson, 1995, 2008). For the current study, the predisposing factors included age, sex, race, ethnicity, relationship status, sexual orientation and health beliefs, sexual attitudes, and religious/spiritual beliefs. Enabling factors may accelerate or

impede the use of health services by an individual (Andersen, 1995). Enabling factors examined in the current study included knowledge of HPV and HPV vaccines, insurance coverage, income, education level, social support, parental, physician, and other recommendations for HPV vaccination, individual attendance at a doctor's visit in the past year, and the perceived ability to access a doctor's care. Need factors are those that represent the potential need for an individual to seek out and use health care services (Li et al., 2016). For the current study, need factors were perceived health, perceived risks of HPV and HPV-related diseases, evaluated health and evaluated risks for HPV, sexual activity, number of sexual partners, and history of using preventive health services.

Research Questions and Hypotheses

The three research questions (RQs) and hypotheses for this study were the following:

RQ1: Based on self-reported survey data, are there differences in predisposing factors in U.S. college students age 18–26 years who received an HPV vaccination while enrolled in college compared to those who never received an HPV vaccination?

H_o1: Based on self-reported survey data, there are no differences in predisposing factors in U.S. college students age 18–26 years who received an HPV vaccination while enrolled in college compared to those who never received an HPV vaccination.

H_a1: Based on self-reported survey data, there are differences in predisposing factors in U.S. college students age 18–26 years who received an HPV vaccination while enrolled in college compared to those who never received an HPV vaccination.

RQ2: Based on self-reported survey data, are there differences in enabling factors in U.S. college students age 18–26 years who received an HPV vaccination while enrolled in college compared to those who never received an HPV vaccination?

H_o2: Based on self-reported survey data, there are no differences in enabling factors in U.S. college students age 18–26 years who received an HPV vaccination while enrolled in college compared to those who never received an HPV vaccination.

H_a2: Based on self-reported survey data, there are differences in enabling factors in U.S. college students age 18–26 years who received an HPV vaccination while enrolled in college compared to those who never received an HPV vaccination.

RQ3: Based on self-reported survey data, are there differences in need factors in U.S. college students age 18–26 years who received an HPV vaccination while enrolled in college compared to those who never received an HPV vaccination?

H_o3: Based on self-reported survey data, there are no differences in need factors in U.S. college students age 18–26 years who received an HPV vaccination while enrolled in college compared to those who never received an HPV vaccination.

H_a3: Based on self-reported survey data, there are differences in need factors in U.S. college students age 18–26 years who received an HPV vaccination while enrolled in college compared to those who never received an HPV vaccination.

Conceptual Framework

The BMHSU was used in my study to examine factors that affect health services use and the use or access of health services required to receive an HPV vaccination. The BMHSU has been used to investigate health services utilization in a variety of diseases,

including cancer screening and prevention studies, and in examining HPV vaccination intention (Babitsch et al., 2012). The BMHSU has been used to identify factors that predict and explain health services utilization (Andersen, 1995, 2008). Andersen (1968) developed the BMHSU in the 1960s to understand the reasons families use health services, to characterize and measure access, and to develop policies that ensure fair and balanced access to health services. The BMHSU includes feedback loops to indicate how parts of the model integrate to affect the predisposing, enabling, and need factors associated with health services use (Andersen, 2008). The most current BMHSU from the 2000s emphasizes that both contextual factors and individual factors work together to improve access to care (Andersen, 2008). Contextual factors were added to recognize the importance of the community or environment in which individuals live, the organization of health services, and the population served (Andersen, 2008). In the current study, the BMHSU guided the development of the hypotheses; organization of the variables as predisposing, enabling, and need factors; development of the survey; analysis of the associations between the variables and the outcome; initiation of HPV vaccination while in college; and interpretation of the results in the context of the recent literature.

Nature of the Study

To answer the research questions in this quantitative study, I chose a prospective, correlational, cross-sectional, web-based survey design. A web-based survey was developed as a data collection tool integrating the predisposing, enabling, and need factors that influence health care use according to the BMHSU. The population examined was U.S. college students 18–26 years of age who received an initial HPV vaccination

while in college compared to those who never received an HPV vaccination. The survey and items were pilot tested with a small sample of college students to ensure the clarity and understanding of the questions by a representative population. A power analysis was conducted to determine the appropriate sample size, and the participants were recruited from existing voluntary internet registries assessable through a partner organization.

Employing a random stratified sampling framework, I collected data from 18–26-year-old college students using an online cross-sectional survey. The college students were recruited from voluntary internet research panels. The panels consisted of groups of individuals who had been prerecruited and had agreed to be contacted for potential inclusion in web-based research. Multiple quality control measures were integrated throughout the data collection process, including digital fingerprinting technologies that ensured that participants completed the survey only once, that participants were in the United States, that the data were unique, and that responses were not fraudulent.

The objective of this study was to examine the relationships between predisposing, enabling, and need factors and HPV vaccine initiation while in college. All variables were measured categorically. The three categories of independent variables were predisposing, enabling, and need factors, and the dependent variable was HPV vaccination status. Predisposing factors were variables that increased the tendency to seek and use health services. Enabling factors were variables that influenced the ability to receive and afford services. Need factors were variables that impacted self-perceived or professionally evaluated need for health care services. HPV vaccination status was defined as the receipt of a participant's first HPV vaccine shot while enrolled in college

or never having received an HPV vaccination. To determine the factors identified as predisposing, enabling, and need to be examined with HPV vaccination initiation in 18–26-year-old college students while enrolled in college compared to students who never received an HPV vaccination, I examined HPV vaccination literature for this population from 2016 to 2021. This cross-sectional, quantitative analysis was conducted to determine the predictors of HPV vaccination initiation in college students 18–26 years of age.

Definitions

Several key terms are defined as they were used in this study:

Enabling factors: Factors that may influence, accelerate, or impede the use of health services by an individual or family (Andersen, 1995). These factors are more malleable than predisposing factors because they are more frequently dynamic and able to be altered (Andersen, 1995, 2008). Enabling factors examined in the current study included knowledge of HPV and HPV vaccines, insurance coverage, income, social support, parental and physician recommendations for HPV vaccination, having a regular HCP, and the perceived ability to access a doctor's care.

Human papillomavirus (HPV): A small, circular, double-stranded DNA virus that infects the epithelium and may cause multiple epithelial lesions and cancers. Estimates are that there are 120 or more HPV subtypes (CDC, 2021a).

Human papillomavirus (HPV) vaccine: Although three HPV vaccines have been approved in the United States to prevent HPV infection caused by high-risk subtypes of the virus, since 2016 only Gardasil 9 has been used in the United States. Gardasil 9 is a 9-

valent vaccine approved in the United States for males and females for protection against HPV infections with high-risk Subtypes 6, 11, 16, 18, 31, 33, 45, 52, and 58 (Kirby, 2015). First generation Gardasil, a quadrivalent vaccine, and Cervarix, a bivalent vaccine, are no longer used in the United States due to limited HPV subtype coverage (CDC, 2010; Meites et al., 2019). When the vaccine is initiated at age 15 years or older, a series of three doses is required to be fully vaccinated (CDC, 2021c). A child age 9–14 years needs two doses of the vaccine except when the doses are given less than 5 months apart, and then a third does is required to be fully vaccinated (CDC, 2021c).

Human papillomavirus (HPV) vaccination status: For the current study, HPV vaccination status was defined as never having received an HPV vaccination or having received a first dose of the HPV vaccine while in college.

Need factors: Factors that represent the potential need for an individual to seek out and use health care services (Li et al., 2016). Health needs may be perceived by the individual or evaluated by a health care professional (Andersen, 2008; Li et al., 2016). Need factors in the current study included perceived health, perceived risks of HPV and HPV-related diseases, evaluated health and evaluated risks for HPV, sexual activity, number of sexual partners, and history of using preventive health care services.

Predisposing factors: *S*ocial, biological, or cultural factors that predict the use of health services (Anderson, 1995, 2008). For the current study, the predisposing factors included age, sex, race, ethnicity, relationship status, sexual orientation and the health beliefs, sexual attitudes, and religious/spiritual beliefs.

Assumptions

A number of assumptions were made during the development of this study. First, I assumed that many college students 18–26 years of age are not fully vaccinated against HPV and men fall behind women in vaccination rates (see Kellogg et al., 2019). Second, I assumed herd immunity through HPV immunizations is important to decrease HPV infections and HPV-related cancers (see Oliver et al., 2017). Third, I assumed catch-up HPV vaccinations for individuals 18–26 years of age are effective in decreasing long-term high-risk subtype HPV infections (see Meites et al., 2019). Fourth, I assumed that there were no underlying reasons that a student was medically unable to receive an HPV vaccine. Fifth, I assumed that the study variables would predict the receipt of HPV vaccination. Lastly, I assumed that I met the assumptions associated with conducting a multivariable logistic regression test.

Scope and Delimitations

My research focused on men and women students 18–26 years of age enrolled in college and living in the United States at the time of the study. Although 60% of people 18–26 years of age in the United States have not completed the HPV vaccination series, college students were the defined population given the ability to access them for a web-based survey. The findings are generalizable only to 18–26-year-olds who are college students in the United States and not to the broader population of people this age. Members of this age group are at risk for HPV infection and long-term sequela because they are unvaccinated and new to making health care decisions for themselves (Boersma & Black, 2020). Individuals under the age of 18 were not included in this study because

their health care decisions are primarily made by parents or guardians and not by them. People over the age of 26 were not included because clinical trials indicated there was limited benefit from HPV vaccination in this age group (CDC, 2019). International students living in the United States were included and were analyzed with the larger population.

Limitations

Limitations of this study were related to design and methodology. A web-based survey was developed for this study, and practice bias may have been introduced when assessing test-retest reliability (see Schober et al., 2018). The instrument employed in this study was newly developed, and the content of the survey may not have been completely representative of the constructs being measured. Content validity of the survey was assessed via three experts in HPV infection, HPV-related cancers, and/or HPV vaccination. I employed a cross-sectional design in which the exposure and outcome variables were assessed at the same time, preventing the collection of evidence that the independent variables caused the students to get an HPV vaccination.

Sampling errors may have been introduced into the study because the sample was drawn from a volunteer sample of the population. Volunteers may differ from nonvolunteers (Laerd Statistics, 2012). A random stratified sampling framework including internet panels was employed to decrease the risk of this sampling error. Participants may not have been honest in their answers, or they may have embellished their answers given the sensitive nature of questions about sexual activity. Inaccurate responses may have occurred from the wording of the survey leading to a

misunderstanding of the questions. A pilot study was conducted to reduce these potential errors and biases (see Szklo & Nieto, 2019). External validity may have been diminished because the eligibility criteria for the study were narrow. Data collected from the surveys were reviewed for inconsistencies, and cases with inconsistent or missing data were removed from the data set prior to analysis.

Significance

Over 60% of students enter college without being fully immunized against HPV and remain unprotected from HPV infections and HPV-related cancers, which may lead to morbidity and mortality among the population (Boersma & Black, 2020). I examined factors that may predict initiation of HPV vaccination by college students 18–26 years of age, thereby preventing future HPV-related cancers and saving lives. Data indicated that college women, along with women presenting to STD clinics, have the highest prevalence of HPV infection, and male vaccination rates have fallen below those of women (Kellogg et al., 2019). There was a lack of information on factors that predict college students' receipt of HPV vaccinations while in college. National guidelines recommend catch-up vaccinations for this age group (CDC, 2019). Identifying the factors that predict the initiation of HPV vaccination may aide in the identification and implementation of strategies that increase college students seeking and receiving HPV catch-up vaccinations, thereby decreasing the development of HPV infections and HPV-related cancers (see CDC, 2019).

Summary

In this chapter, I described the importance of HPV vaccination in decreasing the morbidity and mortality of HPV infections and HPV-related cancers. I also addressed the importance of catch-up HPV vaccinations in college students 18–26 years of age, a subset of the general population that has low vaccination rates. The BMHSU, a conceptual model to predict health utilization behaviors of individuals and/or families, was introduced including the organizing factors for predicting behaviors (i.e., predisposing, enabling, and need factors). Data on HPV vaccination actualization while in college were missing in the literature. The purpose of the current study was to advance knowledge of the initiation of HPV vaccination in college students 18–26 years of age by comparing the characteristics of students who initiated the vaccination while in college to students who never received an HPV vaccination, thereby addressing the literature gap. Further, I presented the research questions and hypotheses, along with the quantitative nature of the study, definitions, assumptions, and limitations. Chapter 2 focuses on the conceptual framework that guided this study and provides a review of recent literature related to HPV vaccinations in college students.

Chapter 2: Literature Review

About 40% of U.S. adults age 18–26 years have received one or more doses of the HPV vaccine (Boersma & Black, 2020). HPV vaccination is recommended for children beginning at age 9 years, and catch-up vaccination is recommended for males and females through age 26 years when not adequately vaccinated in childhood (Markowitz et al., 2014). The purpose of the current study was to examine characteristics of college students in the United States who received an initial HPV vaccination while in college compared to those who never received an HPV vaccination. HPV vaccination status was the dependent variable. The independent variables were predisposing, enabling, and need factors based on Andersen's (1995) BMHSU.

This chapter focuses on peer-reviewed articles addressing the major variables in the target population. The BMHSU, the conceptual framework employed in developing the study, is reviewed, and its use in this study is explained. I present an overview of HPV, HPV-related cancer, and HPV vaccines currently available to prevent HPV-related cancers in college-age students. The relationships between HPV vaccination receipt and the key variables impacting vaccination receipt are reviewed, and the strengths and limitation of the studies are analyzed. This chapter also includes the literature search strategy and potential future studies needed to fill the literature gaps identified. The chapter ends with a summary and conclusion.

Literature Search Strategy

The literature search was conducted using available search engines and five electronic databases related to health care including CINAHL, Medline, PubMed,

Science Direct, and the Thoreau multidatabase. Thoreau multidatabase was searched first because it includes CINAHL, Medline, Science Direct, and 61 additional databases. Thoreau does not search PubMed, which is a publicly available search engine maintained by the National Institutes of Health that includes more than 33 million citations; therefore, the PubMed search was conducted separately.

Search terms used for the Thoreau database included *HPV vaccine* or *HPV vaccination* or *Human Papillomavirus vaccine*, *college students* or *university students* or *undergraduates*, *factors* or *causes* or *influences* or *reasons* or *determinants* or *predictors*, and *United States* or *America* or *USA* or *US* or *United States of America*. The searches were done independently, and various combinations of terms were used to establish a list of potential literature to be incorporated into this comprehensive literature review. The scope of the literature review included peer-reviewed articles published from January 1, 2016, to Dec 18, 2021, with the following selection criteria: (a) article in English, (b) original research, (c) full-text available, (d) HPV vaccination research, and (e) discussion/inclusion of the predefined search terms.

Articles with a focus on testing interventions were excluded. The combination of search terms returned 177 articles, of which (a) 111 were duplicates, (b) seven were in populations outside of the United States, (c) 12 were research to assess interventions to increase awareness of HPV vaccinations and/or HPV vaccination intention, (d) two were in subjects outside of the 18–24-year age range, and (e) six were off topic. The remaining 39 articles were included in the review of literature and were in the following nine databases: Academic Search Complete, CINAH, Communication and Mass Media

Complete, Complementary Index, Education Source, ERIC, Medline, Peer Influence, and Science Direct.

Following the initial Thoreau multidatabase search, a separate PubMed search was conducted using the same search terms. Advanced search selection criteria are different in PubMed than in Thoreau, and the following selection criteria were employed: (a) publication in English, (b) human subjects, (c) 19–26 years of age, (d) original research, (e) full-text available, (f) HPV vaccination research, and (g) discussion/inclusion of the predefined search terms. The search returned 41 articles, of which (a) 22 were duplicates from the original Thoreau multidatabase search, (b) three were in populations outside of the United States, (c) three were research to assess interventions to increase awareness of HPV vaccinations and/or HPV vaccination intention, (d) two were in subjects outside of the 18–26 year age range, and (e) seven were off topic. The remaining four articles were included in the review of literature.

Following these two searches, various combinations of the same keywords were used to search the Thoreau and PubMed databases with the same scope as previously outlined. Seven additional articles were identified and included in the review of literature. The seven articles were found in the following five databases: CINAHL, Directory of Open Access Journals, ERIC, Gale Academic OneFile Select, and Medline. A total of 50 article were included in the review of literature. A literature search was also conducted for BMHSU publications. Seminal articles and studies in which the model was applied to cancer prevention, with a focus on HPV vaccination, formed the basis for the review in this chapter.

Conceptual Framework: BMHSU

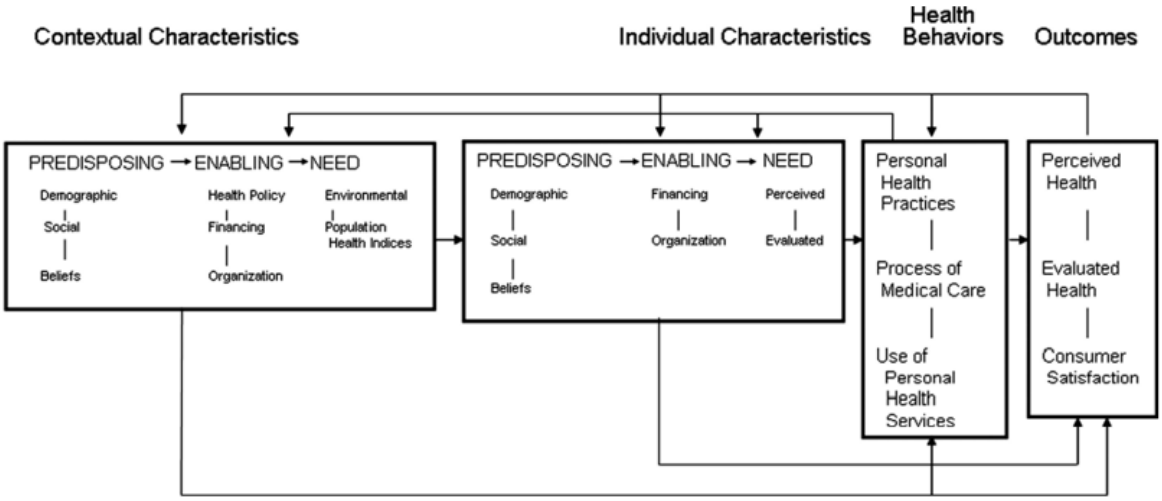
I determined that an appropriate conceptual framework for this study would be one that explained the factors that affect health services use because health services use is a requirement for the receipt of an HPV vaccination. The BMHSU has been used to investigate health services utilization in a variety of diseases including cancer screening and prevention studies, and specifically in examining HPV vaccination intention (Babitsch et al., 2012). In the current study, the framework guided the development of the hypotheses; organization of the variables as predisposing, enabling, and need factors or characteristics; analysis of the associations between variables; and interpretation of the results in the context of the recent literature.

The BMHSU is used to demonstrate factors that predict and explain health services utilization (Andersen, 1995, 2008). Andersen (1968) developed the BMHSU in the 1960s to (a) better understand the reasons families use health services, (b) characterize and measure equitable access, and (c) develop policies to characterize fair and balanced access to health services. Andersen (1995, as cited in Phillips et al. 1998) proposed that the use of health services such as dental services, hospitals, and ambulatory clinics were explained by predisposing factors (e.g., demographic, value beliefs, social structure), enabling factors (e.g., community and family characteristics and resources), and need factors (e.g., perceived or evaluated by clinician). The model, which provides a framework for the use of health services, has evolved over the past 50 years in response to and collaboration with other researchers and as the health care environment has evolved (Aday & Andersen, 1974; Andersen, 1968, 1995, 2008).

In the second iteration of the model developed in the 1970s, the health care system was added to the model because health policy became recognized as important to health care utilization. Measures of health services (type of service, where received, visit purpose) were included as determinants of health services use (Andersen, 1995). During the 1980s, there was recognition that health services should help maintain and improve health; consequently, health status was added to the model in the third phase with perceived health status assessed by the individual (perceived) or evaluated health status assessed by a professional (Andersen, 2008). At this time, environment (physical, political, and economic) was added as a determinant of health behaviors (Andersen, 2008). In the fourth iteration of the BMHSU developed in the 1990s, health outcomes and feedback loops were added to the model. The feedback loops indicate how the various parts of the model integrate to affect predisposing, enabling, and need characteristics and health services use (Andersen, 2008). The most current BMHSU (see Figure 1) from the 2000s emphasizes that both contextual factors and individual factors improve access to care (Andersen, 2008). The contextual factors are divided and categorized as predisposing, enabling, and need but differ from the individual factors because the contextual factors are defined at an aggregate level (Andersen, 2008). Contextual factors were added to recognize the importance of the community or environment in which individuals live, the organization of health services, and the population served (Andersen, 2008).

Figure 1

Behavioral Model of Health Services Use: Phase 5



Note. From *"*National health surveys and the behavioral model of health services use" by R. M. Andersen, 2008, *Medical Care, 46*(7), 647–653. Reprinted with permission.

The BMHSU was used to guide the current study design including the hypotheses, variables assessed, and data interpretation. Three research questions were developed to determine whether college students who received an HPV vaccination had different characteristics that may contribute to the vaccination decision, defined as predisposing, enabling, and need factors, compared to those who never received an HPV vaccination. The dependent variable was first HPV vaccination receipt in college or never having received an HPV vaccination. As defined by the BMHSU, HPV vaccination receipt is a health behavior that requires use of a personal health service. The independent variables were (a) predisposing factors that increase an individual's tendency to seek and use health services, (b) enabling factors that influence the ability to receive and afford services, and (c) need factors (self-perceived or professionally evaluated; see Table 1).

The model proposes that the three factors affect an individual’s decision to seek personal health services.

Table 1

Variables Categorized Based on BMHSU

Predisposing factors	Enabling factors	Need factors	HPV vaccination status
Age	Education: parent and student	Evaluated health/risk	Unvaccinated (no doses)
Gender	Employment: student	Perceived health/risk	Vaccinated (at least one dose, first dose in college)
International status	Health insurance status	History of preventive health services use	
Race/ethnicity	Income: family and student	Number of sexual partners	
Relationship status	Knowledge: HPV and HPV vaccine	Sexually active	
Religiosity	Regular HCP/physician		
Sexual attitudes	Ability to meet an HCP		
Sexual orientation	Vaccine recommendation: HCP		
	Vaccine recommendation: parent		
	Vaccine recommendation: other		
	Social norms		

Justification for Using the Behavioral Model of Health Services Use

In recent research, the BMHSU has been used to explain the use of health services related to cancer screening and prevention, including HPV vaccination intention. When the BMHSU has been applied in HPV vaccination research, the literature indicated age, sex, race, ethnicity, and international student status as some predisposing factors for HPV vaccination (Cook et al., 2010; Jeudin et al., 2014; Lee et al., 2018; Lindley et al., 2013; Okafor et al., 2015). Several enabling factors were identified, including parent education, family income, insurance status, and HPV knowledge (Bakir & Skarzynski, 2015; Jeudin et al., 2014; Wong et al., 2011; Yi et al., 2013). Need factors identified as influencing HPV vaccination included sexual activity and previous preventive health services use (Bernat et al., 2013; Wong et al., 2011). The BMHSU has shown relevancy when applied to HPV research. In the current study, the model's application contributed to the identification of predisposing, enabling, and need factors, and provided a framework to assist with the interpretation of the results.

Introduction to HPV, Related Cancers, and Available Vaccines

HPV is the most common sexually transmitted disease in the United States; HPV is so common that every sexually active person is expected to be infected with HPV at some point in their life (CDC, 2021d). Most HPV infections are removed by the human immune system within 1 to 2 years of infection; however, when the immune system does not eliminate the virus, the infected individual may develop cancer, specifically if the infection is caused by one of the oncogenic HPV subtypes (CDC, 2021b; Senkomago et al., 2019). High-risk subtypes are known to cause six cancers including cervical, vaginal,

vulvar, anal, penile, and oropharyngeal with 70% of cancers caused by HPV Subtypes 16 and 18 (CDC, 2021b).

Three vaccines targeting several high-risk HPV subtypes have been approved in the United States to prevent HPV infection. First generation Gardasil, a quadrivalent vaccine, gained regulatory approval in the United States in 2006 for the prevention of infection for HPV Subtypes 6, 11, 16, and 18 (Meites et al., 2019). Cervarix, a bivalent vaccine to prevent Subtypes 16 and 18 HPV infections, was approved in 2010 for females only (CDC, 2010). The CDC's Advisory Committee on Immunization Practices began recommending routine vaccination for 11–12-year-old girls on first vaccine approval, and in 2011 boys were added to the recommendation. Gardasil 9, a 9-valent vaccine, was approved in the United States in 2014 for males and females for protection against HPV infections with high-risk Subtypes 6, 11, 16, 18, 31, 33, 45, 52, and 58 (Kirby, 2015). In 2016, the Advisory Committee on Immunization Practices recommended that individuals 9 to 14 years of age receive only two doses of Gardasil 9, and three doses were recommended for males and females initiating HPV vaccinations between the ages of 15 and 26 years (Meites et al., 2016). Given its broad coverage of HPV high-risk subtypes, Gardasil 9 has been the only HPV vaccine used in the United States since 2016 (CDC, 2021c).

Only about 40% of US adults, 18–26 years of age, have received one or more doses of the Human Papillomavirus (HPV) vaccine (Boersma & Black, 2020). In 2016, 45.1% of females and 36.4% of males, age 13–15 years, had completed the recommended HPV vaccination series falling far below the Healthy People goal of 80% (Office of

Disease Prevention and Health Promotion, 2021). This leaves an opportunity to vaccinate college students, 18–26 years of age, for HPV as recommended by the AICP. The current literature, while reporting on the factors associated with intention of college students to receive an HPV vaccination, is silent on the drivers of the receipt of HPV vaccination while in college. Additionally, the factors associated with HPV vaccination initiation while in college have not been compared to the same factors in individuals who have never received a vaccination, a current gap in the literature. This study was conducted to identify the differences amongst these two groups of college students.

Literature Review

HPV Vaccination Status

Most of the HPV vaccination literature published from January 2016 to December 2021 reviewed here, was collected prior to 2016 when the change in AICP HPV vaccine guideline dosing schedule was updated. Prior to 2016, vaccination completion was defined as having received three doses of the HPV vaccine. This is an important concept when comparing and contrasting research outcomes and in the operationalization of HPV vaccination status as an outcome variable. Vaccination status has been characterized, in most studies, as individuals being a) unvaccinated, b) initiated or non-completers, or c) completers. Individuals who had never received an HPV vaccination were identified as unvaccinated, initiators have received at least one HPV vaccine dose, but not three, and completers have been defined as receiving all three doses of HPV vaccine (Albright & Allen, 2018; Catalano et al., 2017; Hirth et al., 2018; Hollins et al., 2021; Johnson & Ogletree, 2017; Koplas et al., 2019; Lee et al., 2018; Preston & Darrow, 2019; Ragan et

al., 2018; Thompson, 2019; Winger et al., 2016). Two studies, published in 2021, defined completers as individuals who had received two doses of the vaccine, instead of three (Koskan et al., 2021; Natipagon-Shah et al., 2021). Rohde et al. (2018) and Glenn et al. (2021) did not identify the number of doses to be considered a vaccine initiator or completer. Similarly, Rosen et al. (2018) did not define the number of doses necessary to be considered a vaccine completer and defined initiators as someone who had received at least one dose of HPV vaccine and did not complete the series.

The second most common way to operationalize HPV vaccine status was as dichotomous; an HPV vaccine had been received or had not been received or the individual did not know if they had received a vaccination (Barnard et al., 2017; Best et al., 2019; Britt & Englebert, 2018; Grantham et al., 2020; Kasymova et al., 2019; Kellogg et al., 2019; McLendon et al., 2021; Thompson et al., 2016, 2018; Wilkinson et al., 2018; Yang & Pittman, 2017). D'Errico et al. (2020) collected information on the number of HPV vaccine doses a person had received (zero, one, two, three) and then defined "vaccinated" as having had three doses and under vaccinated as having had zero, one, or two doses of an HPV vaccine. My research study operationalized vaccine status as dichotomous, enrolling individuals who had never received an HPV vaccination as compared to individuals who had initiated HPV vaccination while enrolled in college, receiving at least one initial HPV vaccination in college.

Predisposing Factors

Predisposing factors, based on the BMHSU, are social, biological, or cultural factors that predict the use of health services (Anderson, 1995, 2008). For this study, the

predisposing factors examined included age, sex, race, ethnicity, relationship status, sexual orientation and the health beliefs, sexual attitudes, and religious/spiritual beliefs. HPV vaccination in college students 18–26 years of age is low and significant differences in the rates of vaccination exist between men and women (Catalano et al., 2017; Grantham et al., 2020; Koplas et al., 2019; Lee et al., 2018; LaJoie et al., 2018; Preston & Darrow, 2019; Tung et al., 2019; Vu et al., 2019).

Sex

In a cross-sectional survey design study, Catalano et al. (2017), assessed the differences in vaccination rates between men and women which indicated significant differences in series completers ($\chi^2 = 22.6$, $p < .001$). Vaccination completion rates in men ranged from 47% - 54.5% and in women HPV vaccination completion rates range from 26% - 85.4% (Albright et al., 2018; Britt & Englebert, 2018; Esagoff et al., 2021; Grantham et al., 2020; Lee et al., 2018; Preston & Darrow, 2019; Rosen et al., 2018; Thompson et al., 2017; Tung et al., 2019). Vaccination initiation rates are similar with men reporting one or more HPV vaccine doses 6%–56.3% and women reporting initiation of vaccine doses 42.2% -75.4% (Best et al., 2019; Hunter & Weinstein, 2015; Koplas et al., 2019; Koskan et al., 2021; LaJoie et al., 2018; Natipagon-Shah et al., 2021; Ragan et al., 2018; Thompson et al., 2016; 2019; Vu et al., 2019; Wilkinson et al., 2018; Winger et al., 2016). Lee et al. (2018) reported vaccination rates by age group in males and found that 54.5% of men age 18–20 years and 45.5% of men age 21–26 years had completed the HPV vaccination series. Only in two publications were vaccine completion rates reported to meet the Healthy People 2020 goals of 80% (80.2% and 85.4%) and in

both cases these vaccination rates were reported in women (Esagoff et al., 2021; Rosen et al., 2018).

Age

Much of the current literature indicates that younger age of both men and women college students was associated with increased HPV vaccination uptake and/or completion rates (Grace-Leitch & Shneyderman, 2016; Koskan et al., 2021; LaJoie et al., 2018; Lee et al., 2018; Rosen et al., 2018; Thompson et al., 2016; Tung et al., 2019). Younger age has been reported to be significantly predictive of vaccine acceptability (B= -.011, SE = .05, $p < .05$) in diverse race college men age 18–46 years (M = 23.68, SD = 5.88) and in mostly White college aged men and women (Grace-Leitch & Shneyderman, 2016; LaJoie et al., 2018). In a cross-sectional secondary analysis Lee et al. (2018) reported that male college students 18–20 years of age were significantly more likely to complete the vaccination series than students age 21–26 years (χ^2 (1, N = 2500) = 27.8, $p < .000$) and Koskan et al. (2021) found that HPV vaccination status was impacted by age in an a mostly White men, with younger students, age 18–22 years having a greater likelihood of vaccination initiation and completion than students 22 years of age and older. Additionally, an earlier year in college for men was significantly associated with HPV completion ($p < .000$) (Lee et al., 2018). Similarly, a significant relationship has been reported between completion of vaccination and age in a mostly White (63.4%) group of nursing students ($t(151) = 4.36$, $p = .00$) with younger students compared to older students more likely to have completed the HPV vaccination series (Hollins et al., 2021). A one-year change in age was associated with a 14% reduction in odds of

vaccination completion (*OR* = .86, 95% CI [78, 95], *p* =.003) (Hollins et al., 2021). Similarly, a study of Chinese college students in the US, found that college students at younger ages were more likely to have received the HPV vaccination than older students (Tung et al., 2019). Conversely, in a study of 202 Latino college students and 104 Korean American college women, age was not associated with vaccination intention (Hollins et al., 2021; Kim et al., 2019).

Race and Ethnicity

Race and ethnicity have been studied in association with HPV initiation and completion in college students. Race or ethnicity was not found to be associated with HPV vaccination in mostly White college students (Hollins et al., 2021; Koplas et al., 2019). Conversely, Kellogg et al. (2019) found that Whites (62.7%) and other ethnicities (50.8%) were more likely to be vaccinated than Latinos (40.9%) (*p* = .01) and Asians were more likely to be vaccinated than White college students (OR = .40, 95% CI, [20, 82]) (LaJoie et al., 2018). Conflicting results were reported when comparing White college students to a number of other races (Black, Hispanic/Latina and Asian) as Whites were reported to have higher vaccination rates than all others, including Asian students (LaJoie et al., 2018). Being bi- or multiracial increased the odds of being vaccinated (Thompson et al., 2016).

Religiosity

A number of key demographic variables categorized per the BMHSU were collected in a few studies, including religiosity, international student status, relationship status and type of college institution attendance (public or private); but rarely were they

assessed as variables contributing to HPV vaccination status (Quinn & Lewin, 2020; Shah et al., 2021). Regarding religious beliefs unvaccinated students, both men and women, and mostly White (89.2%), more often reported that religious beliefs influenced their health beliefs (Shah et al., 2021). No associations were found between attending religious services, private religious activities, and religion as an approach to life and receiving at least one HPV vaccine injection (Shah et al., 2021). In a group of White college students, religion did not have an influence on HPV vaccination (Hollins et al., 2021). Conversely, in 605 men and women college students age 18–30 years, increased family religiosity was negatively associated with students' being less likely to have received an HPV vaccination ($p = .05$) than those who reported less frequent participation in religious activities (Quinn & Lewin, 2020). An analysis of data from a sexual health study indicated statistically significant difference in religious and spiritual beliefs among HPV vaccinated and unvaccinated students ($p < .001$) (Best et al., 2019). Upon further mediation analyses, evidence was generated that sexual activity completely mediated the relationship between religious beliefs and HPV vaccination (*OR* = .85, 95% CI [68, 1.05]). When students disagreed that religion influenced their choice, the students were more likely to have been vaccinated ($\chi^2(2, n = 125) = 13.67, p = .001$) (Koplas et al., 2019).

Relationship Status

Relationship status has been reported as being associated with HPV vaccination. Hollins et al. (2021) found a significant relationship between marital status and completion of the HPV vaccination series in vaccine initiators ($\chi^2(3, n = 153) = 20.11, p$

< .000). Nursing students who were single (not married) were more likely to have received an HPV vaccination than married students, with single students being nearly three times more likely to have completed the vaccine series than married students (*OR* = 2.65, 95% CI [1.09, 6.42], *p* =.031) (Hollins et al., 2021). Relationship status was significantly related to HPV vaccination status in individuals not participating in a committed relationship to be less likely to be vaccinated (*OR* = 0.49, 95% CI [29, .85]); however. In the adjusted model relationship did not remain significant (Best et al., 2019). A woman's (*n* = 104) relationship status ($\chi 2$ (2) = 0.40, *p* = .842) had no significant association with intention to be HPV vaccinated in Korean American college women (Kim et al., 2019). Conversely, in a cross-sectional study of 18,919 college students Thompson et al. (2016) found that being in a relationship and living with the person with whom you were having a relationship with increased the odds of the participant having had an HPV vaccination (*aOR* = 1.34 95% CI [1.13, 1.79]. A strong preference for a participant's partner to be HPV vaccinated has been reported to predict vaccine uptake (*aOR* = 4.04, 95% CI [2.31–7.05}), and the lack of preference for a partner to be vaccinated predicted an unvaccinated self (*aOR* = 0.50, 95% CI [.27,.93]) (LaJoie et al., 2018).

International Student Status and Type of College

There are limited data on the evidence regarding type of college institution (public or private) on HPV vaccine completion. Lee et al. (2018) reported that college aged men (*n* = 2516) at four-year private schools were significantly more likely to complete the HPV vaccination series as compared to students attending two-year public schools (*p* =

.0000). International student status and number of years in the US has been explored as factors related to HPV vaccination status or intention to obtain an HPV vaccination. Korean American college women that had been in the US from 0-5 years were more likely to intend to receive an HPV vaccination as compared to those that were US born (χ^2 (2, n = 104) = 7.873; p = .029) (Kim et al., 2019). Vu et al. (2018) similarly found that among 1552 women college students, being born in another country decreased the prediction of having received an HPV vaccination recommendation (*aOR* = 0.4, 95% CI [.2, .7]), this did not hold true for men born outside of the US.

Sexual Orientation

While sexual orientation was collected as a demographic factor in some of the contemporary literature the number of people identifying as gay/lesbian or bisexual was rarely assessed to determine the association with HPV vaccination uptake (Cooper et al., 2018; LaJoie et al., 2018; Preston & Darrow, 2019). Sexual orientation was assessed as a predictor of HPV vaccination uptake in 386 men and women college students and sexual orientation was not significantly related with vaccine uptake (*OR* = 1.04, 95% CI [060, 1.78], p =.892) (Preston & Darrow, 2018). Conversely, in a group of 13,906 college students, identifying as bisexual more than doubled the likelihood of having had an HPV vaccination *(aOR* = 2.41, 95% CI [1.71, 3.38], $p \leq .001$) (Thompson et al., 2016). In men and women students self-identified as heterosexual (n = 160) or as a sexual minority (n = 15), 23.8% of the heterosexual students reported an intention to be vaccinated, while 76.3% had no intention to receive an HPV vaccination Cooper et al., 2018). Of 553 college students, 13 identified as gay or lesbian with five (38.5%) having received one or

more HPV vaccinations, 36 identified as bisexual with 21 (58.3%) having initiated HPV vaccination, and nine self-identified as questioning their sexuality with seven (77.7%) of them having initiated vaccination (LaJoie et al., 2018).

Sexual Attitudes

Sexual attitudes indicated that, while not predictive of vaccination status, there are strong preferences for vaccinated people to prefer HPV vaccination in their partners (*OR* = 5.47, 95% CI [3,42, 8.73]). In the current literature, vaccinated individuals were more likely to forego sex with someone who was not vaccinated, and this was true of both men and women (LaJoie et al., 2018). Quinn & Lewin (2020) noted that family sex attitudes, particularly communication about sex, was significantly associated with receipt of the HPV vaccine by the 608 men and women participants (*aOR* = .864, *p* =.009).

Enabling Factors

According to the BMHSU, enabling factors may accelerate or impede the use of health services by an individual (Andersen, 1995). Enabling factors include personal and family factors that may influence an individual's access to health services and these factors are more malleable than the predisposing factors, as they are more frequently dynamic and able to be altered (Andersen 1995; 2008). This research study assessed the association of HPV vaccination status with a number of enabling variables in college students including, knowledge of HPV and HPV vaccines, insurance coverage, income, education level, social support, parental and physician recommendations for HPV vaccination, having a regular HCP, and the perceived ability to access a doctor's care.

Education Level

This review of literature was limited to studies in college students, still, a couple of studies examined the influence of education on HPV vaccination status. Lee et al. (2018) investigated HPV vaccination predictors in 2516 college men using a secondary data analysis, cross sectional design. Having a parent with a graduate degree (*OR* = 1.611, $p < .001$) was found to be a significant predictor of HPV vaccination (Lee et al., 2018). The level of family education was examined in a study of 212 mostly Latino/Hispanic college students using a cross sectional survey design and family education was again found to be associated with self-reported HPV immunization status (Kellogg et al., 2019). However, in this study, students reporting the highest levels of education in their family as master's degrees and greater were 27.3% less likely to have received the HPV vaccine and students reporting "some" or "less than some" college as the highest level of education in their family were more likely to have been vaccinated ($p = .002$).

Family Income Level

Regarding income students in families with higher incomes ≥ $60,000 were more likely to have been vaccinated against HPV ($p = .0007$) (Kellogg et al., 2019). In a cross-sectional survey study of 527 college students, income was a predictor of HPV vaccine receipt in men with incomes of $75,000 as compared to those with incomes >$200,000 (*PR* = 0.51 95% CI [.28, .94] $p \leq .05$) (Ragan et al., 2017). For women differences were seen with incomes of $75,000 - $149,000 compared to >$200,000 (*PR* = .75 95% CI [.60, .95], $p \leq .05$] (Ragan et al., 2018).

Student Employment Status

The current literature rarely identifies the employment status of college students. In a qualitative study using structured interviewing and small (n = 19) purposive sample the majority (63.25%) of students were unemployed and only 15.8% were employed full time (Hirth et al., 2018). In a secondary data analysis of the National College Health Assessment – II (NCHA-II) in 356 women students age 18–30, women who worked for pay had a lesser chance of having had an HPV vaccination than those students who did not work for pay (χ^2 = 8.16, p = .04) (Wilkinson et al., 2018).

Health Insurance Status

Health insurance status was often collected as a demographic factor to characterize study participants; but rarely was the association of insurance status and HPV vaccination assessed. The reported percentage of college aged students with insurance coverage from this review of literature was 71%–100%, with parents being the most frequent primary source of insurance for the college students (Catalano et al., 2017; Cooper et al., 2018; Christy et al., 2016; D'Errico et al., 2020; Glenn et al., 2021; Hernandez at al., 2019; Jozkowski & Geshnizjani, 2016; McLendon et al., 2021; Ragan et al., 2018; Thompson et al., 2016). In a group of 190 men college students there was a statistically significant difference (p = .028) in self-reported Black and Hispanic men having health insurance (63.6%) compared to White, Asian, and "other" men (36.4%). This was not explored in other studies (Cooper et al., 2018).

Two studies indicated an association between insurance status and HPV vaccination status (D'Errico et al., 2020; Thompson et al., 2016). In a secondary analysis

of the NCHA-II, insurance status was significantly associated with women's HPV vaccination status; those with insurance were more likely to be vaccinated (*OR* = .21, 95% CI [.14, .31], p ≤ .01) (Thompson et al., 2016). Insurance was provided to the students (*n* = 18,919) by parents or "others" and both provisions of insurance were significantly positively related to vaccination status. Of note, students with "other" insurance plans were more likely to report that had been vaccinated (*OR* = 2.36, 95% CI [1.62, 3.43]) (Thompson et al., 2016). Similarly, D'Errico et al. (2020) found that of those participants that did not have a health care provider, not having insurance was a barrier predictive of not receiving the recommended doses of HPV vaccine (*OR* = .29; 95% CI [.11, v.79], *p* = .015)

Thomas et al. (2016) did not report insurance status or income but found that of 116 Hispanic men the expense of HPV vaccination was related to participants deciding not to be vaccinated (*OR* = .052, 95% CI [.28,.99], *p* = .045). Similarly, Kim et al. (2019) studied 104 Korean American college women's cultural factors, knowledge, and attitudes related to cancer prevention practices and found that 97.1% had health insurance; yet 49.5% of the women were concerned about the cost of the HPV vaccination. In a sample of 585, free vaccine nearly doubled the likelihood of being vaccinated (*aOR* = 1.90, 95% CI [1.05–3.41], *p* ≤ .05) and Thompson et al. (2018) found that amongst 25 unvaccinated college women, 15 quoted lack of insurance and vaccine cost as potential barriers to HPV vaccination receipt.

Parent, HCP, and Other Vaccination Recommendations

Among enabling factors identified in the literature, physician and parent recommendations were often assessed as variables that influenced HPV vaccination status or intention to be vaccinated. Recommendations from others, e.g., partner/spouse, friends were also identified in the current literature as influential in HPV vaccination decision making of college students. In a secondary analysis of 153 undergraduate student nurses from an intervention study, who had received at least one dose of HPV vaccine, two factors reported as being the most influential in the students receiving an HPV vaccine were a providers' recommendation (n = 25, 39%) and a parents' recommendation (n = 9, 14%) (Hollins et al., 2021). Among 627 men and women college students completing a cross-sectional survey, the majority of participants (70.7%) identified a healthcare provider (HCP) recommendation as the most important influence for them receiving an HPV vaccination (D'Errico et al., 2020). Lack of an HCP recommendation was cited as a barrier to HPV vaccination initiation and completion by study participants (19.95%) (D'Errico et al., 2020).

Parent recommendations (39.9%) were the second most influencing factor participants identified for having an HPV vaccination (D'Errico et al., 2020). In addition to parent or provider, other influencers of HPV vaccinations based on recommendations, all were statistically significant, included spouses ($p < .0001$) for married people) girlfriends/boyfriends, an instructor/professor, and same-sex friends (D'Errico et al., 2020). Similarly, McLendon et al. (2021) studied factors associated with HPV vaccination intention in 1725 college students finding that that students who had received

an HCP recommendation for vaccination were nearly five times more likely to have received the HPV vaccination (*aOR* = 4.99, 95% CI [3.30, 7.53], $p <$ .0001) and those unsure if they had received a HCP recommendation were eight times less likely to have been vaccinated (*aOR* = 0.14; 95% CI [0.05, 0.38], $p < .0001$) compared to participants who had not received an HCP recommendation. Additionally, participants who communicated that an HCPs recommendation would encourage them to be vaccinated were nearly twice as likely to have been vaccinated (*aOR* = 1.92; 95% CI [1.20, 3.06], $p = .0064$)). These same students who had received a recommendation to be vaccinated from a parent were eight times more likely to have been vaccinated (*aOR* = 8.72; 95% CI [4.51, 16.86], $p < .0001$) when compared to participants who did not have a parental recommendation (McLendon et al., 2021).

Both HCP and parent recommendation were studied in association with HPV vaccination intent in 104 Korean American college women (Kim et al., 2019). HPV recommendation by an HCP ($\chi 2$ (2)=6.57, $p < .000$) and an HPV recommendation by a parent (*OR* = 4.58, 95% CI [1.37–15.36]) were independent predictors of HPV vaccination intent (Kim et al., 2019) (Kim et al., 2019). Ragan et al. (2018) added that HPV vaccination was influenced not just by an HCP recommendation but by having a conversation with an HCP (*PR* = 3.25, 95% CI [2.41, 4.39], $p < .001$)), with a parent (*PR* = 2.21, 95% CI [1.73, 2.82], $p < .001$) or receiving encouragement to vaccinate from anyone (*PR* = 6.65, 95% CI [4.48, 9.85], $p < .001$). Importantly, when a parent discouraged a child from having the HPV vaccine, the child/participant was significantly less likely to have been vaccinated (*PR* = .032, 95% CI [.16, .65], $p < .01$) (Ragan et al.,

2018). Similarly, in 129 undergraduate college students, Koplas et al. (2019) found that participants who agreed that parent and provider recommendations were important to the HPV vaccination decision were more likely to have received the vaccine (parents: p = .001; HCPs: $p < .0001$).

In studying personal and parental decision making in regard to HPV vaccine uptake, both personal ($p <$. 001) and parental (p = .008) decision making were significantly associated with receipt of an HPV vaccine (Rosen et al., 2018). When the decision to receive the HPV vaccine was parental, the age of the initial HPV vaccination was younger than 18 years of age (p = .001) (Rosen et al., 2018). Regarding parental influence, Hirth et al. (2018) in a qualitative study, found that it is more often the mother mentioned that influenced the HPV vaccine decision. Mothers, more often than fathers, were reported as decision makers by Glenn et al. (2021) and they also reported that college men often cite themselves as the decision maker compared to college women.

When studying the influencers and predictors of HPV vaccine uptake in 585 men and women college students, LaJoie et al. (2018) found that parental influence for vaccination was a predictor of vaccine uptake (*aOR* = 1.90, 95% CI [1.05–3.41]). In addition, the strong preference for the respondent's partner to be HPV vaccinated predicted vaccine uptake (*aOR* = 4.04, 95% CI [2.31–7.05]), but the lack of preference for partner vaccination predicted an unvaccinated self (*aOR* = 0.50, 95% CI [0.27–0.93]) Thompson et al. (2018) interviewed 50 college women to determine their knowledge motivation and behavioral skills for receiving an HPV vaccination. Women communicated that a trusting relationship with their HCP or reassurance from an HCP (*n*

= 13) influenced their vaccine decision making. Lack of a provider recommendation was cited as a barrier by four women. Similarly, noting gender differences, the vaccination choices of Hispanic male college students was examined and the strongest predictor of choice for HPV vaccine was over five times greater when an HCP recommendation had been received (*OR* = 5.14, 0 95% CI [2.13, 12.38], $p < .001$) (Thomas et al., 2016). Ethnicity differences have been noted when studying 187 unvaccinated Latina college aged women, to determine if a HCPs gender and ethnicity were associated with HPV vaccination intention and gender was found to be more important than ethnicity in intention to HPV vaccinate (Hernandez et al., 2019). Women who reported high medical mistrust preferred a recommendation from a Latino or Latina provider while 64% of women had no preference for gender or ethnicity of for HPV vaccine recommendations. Latina women who preferred provider race and sex had an increased odds of intention to get the vaccine within the next year (a*OR* = 2.67, 95% CI: [1.14, 6.22], $p = .05$) (Hernandez et al., 2019). MacArthur (2017) examined trust in 755 college and found that HCP trust was significantly directly and indirectly associated to the intention to be HPV vaccinated. The indirect pathways of trust were through perceived HPV vaccine efficacy ($\beta = .14$, $p < .05$) and through perceived severity ($\beta = .13$, $p < .001$).

HCP Related Factors

Not having a regular physician has been cited as a reason for not initiating the HPV vaccine series. For women college students ($n = 286$) having a regular HCP was associated with completion of the HPV vaccination series ($\beta = 1.05$, *SE* =.40, *OR* = 2.85, $p < .05$) Winger et al., 2016). Similarly, not having regular visits with an HCP has been

tied to lack of HPV vaccine initiation. Wilkinson et al. (2018) assessed the association between OB/GYN visits and HPV vaccination uptake in 356 women college students and determined that women students who completed an OB/GYN appointment within the past 12 months were 1.82 times more likely to have received an HPV vaccination than women who had not been to an OB'GYN in the same period of time. In another study, women who had not received a routine gynecological exam in the past year were more likely to have not been vaccinated against HPV (*aOR* =.21, 95% CI [.16, .26], $p < .001$) (Thompson et al., 2016).

The real or perceived ability to meet with an HCP is reported to influence HPV vaccination uptake. In a qualitative study of 19 college students Hirth et al. (2018) reported that barriers to the ability to visit with a doctor included limited access, transportation, being available to go to the doctor, and knowing if the doctor has the HPV vaccine available. Influencers of meeting with a doctor included ability to get vaccine on campus. Additionally, some students reported they needed help making appointments and they needed to receive appointment reminders. Britt and Englebert (2018) added that vaccination uptake was associated with work demands, ($r = .168$, $p < .001$), school demands ($r = .227$, $p < .01$), and social demands ($r = .056$, $p < .001$). Vaccination intent was also predicted by work demands ($r = .143$, $p < .01$), school demands ($r = .130$, $p < .01$), and social demands ($r = .080$, $p < .01$). For all of these demands there was a negative relationship with vaccination receipt. In a similar trend, Kim et al. (2019) reported that 48.5% of 104 Korean American college students were "too busy" to get the HPV vaccine. In unvaccinated college students, Johnson and Ogletree (2017) reported

that men had a great sense of control over being HPV vaccinated (mean perceived behavioral control 14.76 of 21) and Catalano et al. (2017) found that perceived behavioral control (r =.372, $p < .01$) was significantly associated with students who had initiated the HPV vaccine. In a qualitative study of 25 vaccinated and 25 unvaccinated college women, logistics and convenience of HPV vaccination were primary facilitators of vaccination (n = 19) (Thompson et al., 2019).

Social Support and Subjective Norms

Social support or subjective norms are beliefs about what most people think is appropriate behavior. Britt and Englebert studied 208 students enrolled in a rural college and found that subjective norms (family friends, coworkers think I should get the vaccine) influenced intention of these students to receive an HPV vaccine (t = 2.3066, p = .0211) and friends were reported to be a social influence associated with HPV vaccination among 1725 college men and women (McLendon et al., 2021). When students had friends that had received the HPV vaccination, the student was more than twice likely to have been HPV vaccinated (*aOR* = 2.25; 95% CI: [1.08, 4.70]; p = .0314). Students who thought their sexual partners receipt of the vaccination was important , were almost three times more likely to have been vaccinated (*aOR* = 2.85; 95% CI [1.73, 4.69]; $p < .0001$) (McLendon et al., 2021).

Self-control to get the HPV vaccination ($\beta = .292$, $p < .001$) and situational perception ($\beta = .332$, $p < .001$) were found to be predictors of a participants' intention to get vaccinated in 197 unvaccinated women (Catalano et al., 2016). These two variables explained 23.5% of variance in the regression model for behaviors associated with

intention to be vaccinated. Situational perception was assessed using three situational questions related to women getting HPV vaccinations (Catalano et al., 2016). Similarly, subjective norms, (t (199) = 5.65, $p < .001$) were a significant predictor of college students' intentions to be HPV vaccinated in men (Johnson & Ogletree, 2017).

HPV Knowledge

Knowledge of HPV and knowledge of HPV vaccines were often included as variables to characterize participants in the current literature with a low level of knowledge frequently reported. For instance, 74.8% of students at a two-year college had heard of HPV before given a survey (Grace-Leitch & Shneyderman, 2016). Most participants (81.9%) scored below ten (the 75th percentile score is nine), indicating lower levels of knowledge in this population (Grace-Leitch & Shneyderman, 2016). In a qualitative study, college students voiced that they were not aware that HPV vaccines could prevent cancer (Hirth et al., 2021), and Glenn et al. (2021) found that students often lacked knowledge of HPV vaccine benefits, even though 93% had heard of the HPV vaccine prior to the study start. More men than women, in a study of 627 students, did not know where to obtain an HPV vaccination (OR = 2.94, 95% CI [.46, 5.91], p = .003) (D'Errico et al., 2020). Albright and Allen (2018) were the only authors who assessed the associated between health literacy in vaccinated and unvaccinated students and while health literacy was associated with HPV and HPV vaccine knowledge, it did not differ between vaccinated and unvaccinated college students; therefore, a health literacy variable was not included in this dissertation research.

The current literature includes some studies that assess the association of knowledge of HPV and HPV vaccine with vaccination uptake or intention to be vaccinated. The outcomes of the studies are mixed with some reporting knowledge associated with HPV vaccination outcome and others reporting a lack of association (McCutcheon et al., 2017). In 197 unvaccinated college women, Catalano et al. (2016), found that even though knowledge of both HPV and HPV vaccines were high, knowledge was not a significant predictor ($p = .319$) of intention to be vaccinated. Similarly, in 208 unvaccinated college aged men, the mean HPV knowledge score was 7.65 ($SD = 3.65$), indicating that half of the questions were answered correctly; however, HPV knowledge was not significantly associated with intention to be HPV vaccinated ($r = .006$, $p = .43$). Keeping with this trend, Los Angeles based college students, found self-reported knowledge level of HPV disease and HPV vaccine awareness to be significantly associated with vaccination status as compared to having no knowledge ($p < .001$); in logistic regression analysis, self-perceived knowledge or knowledge scores did not influence self-reported immunization status (Kellogg et al., 2019). Knowledge of HPV and HPV associated cancers was also non-predictive of vaccination status in 585 men and women undergraduate students (LaJoie et al., 2018). Additional evidence was provided to support that HPV knowledge is not associated with HPV vaccination uptake in two studies. Koplas et al. (2019) did not find significant differences in knowledge of HPV vaccines and HPV vaccination uptake amongst 129 undergraduate students and Klasko-Foster et al. (2020) found that while HPV and HPV vaccine awareness were

prevalent among the participants, neither type of awareness was associated with vaccine intention.

Conversely, Preston and Darrow (2019) studied 386 diverse undergraduate students and compared those that had received no HPV vaccine doses to those who had received one or more doses of HPV vaccine. Higher measured knowledge scores were found in participants who had received at least one dose of vaccination as compared to no vaccine receipt ($p < .001$). Statistically significant perceived knowledge scores ($p = .007$) were also found among participants who had not initiated HPV vaccinations as compared to those who had at least one vaccine doe (Preston & Darrow, 2019). A study of 449 Chinese college students found that higher as compared to lower knowledge scores were associated with having received an HPV vaccination (*OR* = 2.36, 95% CI [1.47, 3.79], $p < .0004$) and men had lower knowledge scores compared to women (*OR* =.59, 95% CI [.39, .88], $p = .009$, $p < .05$) (Tung et al., 2019). Additional evidence of associations was reported in multivariate analysis of 104 Korean American women where a high level of knowledge (a*OR* = 1.11, 95% CI [1.11, 1.22], $p < .05$) was found to be an independent predictor of intention to receive the HPV vaccine (Kim et al., 2019). In the same study there was a statistically significant association amongst college women ($n = 104$) that had heard of the HPV vaccine ($\chi2$ (1) = 9.088, $p = .003$) and the cervical cancer vaccine ($\chi2$ (2)=12.53, $p = .000$), and their intention to become HPV vaccinated. (Kim et al., 2019). Awareness of HPV ($\chi2$ (2)=3.75, $p = .053$) was not significantly associated with intention to vaccinate.

In a study of 153 undergraduate student nurses who had all received at least one dose of HPV vaccine, adequate knowledge of HPV and HPV vaccines (n = 9, 14%) influenced their decision to have HPV vaccination (Hollins et al., 2021). Outcomes from a study in South Carolina revealed that three variables significantly predicted HPV knowledge (gender, HPV vaccination status, and race) (Kasymova et al., 2019). Female sex predicted HPV knowledge (β =1.20, SE = 0.59, p = .04) as did having received the HPV vaccine (β =1.25, SE = 0.48, p = .01). Being of White race predicted higher levels of total HPV knowledge (β =1.21, SE = 0.60, p = .04) (Kasymova et al., 2019).

Need Factors

The BMHSU identifies individual need factors as those factors that represent the potential need for an individual to seek out and use health care services (Li et al., 2016). Health needs may be perceived by the individual or evaluated by a health care professional (HCP) (Andersen, 2008; Li et al., 2016). Need factors may help determine if a college student will use health services to initiate HPV vaccinations. Some need factors that are identified in the current literature that may be associated with HPV vaccination uptake in college students include perceived health, perceived risks of HPV and HPV-related diseases, evaluated health and evaluated risks for HPV, sexual activity, number of sexual partners, and a history of using preventive health services.

Perceived Health/Risk

Perceived health, or the perception of general health and perceived risks of acquiring a disease have been reported in the current HPV vaccination literature and inconsistent collection and analysis of the data are noted in this review. Researchers

discuss risk perceptions but do not always assess the association of these perceptions to HPV vaccination intention or uptake (Grantham et al., 2020; Hirth et al., 2018; Thompson et al., 2019).

In an examination of 616 college students, risk perceptions were studied as a barrier to HPV vaccination. Most students (76%) considered themselves at very low or low risk of HPV infection and 24% reported their risk of HPV infection to be moderate or high. Unvaccinated women, those that are in dating relationships as compared to committed relationships, were more likely to perceive their risk of HPV infection as high (OR = 5.33, 95% CI [1.16–24.50], $p < .005$); this did not hold true for vaccinated women or vaccinated or unvaccinated men (Thompson et al., 2019). In qualitative interviews with college students, Hirth et al. (2018) noted that fear of needles, fear of side effects, and perceived lack of vaccine effectiveness, were barriers to HPV vaccination; but that perceived regret of illness, if the person does not receive the HPV vaccination, was considered a motivator of HPV vaccination. Men's adoption of HPV vaccines was not impacted by Direct -to-Consumer (DTC) advertising; however, women identified with several risk constructs in DTC advertising including empowerment t (284) = 4.90, $p <$ .001; control t (283) = 4.08, $p < .001$; reduced dread t (282) = 3.88, $p < .001$; and benefit t(285) = 4.21, $p < .00$ (Grantham et al., 2020). In an effort to define barriers associated with uptake of the HPV vaccination, D'Errico et al. (2020) found a lack of perceived risks from HPV infection was a barrier to receiving the HPV vaccine and students with higher HPV knowledge scores were more likely to report no self-perceived HPV risks (OR = 2, 95% CI [1.04, 3.88], $p = .039$) (D'Errico et al., 2020).

Perceived risks of HPV-related disease have been associated with HPV vaccination intention. In 101 HPV vaccine naïve college students, the association of absolute and comparative risks for genital warts, and cervical, anal, and oral cancers, were assessed with HPV vaccination intention (Klasko-Foster et al., 2020).Absolute risk was defined as the perceived risk of getting genital warts or HPV-related cancers, while comparative risk was defined as the perceived risks of getting genital warts or HPV-related cancer as compared to another person. Absolute risk of genital warts ($\beta = .39$; $p < .001$) and of HPV-related cancers ($\beta = .26$, $p < .05$) were positively and significantly associated with intentions to be vaccinated in the next one year. Comparative risk was correlated with genital warts only ($\beta = .25$, $p < .05$) (Klasko-Foster et al., 2020). Additionally worry about genital warts and HPV-related cancers were significantly associate with perceived acquisition of genital warts ($\beta = .42$, $p < .001$) and HPV-related cancers ($\beta = .29$, $p < .01$) as was fear of genital warts ($\beta = .43$, $p < .001$) and HPV-related cancers ($\beta = .23$, $p < .05$) (Klasko-Foster et al., 2020). Similarly, in 279 women students, perceived general health ($\beta = 117$, $p < .005$) perceived susceptibility to cervical cancer ($\beta = .997$, $p < .005$) and perceived severity of cervical cancer ($\beta = -.994$, $p < .005$) were associated with the intention to get HPV vaccinated, indicating that higher perceived general health, higher perceived susceptibility and lower severity to cervical cancer was associated with increased intentions to be vaccinated (Jozkowski & Geshnizjani, 2016).

Conversely, the association between perceived risk of contracting HPV and vaccination intention was assessed and no statistical relationship was found (Hunter & Weinstein, 2015). While there was a near significant association of perceived risk and

knowledge of HPV and HPV vaccination (p = .07), there was no association of perceived risks of genital warts, penile and anal cancers with HPV vaccination (Hunter & Weinstein, 2015). Another study reported similar findings in 104 Korean American college women's perception and feelings to receive the HPV vaccination and found that perceptions were not related to intention to receive the vaccination (F (1,100)=0.003, p = .957) (Kim et al., 2019).

Some studies report the associations of perceived health and/or risks and HPV vaccination uptake. In a secondary analysis of college students (n = 28,237), education about sexually transmitted infection for women (OR = 1.46, 95% CI: [1.27, 1.67], $p \leq$ .001) and men (OR = 1.52, 95% CI: [1.23, 1.88], $p \leq .001$) were associated with reports of HPV vaccination uptake (Thompson et al., 2016). In 257 college students completing an online survey about HPV vaccination, a significant difference was found between students who had received at least one vaccination (n = 98) and those had had received no HPV vaccine shots (n = 159) as related to perceptions that HPV causes cancer (χ^2 = 6.929, p = .008), however, as related to genital warts, the difference was not significant (χ^2 = 3.329, p = .068) (Shah et al., 2021). Regarding perceptions of the HPV causing health problems, the perceptions that the HPV vaccine causes health problems in was associated with lack of HPV vaccination uptake in 393 students (OR = .38, 95% CI [.58, .88], p = .011) (Barnard et al., 2017). In collecting perceptions of general health from 356 college women Wilkinson et al. (2018) found that 79.8 % of students considered themselves to be in excellent, very good, or good health. When the general health of students who had and had not received the HPV vaccination were compared, no

differences in perceived general health perceptions were noted between the groups (χ^2 = .44, p = .93) (Wilkinson et al., 2018). Likewise, in a qualitative study, Glenn et al. (2021) reported some college students accepted the HPV vaccine to prevent the risk associated with getting HPV since they were sexually active, alternatively, there were concerns voiced about the safety of the vaccine and the risks associated with getting the vaccine when 90% of HPV strains will clear on their own.

Vaccine acceptability and decision making has also been studied in association with perceived risks. An association was found between "worry" about contracting HPV and HPV vaccine acceptability (β= .57, SE = .20, p < .01) in 123 male college students and while there was high condom use (86%) reported, no significance with HPV vaccine acceptability was found (Grace-Leitch & Shneyderman, 2016). MacArthur (2017) studied the role of trust in college students HPV vaccine decision making process (n = 755) and found that there was a direct effect of perceived susceptibility of getting HPV/HPV-related diseases (β = .20, $p \leq .001$) and the perceived severity of HPV/HPV-related disease as serious (β = .10, $p \leq .05$) and the decision to get an HPV vaccine.

Evaluated Health/Risk

Evaluated health is defined as a health issue or health risk assessed by an HCP. In some studies data were collected on diagnosis and treatment of STIs/STDs, for example, Kellogg et al. (2019) found that 19.1% of women and 2.5% of men had received treatment for STDs. Wilkinson et al. (2018) determined that 7.6% of 356 women college students had been diagnosed with an STI within the past 12 months. Upon comparison of

students who had and had not been vaccinated, no statistical differences were noted ($\chi 2$ = .26, p = .61) (Wilkinson et al., 2018).

Conversely, three studies found an association between evaluated health risks and HPV vaccination. Esagoff et al. (2021) found that a prior visit to the student health center was significantly associated with HPV vaccination uptake in Chinese international college students in the US ($p < .0001$). The reason for the visits was not reported (Esagoff et al., 2021). Both women (n = 13,906. OR = 37.67, 95% CI: [26.00, 54.59], $p \leq .001$) and men (n = 5013; OR = 39.81, 95% CI: [22.13, 71.64], $p \leq .001$) who received a diagnosis of and treatment for a urinary tract infection (UTI) were more likely to report HPV vaccination receipt (Thompson et al., 2016). Similarly, Pask and Rawlins (2016) measured college men's (n = 157) intentions to engage in protective behaviors against HPV including HPV vaccinations and found that number of lifetime STD tests (β = .27, <.01) and perceived risks, defined as susceptibility to HPV and the severity of HPV (β = .35, p < .001) were associated with the intention of these men to receive the HPV vaccination, supporting that health evaluated by an HCP impacts vaccination intentions.

Sexually Active and Number of Sexual Partners

Based on current research, between 50.6% and 91% of college students self-report ever having had sex or currently being sexually active (Catalano et al., 2016; 2017; Christy et al., 2016; 2019; Cooper et al., 2018; Hernandez et al., 2019; Jozkowski et al., 2019; Kasymova et al., 2019; Kellogg et al., 2019; Koplas et al., 2019; Koskan et al., 2021; LaJoie et al., 2018; Navalpakam et al., 2016; Ragan et al., 2018; Rohde et al., 2018; Rosen et al., 2018; Winger et al., 2016). Sexual activity is most often defined as

having oral, anal, or vaginal sex (Catalano et al., 2017; Rohde et al., 2018). Among 104 Korean American college women, of which 48.1% were international students, only 38.5% of these women had ever been sexually active, and similarly 39% of women and 49% of Chinese international men students had ever engaged in sexual activity (Esagoff et al., 2021; Kim et al., 2019).

Three authors reported an association between sexual activity and HPV vaccination uptake. Glenn et al. (2021) conducted semi-structured interviews (n = 28) and focus groups (n = 18) where students reported that their decision to be vaccinated was influenced by their sexual activity. Two studies assessed the association of sexual activity with HPV vaccine uptake in college students. In 396 Chinese international, men and women college students, sexual activity was found to be correlated with increased years in the US (p = .0003) and in men, sexual activity and HPV vaccination status were significantly positively associated (p = .0049) (Esagoff et al., 2021). Inverse to this report, Winger et al., 2016 found that in 286 women college students there was no difference in HPV vaccine uptake between those who were sexually active and those who were not (p > .05). Data on the number of sexual partners that the students had in their lifetime was collected in a handful of studies with the majority of students who were sexually active having one partner or at most two partners, with a minority having three to greater than five sexual partners in their lifetime (Rohde et al., 2018; Thomas et al., 2016; Wilkinson et al., 2018). Number of sexual partners was not assessed in correlation analysis with HPV vaccination uptake.

History of Preventive Health Services Use

Use of preventive health services has been explored as a need factor associated with HPV vaccine uptake, with most studies exploring past vaccination use, e.g., hepatitis vaccination, Tdap vaccination, meningitis vaccination. Vu et al. (2019) reported that in a cross-sectional survey of college students that most men and women had received the Tdap and meningitis vaccines; however, other vaccination receipt was not assessed against HPV vaccination status.

McLendon et al. (2021) found that men and women students (n = 1725), who reported receiving the flu vaccine, were almost 1.5 times more likely to have received the HPV vaccine (aOR = 1.49, 95% CI [1.01, 2.20], p = .047). Similarly, in 286 men and women students, Winger et al. (2016) found HPV vaccination uptake to be associated with past receipt of the hepatitis B vaccination (aOR = 1.8, β = .59, SE = .26, p < .005) and also associated with having a past Pap smear (aOR = 1.99, β = .69, SE = .31, p < .005). Both men and women who had received the flu vaccine (Women: OR = 6.88, 95% CI [5.80, 8.16]; $p \leq .001$; Men: OR = 6.52, 95% CI: [5.05, 8.43], p ≤ .001) and STI information (Women: OR = 1.46, 95% CI [1.27, 1.67], $p \leq .001$; Men: OR = 1.52, 95% CI [1.23, 1.88], $p \leq .001$) were more likely to report HPV vaccination uptake (Thompson et al., 2016). Women who self-reported that they did not receive a routine gynecological exam in the past year (OR = 0.21, 95% CI [0.16, 0.26]; $p \leq .001$) or were unsure of their status (OR = 0.02, 95% CI: [0.01, 0.02], $p \leq .001$) were less likely to report HPV vaccination uptake (Thompson et al., 2016). Conversely, women who reported receiving the hepatitis B vaccine were less likely to report HPV vaccination uptake (OR = .41, 95%

CI [0.23, 0.71], $p \geq .05$). (Thompson et al., 2016). In men, receipt of the meningitis vaccine (*PR* = 1.57, 95% CI [1.06, 2.31], $p < .05$) and the Tdap vaccine (*PR* = 1.50, 95% CI [1.01, 2.25], $p < .05$) were positively associated with HPV vaccine uptake (Ragan et al., 2018). In women, receipt of the meningitis vaccine (*PR* = 1.26, 95% CI [1.04, 1.53], $p < .05$) was associated with HPV vaccine uptake and not receiving the meningitis vaccine was negatively correlated with HPV vaccine uptake (*PR* = 0.45, 95% CI [.23, .87], < .05). The Tdap vaccine, in women, did not correlate with HPV vaccine uptake (Ragan et al., 2018). Study outcomes mostly indicate a positive association with past vaccination and adoption of the HPV vaccine, with an occasional subset of the populations studied not being corelated (Ragan et al., 2018; Thompson et al., 2016).

Summary

HPV infection is the most common sexually transmitted disease in the US and the vaccination rate in adults, 18–26 years of age, is about 40%, less than half of the US national goal of 80% recommended for improving health (Boersma & Black, 2020; CDC, 2021d; Office of Disease Prevention and Health Promotion, 2021). Unvaccinated, sexually active, young adults entering college, and their sexual partners, are at risk of HPV infection and HPV-related cancers. College provides an opportunity for 18–26-year-old students, who are not appropriately vaccinated, to catch up on HPV vaccinations and hence the opportunity to prevent HPV-related cancers. The literature provides evidence on factors associated with intention to be vaccinated, and on HPV vaccination uptake, but is silent on the factors associated with the actualization of HPV vaccine while in college. The BMHSU guided variable selection in this dissertation research and the

organization of the literature review by predisposing factors, enabling factors, and need factors in association with HPV vaccination intent and/or uptake by college students.

Predisposing factors are social, biological, and cultural and harder to alter than other factors. Current evidence strongly supports significant differences in vaccination initiation and completion rates in people, with men being vaccinated less often than women, indicative of the HPV vaccine first being marketed for the prevention of cervical cancer. While the review of literature was conducted in the 18–26-year-old college population, younger age (18–20 years) and earlier year in college were predictive of HPV vaccine acceptability as compared to older age (21–26 years). The evidence related to race and ethnicity and HPV vaccine uptake is mixed. Studies have been conducted in diverse populations with Whites, Asians, and bi/multiracial people all showing increased odds of having been HPV vaccinated and conversely with Asians showing increased odds of vaccination over Whites. Similarly, increased religiosity has been shown to be both associated and not associated with HPV vaccine uptake. International student status positively impacts HPV vaccination intention for female students who have been in the US up to 5 years, and for students who were born in the US to foreign parents. While the data are limited, there are mixed results on HPV vaccination uptake and intention based on sexual orientation with one study showing a doubling of likelihood of vaccination in the bisexual population. Similarly, data on sexual attitudes are limited with a preference for vaccinated people to prefer relationships with other vaccinated people.

Enabling factors, more malleable than predisposing factors, have been shown to accelerate or impede the use of health care services. Parent education level is associated

with student HPV vaccination uptake and graduate-level education was strongly predictive of HPV vaccination in a diverse college population. Conversely, in Latino/Hispanic populations lower-level parental education was predictive of vaccination uptake. Income is a predictor of vaccination, and studies indicate that moderate incomes (over $60,000) are predictive of vaccination as compared higher incomes. Student employment is rarely assessed in association with HPV vaccination uptake or intention; however, one study found that students that work have a less likelihood of HPV vaccination uptake posited to be due time constraints. Strong evidence exists that most college students have health insurance, provided to them by their parents. Having health insurance is positively associated with HPV vaccination uptake; not having insurance is a barrier to vaccination as is the cost associated with having a vaccination. Students with insurance still quote cost of the vaccination as a barrier to vaccination and free vaccination has been found to double vaccination rate. Recommendations to obtain the HPV vaccination by HCPs, parents, and others (friends, spouses) are predictive of both HPV uptake and intention to be vaccinated. The strongest predictor of vaccination, with consistency in the literature, was an HCP recommendation, followed by a parent recommendation, with mothers most often being the recommending parent. Additionally, not having a recommendation has been associated with decreased likelihood of a college student being vaccinated. HCP related factors, such as having a regular physician and the ability to meet with a physician were sometimes studied in relationship to HPV vaccination uptake. Having a regular physician was associated with uptake in the literature. The real or perceived ability to meet with an HCP was related to vaccination

status. Work, school, and social demands were all reported to be barriers to the ability to meet with an HCP as were transportation, knowing if the doctor had the vaccine, making appointments, and appointment reminders. One of the most often assessed variables, showing mixed association with HPV vaccination uptake and intention is HPV and HPV vaccine knowledge. In most all studies reviewed, the overwhelming majority of students had heard of HPV and HPV vaccines prior to participating in a study. Knowledge deficits were called out in the studies, such as students not knowing that the HPV vaccine was a cancer prevention vaccine, and most were unclear of the vaccine benefits. The outcomes, associating knowledge with HPV vaccination uptake or intention have mixed results. In these studies, knowledge was inconsistently assessed with numerous measures employed.

Need factors are variables associated with the need for an individual to seek out and use health care, such as when they are ill. An evaluated health issue or risk is one that has been assessed and diagnosed by an HCP. Again, there are mixed result, with college students reporting STIs showing no association with HPV vaccination uptake, and those with an increased number of lifetime STI tests being associated with vaccination uptake. Conversely, associations with HPV vaccination intent have been found in students diagnosed and treated with UTIs. Perceived health risks are discussed, but rarely reported in the literature as related to HPV vaccine uptake. Many students report low perception of HPV infection risk; though, women in dating relationships perceive their risk higher than women in committed relationships. Women's perceptions of HPV risk have been shown to be driven by advertising. Knowledge of HPV and the HPV vaccine, worry about HPV, and general health perception have all been strongly associated with HPV vaccine uptake,

intention, or acceptance. The majority of college students report they have been sexually active and have had from one to greater than five sexual partners. HPV vaccination associated with sexual activity has been assessed in limited studies and mixed results are reported. While sexual activity is reported to influence HPV vaccination and has been positively associated with male vaccination uptake, conversely, one study indicates no relationship of sexual activity and HPV vaccination uptake in a mixed-sex student population. Finally, the use of preventive health services by college students are mostly positive , indicating an association between preventive health services use and HPV vaccination uptake. Receipt of influenza, Tdap, meningitis or hepatitis vaccines are positively correlated with HPV vaccination uptake, with the strongest evidence in men. Two studies in women found no correlation with HPV vaccine uptake and Hepatitis or Tdap vaccines. A gynecological examination in the past year by women positively predicted HPV vaccine uptake while the lack of a visit negatively predicted HPV vaccine uptake.

In an effort to identify the critical factors associated with HPV vaccination actualization in college students, the variables described here were assessed in my research. The purpose of the study was to determine distinguishing characteristics of college students who received an initial HPV vaccination while in college as compared to those who had never received an HPV vaccination. The methodology chosen for this research, described in the next chapter, supported characterization of factors predictive of actualization of HPV vaccination by college students as opposed to intent to vaccinate, as prior research has described.

Chapter 3: Research Methods

HPV is the most common sexually transmitted disease in the United States (Meites et al., 2019). Despite CDC recommendations for 11–26-year-olds to be HPV vaccinated, only 51.1% of U.S. adolescents 17 years and younger have completed the vaccination series (Meites et al., 2019; Walker et al., 2019). Unvaccinated young adults entering college and their sexual partners are at risk of HPV and HPV-related cancers. The purpose of the current study was to examine differences in the predisposing, enabling, and need factors that influence men and women college students 18–26 years of age to receive an HPV vaccination while enrolled in college. Factors associated with initiation of HPV vaccination of students while in college had not been addressed the literature. This study was needed to identify factors in college students who received an initial HPV vaccination while in college compared to students who never received an HPV vaccination.

This chapter outlines the design of this study, the methods used, and the data analysis plan to assess the associations between predisposing, enabling, and need factors and HPV vaccination initiation. The target population, recruitment procedures, sample size decisions, sampling procedures, data collection, survey development, and operationalization of constructs are detailed. Ethical procedures implemented for this research are reviewed.

Research Design and Rationale

In this quantitative study, the dependent or response variable was students' HPV vaccination status (initiation of vaccination while in college or no HPV vaccination).

Independent variables assessed to predict the response were categorized as predisposing, enabling, and need factors defined by the BMHSU. The predisposing factor variables included age, gender, race/ethnicity, international student status, relationship status, sexual orientation, sexual attitudes, and religious/spiritual beliefs. Enabling factor variables included knowledge of HPV and HPV vaccines; student employment status; health insurance coverage; family income; parent education; vaccine recommendations by an HCP, parents, and others; having a regular physician; having a physician visit in the past year; and perceived ability to see an HCP. Need factor variables were perceived health/risk of HPV, evaluated health/risk of HPV, sexual activity, number of lifetime sexual partners, and history of preventive health services use.

Most of the 50 studies synthesized in the literature review had nonexperimental, quantitative, cross-sectional designs that included secondary data analysis of either a web-based or paper-and-pencil survey questionnaire for data collection. The studies reviewed addressed current vaccination status or intention to receive an HPV vaccination. The secondary data sets explored for the purposes of data analyses did not provide dates that vaccination initiation occurred; therefore, vaccination initiation in students while enrolled in college could not be determined using retrospective data. To advance knowledge of HPV vaccination of college students, I designed a nonexperimental, observational, cross-sectional, web-based survey using a primary data collection method. The survey was designed so that answers provided by participants were numerically quantifiable to determine which independent variables predicted HPV vaccination initiation in college students 18–26 years of age in the United States (see Ponto, 2015).

Survey questions addressed the predisposing, enabling, and need factor variables consistent with the research questions for the study.

Research Questions and Hypotheses

The research questions and hypotheses for this quantitative study were the following:

RQ1: Based on self-reported survey data, are there differences between predisposing factors in U.S. college students, 18–26 years of age, who received an HPV vaccination while enrolled in college compared to those who never received an HPV vaccination?

H_o1: Based on self-reported survey data, there are no differences between predisposing factors in USs college students, age 18–26 years, who received an HPV vaccination while enrolled in college compared to those who never received an HPV vaccination.

H_a1: Based on self-reported survey data, there are differences between predisposing factors in U.S. college students, age 18–26 years, who received an HPV vaccination while enrolled in college compared to those who never received an HPV vaccination.

RQ2: Based on self-reported survey data, are there differences between enabling factors in U.S. college students, age 18–26 years, who received an HPV vaccination while enrolled in college compared to those who never received an HPV vaccination?

H_o2: Based on self-reported survey data, there are no differences between enabling factors in U.S. college students, age 18–26 years, who received an HPV

vaccination while enrolled in college compared to those who never received an HPV vaccination.

H_a2: Based on self-reported survey data, there are differences between enabling factors in U.S. college students, age 18–26 years, who received an HPV vaccination while enrolled in college compared to those who never received an HPV vaccination.

RQ3: Based on self-reported survey data, are there differences between need factors in U.S. college students, age 18–26 years, who received an HPV vaccination while enrolled in college compared to those who never received an HPV vaccination?

H_o3: Based on self-reported survey data, there are no differences between need factors in U.S. college students, age 18–26 years, who received an HPV vaccination while enrolled in college compared to those who never received an HPV vaccination.

H_a3: Based on self-reported survey data, there are differences between need factors in U.S. college students, age 18–26 years, who received an HPV vaccination while enrolled in college compared to those who never received an HPV vaccination.

A cross-sectional survey was developed to collect data that could be analyzed to answer the research questions. Cross-sectional surveys provide a way to measure a defined population at a specific point in time on multiple variables. This design is less costly than longitudinal research and is often used in observational research (Wang & Cheng, 2020). Cross-sectional research is correlative in nature, and the outcomes cannot be used as causal evidence. Utilizing a web-based survey for cross-sectional research has the benefit of quickly reaching a number of subjects and providing anonymity, which may be important when sensitive questions are asked (Wang & Cheng, 2020). The

disadvantages of survey research include a number of sources of error such as misunderstanding of a question, no opportunity for participants to seek clarification, sampling errors, nonresponse, and social bias errors. Although survey research may be faster to conduct, lack of response is a problem, and multiple reminders may have to be sent, which may increase the time to gather the data required for meaningfulness (Ponto, 2015).

Population

The target population for this study included men and women college students 18–26 years of age in the United States. The number of students in this age group enrolled in college is unknown (U.S. Census Bureau, 2020). A cross-sectional, nationally representative U.S. sample was recruited via a partner organization that has existing panels of individuals enrolled in registries who participate in online surveys. Only students who never received an HPV vaccination or students who initiated at least one HPV vaccine shot while in college were enrolled in the study. Students who had their first HPV vaccination prior to college were not eligible to participate in this study.

Sampling, Sampling Procedures, and Recruitment

Participants were recruited using voluntary internet panels. A random stratified sampling framework, a probability sampling technique, was employed to ensure a demographic composition similar to the U.S. Census. Student panelists who met the study criteria were sent an email through the partner organization research network panel inviting them to complete the online survey. The email included a link to the survey along with the following text: “Based on the information stored in your research panel

profile, we believe we have a survey that you will qualify and earn from. The survey takes approximately 20 minutes and if you successfully complete it, your account will be credited with [incentive].” Users who clicked the link were brought to the partner organization survey home page, which was labeled as the US Health & College Study. Participants were required to complete the online informed consent, and then were provided access to the survey questions. Survey participation was anonymous. Participants were compensated by the partner organization’s prespecified reward structure that is a function of survey length and complexity, typically between $1.50 and $5.00. The inclusion criteria included male and female college students 18–26 years of age who were enrolled in college and never received an HPV vaccination or received at least the first HPV vaccination while enrolled in college. Students not enrolled in college, younger than 18 years of age, and older than 26 years of age were not eligible for the study, and students who initiated HPV vaccinations prior to being enrolled in college were excluded from the study.

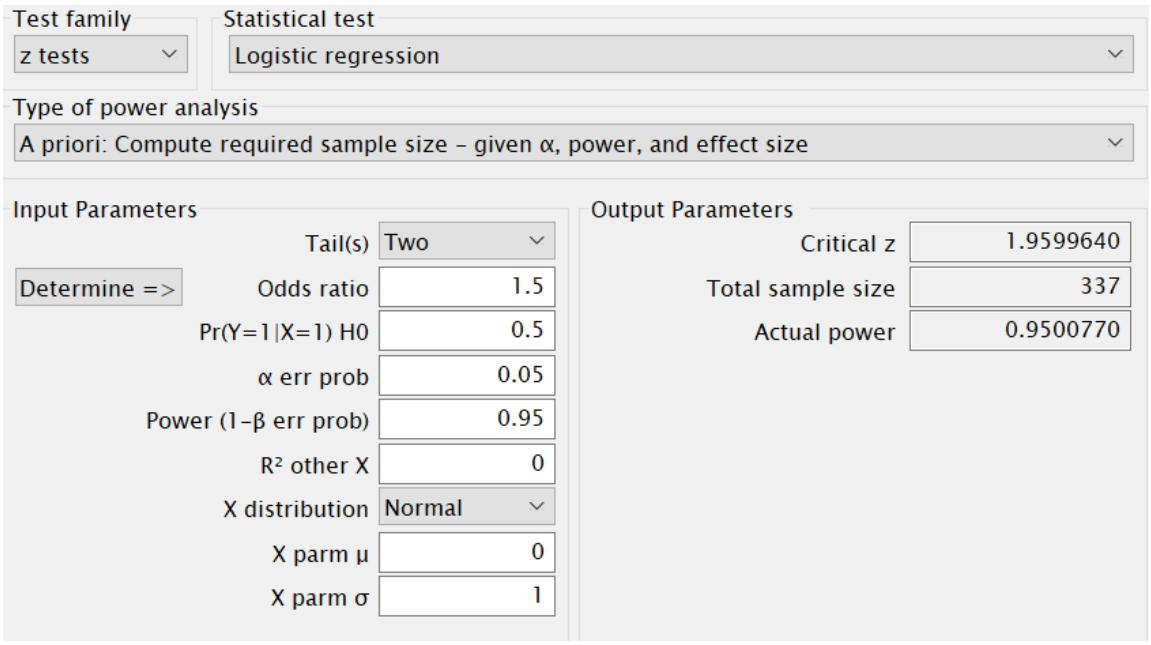
Sample Size Calculation

Multivariable logistic regression was employed to assess the association between the multiple independent predictor variables and the binary response variable, HPV vaccination status (see GraphPad, 1995). Observational studies may require a minimum of 500 subjects when conducting multivariate logistic regression analysis to support the parameters in large target populations; however, traditional power analysis software provided a smaller sample size that was more easily obtainable for the current study (see Bujang et al., 2018). To increase the probability of detecting an effect and to avoid

rejecting a false null hypothesis (a Type II error), a power of 0.95 was chosen for the power calculation (see Chen et al., 2010). To decrease the chance of rejecting the null hypothesis when it was correct (Type I error), a standard alpha of 0.05 was chosen (see Chen et al., 2010; Frankfort-Nachmias & Leon-Guerrero, 2018). There was information on the strength of the associations between the independent variables and the dependent variable in this study; therefore, a medium effect size of 50% was used in the sample size calculation. G* Power 3.1.9.7 was employed to calculate the sample size (see Heinrich-Heine-Universität Düsseldorf, 2020; Sharma et al., 2020). Based on the power calculation, a sample size of 337 participants was required, and 403 participants were enrolled (see Figure 2).

Figure 2

*G*Power Logistic Regression Power Analysis Calculation*



Collection Methods

Data were collected through an online cross-sectional survey of 18–26-year-old college students, employing a random stratified sampling framework. The college students were recruited from voluntary internet research panels. Multiple quality control measures were integrated throughout the data collection process, including digital fingerprinting technologies that ensured that participants could complete the survey only one time, that participants were in the United States, that the data were unique, and that responses were not fraudulent. Prior to data collection, Walden University Institutional Review Board (IRB) approval was obtained. Internet panelists were sent a text inviting them to participate in the online survey. After providing their consent, the potential participants were asked the following questions to determine their eligibility: (a) Are you enrolled in college? (b) Are you living in the United States? (c) Are you 18–26 years of age? (d) Have you received an HPV vaccination? (e) Did you receive your first HPV vaccination while in college? Depending on the answers, students were provided a "thank you and do not qualify" letter or were provided the survey for completion. The informed consent form included contact information for Walden University should participants have further questions about the research. The survey was conducted in September 2022.

Because I conducted primary research and developed the instrument, I conducted a small pilot study to assess the instrument. Specifically, I evaluated wording and clarity of questions, spelling errors, content, and survey functionality (see Jones et al., 2013). In the pilot study, I assumed a similar rigor as the primary study in that participants were recruited via email using the same survey questions, and the downloaded data remained

anonymous; however, the survey was sent to family and friends, not strictly to college students. Reliability and validity of the instrument was established while piloting the survey to determine the accuracy of the survey questions.

Instrumentation

Instrument Development

The HPV Vaccination Prediction Survey (PredictHPVVac) was developed with guidance from the BMHSU following an extensive review of the literature regarding factors associated with HPV vaccination intention in college students 18–26 years of age (see Appendix A). The survey was used to examine differences in predictive factors associated with students never having received an HPV vaccine and those who received their first HPV vaccine while in college. The PredictHPVVac was designed with 53 questions for anonymous, online, self-administration. The survey was used to identify the factors that predict college students' decisions to get an initial HPV vaccination while in college. Most survey questions were adapted from HPV and HPV vaccine surveys determining vaccination use or intent to vaccinate and were reported in the literature to be reliable and valid (Barnard et al., 2017; Best et al., 2019; CDC, 2022; Goldfarb & Comber, 2022; He & He, 2018; National Institutes of Health, 2020).

Survey questions were organized in four major categories: (a) predisposing factors, (b) enabling factors, (c) need factors, and (d) HPV vaccination status. Nine questions addressed predisposing factors, 29 questions addressed enabling factors (16 specific to knowledge of HPV and HPV vaccination), 11 addressed need factors, and three addressed HPV vaccination status. Survey questions related to the predisposing,

enabling, and need factors were separated within the survey so that more general questions such as age and gender came before more sensitive questions such as income status and sexual conduct/activity.

Instrument Reliability and Validity

The reliability and validity of the survey were estimated during the pilot test. A small group (n = 14) of family and friends were sent an email requesting their participation in responding to the survey twice. Those that agreed were emailed a link to the HPV Survey two times, initially and 5 days after they responded to the first survey, and the results were correlated using a Pearson Correlation Coefficient (Schober et al., 2018). Bias can result with test-retest reliability secondary to a practice effect (taking the test more than once), knowledge gained between the two tests, and differences in the conditions under which the participants respond to the survey such as time of day lighting conditions, fatigue, etc. (Schober et al., 2018).

Validity is an assessment that an instrument contains questions that represent constructs being measured (Schober et al., 2018). The literature provided little guidance on the essential criteria to be used to judge content validity for the constructs being assessed in this dissertation research, except for the construct of HPV and HPV vaccine knowledge. HPV and HPV vaccine knowledge questions in the survey are being adapted from a validated tool developed by Goldfarb and Comber (2022). Three individuals were asked to assess the content validity of the PredictHPVVac Survey. The individuals were chosen secondary to their familiarity with the field of study including HPV infection, HPV-related cancers, and / or HPV vaccination. Each individual was asked to rate each

survey question and the survey as a whole on appropriateness and relevance to the issue of HPV vaccination. A 5-point Likert scale with answers ranging from *strongly disagree* to *strongly agree*, were provided to the raters for evaluation purposes. Content validity of the instrument was assessed as a percentage of agreement amongst the three content experts.

Operationalization of Variables

The objective of this study was to assess the relationships between predisposing, enabling, and need factors and HPV vaccine initiation while in college. All variables were measured categorically. A description of the dependent and independent variables follows. The three categories of independent variables were predisposing, enabling, and need factors and the dependent variable was HPV vaccination and the variables were operationalized as follows:

Predisposing factors: variables that increase the tendency to seek and use health services.

Enabling factors: variables that influence the ability to receive and afford services.

Need factors: variables that impact self-perceived or professionally evaluated need for health care services.

HPV vaccination: the receipt of a participants first HPV vaccine shot, by 18–26-year-old students, while enrolled in college.

For this study predisposing factors included age, gender, international student status, race and ethnicity, relationship status, religiosity, sexual attitudes, and sexual

orientation. Age was collected in the following groups: “17 years of age or younger”, “18”, “19”, “20”, “21”, “22”, “23”, “24”, “25”, “26”, and “27 years of age or older”. Gender was categorized as “male”, “female”, or “transgender”. Race was categorized as “White/Caucasian”, “Black/African American”, “Asian”, or “other”. Ethnicity was categorized as “Hispanic” or “non-Hispanic”. Religiosity was defined as the extent that religious or spiritual beliefs influence healthcare decisions and was categorized as “very much”, “moderately”, or “not very much”. Relationship status included two categories; “married, cohabitating, in a committed relationship” or “single, not cohabitating, not in a committed relationship”. International student status was defined as being born in another country (yes/no) and the length of time in the US categorized as “0”, “1”, “2”, “3”, “4”, “5”, “6”, “7”, “8”, “9”, “10”, or “11 or more years”. Sexual orientation, defined as the gender to which a person is attracted was categorized as “heterosexual”, “homosexual (gay/lesbian)”, “bisexual/pansexual” or “other”. Sexual attitudes, based on the literature review, was defined as the frequency of talking with a parent or guardian about sexual matters and will be categorized as “frequently”, “infrequently”, and “never”.

The enabling factors included knowledge of HPV vaccines, parental and student education, parental and student income, student employment status, student health insurance status, HCP recommendation to receive an HPV vaccination, parent(s) or guardian recommendation to receive an HPV vaccination, other people’s recommendation to receive an HPV vaccination, having a regular HCP, perceived ability to meet with an HCP, and social norms. Knowledge of HPV and HPV vaccination were operationalized as 16 questions adapted from Goldfarb & Comber (2022) to determine

the knowledge of the characteristics of HPV infection and HPV vaccination. All of these questions were categorized as yes/no/I do not know.

Education was defined as the level of education of the college students' family and of self. Parental education was categorized as high school or less, associate degree or some college, having a 4-year degree, completing graduate school, or do not know/refuse to answer. The research participant's level of education was categorized as having "completed some college courses", "completed a 2-year degree", "completed a 4-year degree", or having "completed a graduate degree". Assessment of participant education also includes the year of college the student was in when taking the survey i.e., "first", "second", "third", "fourth", and "fifth or greater". Income was defined as both the participants' family income and their own income, Family income was categorized as "under $40 thousand", "$40,000-$59,999", "$60,000-$79,999", "$80,000-$99,000", "$100,000" or "prefer not to answer". The participants' income was defined in the same way with the added category of "I do not have an income". Current student employment status was categorized as "not employed", "employed part-time", or "employed full-time". Participant health insurance status was categorized as "yes", "no", or "not sure". HCP recommendation was defined as a doctor or health care provider having recommended that the participant get an HPV vaccination. This was categorized as "yes, "no", or "not sure". Parent or guardian recommendation to the participant that they get an HPV recommendation was categorized as "yes", "no", or "not sure". Other recommendation for the participant to get an HPV vaccination was defined as anyone, other than an HCP or parent/guardian having recommended that the participant get an

HPV vaccination, and this was categorized as “yes”, “no”, or “not sure”. Having a regular HCP was categorized as “yes” or “no”. Perceived ability to meet with an HCP was defined as the confidence to schedule an appointment with a doctor and was categorized as “completely confident”, “moderately confident”, or “not confident”. Social norms were defined as people important to the participant thinking he/she should get an HPV vaccine and was categorized as “completely agree”, “somewhat agree”, or “completely disagree”.

Variables included as need factors included evaluated health and health risk, perceived health and health risk, history of preventive health services use, the number of lifetime sexual partners, and sexual activity. Perceived health or perceived health risk were defined as the participants perception of current health status, perceived risk of getting HPV, and worry about HPV-related illnesses. Perceived current health status was categorized as “very good or good”, “fair, or moderate”“, and not very good or poor”. Perceived risk of getting an HPV infection was categorized as “very high or high”, “moderate”, or “low or very low”. Worry about getting genital warts and/or an HPV cancer were categorized as “very high or high”, “moderate”, or “low or very low”. Evaluated health or health risk was defined as having had health evaluated at the student clinic, having had a diagnosis or treatment of a UTI since being in college, and having been diagnosed with a sexually transmitted infection. Each of these three areas of evaluated health or health risk were categorized as “yes”, “no”, or “do not know”. Sexual activity was defined as ever having been sexually active which includes vaginal, oral, or anal sexual activity and having had sexual activity (vaginal, oral, or anal) in the past 12

month. Both of these were categorized as “yes” or “no”. The number of sexual partners was categorized as “zero”, “1-3 partners”, or “≥ 4 partners”. Use of preventive health services included having received a hepatitis B vaccination or an annual flu shot. The categories for evaluation of having received a hepatitis B vaccination were “yes”, “no”, or “do not know” and the categories for receiving an annual flu shot were “yes”, “no”, and “sometimes”.

The dependent variable for this study was initiation of HPV vaccination and was defined as having received the first HPV vaccination of the series (initiation of vaccination) while enrolled in college as compared to never having received an HPV vaccination. Having ever received an HPV vaccination was categorized as “yes” or “no”. The first HPV vaccination being initiated in college was categorized as “yes” or “no”. The number of HPV vaccination shots received while in college was categorized as “one”, “two”, or “three” shots within the vaccination series and a “do not know” response was included.

Data Analysis Plan

Statistical Package for Social Sciences (SPSS), version 28 was employed to analysis the data collected for this study using a cross-sectional research design. Both descriptive statistics and multivariable logistic regression analyses were conducted. Descriptive statistics were used to analyze the size of the sample, mean age of the participants, and frequencies and percentages of the sample for gender, race, ethnicity, relationship status, international student status, sexual orientation, parental and participant education level and income, employment status, health insurance status, HPV

recommendations by HCPs, parents, and other, having a regular HCP, perceived ability to meet with an HCP, social norms, perceived and evaluated health status, lifetime and past 12 month sexual activity, and sexual activity, the number of lifetime sexual partners, use of health care services, and HPV vaccination status. Multivariable logistic regression analysis was employed to determine which variables predicted the dependent variable, initiation of HPV vaccination while enrolled in college, by estimating the strengths of the associations and inferences from the sample to the population from which the sample was drawn (Frankfort-Nachmias & Leon-Guerrero, 2018). Significance level for Exp(B) was set at $p = .05$.

Only fully completed participant surveys were included in the analysis. The data were first reviewed to detect a lack of completeness and inaccuracies. Then the inaccurate and incomplete cases were removed from the data set before the analysis was conducted. When participants 1) only answered a portion of the survey questions, 2) answered "not sure" or "do not know" for all questions with these options, or 3) did not respond to the dependent variable questions, the cases were removed prior to analysis. Data were analyzed in response to the following research questions:

RQ1: Based on self-reported survey data, are there differences between predisposing factors in U.S. college students, 18–26 years of age, who received an HPV vaccination while enrolled in college compared to those who never received an HPV vaccination?

H_o1: Based on self-reported survey data, there are no differences between predisposing factors in U.S. college students, 18–26 years of age, who received an HPV

vaccination while enrolled in college compared to those who never received an HPV vaccination.

H_a1: Based on self-reported survey data, there are differences between predisposing factors in U.S. college students, 18–26 years of age, who received an HPV vaccination while enrolled in college compared to those who never received an HPV vaccination.

RQ2: Based on self-reported survey data, are there differences between enabling factors in U.S. college students, 18–26 years of age, who received an HPV vaccination while enrolled in college compared to those who never received an HPV vaccination?

H_o2: Based on self-reported survey data, there are no differences between enabling factors in U.S. college students, 18–26 years of age, who received an HPV vaccination while enrolled in college compared to those who never received an HPV vaccination.

H_a2: Based on self-reported survey data, there are differences between enabling factors in U.S. college students, 18–26 years of age, who received an HPV vaccination while enrolled in college compared to those who have received an HPV vaccination.

RQ3: Based on self-reported survey data, are there differences between need factors in U.S. college students, 18–26 years of age, who received an HPV vaccination while enrolled in college compared to those who never received an HPV vaccination?

H_o3: Based on self-reported survey data, there are no differences between need factors in U.S. college students, 18–26 years of age, who received an HPV vaccination while enrolled in college compared to those who never received an HPV vaccination.

H_a3: Based on self-reported survey data, there are differences between need factors in U.S. college students, 18–26 years of age, who received an HPV vaccination while enrolled in college compared to those who never received an HPV vaccination.

Statistical Assumptions

When analyzing data using multivariable logistic regression, the following assumptions were made about the data (Laerd Statistics, n.d.) The dependent variable must be and was categorical and at least one independent variable must be categorical or continuous. The independent variables were assumed to be mutually exclusive and exhaustive and there was no correlation or multicollinearity between the independent variables. A linear relationship was assumed between continuous independent variables and the logit transformation of the dependent variable, and the data was free of outliers or highly influential points (Laerd Statistics, n.d.). Initial review and testing of the data were conducted to ensure that the assumptions were met. Multivariable logistic regression analysis was used to determine which of the variables categorized as predisposing, enabling, and need factors had statistically significant associations that predict college students having received their initial HPV vaccination while in college. The results from the logistic regression analysis were used to determine the significance of the associations and informed the decisions to reject or retain the null hypothesis for the three research questions posed.

Threats to Validity

Internal and external factors can impact the results of a research study. Internal validity is the degree of confidence that the relationships established amongst variables is

true and not influenced by other factors or variables (Laerd Statistics, 2012). This research study employed a cross-sectional design where the exposure and outcome variable were assessed at the same time, preventing the collection of evidence that the independent variables caused the students to get an HPV vaccination.

External validity is the extent to which the study results of the sample represent the population from which the sample was drawn (Laerd Statistics, 2012). Due to the voluntary nature of participants from internet panels, sampling errors may have introduced bias into the study. It is possible that volunteers in this study were somehow different from the population of U.S. college students. The random stratified sampling framework, employed by the Partner Organization using internet panels, was employed to decrease the risk of this sampling error. Participants may not have been honest in their answers, or they may have embellished their answers given the sensitive nature of questions about sexual activity and inaccurate responses may have occurred from the wording of the survey leading to a misunderstanding of the questions. A pilot study was conducted to reduce these potential errors and biases (Szklo & Nieto, 2019). External validity may have been diminished since the eligibility criteria for the study was narrow. Data collected from the surveys were reviewed for inconsistencies and cases with inconsistent or missing data were removed from the dataset prior to analysis.

Ethical Considerations

Walden University's Institutional Review Board (IRB) approved this research study (#09-06-22-0231844), prior to data collection, to protect the participants from harm and to ascertain that proper security processes were in place to safeguard participants

privacy and confidentiality and to ensure transparency throughout the study. The data collection method was an online survey with a link distributed to students who volunteer on US based internet panels. No identifying participant data was collected via the survey or at any other time during this research study. No IP or other geo identifying variables were part of the data file. Census region is in the data file; state or zip code were not included. No open-ended text responses were included in the data file. An informed consent was provided and was agreed to by every participant before survey access was granted, and panelists had the opportunity to review and accept the informed consent before completing the survey or deny the consent and not move forward with the survey.

Responses were collected online through the Partner Organization, anonymously, using unique identifier numbers. The Partner Organization implemented stringent data privacy guidelines in compliance with the Health Insurance Portability and Accountability Act (HIPAA). All data were anonymous and not linkable to an individual respondent. The investigator and participants had no access to each other. Participants were directed to Walden University's IRB for any questions they had about the research. Survey participants are not traceable, and no follow-up was or will be done. Data files are stored on a secure computer which is password protected. Data will only be accessible by the investigator and Walden University.

Summary

This study was conducted as a cross-sectional, quantitative study using a primary online survey data collection tool. The predictors of Human Papillomavirus (HPV) vaccination initiation while in college were assessed as compared to college students who

never received an HPV vaccination. The data were analyzed using SPSS 28.0 for Windows. Predictors of vaccination were categorized as predisposing, enabling, and need factors as guided by the BMHSU, among 403 college students. A description of the study methodology has been presented in this chapter and the proceeding chapter includes details of the actual data collection, analysis outcomes.

Chapter 4: Results

The purpose of this study was to examine the characteristics of college students who received their initial HPV vaccination while in college compared to those who never received an HPV vaccination. I conducted a nonexperimental, quantitative, cross-sectional, online survey study and collected data using the PredictHPVVac, a self-developed 53-item survey. Characteristics of college students were categorized as predisposing, enabling, and need factors as defined by the BMHSU and the literature review. The following research questions and associated hypotheses were assessed:

RQ1: Based on self-reported survey data, are there differences between predisposing factors in U.S. college students, age 18–26 years, who received an HPV vaccination while enrolled in college compared to those who never received an HPV vaccination?

H_o1: Based on self-reported survey data, there are no differences between predisposing factors in U.S. college students, age 18–26 years, who received an HPV vaccination while enrolled in college compared to those who never received an HPV vaccination.

H_a1: Based on self-reported survey data, there are differences between predisposing factors in U.S. college students, age 18–26 years, who received an HPV vaccination while enrolled in college compared to those who never received an HPV vaccination.

RQ2: Based on self-reported survey data, are there differences between enabling factors in U.S. college students, age 18–26 years, who received an HPV vaccination while enrolled in college compared to those who never received an HPV vaccination?

H_o2: Based on self-reported survey data, there are no differences between enabling factors in U.S. college students, age 18–26 years, who received an HPV vaccination while enrolled in college compared to those who never received an HPV vaccination.

H_a2: Based on self-reported survey data, there are differences between enabling factors in U.S. college students, age 18–26 years, who received an HPV vaccination while enrolled in college compared to those who never received an HPV vaccination.

RQ3: Based on self-reported survey data, are there differences between need factors in U.S. college students, age 18–26 years, who received an HPV vaccination while enrolled in college compared to those who never received an HPV vaccination?

H_o3: Based on self-reported survey data, there are no differences between need factors in U.S. college students, age 18–26 years, who received an HPV vaccination while enrolled in college compared to those who never received an HPV vaccination.

H_a3: Based on self-reported survey data, there are differences between need factors in U.S. college students, age 18–26 years, who received an HPV vaccination while enrolled in college compared to those who never received an HPV vaccination.

In this chapter, I review the pilot study and outline the data collection and cleaning procedures. This is followed by a discussion of the data analyzed, including a

post hoc power calculation, sample demographics, assumption testing, and the multivariable logistic regression analysis results for each research question.

Study Instrument

The study instrument was a 53-item online questionnaire named PredictHPVVac. The instrument was pilot tested for reliability and validity prior to implementing for the study. Answers to the survey questions were categorical, varying from dichotomous to multiple selections, and all variables were coded as nominal.

Pilot Study

Reliability

The pilot study took place prior to the main study data collection and was conducted to ensure that the survey was working properly and to determine survey reliability and validity. Data collected during the pilot study were not included in the final analysis or results. The pilot test-retest reliability to determine the consistency of scores over time was started on September 13, 2022 and completed on September 26, 2022. Fourteen individuals agreed to receive an email to participate in the pilot study. A link to the survey hosted by a partner organization was included in the email along with a unique identifier for each tester. The same link and identifier were used for the initial and repeat reliability testing, done at least 5 days apart. Three of the 14 testers submitted responses three times; therefore, a rule was applied to use the tester's second and last survey submissions because there were incomplete responses on the first attempt from two testers. Of those who completed the test three times, the first and second tests were completed back-to-back on the same day. There was a 42.86% completion rate (n = 6)

with a mean number of days between tests of 7.83 days (range 7–10 days) and a positive correlation between the first and second testing scores, $r(4) = .981$, $p < .001$. The online survey was found to be functioning properly, and no changes were made to the survey.

Validity

Three individuals with knowledge of HPV, HPV vaccination, and/or survey development were asked to participate in assessing the validity of the PredictHPVVac. The three individuals who assessed validity were provided background information about the study, including the purpose, research question, information about the conceptual framework (the BMHSU), survey development, and the survey itself. The individuals agreeing to validate the survey were sent the survey and asked to rate each item and the overall survey using a Likert scale with five ratings: *strongly disagree* (1 point), *disagree* (2 points), *neither agree or disagree* (3 points), *agree* (4 points) and *strongly agree* (5 points). Mean scores on each item ranged from 4 to 4.66 indicating agreement to near strong agreement by all validators, and the mean overall score for the survey as a whole was 4.66 indicating the content of the survey was considered valid by the reviewers to reflect the characteristics of college students who may or may not seek an HPV vaccination. Validity testing did not impact the design of the survey, the survey questions, or the conduct of the main study.

Data Collection

After IRB approval and completion of the pilot study, I notified the partner organization that they could open the survey and post invitations to the internet panelists. The main study was opened to enrollment on September 28, 2022 and closed to

enrollment on September 30, 2022. There were 470 study consents completed, and of those 403 (85.7%) students completed the study survey, while 67 (14.3%) students did not complete the survey. There were five prescreening questions which led either to the informed consent form for eligible participants or to a notification that ineligible participants did not meet the screening qualifications for this survey.

At the end of the recruiting period, the data were downloaded by the partner organization from their database into an SPSS Export.sav file. The file was emailed to me for review to ensure that the file was not corrupt and that the data set was complete. After my confirmation, the partner organization deleted the data set permanently from their system. I saved the data set to my personal computer for analysis using IBM SPSS Version 28.

Data Cleaning

Multiple quality control measures were integrated by the partner organization throughout the data collection period. These measures included digital fingerprinting technologies to ensure that participants were unique, could complete the survey only one time, and were in the United States. Incomplete surveys were not accepted. Additional quality control measures used by the partner organization for data collection included monitoring for the flatlining of responses and the length of time to complete the survey. Participants who flatlined responses or completed the questionnaire too quickly were excluded. The internet panels geographically stratify the sample, and the data I received contained a region variable generated from the data indicating the region of the country

for each participant (i.e., Northeast, Midwest, South, and West). After careful review of the data set, I determined that the data were in order.

I revised and updated the variable coding (see Appendix C). Some researchers argued that multivariable logistic regression requires at least 10 subjects per variable category, and large-scale studies are needed to provide sample size per variable category guidance (van Smeden et al., 2016). Therefore, I collapsed variable categories when there were fewer than 10 participants in a category. The variable gender was collapsed from four to three categories. The category other (n = 3) and category transgender (n = 8) were combined into one transgender/other category (n = 11). Race was converted from six to five categories, with the American Indian or Alaska Native category (n = 10) combined with the Native Hawaiian or Other Pacific Islander category (n = 3) to create a new category labeled Indigenous Americans (n = 13). For participants born outside of the country, their years in the United States were collapsed into two categories from 12 categories. Participants in the United States in the 0-, 1-, 2-, 3-, 4-, and 5-year categories were combined to form a category labeled 0 to 5 years (n = 36). Categories 6, 7, 8, 9, 10, and >11 years were combined to form a category labeled > 6 years (n = 36).

Survey Questions 14 through 29 (see Appendix A) represented variables related to knowledge of HPV and/or HPV vaccines. These 16 questions were originally coded 0 = No, 1 = Yes, and 2 = I do not know. Correct answers for Questions 14, 15, 16, 17, 21, 22, 23, 26, 28, and 29 were "Yes," and correct answers for Questions 18, 19, 20, 24, 25, and 27 were "No." Correct answers were recoded as 1 = knowledgeable, and incorrect answers plus "I do not know" answers were recoded as 0 = lack of knowledge. Survey

question 23 was posed only to individuals who correctly responded “Yes” to Question 22. The 119 participants who responded incorrectly “No” to Question 22 were not asked to answer Question 23 and were included in the “lack of knowledge” variable recoding for Question 23 because they were not aware of HPV vaccinations prior to the survey. The remainder of the variables were not altered.

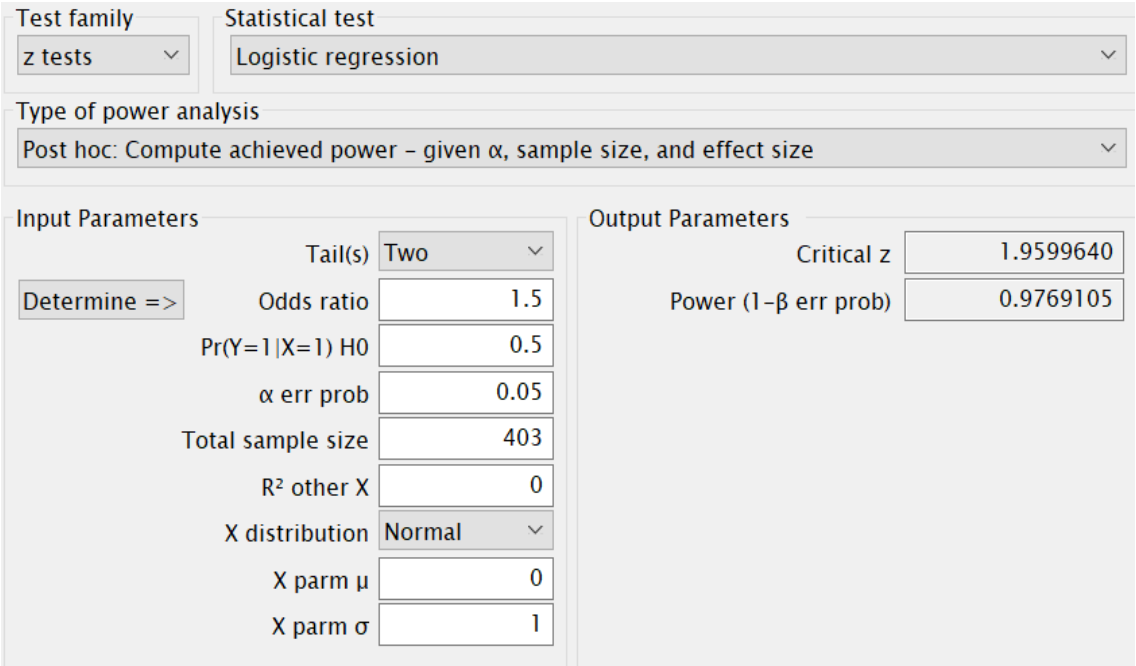
Results

Power Analysis

The original power analysis conducted prior to study start-up indicated that 337 participants were needed for a power of 0.95 with an alpha of .05 and a medium effect size of 50%. The final sample size of eligible participants enrolled in the study and analyzed was 403 due to a fast-paced enrollment. Because a larger sample size was obtained, I conducted a post hoc power analysis using the same parameters from the original calculation (two-tailed test, *OR* = 1.5, alpha = .05) and determined that the resulting power was .98 (or 98%), slightly higher than the original power projected (see Figure 3). The increased power decreased the probability of making a Type II error, or accepting a false null hypothesis, to 2% (see Chen et al., 2010).

Figure 3

*Post-Hoc G*Power Logistic Regression Power Analysis Calculation*



Demographics

My final sample was 403 U.S. college students 18–26 years of age (see Table 2); 238 received their first HPV vaccination in college (see Table 3). A random stratified sampling framework was employed for recruitment, and enrollment occurred through online internet panels that reflected the U.S. population. U.S. Census population data characterizing college students were not an exact match for my sample characteristics because census data were provided for 18–24 years of age compared to 18–26 years of age in my sample and broken out by undergraduate and graduate students instead of combined. Shifts in demographics for college students have occurred since the beginning of the COVID-19 pandemic in early 2020 and or beginning to return to prepandemic levels (National Student Clearinghouse Research Center, 2022). The sample

characteristics of participants in my study by region (see Table 4), gender (see Table 5), and race (see Table 6) were comparable to the U.S. population.

Table 2

Key Sample Demographics

Characteristic	Category	Number	Percentage
Age (18–26 years)		403	100%
HPV vaccination status (*N* = 403)	Never received	165	40.9%
	Received first HPV vaccination in college	238	59.1%
Gender (*N* = 403)	Male	141	35.0%
	Female	251	62.3%
	Transgender/other	11	2.7%
Race (*N* = 403)	White	215	53.3%
	Black or African	109	27.0%
	American	13	3.2%
	Indigenous American	27	6.7%
	Asian American	39	9.7%
	Other		
Ethnicity (*N* = 403)	Hispanic	120	29.8%
	Non-Hispanic	283	70.2%
Born in another country (*N* = 403)	No	331	831.%
	Yes	72	17.9%
Years in US for those born in another country (*N* = 72)	0–5 years	36	50.0%
	>6 years	36	50.0%
Sexual orientation (*N* = 403)	Heterosexual	288	71.5%
	Gay/lesbian	29	7.2%
	Bisexual/pansexual	72	17.9%
	Other	14	3.5%
College level (*N* = 403)	No college courses completed	21	5.2%
	Some college completed	157	38.9%
	2-year degree completed	134	33.3%
	4-year degree completed	77	19.1%
	Graduate degree completed	14	3.5%
Employment (*N* = 403)	Not employed	64	15.9%
	Employed part-time	203	50.4%
	Employed full-time	136	33.7%
Health Insurance (*N* = 403)	No	57	14.1%
	Yes	334	82.9%
	Not sure	12	3.0%

Table 3

Key Sample HPV Vaccination Statistics

Characteristic	Yes	No
Received HPV vaccination in college (*N* = 403)	238 (59.1%)	165 (40.9%)
Male	89 (37.3%)	52 (31.5%)
Female	142 (59.7%)	109 (66.1%)
Transgender	7 (3.0%)	4 (2.4%)
Number HPV vaccinations received in college (*N* = 238)		
One	108 (45.4%)	
Two	106 (44.5%)	
Three	23 (9.7%)	
Missing	1 (0.4%)	

Table 4

Participants' U.S. Region Compared to U.S. Population Census

Region	Participant percentage	U.S. population percentage
Northeast	18.9%	17.4%
Midwest	19.6%	20.8%
South	41.7%	38.1%
West	19.9%	23.7%

Note. U.S. population percentage adapted from U.S. Census Bureau (2021).

Table 5

Participants' Gender Compared to U.S. College Population Gender

Gender	Participant percentage	U.S. undergraduate percentage	U.S. graduate percentage
Male	35%	42%	39%
Female	62.3%	58%	61%
Transgender/other	2.7%	NA	NA

Note. U.S. population percentages adapted from National Center for Education Statistics (2020).

Table 6

Participants' Race Compared to U.S. College Population Race

Race	Participant percentage	U.S. undergraduate percentage
White	53.3%	51%
Black/African American	27%	12.6%
Indigenous American	3.2%	<1%
Asian American	6.6%	7%
Other	9.7%	28.4%

Note. U.S. population percentages adapted from National Center for Education Statistics (2020). Other includes Hispanic ethnicity (21%) and mixed race (7.4%) in the U.S. undergraduate population.

Of the 403 participants enrolled in the study, 40.9% had never received an HPV vaccination and 59.1% received their first HPV vaccination after starting college. The number of HPV vaccination shots received while in college ranged from one to three, with 26.8% having received one HPV vaccination, 26.3% having received two HPV vaccinations, and 5.7% having received three HPV vaccinations (see Table 3). The sample was mostly women (62.3%), White (53.3%), and non-Hispanic (70.2%), with 82.1% having been born in the US. Most of the students were not in a committed relationship (66.5%) and identified as heterosexual (71.5%). Educationally, while most students were in their second to fourth year of college (78.4%), 55% had completed a 2-year, 4-year, or graduate degree. Just over 84% were employed full- or part-time, had an income under $40,000 (40.2%), and had health insurance (82.9%). Most of the participants characterized their family income to be between $40,000 to $59,999 (27.8%).

The majority of students had received a recommendation to be vaccinated from a health care provider(HCP) (51.4%); their parents (43.7%), or from someone else (42.9%). Just over 41% completely agreed that people important to them felt like they should get an HPV vaccination. Most of the students reported having a regular HCP (80.4%) and were completely confident they could schedule an appointment with an HCP (61.8%). The participants were split on the knowledge of HPV and HPV vaccination survey questions, with 50% demonstrating knowledge (correct answers on 16 knowledge questions) and 48% demonstrating a lack of knowledge (incorrect or "I do not know) answers on 16 knowledge questions).

Most of the participants described their risk of HPV and worry about HPV as low or very low (41.4% and 38.2%, respectively). Of the 403 participants, 357 (88.6%) attended a school that had a health clinic on campus, and 43.4% had never visited the health clinic. Most participants had not been diagnosed with a urinary tract infection since starting college (62.8%), nor had they been diagnosed with a sexually transmitted infection (71.7%). The majority of participants have been sexually active (65.5%) with most having been sexually active in the past 12 months (60%). The average number of sexual partners among this sample was one to three partners (57.8%). While most have not had a hepatitis B vaccination (49.4%), most do get annual flu shots (50.9%) indicating they participation in preventative health measures. The age variable was not included in the logistic regression analysis because all enrolled participants were 18–26-years of age which was the age required for all three research questions.

Statistical Analysis

Assumptions

Multivariate logistic regression analysis was used to analyze the differences between predisposing, enabling, and need factors in U.S. college students, age 18–26 years, who had received an HPV vaccination while enrolled in college compared to those who never received an HPV vaccination. The four assumptions of multivariate logistic regression analysis were assessed prior to data analysis for all research questions (Laerd Statistics, 2018). The first assumption is that the dependent variable should be measured on a dichotomous scale. The dependent variable for this study is "Yes" the participant received their first HPV vaccination while in college and "No" the participant had never received an HPV vaccination. The second assumption is that there must be one or more independent variables that are measured continuously or categorically. All independent variables in this study were measured categorically. The third assumption of multivariate logistic regression is that there is independence of observations and the dependent variable categories must be mutually exclusive. Mutual exclusivity is a study design concept and not one that is assessed statistically (Laerd Statistics, 2018). The independent variable has two mutually exclusive categories, never having had an HPV vaccination or having a first HPV vaccination while in college. Participants can only be placed into one category, not both. Pearson correlations were tested for the variables grouped by the research question posed. For the predisposing factor variables (research question one), correlations between variables ranged from -.039 to .181; for the enabling factor variables (research question two), correlations between variables ranged from -.005 to .503, and for

the need factor variables (research question three), correlations between variables ranged from -.004 to .623, indicating independence of observations. Since there are no continuous variables included in the dataset for this study, assumption four, that there should be no linear relationship between any continuous independent variables and the logit transformation of the dependent variable r, is not applicable. The dataset analyzed for this study meets all assumptions to employ multivariable logistic regression.

Logistic Regression Analysis

A binomial logistic regression analysis was performed for each of the three research questions. The null regression model (n = 403) for each of the research questions indicated that 59.1% of participants were predicted to have received their first HPV vaccination while in college with the predicted odds of receiving the first HPV vaccination while in college being 1.4 times greater than never having received an HPV vaccination (Exp[B] = 1.442).

Research Question1

Multivariable logistic regression analysis was conducted to determine the differences between predisposing factors in U.S. college students, age 18–26 years, who have received an HPV vaccination while enrolled in college compared to those who never received an HPV vaccination. Years that a participant had been in the US, when born ex-U.S. (n = 72), was not included in the model as the data were collected to be analyzed in the event that being born ex-U.S. was statistically significant. Upon conducting the logistic regression, a test of the full model was statistically significant X_2 (16) = 39.087, p = .001. The strength of the association between first HPV vaccination

while in college (versus never having had an HPV vaccination) and the predisposing factor variables is small with R^2 = .092 (Cox & Snell) and .125 (Nagelkerke) indicating that 9-12.5% of the variability in HPV vaccination status in this model is accounted for by the predisposing factor variables entered into the model. A Homser and Lemeshow test indicated that the model improved the fit of the null regression model (X_2 (8) = 12.271, p = .140). Participants were correctly classified as first receiving an HPV vaccination while in college 79.4% of the time, as compared to 59.1% in the null model. Raw scores of the logistic regression coefficients, Wald statistics, and estimated change in odds of participants having received their first HPV vaccination while in college by predisposing factors as compared with participants who never received an HPV vaccination are summarized in Table 7. Two variables in the model were statistically significant, the influence of religious and spiritual beliefs on health care decisions and sexual attitudes.

Influence of Religious and Spiritual Beliefs on Health Care Decisions

There was a reduced likelihood, about 57.8%, of having had the first HPV vaccination while in college for participants who reported that their religious and spiritual beliefs “moderately” influenced their health care beliefs as compared to those who reported that religious and spiritual beliefs “very much” influenced their health care beliefs (p = .042; Exp[B] = .578; 95% CI [.341, .981]). For participants reporting that religious and spiritual beliefs did “not at all” influence their health care decisions, there was a 49.7% reduced likelihood of having their first HPV vaccination while in college as

compared to never having had an HPV vaccination (p = .027; Exp[B] = .491; 95% CI [.267, .924]).

Sexual Attitudes

Sexual attitudes which were measured by college students speaking with parents about sexual matters, were found to be statistically significant within the model. As compared to participants who frequently spoke with their mother and/or father about sexual matters, those who never spoke to their mother/father about sexual matters had a 53.7% reduced likelihood of having their first HPV vaccination while in college (p = .033; Exp[B] = .537; 95% CI [.302, .952]).

RQ1 Summary

Based on these findings, the null hypothesis was rejected in favor of the alternative hypothesis which indicated that there are differences between predisposing factors in U.S. college students, age 18–26 years, who received an HPV vaccination while enrolled in college compared to those who never received an HPV vaccination.

Table 7

Predisposing Factor Variables in the Regression Model

							95% C.I.for EXP(B)	
Step 1	B	*SE*	Wald	*df*	Sig.	Exp(B)	Lower	Upper
Re What is your gender?			.524	2	.770			
Re What is your gender?(1)	-.129	.236	.299	1	.584	.879	.554	1.395
Re What is your gender?(2)	.232	.720	.104	1	.747	1.261	.308	5.168
Re What race best describes you?			5.626	4	.229			

Step 1	B	*SE*	Wald	*df*	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Re What race best describes you?(1)	.404	.262	2.383	1	.123	.668	400	1.115
Re What race best describes you?(2)	-.229	.633	.130	1	.718	.796	.230	2.752
Re What race best describes you?(3)	.247	.461	.287	1	.592	1.280	.518	3.162
Re What race best describes you?(4)	-.735	.414	3.144	1	.076	.480	.213	1.080
What is your ethnicity?(1)	-.466	.273	2.903	1	.088	.628	.367	1.073
To what extent does your religious and/or spiritual beliefs influence your health care decision making?			5.682	2	.058			
To what extent does your religious and/or spiritual beliefs influence your health care decision making?(1)	-.548	.270	4.132	1	**.042**	.578	.341	.981
To what extent does your religious and/or spiritual beliefs influence your health care decision making?(2)	-.699	.316	4.880	1	**.027**	.497	.267	.924
What is your current relationship status?(1)	-.385	.232	2.753	1	.097	.680	.431	1.072

Step 1	B	*SE*	Wald	*df*	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Were you born in another country?(1)	.523	.313	2.791	1	.095	1.688	.913	3.119
What is your sexual orientation?			2.761	3	.430			
What is your sexual orientation?(1)	.027	.421	.004	1	.949	1.027	.450	2.346
What is your sexual orientation?(2)	.229	.296	.601	1	.438	1.258	.704	2.246
What is your sexual orientation?(3)	1.079	.707	2.330	1	.127	2.941	.736	11.749
How often do you talk to your mother and/or father about sexual matters?			4.913	2	.086			
How often do you talk to your mother and/or father about sexual matters?(1)	-.207	.277	.556	1	.456	.813	.473	1.400
How often do you talk to your mother and/or father about sexual matters?(2)	-.622	.293	4.524	1	**.033**	.537	.302	.952
Constant	1.769	.382	21.453	1	<.001	5.866		

a. Variable(s) entered on step 1: Re What is your gender?, Re What race best describes you?, What is your ethnicity?, To what extent does your religious and/or spiritual beliefs influence your health care decision making?, What is your current relationship status?, Were you born in another country?, What is your sexual orientation?, How often do you talk to your mother and/or father about sexual matters?

Research Question 2

A second multivariable logistic regression analysis was performed to determine the differences between enabling factors in U.S. college students, age 18–26 years, who have received an HPV vaccination while enrolled in college compared to those who never received an HPV vaccination. All enabling factor variables assessed, shown in Table 8, were entered into the regression model. A test of the full model was statistically significant X_2 (54) = 345.876, $p < .001$. The strength of the association between first HPV vaccination while in college and the predisposing factor variables is medium with R^2 = .576 (Cox & Snell) and .777 (Nagelkerke) indicating that 58% to 77% of the variability in HPV vaccination status is accounted for by the enabling factor variables included in the model. A Homser and Lemeshow test indicated that the data are a good fit for the predictive model (X_2 (8) = 13.848, $p = .086$). Participants were correctly classified as first receiving an HPV vaccination while in college 92.9% which was much greater than the 59.1% predicted in the null model. Raw scores of the logistic regression coefficients, Wald statistics, and estimated change in odds of participants having received their first HPV vaccination while in college by enabling factor variables as compared with participants who never received an HPV vaccination are summarized in Table 8.

Five categories of the enabling factor variables in the regression model were statistically significant: 1) parental and student education, 2) family and student education, 3) vaccine recommendations (HCP, parents, and other), 4) social norms, and 5) knowledge of HPV and HPV vaccine.

Education: Parental and Student

The year of college that study participants were in was significantly related to receiving the first HPV vaccination while in college, except for those students in their fifth or greater year of college. Being in the first year of college was reported to be significantly related to receiving an HPV vaccination in college (p = .033). Participants in the second year of college were 5.9 times more likely (p = .008; Exp[B] = 5.914; 95% CI [1.582, 22.105]) to have received their first HPV vaccination while in college, as compared to those in their first year of college. Students in their third year of college were 7.8 times more likely (p = .006; *OR* = 7.831; 95% CI [1.828, 33.559]) and students in their fourth year of college were 12.8 times more likely (p = .003; Exp[B] = 12.802; 95% CI [672.442, 67.124]) to have had their first HPV vaccination while in college (versus never having had an HPV vaccination) as compared to students in their first year of college.

Income: Family and Student

Participants reporting a family income of under $40,000 were statistically significantly related to participants receiving their first HPV vaccine while in college (p = .047). Participants who preferred not to answer the question about family income were 41 times more likely to have had their first HPV vaccination while in college (versus never having had an HPV vaccination), as compared to participants with less than a $40,000 family income ($p$ = .005; Exp[B] = 41.01; 95% CI [3.082, 545.633]).

In contrast to family income, participants who preferred not to answer the question about their personal income, as compared to those reporting they had no

personal income, had a 4.8% reduced likelihood of having had their first HPV vaccination while in college (p = .035; Exp[B] = .048; 95% CI [.003, .804]).

Vaccine Recommendations

Participants who had a doctor or health care providers (HCP) recommendation to receive an HPV vaccination were 5.1 times more likely to have received their first vaccination while in college versus never having received an HPV vaccination, as compared to participants who had not received a doctor or HCP recommendation (p = .001; Exp[B] = 5.107; 95% CI [1.906, 13.685]).

Similarly, participants who had a recommendation from one or both of their parents/guardians were 6.1 times more likely to have received their first vaccination while in college versus never having received an HPV vaccination, as compared to participants who had not received a parent / guardian recommendation (p = .002; Exp[B] = 6.123; 95% CI [1.930, 19.432]).

Participants who had a recommendation from someone other than an HCP or parent / guardian were 3.6 times more likely to have received their first vaccination while in college versus never having received an HPV vaccination, as compared to participants who had not received a recommendation from someone other than a doctor or parent / guardian (p = .016; Exp[B] = 3.623; 95% CI [1.268, 10.351]).

Social Norms

Social norms were assessed by response to the statement, “Most people that are important to me think that I should get the HPV vaccination series”. As compared to participants who “completely agreed” with the statement, participants who somewhat

agreed (p = .009; Exp[B] = .275; 95% CI [.104, .726]) and participants who completely disagreed (p < .001; Exp[B] = .051, 95% CI [.012, .210]) had a 27.5% and 5.1% decreased likelihood of having had an HPV vaccination, respectively.

Knowledge: HPV and HPV Vaccine

Four of the sixteen knowledge survey questions were found to contribute, statistically, to the prediction of HPV vaccination status in the regression model. When asked, does HPV affect both women and men (?), participants who answered the question correctly were 19.4% less likely to have had an HPV vaccination than those who were not knowledgeable about the answer to this question (p = .007; Exp[B] = .194; 95% CI [.059, .645]).

Participants who had knowledge of the HPV vaccine before participating in this research were 25.5 times more likely to have had an HPV vaccination compared to those who were not aware of the HPV vaccine before participating in the study (p < .001; Exp[B] = 25.546; 95% CI [7.528; 86.695]).

Similarly, participants who thought the HPV vaccination was safe, as compared to those who did not, were 4.3 times more likely to have had an HPV vaccination while in college, versus never having had an HPV vaccination (p = .008; Exp[B] = 4.271; 95%CI [1.465, 12.452]).

Lastly, participants who responded “no” to the question, “is the HPV vaccination only needed if you have multiple sexual partner?”, were 2.5 times more likely to have received an HPV vaccination while in college, as compared to participants who responded incorrectly to this question (p = .050; Exp[B] = 2.457; 95% CI [.999; 6.047]).

RQ2 Summary

Based on these findings of self-reported survey data, the null hypothesis is rejected in favor of the alternative hypothesis which indicated that there are differences between enabling factors in U.S. college students, age 18–26 years, who received an HPV vaccination while enrolled in college compared to those who never received an HPV vaccination.

Table 8

Enabling Factors: Variables in the Regression Equation

							95% C.I.for EXP(B)	
Step 1	B	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
What is the highest level of education of your parent/guardian?			2.610	4	.625			
What is the highest level of education of your parent/guardian?(1)	-.630	.677	.865	1	.352	.533	.141	2.009
What is the highest level of education of your parent/guardian?(2)	-1.108	.751	2.175	1	.140	.330	.076	1.440
What is the highest level of education of your parent/guardian?(3)	-.357	.884	.163	1	.686	.700	.124	3.956
What is the highest level of education of your parent/guardian?(4)	-31.407	3065221.651	.000	1	1.000	.000	.000	.

Step 1	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
What year of college are you in?			10.454	4	**.033**			
What year of college are you in?(1)	1.777	.673	6.982	1	**.008**	5.914	1.582	22.105
What year of college are you in?(2)	2.058	.742	7.685	1	**.006**	7.831	1.828	33.559
What year of college are you in?(3)	2.550	.845	9.096	1	**.003**	12.802	2.442	67.124
What year of college are you in?(4)	1.902	1.082	3.091	1	.079	6.700	.804	55.851
What is your highest level of college education?			7.289	4	.121			
What is your highest level of college education?(1)	-.470	1.088	.186	1	.666	.625	.074	5.277
What is your highest level of college education?(2)	-1.001	1.132	.782	1	.377	.368	.040	3.380
What is your highest level of college education?(3)	-2.259	1.219	3.437	1	.064	.104	.010	1.138

							95% C.I.for EXP(B)	
Step 1	B	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
What is your highest level of college education?(4)	.094	1.657	.003	1	.955	1.098	.043	28.274
What is the income level of your family?			11.211	5	**.047**			
What is the income level of your family?(1)	-.418	.663	.398	1	.528	.658	.180	2.413
What is the income level of your family?(2)	.862	.661	1.703	1	.192	2.369	.649	8.652
What is the income level of your family?(3)	-.147	.891	.027	1	.869	.864	.151	4.953
What is the income level of your family?(4)	.115	.879	.017	1	.896	1.122	.200	6.280
What is the income level of your family?(5)	3.714	1.320	7.910	1	**.005**	41.010	3.082	545.633
What is your income level?(none)			9.596	6	.143			
What is your income level?(1)	.417	.754	.306	1	.580	1.518	.346	6.655
What is your income level?(2)	1.269	.930	1.864	1	.172	3.559	.575	22.019
What is your income level?(3)	-.104	.968	.011	1	.915	.901	.135	6.006
What is your income level?(4)	.370	1.449	.065	1	.798	1.447	.085	24.757

							95% C.I.for EXP(B)	
Step 1	B	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
What is your income level?(5)	-.452	1.331	.115	1	.734	.636	.047	8.639
What is your income level?(6)	-3.035	1.437	4.461	1	**.035**	.048	.003	.804
What is your current employment status?			1.400	2	.497			
What is your current employment status?(1)	-.724	.661	1.198	1	.274	.485	.133	1.772
What is your current employment status?(2)	-.839	.745	1.270	1	.260	.432	.100	1.860
Do you have health insurance?			3.168	2	.205			
Do you have health insurance?(1)	1.127	.680	2.747	1	.097	3.086	.814	11.698
Do you have health insurance?(2)	.285	1.367	.043	1	.835	1.329	.091	19.395
Has a doctor or health care provider recommended that you get an HPV vaccination?			11.624	2	**.003**			
Has a doctor or health care provider recommended that you get an HPV vaccination?(1)	1.631	.503	10.516	1	**.001**	5.107	1.906	13.685
Has a doctor or health care provider recommended that you get an HPV vaccination?(2)	-.051	.849	.004	1	.952	.950	.180	5.020

							95% C.I.for EXP(B)	
Step 1	B	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
Has one or both of your parents/guardians recommended that you get an HPV vaccination?			11.047	2	**.004**			
Has one or both of your parents/guardians recommended that you get an HPV vaccination?(1)	1.812	.589	9.459	1	**.002**	6.123	1.930	19.432
Has one or both of your parents/guardians recommended that you get an HPV vaccination?(2)	-.411	.799	.264	1	.607	.663	.138	3.178
Has anyone other than a health care practitioner or parent/guardian recommended that you get an HPV vaccination (friend, counselor, community leader, teacher, etc.)?			5.943	2	.051			

Step 1	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Has anyone other than a health care practitioner or parent/guardian recommended that you get an HPV vaccination (friend, counselor, community leader, teacher, etc.)?(1)	1.287	.536	5.774	1	**.016**	3.623	1.268	10.351
Has anyone other than a health care practitioner or parent/guardian recommended that you get an HPV vaccination (friend, counselor, community leader, teacher, etc.)?(2)	.904	.832	1.182	1	.277	2.470	.484	12.615
Do you have a regular healthcare provider?(1)	.622	.635	.961	1	.327	1.863	.537	6.461
Do you have confidence that you can schedule an appointment with a healthcare provider?			3.679	2	.159			
Do you have confidence that you can schedule an appointment with a healthcare provider?(1)	.285	.479	.355	1	.551	1.330	.520	3.400

							95% C.I.for EXP(B)	
Step 1	B	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
Do you have confidence that you can schedule an appointment with a healthcare provider?(2)	2.229	1.164	3.667	1	.056	9.294	.949	91.028
Most people that are important to me think that I should get the HPV vaccination series.			17.420	2	**<.001**			
Most people that are important to me think that I should get the HPV vaccination series.(1)	-1.292	.496	6.795	1	**.009**	.275	.104	.726
Most people that are important to me think that I should get the HPV vaccination series.(2)	-2.981	.723	16.976	1	**<.001**	.051	.012	.210
Is HPV a sexually transmitted infection?(1)	.443	.508	.761	1	.383	1.557	.576	4.211
Can a person get HPV from skin-to-skin contact with a person infected with HPV?(1)	.801	.452	3.145	1	.076	2.227	.919	5.396
Can HPV cause cancer?(1)	.761	.484	2.470	1	.116	2.141	.828	5.532

							95% C.I.for EXP(B)	
Step 1	B	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
Does HPV affect both women and men?(1)	-1.638	.612	7.172	1	**.007**	.194	.059	.645
Can HPV infection be prevented?(1)	-.248	.537	.214	1	.644	.780	.273	2.234
Before starting this survey, did you know that there is a vaccine for HPV?(1)	3.240	.623	27.017	1	**<.001**	25.546	7.528	86.695
If you were aware that there is a vaccine for HPV, did you know it can be given until ag 45?(1)	-.432	.531	.663	1	.415	.649	.229	1.837
Is the HPV vaccine safe?(1)	1.452	.546	7.071	1	**.008**	4.271	1.465	12.452
Is the HPV vaccine effective at preventing HPV infection?(1)	-.603	.508	1.408	1	.235	.547	.202	1.481
If someone is vaccinated for HPV are safe sex practices (i.e., condoms, contraceptives) still needed?(1)	-.009	.493	.000	1	.985	.991	.377	2.603
Does HPV cause cancer only in women?(1)	.593	.457	1.685	1	.194	1.810	.739	4.434

							95% C.I.for EXP(B)	
Step 1	B	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
Is the HPV vaccination only needed if you have multiple sexual partners?(1)	.899	.459	3.830	1	**.050**	2.457	.999	6.047
Is there a cure for HPV?(1)	-.936	.494	3.599	1	.058	.392	.149	1.031
Does the HPV vaccination have significant side effects?(1)	.569	.553	1.060	1	.303	1.767	.598	5.221
Can you get HPV from receiving the HPV vaccination?(1)	-.038	.446	.007	1	.932	.963	.402	2.307
Constant	-4.653	1.669	7.771	1	.005	.010		

a. Variable(s) entered on step 1: What is the highest level of education of your parent/guardian?, What year of college are you in?, What is your highest level of college education?, What is the income level of your family?, What is your income level?, What is your current employment status?, Do you have health insurance?, Has a doctor or health care provider recommended that you get an HPV vaccination?, Has one or both of your parents/guardians recommended that you get an HPV vaccination?, Has anyone other than a health care practitioner or parent/guardian recommended that you get an HPV vaccination (friend, counselor, community leader, teacher, etc.)?, Do you have a regular healthcare provider?, Do you have confidence that you can schedule an appointment with a healthcare provider?, Most people that are important to me think that I should get the HPV vaccination series., Is HPV a sexually transmitted infection?, Can a person get HPV from skin-to-skin contact with a person infected with HPV?, Can HPV cause cancer?, Does HPV affect both women and men?, Can HPV infection be prevented?, Before starting this survey, did you know that there is a vaccine for HPV?, If you were aware that there is a vaccine for HPV, did you know it can be given until ag 45?, Is the HPV vaccine safe?, Is the HPV vaccine effective at preventing HPV infection?, If someone is vaccinated for HPV are safe sex practices (i.e. condoms, contraceptives) still needed?, Does HPV cause cancer only in women?, Is the HPV vaccination only needed if you have multiple sexual partners?, Is there a cure for HPV?, Is the HPV vaccination only needed if you have multiple sexual partners?, Does the HPV vaccination have significant side effects?, Can you get HPV from receiving thee HPV vaccination?.

Research Question 3

A third multivariable logistic regression analysis was performed to determine the differences between need factors in U.S. college students, age 18–26 years, who have received an HPV vaccination while enrolled in college compared to those who never received an HPV vaccination.

Upon conducting the logistic regression, a test of the full model was statistically significant X_2 (21) = 33.385, $p < .001$. The strength of the association between first HPV vaccination while in college and the predisposing factor variables is medium with R^2 = .282 (Cox & Snell) and .380 (Nagelkerke) indicating that 28% to 38% of the variability in HPV vaccination status is accounted for by the need factor variables included in the model. A Homser and Lemeshow test indicated that the data are a good fit for the predictive model (X_2 (8) = 10.210, p = .251). Participants were correctly classified as first receiving an HPV vaccination while in college 79.4% of the time which is greater than 59.1% noted in the null model. Raw scores of the logistic regression coefficients, Wald statistics, and estimated change in odds of participants having received their first HPV vaccination while in college by need factor variables as compared with participants who never received an HPV vaccination are summarized in Table 9. Four of the broad need factor variables in the regression model were statistically significant; 1) perceived health risk (risk of getting an HPV infection and worry about genital warts and HPV cancers), 2) evaluated health risk (use of the campus student health clinic), 3) sexual activity and number of sexual partners, and 4) health services use (receipt of hepatitis B vaccine and annual flu shot).

Perceived Health Risk

Participants reporting that their risk of getting an HPV infection was low or very low as compared to participants who reported their risk of getting HPV infection as high or very high had a 37.5% reduced likelihood that of having an HPV vaccination while in college (p = .027; [B] = .375; 95% CI [.157, .897]). Participants reporting their worry about getting genital warts and/or HPV cancers as low/very low as compared to high/very high had a 31.4% reduced likelihood of having an HPV vaccination while in college as compared to never having an HPV vaccination (p = .004; Exp[B] = .314; 95% CI [.142, .693]).

Evaluated Health

Study participants who reported having been to the student health clinic on campus were 2.5 times more likely to have had an HPV vaccination while in college, compared to students who reported never having visited the campus health clinic (p = .004; Exp[B] = 2.353; 95% CI [1.332, 4.156]).

Sexual Activity and Number of Lifetime Sexual Partners

Participants who reported having had sexual activity (vaginal, anal, oral) in the past 12 months were 1.9 times more likely to have had an HPV vaccination while in college compared to participants who had not been sexually active in the past 12 months (p = .049; Exp[B] = 1.951; 95% CI [1.003, 3.794]). Participants who had four or more lifetime sexual partners had a 36% reduced likelihood of having had an HPV vaccination while in college as compared to participants who had no lifetime sexual partners (p = .034; Exp[B] = .36; 95% CI [.140, .925]).

Preventive Health Services Use

Study participants who reported having had a hepatitis B vaccination were 3.3 times more likely to have had an HPV vaccination while in college as compared to participants who never received a hepatitis B vaccination ($p < .001$; Exp[B] = 3.330; 95% CI [1.878, 5.906]). Similarly, participants who reported receiving an annual flu shot as compared to students who did not were 2 times more likely to have had an HPV vaccination while in college versus never having had an HPV vaccination ($p < .008$; Exp[B] = 2.015; 95% CI [1.205, 3.369]).

RQ3 Summary

Based on these findings of self-reported survey data, the null hypothesis is rejected in favor of the alternative hypothesis that indicates there are differences between need factors in U.S. college students, age 18–26 years, who received an HPV vaccination while enrolled in college compared to those who never received an HPV vaccination.

Table 9

Need Factors: Variables in the Regression Equation

							95% C.I.for EXP(B)	
Step 1	B	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
How do you describe your current health status?			.933	2	.627			
How do you describe your current health status?(1)	-.098	.263	.140	1	.709	.907	.542	1.517
How do you describe your current health status?(2)	.544	.691	.618	1	.432	1.722	.444	6.677
I believe that my risk of getting HPV infection is:			5.310	2	.070			

							95% C.I.for EXP(B)	
Step 1	B	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
I believe that my risk of getting HPV infection is:(1)	-.436	.400	1.189	1	.276	.646	.295	1.416
I believe that my risk of getting HPV infection is:(2)	-.980	.445	4.862	1	**.027**	.375	.157	.897
My worry about getting genital warts and/or HPV cancers is:			8.914	2	**.012**			
My worry about getting genital warts and/or HPV cancers is:(1)	-.381	.353	1.163	1	.281	.683	.342	1.365
My worry about getting genital warts and/or HPV cancers is:(2)	1.159	.404	8.219	1	**.004**	.314	.142	.693
Have you been to the student health clinic on campus?			12.650	3	**.005**			
Have you been to the student health clinic on campus?(1)	.856	.290	8.688	1	**.003**	2.353	1.332	4.156
Have you been to the student health clinic on campus?(2)	.131	.631	.043	1	.835	1.140	.331	3.923
Have you been to the student health clinic on campus?(3)	-.425	.398	1.143	1	.285	.654	.300	1.425
Have you had a diagnosis and treatment of a urinary tract infection since being in college?			.771	2	.680			
Have you had a diagnosis and treatment of a urinary tract infection since being in college?(1)	.038	.320	.014	1	.906	1.039	.555	1.944

							95% C.I.for EXP(B)	
Step 1	B	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
Have you had a diagnosis and treatment of a urinary tract infection since being in college?(2)	.429	.489	.770	1	.380	1.536	.589	4.009
Have you ever been diagnosed with a sexually transmitted infection?			1.137	2	.566			
Have you ever been diagnosed with a sexually transmitted infection?(1)	.097	.371	.069	1	.793	1.102	.532	2.283
Have you ever been diagnosed with a sexually transmitted infection?(2)	-.513	.520	.973	1	.324	.599	.216	1.659
Have you ever been sexually active (vaginal, oral, or anal sex)?(1)	.226	.349	.422	1	.516	1.254	.633	2.484
In the past 12 months have you had vaginal, anal, or oral sex?(1)	.668	.339	3.876	1	**.049**	1.951	1.003	3.794
How many sexual partners have you had in your lifetime?			4.524	2	.104			
How many sexual partners have you had in your lifetime?(1)	-.466	.331	1.990	1	.158	.627	.328	1.199
How many sexual partners have you had in your lifetime?(2)	1.022	.481	4.505	1	**.034**	.360	.140	.925
Have you received a hepatitis B vaccination?			17.344	2	**<.001**			
Have you received a hepatitis B vaccination?(1)	1.203	.292	16.937	1	**<.001**	3.330	1.878	5.906
Have you received a hepatitis B vaccination?(2)	.137	.384	.127	1	.721	1.147	.540	2.436

							95% C.I.for EXP(B)	
Step 1	B	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
Do you receive an annual flu shot?			9.585	2	**.008**			
Do you receive an annual flu shot?(1)	.701	.262	7.130	1	**.008**	2.015	1.205	3.369
Do you receive an annual flu shot?(2)	-.407	.488	.695	1	.404	.666	.256	1.733
Constant	.463	.474	.956	1	.328	1.589		

a. Variable(s) entered on step 1: How do you describe your current health status?, I believe that my risk of getting HPV infection is:, My worry about getting genital warts and/or HPV cancers is:, Have you been to the student health clinic on campus?, Have you had a diagnosis and treatment of a urinary tract infection since being in college?, Have you ever been diagnosed with a sexually transmitted infection?, Have you ever been sexually active (vaginal, oral, or anal sex)?, In the past 12 months have you had vaginal, anal, or oral sex?, How many sexual partners have you had in your lifetime?, Have you received a hepatitis B vaccination?, Do you receive an annual flu shot?.

Summary

To review, Chapter 4 provided the results from the data analyses for the three research questions posed. This was a quantitative, cross-sectional research study where primary data were collected from an online survey. A sample of 403 participants were analyzed. The inclusion criteria for participating in the study included being 18–26 years of age, enrolled in college in the US, living in the US, and either never having received an HPV vaccination or having received the first HPV vaccination while in college. The three research questions were posed to determine the differences between predisposing, enabling, and needs factors in U.S. college students, age 18–26 years, who have received an HPV vaccination while enrolled in college compared to those who never received an HPV vaccination. Binomial logistic regression analyses were conducted to answer the research questions. Two predisposing variables in RQ1 and the Omnibus Test of Model

Coefficients were found to be significant ($p = .001$). For RQ2, twelve enabling factor items were found to be statistically significant along with the Omnibus Test of Model Coefficients was found to be significant ($p < .001$). Seven items in the regression model were statistically significant for RQ3 as was the Omnibus Test of Model Coefficients ($p < .001$). These were all in the predefined study limit of $p < .05$ leading me to reject the null hypotheses for each of the three research questions in lieu of the alternative hypotheses indicating that enabling, predisposing, and needs factors differentiated students who received their first HPV vaccination while in college from students who never received an HPV vaccination. A discussion and interpretation of the findings, the limitations of the study, implications of the research, and recommendations for future research are provided in Chapter 5.

Chapter 5: Interpretation of the Findings

The purpose of this quantitative study was to examine the distinguishing characteristics of U.S. college students 18–26 years of age who received their initial HPV vaccination while in college compared to those who never received an HPV vaccination. The recent literature focused on intent to be vaccinated and not on actualization of HPV vaccination while in college, which indicated a gap that needed to be filled to understand the factors that lead to initiation of HPV vaccination in college. Identifying these factors may increase vaccination rates and lead to positive social change by protecting the population from HPV-related cancers.

This study was guided by Andersen's (1995, 2008) BMHSU, a conceptual model that categorizes behaviors as predisposing, enabling, and need factors to predict health services use. The research questions were designed to address the differences in these factors in U.S. college students by comparing students who initiated HPV vaccination while enrolled in college to those who never received an HPV vaccination. Data were collected and analyzed from 403 college students 18–26 years of age who completed a cross-sectional web-based survey. College is a time of declining parental control and increasing independence and a time to encourage catch-up HPV vaccinations. Recent data indicated that a significant number of students are entering college unvaccinated (Glenn et al., 2021). Identifying the distinguishing characteristics of college students who received an initial HPV vaccine in college may provide knowledge to assist in the development of interventions that may increase vaccinations rates to support herd

immunity against HPV in the United States, thereby decreasing the morbidity and mortality associated with HPV infection.

Summary of Key Findings

There were a number of key findings in this study. I found that nearly 60% of participants had initiated their first HPV vaccination once enrolled in college, and nearly 90% had completed two doses of the vaccine. The participants were primarily women, White, born in the United States, and heterosexual, and two thirds were 22 years of age or older. Most participants were not in a committed relationship, and over half had earned at least a 2-year degree. Most were employed either part-time or full-time and had health insurance coverage.

Two of the predisposing factor variables (the influence of religious and spiritual beliefs on health care decisions and sexual attitudes) were found to predict HPV vaccination status. The enabling factor variables that were found to predict HPV vaccination status included (a) participants' year of college, (b) family income, (c) student income, (d) receipt of a vaccine recommendation, (e) social norms, and (f) knowledge of HPV and HPV vaccine. Need factor variables found to predict HPV vaccination status were (a) perceived risk of getting an HPV infection, (b) worry about genital warts and HPV cancers, (c) use of the campus student health clinic, (d) sexual activity, (e) number of sexual partners in the past 12 months, (f) receipt of the hepatitis B vaccine, and (g) receipt of an annual flu shot. In Chapter 5, I discuss the interpretation of the findings, limitations, recommendations, and implications for social change.

Predisposing Factors

Predisposing factors are the social, biological, or cultural factors that predict the use of health services (Andersen, 1995, 2008). The predisposing factor variables in the current study included age, sex, race, ethnicity, relationship status, sexual orientation and the health beliefs, sexual attitudes, and religious/spiritual beliefs. Two of the predisposing factor variables (the influence of religious and spiritual beliefs on health care decision making and sexual attitudes) were found to be predictors of HPV vaccination status. Moderate influence (p = .042) and no influence (p = .027) of religious and spiritual beliefs on health care decisions compared to very much influence were predictive of not initiating an HPV vaccination in college. Similarly, college students never speaking with parents about sex (p = .33) compared to frequently speaking to parents was predictive of not initiating HPV vaccination in college. The other predisposing factor variables did not significantly contribute to the prediction of HPV vaccination status.

All participants were 18–26 years of age. My results indicated that younger students (18–19 years of age) were less likely to have initiated HPV vaccinations in college, which was divergent from the literature that younger students are more accepting of the HPV vaccine (see Grace-Leitch & Shneyderman, 2016; Koskan et al., 2021; LaJoie et al., 2018). However, I measured initiation of vaccination, not vaccine acceptance. It is unknown whether vaccine acceptance results in health care system utilization and actualization of vaccination. My data suggest that students become more independent in decision making about HPV vaccinations and more engaged in the health care system as they age. Additionally, although the age range for my study and the current literature was

18–26 years, my study included a much larger percentage of participants 22 years of age or older, which may account for the differences in outcomes (see Koskan et al., 2021; LaJoie et al., 2018; Lee et al., 2018; E. L. Thompson et al., 2016).

Consistent with Hollins et al. (2021) and Koplas et al. (2019), my results indicated neither race nor ethnicity were related to HPV vaccination actualization. Other investigators found that White or Asian students had higher rates of vaccination by the time they were in college (LaJoie et al., 2018; Kellogg et al., 2019). I measured initiation of HPV vaccination after entering college, which could account for the difference seen. Similarly, Kim et al. (2019) found that Korean American women living in the United States from 0–5 years of age had a greater intention to be HPV vaccinated compared to other women born in the United States. My results indicated international student status did not predict vaccination status. Again, it seems that intention to be vaccinated may differ from actualization of HPV vaccination once entering college.

One third of my participants reported being married, cohabiting, or being in a committed relationship, and relationship status did not predict initiation of HPV vaccination after entering college, nor did sexual orientation. Contradictory results of the association between relationship status and HPV vaccination status have been reported, as have results on sexual orientation and HPV vaccination uptake status (Hollins et al., 2021; Preston & Darrow, 2018; E. L. Thompson et al., 2016). My results indicated initiation of HPV vaccination in college students is not driven by relationship status or sexual orientation. Although age, sex, race, ethnicity, relationship status, and sexual orientation did not predict the initiation of HPV vaccination status in my study, the

predisposing factors of influence of religious and spiritual beliefs on health care decisions and sexual attitudes predicted vaccination initiation.

Influence of Religious and Spiritual Beliefs on Health Care Decisions

I found that college students who reported their religious spiritual beliefs did not influence or only moderately influenced their health care decision making were less likely to have initiated HPV vaccination while in college compared to those who reported that their religious beliefs very much influenced their health care decision making. Though the literature on HPV vaccination and religiosity is limited, this self-report from college students is not surprising because one study indicated that unvaccinated students, mostly White students, reported that religious beliefs influenced their health beliefs (Shah et al., 2021). However, in the same study, no associations were found between participation in religious activities and receipt of at least one HPV vaccination. Conversely, increased family religiosity has been negatively associated with HPV vaccination (Quinn & Lewin, 2020). Family religiosity was not assessed in my study. The sample in my study was unique compared to other studies in that participants had initiated their HPV vaccinations in college or never received an HPV vaccination. My students may have had different characteristics from students who started their HPV vaccinations in adolescence, a population not included in my study. Religiosity seems to be a complex predictor of HPV vaccination and needs further assessment. .

Sexual Attitudes

Sexual attitudes, measured in the current study by how frequently college students spoke with their parents about sexual matters, were found to be a significant predictor of

HPV vaccination status. Family sexual attitudes, particularly communication about sex, had been significantly associated with the receipt of the HPV vaccination in both men and women (Quinn & Lewin, 2020). In my study, college students who reported speaking to their parents about sex frequently were shown to have more likely initiated HPV vaccination while in college. Engaging in communication about sex may increase a college student's understanding of HPV, risk of STIs, and protective effects of HPV vaccinations, leading to actualization of HPV vaccination once a student enters college and gains additional independence from their parents.

Enabling Factors

Enabling factors as defined by the BMHSU are more malleable than predisposing factors and have been shown to accelerate or impede the use of health care services (Andersen, 1995, 2008). Enabling factor variables assessed in the current study included parent and student education; student employment status; health insurance status; family and student income; knowledge of HPV and HPV vaccination; having a regular HCP; the ability to meet with an HCP; receiving a vaccine recommendation from an HCP, parent, or other person; and social norms. Of these variables, student education level (second year [$p = .008$], third year [$p = .006$], and fourth year [$p = .003$] compared to first year), family income (preferred not to answer [$p = .005$] compared to <$40,000) personal income) (preferred not to answer [$p = .035$] compared to no income), receiving a vaccine recommendation from anyone (HCP [$p = .001$], parents [$p = .002$]; other [$p = .016$]), social norms (sometime agreed with statement [$p = .008$], completely disagreed with statement [$p = .001$] compared to completely agree), and knowledge of HPV and HPV

vaccination (believed HPV affects both men and women [p = .007], had knowledge of HPV vaccination before taking the survey [p = .001], thought the HPV vaccination was safe [p = .008], believed HPV was needed regardless of the number of sexual partners [p = .050]) were predictive of HPV vaccination status. Nonpredictors of HPV vaccination status in this population of 18–26-year-old college students who either initiated an HPV vaccine after starting college or never received an HPV vaccination included student employment status, health insurance status, and ability to meet with an HCP.

Few studies addressed employment status of college students in relationship to HPV vaccination status in 18–26-year-old college students. Although my analysis did not indicate a relationship between employment status and HPV vaccination, Wilkinson et al. (2018) found that women college students 18–30 years of age in the Southeast United States who worked for pay had a decreased chance of having been HPV vaccinated compared to nonworking students. The differences in outcomes are potentially accounted for by the differences in populations (e.g., gender [women compared to men and women], age [up to age 30 compared to age 26], geography [Southeastern United States compared to entire United States], and full time employment status 4.3% compared to 33.7%). Further investigation is needed to determine the relationship between HPV vaccination initiation and employment status in college students.

Having health insurance positively contributes to HPV vaccination status in college students, and free HPV vaccinations have been shown to double the likelihood of being vaccinated (D'Errico et al., 2020; Kim et al., 2020; Thompson et al., 2016). The findings in the literature are inconsistent with my analysis of a student population in

which most participants were employed and had health insurance. Having health insurance was not predictive of HPV vaccination status. Perhaps the unvaccinated students were not aware that health insurance covers the cost of HPV vaccinations, which could be included in health education, or perhaps the unvaccinated students were aware that HPV vaccination costs are covered by health insurance and other barriers prevented HPV vaccination.

The real or perceived ability to meet with an HCP has been identified as an influencer of HPV vaccination status and has been associated with work demands, school demands, and social demands (Britt & Englebert, 2018). Logistics, convenience, and perceived behavioral control have been associated with HPV vaccination status (Catalano et al., 2017; Johnson & Ogeltree, 2017; Thompson et al., 2019). In my study, the potential for life demands as a barrier to HPV vaccination among mostly employed 18–26-year-old students is probable, but life demands other than being a college student and work status were not measured. However, most participants reported a high level of confidence to meet with an HCP, and that confidence may supersede life's demands.

Vaccine Recommendations

HPV vaccine recommendations by HCPs, parents, and others have been positively associated with self-reported HPV vaccination status and intent to be vaccinated. Of the three recommendations, those by HCPs and parents have been reported to be the strongest predictors of receiving an HPV vaccination (D'Errico et al., 2020; Hollins et al., 2021; McLendon et al., 2021). Having a recommendation is a predictor of HPV vaccination across male and female populations, races, and place of birth (U.S. compared

to non-U.S.; Hernandez et al., 2019; Kim et al., 2019; LaJoie et al., 2018; Thomas et al., 2016). In my study, having a parent recommendation for HPV vaccination was stronger than an HCP recommendation, indicating the continued influence of parents on health care decisions well into college.

Similarly, a lack of a recommendation is a strong predictor of college students not getting an HPV vaccination (D'Errico et al., 2020; Ragan et al., 2018). There is limited evidence that being unsure of whether a recommendation had been received was associated with not receiving an HPV vaccination (McLendon et al., 2021). The strong influence of having a recommendation to be HPV vaccinated by an HCP, one or both parents, or someone else (e.g., friend, counselor, community leader, teacher) was substantiated in my study with participants who received recommendations associated with HPV vaccination initiation in college. This affirms the influence of these individuals on college students' decisions. However, in my study, being unsure of having received a recommendation was not predictive of vaccination status. Not knowing whether a vaccine recommendation has been received indicates the message was weak, if a recommendation was given, and a strong message is required to influence HPV vaccination decision making in college students. Outreach to HCPs and parents on the importance of their recommendations to college students should continue and be enhanced.

Education: Parent and Student

There are conflicting reports on the association of parental education and HPV vaccination status in college students (Kellogg et al., 2019; Lee et al., 2018). When guided by the same conceptual framework used in my study, the BMHSU, having a

parent with a graduate degree has been found to be predictive of completion of the HPV vaccination series in college men (Lee et al., 2018). Conversely, in Latino/Hispanic families, while education was predictive of self-reported vaccination status, students with family members having a graduate degree or greater were less likely to report having been vaccinated (Kellogg et al., 2019). In my study, family education level was not found to predict HPV vaccination status, nor was the students' level of education predictive of HPV vaccination status. However, the year of college that the student was enrolled in at the time they took the survey, was positively associated with HPV vaccination initiation in college, through the fourth year of college. There are reports in the literature indicating that younger age (18-20 or 18-22 years) is predictive of vaccine acceptability and completion in men and women students, and this may be one possible explanation for this observation (Grace-Leitch & Shneyderman, 2016; Koskan et al., 2021; LaJoie et al., 2018).

Income: Family and Student

Family income has been associated with HPV vaccination status in college students with students belonging to families with higher incomes, but not the very highest incomes, reporting higher rates of HPV vaccinations (Kellogg et al., 2019; Ragan et al., 017). In my study the very lowest income level (<$40,000 annually) was associated with HPV initiation once in college which may potentially be explained by students' access to a campus health center. I did not collect information about participants access to student health clinics in my study. I, also, found that participants who refused to answer questions about family income were much more likely to have initiated HPV vaccination

once enrolled in college; conversely, participants who preferred not to provide information about their personal income were less likely to have initiated an HPV vaccination. Participants who refuse to reveal their income may differ from others on relevant sociodemographic characteristics, and this needs to be further explored (Kim et al., 2007).

Social Norms

Social norms or influence were found to be a significant predictor of HPV vaccination initiation once in college, in this study, supporting literature that social influence predicts HPV vaccination intention in college students (McLendon et al., 2021). College students are more likely to receive an HPV vaccination when their friends and/or sexual partners think they should be vaccinated and when these influencers have received an HPV vaccination (Johnson & Ogletree, 2017; McLendon et al., 2021). Congruent with the literature, disagreement by participants that people important to them should have a vaccination, was predictive of never having had an HPV vaccination. As communicated by McLendon et al., 2021 college students may associate with like-minded individuals, and this may impact their healthcare decisions. A better understanding of social influence in this population may assist us in identifying interventions to promote HPV catch-up vaccinations for the college-aged student population.

Knowledge: HPV and HPV Vaccine

Four of 16 knowledge survey questions were found to contribute to the prediction of HPV vaccination status in this study, with only one question specific to HPV infection being predictive. The other three predictive questions were about the HPV vaccine.

Correctly identifying that HPV affects both men and women was associated with never having received an HPV vaccination. Knowledge of HPV and HPV vaccines has shown contradictory results in association to HPV vaccination status with many of the outcomes indicating that HPV and HPV vaccine knowledge do not always predict HPV vaccination intention or receipt, and this aligns with the current study findings (Catalano et al., 2016; Koplas et al., 2019; LaJoie et al., 2018; McCutcheon &Schaar, 2017).

Having knowledge of the HPV vaccine prior to participating in this research, believing that the HPV vaccine is safe, and understanding that the HPV vaccine is needed even when there is only one sexual partner were all highly predictive of college students in this study having initiated the HPV vaccination in college. Higher HPV and HPV vaccine knowledge scores have been associated with individuals who have received an HPV vaccination or who intend to receive an HPV vaccination (Kim et al., 2019; Preston & Darrow, 2019; Tung et al., 2019). Since the study design does not support causation, it is unknown which came first the HPV/HPV vaccine knowledge or HPV vaccination initiation. Interventional study designs educating students prior to vaccination are needed to determine the influence of knowledge on HPV vaccination status.

Need Factors

Need factors are defined by the BMHSU as variables that impact self-perceived or professionally evaluated need for health services. Variables included in this study as need factors included evaluated health and health risk, perceived health and health risk, history of preventive health services use, the number of lifetime sexual partners, and sexual activity. Of these variables, evaluated health (student health center visit [$p = .004$]),

perceived health risk (low risk perception [$p = .027$], preventive use of health services (Hepatitis B vaccination [$p = .001$]; annual flu vaccination [$p < .008$], the number of lifetime sexual partners (> 4 [$p = .034$] and sexual activity (past 12 months [$p = .049$]) were predictive of HPV vaccination status. The only non-predictor of HPV vaccination status was perceived health.

Similar to the outcomes in my study, Wilkinson et al. (2018) found no difference in perceived general health in vaccinated and unvaccinated women students in college. Conversely, another study, also in women college students, found that perceived general health was associated with intention to receive the HPV vaccination. A probable explanation of the differences are barriers, such as time, money, and confidence, to make and attend a health care appointment, and the barriers may prevent students from moving away from intention to use health services and toward engaging the use of health services. Barriers that prevent students from actualization of HPV vaccination need to be defined in this 18–26 years of age college population.

Perceived Health Risk

The perception of risk to health has been reported in the literature to be associated with intention to receive an HPV vaccination and with HPV vaccination uptake in college students. These risk perceptions include worry about contracting HPV, the severity of HPV, perceived susceptibility to and severity of cervical cancer and getting genital warts (D'Errico et al., 2020; Grace-Leitch & Shneyderman, 2016; Klasko-Foster et al., 2020). Low perceived risk of HPV infection has been identified as barrier to receiving the HPV vaccination (D'Errico et al., 2020). I found comparable outcomes, with low perceived

risk of HPV infection, worry about getting genital warts and/or HPV cancers predictive of a decreased likelihood of receiving an HPV vaccination while in college or alternately never having received an HPV vaccination. Perceived health risks have similar associations with both intent to be vaccinated and actualization of vaccination by college students.

Evaluated Health

Health status, as evaluated by an HCP, has been associated with HPV vaccination intentions and positive HPV vaccination status. Specifically, college students diagnosed with urinary tract infections (UTIs), sexually transmitted infections (STIs), and who have been to the student health clinic are more likely to have received or intended to receive an HPV vaccination (Esagoff et al., 2021; Pask & Rawlins, 2016; Thompson et al., 2016). Related to the diagnosis of UTIs and STIs, my data differs and was not found to predict HPV vaccination status. A small study of college aged women support my findings as these students who had received a diagnosis of STI were not more or less likely to have been vaccinated (Wilkinson et al., 2018). Interestingly, I did find that a prior visit to the health student center, reasons for visits not reported, did positively predict HPV vaccination while in college. It is unknown whether HPV vaccinations were recommended to students during their visits, but this could account for the predictive nature of the visit to the school health center. Further investigation into school health center visits by college students and possible HCP recommendations while at the clinic should be explored.

Preventive Health Services Use

While there are occasional reports of a lack of association between use of health services and HPV vaccination status in college students, consistent with my results there are mostly strong positive associations of historic receipt of vaccinations, including flu and Hepatitis B vaccinations and HPV vaccination status (McLendon et al., 2021; Ragan et al., 208; Winger et al., 2016). More similar to my study population, these studies consistently measured self-reported vaccination uptake, as compared to intention.

Sexual Activity and Number of Lifetime Sexual Partners

Sexual activity in the past 12 months and number of lifetime sexual partners was predictive of HPV vaccination status in my study. Both were predictive of having a greater chance of having had an HPV vaccination while in college. This finding is consistent with results from a qualitative focus group study that sexual activity influenced college students' decision to be vaccinated (Glenn et al., 2021). Similar findings have been reported for men in colleges (Esagoff et al., 2021). Outcomes on the number of lifetime sexual partners and HPV vaccination status had been collected by others; but not assessed in correlational analysis. The predictive nature of the number of lifetime sexual partners and HPV vaccination status is novel and needs further validation.

Key Findings Summary

While two of the predisposing factor variables were found to significantly predict HPV vaccination status, a number of the outcomes found in this study differed from the current literature. As noted, while the participants were 18–26 years of age, the percentage of students 22 years of age and older were greater in this study as compared to

most of the current literature reviewed. Additionally, most studies measured intent to have an HPV vaccination or HPV vaccination status in college, but not the initiation of HPV vaccination after enrollment in college. Intention to vaccinate and actual vaccination may differ. Initiating an HPV vaccination requires engagement and utilization of the health system.

A number of the enabling factor variables were found to significantly contribute to the prediction of HPV vaccination status in my study. However, conflicting outcomes have been reported for some of the enabling variables evaluated. Already noted are the differences in the age of the populations in the current literature and this study, and the outcomes of interest, intent to vaccinate as compared to actual initiation of vaccination. For the enabling factors, further differences in the populations studied in the current literature and my study were introduced, e.g., percent of students working for pay, transparency in income, and life demands.

Many of the need factor variables significantly predict HPV vaccination status in my study. Most of the findings are not surprising, though the population of my study and past studies differ in that my study, uniquely compares a population of students who received their first HPV vaccination while in college to those who never received an HPV vaccination. Most past studies report intention to be vaccinated and/or HPV vaccination status of college students without knowing if they received their vaccinations prior to or during college, making the populations different. Of interest is that this is the first report that predicts the relationship between the number of lifetime sexual partners and HPV vaccination status. Given the inherently different populations, and some conflicting

literature, the prediction models need to be validated before interventions are created and assessed.

Limitations of the Study

Limitations of this study were related to design and methodology. To the best of my knowledge, based on an extensive review of the published literature, this study was the first to determine predictive characteristics of students who received their initial HPV vaccination once in college compared to students who never received an HPV vaccination. Due to the fact that this study was the first of its kind, comparison of the results to previously published studies is difficult and problematic secondary to the differences in study populations. A web-based survey was developed specifically for this study, there was a small number of testers for retest reliability and both practice and instrument bias may have been introduced (Schober et al., 2018). While three experts assessed the instrument's content validity, the content may not have been completely representative of the BMHSU constructs being measured as the assessments are subjective (Zamanzadeh et al., 2015). This study employed a cross-sectional design where the exposure and outcome variables were assessed at the same time, preventing the collection of evidence that the independent variables caused the students to get an HPV vaccination in college. A random stratified sampling framework was employed to be representative of the U.S. college student population and the study can only be generalized to U.S. college students age 18–26 years of age who have internet access. The participants were volunteers of established internet panels and volunteers may differ from non-volunteers introducing sampling errors (Laerd Statistics, 2012). Additionally,

while the majority of 18–26 year-olds use the internet, there are disparities among broadband access at home by race with the white race having greater access than the Black race, and people with hispanic ethnicity having less access to broadband services than Black people, which could limit generalizability (Pew Research Center, 202).

Answers to survey questions were self-reported which may have introduced measurement error as the observed responses may not reflect accurate responses; participants may not have been honest in their answers, or they may have embellished their answers given the sensitive nature of questions about sexual activity (Suen & Cerin, 2014). Responses to questions about income, sexual activity, and HPV vaccination status may have been influenced by social desirability bias (King, 2022). Participants may have misunderstood survey questions; however, this was managed by conducting a pilot study to reduce potential errors and biases associated with misunderstanding of questions (Szklo & Nieto, 2019). Data collected from the surveys were reviewed for inconsistencies and cases with inconsistent or missing data were removed from the dataset prior to analysis.

Recommendations

This study was the first to determine predictive characteristics of students who received their initial HPV vaccination once in college compared to students who never received an HPV vaccination. Therefore, the study results need to be validated in the context of Andersen's BMHSU. The BMHSU explains the factors that affect the use or access of health services and accessing health services is required for HPV vaccine

actualization. Additionally, a number of variables within the predisposing, enabling, and need factors need to be further investigated and defined.

Religiosity, a predisposing factor was found in this study to predict HPV vaccination status; however, data on the association between religiosity and HPV vaccination are both limited and the results conflict with each other (Shah et al., 2021). Family religiosity, not included in my study, should be explored as it has been negatively associated with HPV vaccination and/or intent to vaccinate (Quinn & Lewin, 2020).

Interactions between year of college, age, employment status, and income needs exploration. Younger age has been shown to be predictive of vaccine acceptability and completion, and my data agree with this premise through the fourth year of college (Grace-Leitch & Shneyderman, 2016; Koshkin et al., 2021; LaJoie et al., 2018). A better understanding of how employment status and therefore, income may impact vaccination actualization as college students progress through school is needed. In my study participants with lower incomes were more likely to be vaccinated and most participants were employed and had health insurance. Employed students may have more barriers to vaccination than unemployed students due to employment and school and social commitments (Wilkinson et al., 2018). Knowledge of both HPV and HPV vaccination, other enabling factors, need to be investigated to determine the specific knowledge needed that influences HPV vaccination actualization. There are many reports that knowledge is associated with HPV vaccination uptake and intention; however, of the 16 questions posed in this study, only four significantly contributed to the prediction of HPV vaccination (Kim et al., 2019; Preston & Darrow, 2019; Tung et al., 2019).

Understanding the specific knowledge needed for vaccination actualization will assist with focused intervention development.

Further research into how visiting a student health center impacts HPV vaccination status is needed. Use of preventive health services has been associated with HPV vaccination uptake and intention as has a visit to the student health center (McLendon et al., 2021; Ragan et al., 208; Wilkinson et al., 2018; Winger et al., 2016). The reasons that students visited the student health center has not been captured, nor is it known if the visits resulted in recommendations for HPV vaccination by an HCP, which would be strongly predictive of HPV vaccination actualization. Additionally, there is only limited information about the impact of the COVID-19 pandemic on HPV vaccination status in U.S. college students. Data from a national cross-sectional study (*n* = 1683) suggests that there were HPV vaccination disruptions in 8.6% of individuals, 18-45 years of age, who intended to be HPV vaccinated during the pandemic (Turner, et al., 2022. Factors most highly associated with reported HPV vaccine disruptions were having a non-English language preference and being a cancer survivor, which may have limited healthcare access. These factors were not known and therefore, not considered in this research study and should be examined in future studies, particularly if using a secondary data set inclusive of HPV vaccination during the dates of the Covid-19 pandemic. In summary, validation of the results of this study, using the BMHSU and further delineation of several of the predisposing, enabling, and need factors variables need investigation.

Implications

It has been established that HPV vaccination has resulted in a reduced incidence of cervical cancer in the US population with the greatest decrease in 15-20-year-old women, the age group who were eligible for HPV vaccination (Mix et al., 2021). Data from my study are an initial step to understanding the characteristics of U.S. college students, 18–26 years of age, seeking access to health services and actually obtain a catch-up vaccination in college and those that never had an HPV vaccination. Pinpointing the predictors of HPV vaccination initiation by college students should help with the development of interventions to drive HPV vaccination. These interventions are critical to providing a foundation for social change upon which to promote HPV vaccination to increase vaccination rates in the population of U.S. college students age 18–26 years.

Current literature focuses on the intention of college students to be vaccinated (initiation and/or completion), or current HPV vaccination status, and it does not distinguish at what age HPV vaccinations were received. Methodologically, we need to move away from secondary data analysis study designs and toward prospective study designs that include validated time sequences of HPV vaccinations so that we understand the characteristics of college students that lead to HPV vaccination actualization. While this study does not support practice recommendations, it does validate that a recommendation by an HCP, parent/guardian, and/or other (family, friend, teacher, etc.) is a statistically significant and very strong predictor of HPV vaccine actualization in U.S. college students 18–26 years of age.

Conclusion

Results of the study confirm that many of the predisposing, enabling, and need factor characteristics of U.S. college students differ among those students who initiated their first HPV vaccination in college as compared to students who never received an HPV vaccination. Characteristics of students who actually initiate an HPV vaccination in college appear to deviate from the characteristics of college students who intend to receive an HPV vaccination, based on current literature, though some variables overlap. It is critical to define the characteristics of college students that have moved from intention to be vaccinated and have actually engaged with the health care system to get a vaccination as HPV vaccination decreases HPV infection and cancers and the associated morbidity and mortality in our population.

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Appendix A: Predict HPV Vaccination Survey

Study Screening Questions to Determine Eligibility

Pre-Screening Eligibility Questions

1. Are you in college?
    - Yes
    - No (direct to “do not qualify” notification)
2. Are you living in the US?
    - Yes
    - No (direct to “do not qualify” notification)
3. Are you 18 to 26 years of age?
    - Yes
    - No (direct to “do not qualify” notification)
4. Have you received an HPV vaccination?
    - Yes
    - No (direct to informed consent)
    - Do not know (direct to “do not qualify” notification)
5. Did you receive your first HPV vaccination while in college?
    - Yes (direct to informed consent)
    - No (direct to “do not qualify” notification)
    - Do not know (direct to “do not qualify” notification)

Predict HPV Vaccination Study Survey Questions

1. How old are you?

- 17 years or younger
- 18 years
- 19 years
- 20 years
- 21 years
- 22 years
- 23 years
- 24 years
- 25 years
- 26 years
- 27 years or older

2. Have you ever received an HPV vaccination?

- Yes (direct to next question)
- No

3. Was your first HPV vaccination received while you were in college?

- Yes (direct to next question)
- No

4. How many HPV vaccine shots have you received since you have been enrolled in college?

- One

- Two
- Three
- Do not know

5. What is your gender?

- Male
- Female
- Transgender
- Other

6. What race best describes you?

- White/Caucasian
- Black/African American
- Asian
- Other

7. What is your ethnicity?

- Hispanic
- Non-Hispanic

8. To what extent does your religious and/or spiritual beliefs influence your health care decision making?

- Very Much
- Moderately
- Not at All

9. What is your current relationship status?

- Married or cohabitating or in a committed relationship
- Single or not cohabitating or not in a committed relationship

10. Were you born in another country?
    - Yes (direct to Question 11)
    - No (direct to Question 12)
11. If yes; How long have you been in the US? (Then go directly to Question 12)
    - 0 years
    - 1 year
    - 2 years
    - 3 years
    - 4 years
    - 5 years
    - 6 years
    - 7 years
    - 8 years
    - 9 years
    - 10 years
    - 11 or more years
12. What is your sexual orientation?
    - Heterosexual
    - Homosexual (Gay/Lesbian)
    - Bisexual / pansexual

- Other

13. How often do you talk to your mother and/or father about sexual matters?
    - Frequently
    - Infrequently
    - Never
14. Is HPV a sexually transmitted infection?
    - Yes
    - No
    - I do not know
15. Can a person get HPV from skin-to-skin contact with a person infected with HPV?
    - Yes
    - No
    - I do not know
16. Can HPV cause cancer?
    - Yes
    - No
    - I do not know
17. Does HPV affect both women and men?
    - Yes
    - No
    - I do not know
18. Does HPV cause cancer only in women?

- Yes
- No
- I do not know

19. Can condoms ensure you will not get HPV?
    - Yes
    - No
    - I do not know
20. Is there a cure for HPV?
    - Yes
    - No
    - I do not know
21. Can HPV infection be prevented?
    - Yes
    - No
    - I do not know
22. Before starting this survey, did you know that there is a vaccine for HPV?
    - Yes
    - No
23. If you were aware that there is a vaccine for HPV, did you know it can be given until age 45?
    - Yes
    - No

- I do not know

24. Is the HPV vaccination is only needed if you have multiple sexual partners?

- Yes
- No
- I do not know

25. Does the HPV vaccine have significant side effects

- Yes
- No
- I do not know

26. Is the HPV vaccine safe?

- Yes
- No
- I do not know

27. Can you get HPV from receiving the HPV vaccination?

- Yes
- No
- I do not know

28.Is the HPV vaccine effective at preventing HPV infection?

- Yes
- No
- I do not know

29. If someone is vaccinated for HPV are safe sex practices, (i.e., condoms,

contraception) still needed?

- Yes
- No
- I do not know

30. What is the highest level of education of your parent/guardian?
    - High school or less
    - Associate degree / some college
    - 4-year college degree
    - Graduate school
    - Do not know / refuse to answer
31. What year of college are you in?
    - First
    - Second
    - Third
    - Fourth
    - Fifth or greater
32. What is your highest level of college education?
    - I have completed some college courses.
    - I have completed a 2-year degree.
    - I have completed a 4-year degree.
    - I have completed a graduate degree.
33. What is the income level of your family?

- Under $ 40, 000
- $ 40K - $ 59,999
- $ 60K - $79,999
- $80K - $99,999
- $100K and greater
- Prefer not to answer

34. What is your income level?
    - Under $ 40K
    - $ 40K - $ 59,999
    - $ 60K - $79,999
    - $80K - $99,999
    - $100K and greater
    - Prefer not to answer
    - I do not have an income
35. What is your current employment status?
    - Not employed
    - Employed part-time
    - Employed full-time
36. Do you have health insurance?
    - Yes
    - No
    - Not Sure

37. Has a doctor or health care provider recommended that you get an HPV vaccination?

- Yes
- No
- Not Sure

38. Has one or both of your parents/guardians recommended that you get an HPV vaccination?

- Yes
- No
- Not Sure

39. Has anyone other than a health care practitioners or parent/guardian recommended that you get an HPV vaccination (friend, counselor, community leader, teacher, etc.)?

- Yes
- No
- Not Sure

40. Do you have a regular healthcare provider?

- Yes
- No

41. Do you have confidence that you can schedule an appointment with a healthcare provider?

- Completely confident
- Moderately confident

- Not confident

42. Most people that are important to me think that I should get the HPV vaccination series.
    - Completely agree
    - Somewhat agree
    - Completely disagree
43. How do you describe your current health status?
    - Very good/good
    - Fair/Moderate
    - Not Very good/poor
44. I believe that my risk of getting HPV infection is:
    - Very high / high
    - Moderate
    - Low/Very low
45. My worry about getting genital warts and/or HPV cancers is:
    - Very high / High
    - Moderate
    - Low/ Very low
46. Have you been to the student health clinic on campus?
    - No
    - Yes
    - Do not know

- No health clinic on campus

47 Have you had a diagnosis and treatment of a urinary tract infection since being in college?

- Yes
- No
- Do not know

48. Have you ever been diagnosed with a sexually transmitted infection?

- Yes
- No
- Do not know

49. Have you ever been sexually active (vaginal, oral, anal sex)?

- Yes
- No

50. In the past 12 months have you had vaginal, anal, or oral sex?

- Yes
- No

51. How many sexual partners have you had in your lifetime?

- 0
- 1-3
- ≥4

52. Have you received a Hepatitis B vaccination?

- Yes

- No
- Do not know

53. Do you receive an annual flu shot?

- Yes
- No
- Sometimes

Appendix B: Do Not Qualify Notification

Thank you for your interest in the US Health and College Study. Based on the screening questions, you are not eligible to participate.

Appendix C: Variable Coding

REGION

		Value	Count	Percent
Standard Attributes	Position	2		
	Label	Region		
	Type	Numeric		
	Format	F5		
	Measurement	Nominal		
	Role	Input		
Valid Values	1	Northeast	76	18.9%
	2	Midwest	79	19.6%
	3	South	168	41.7%
	4	West	80	19.9%

HPV_VACC

		Value	Count	Percent
Standard Attributes	Position	5		
	Label	Have you ever received an HPV vaccination?		
	Type	Numeric		
	Format	F5		
	Measurement	Nominal		
	Role	Input		
Valid Values	0	No	165	40.9%
	1	Yes	238	59.1%

HPV_VACC_COLLEGE

		Value	Count	Percent
Standard Attributes	Position	6		
	Label	Was your first HPV vaccination received while you were in college?		
	Type	Numeric		
	Format	F5		

	Measurement	Nominal		
	Role	Input		
Valid Values	0	No	0	0.0%
	1	Yes	238	59.1%
Missing Values	System		165	40.9%

HPV_VACC_NUM

		Value	Count	Percent
Standard Attributes	Position	7		
	Label	How many HPV vaccine shots have you received since you have been enrolled in college?		
	Type	Numeric		
	Format	F5		
	Measurement	Nominal		
	Role	Input		
Valid Values	1	One	108	26.8%
	2	Two	106	26.3%
	3	Three	23	5.7%
	88	Do not know	1	0.2%
Missing Values	System		165	40.9%

ETHNICITY

		Value	Count	Percent
Standard Attributes	Position	8		
	Label	What is your ethnicity?		
	Type	Numeric		
	Format	F5		
	Measurement	Nominal		
	Role	Input		
Valid Values	1	Hispanic	120	29.8%
	2	Non-Hispanic	283	70.2%

RELIGION_INFLUENCE

		Value	Count	Percent
Standard Attributes	Position	9		
	Label	To what extent does your religious and/or spiritual beliefs influence your health care decision making?		
	Type	Numeric		
	Format	F5		
	Measurement	Nominal		
	Role	Input		
Valid Values	1	Very Much	128	31.8%
	2	Moderately	166	41.2%
	3	Not at All	109	27.0%

RELATIONSHIP

		Value	Count	Percent
Standard Attributes	Position	10		
	Label	What is your current relationship status?		
	Type	Numeric		
	Format	F5		
	Measurement	Nominal		
	Role	Input		
Valid Values	1	Married or cohabitating or in a committed relationship	135	33.5%
	2	Single, divorced, separated, widowed or not cohabitating or not in a committed relationship	268	66.5%

BORN_NOT_US

		Value	Count	Percent
Standard Attributes	Position	11		
	Label	Were you born in another country?		

	Type	Numeric		
	Format	F5		
	Measurement	Nominal		
	Role	Input		
Valid Values	0	No	331	82.1%
	1	Yes	72	17.9%

ORIENTATION

		Value	Count	Percent
Standard Attributes	Position	12		
	Label	What is your sexual orientation?		
	Type	Numeric		
	Format	F5		
	Measurement	Nominal		
	Role	Input		
Valid Values	1	Heterosexual	288	71.5%
	2	Homosexual (Gay/Lesbian)	29	7.2%
	3	Bisexual/Pansexual	72	17.9%
	4	Other	14	3.5%

PARENTS_TALK

		Value	Count	Percent
Standard Attributes	Position	13		
	Label	How often do you talk to your mother and/or father about sexual matters?		
	Type	Numeric		
	Format	F5		
	Measurement	Nominal		
	Role	Input		
Valid Values	1	Frequently	122	30.3%
	2	Infrequently	143	35.5%
	3	Never	138	34.2%

EDUCATION_PARENT

		Value	Count	Percent

Standard Attributes	Position	14		
	Label	What is the highest level of education of your parent/guardian?		
	Type	Numeric		
	Format	F5		
	Measurement	Nominal		
	Role	Input		
Valid Values	1	High school or less	54	13.4%
	2	Associate degree/some college	174	43.2%
	3	4-year college degree	115	28.5%
	4	Graduate school	57	14.1%
	88	Do not know/refuse to answer	3	0.7%

COLLEGE_YEAR

		Value	Count	Percent
Standard Attributes	Position	15		
	Label	What year of college are you in?		
	Type	Numeric		
	Format	F5		
	Measurement	Nominal		
	Role	Input		
Valid Values	1	First	50	12.4%
	2	Second	122	30.3%
	3	Third	109	27.0%
	4	Fourth	85	21.1%
	5	Fifth or greater	37	9.2%

COLLEGE_LEVEL

		Value	Count	Percent
Standard Attributes	Position	16		
	Label	What is your highest level of college education?		
	Type	Numeric		
	Format	F5		

	Measurement Role	Nominal Input		
Valid Values	1	I have not completed any college courses	21	5.2%
	2	I have completed some college courses	157	39.0%
	3	I have completed a 2-year degree	134	33.3%
	4	I have completed a 4-year degree	77	19.1%
	5	I have completed a graduate degree	14	3.5%

FAMILY_INCOME

		Value	Count	Percent
Standard Attributes	Position	17		
	Label	What is the income level of your family?		
	Type	Numeric		
	Format	F5		
	Measurement Role	Nominal Input		
Valid Values	1	Under $40,000	100	24.8%
	2	$40K - $59,999	112	27.8%
	3	$60K - $79,999	92	22.8%
	4	$80K - $99,999	36	8.9%
	5	$100K and greater	49	12.2%
	88	Prefer not to answer	14	3.5%

YOUR_INCOME

		Value	Count	Percent
Standard Attributes	Position	18		
	Label	What is your income level?		
	Type	Numeric		

	Format	F5		
	Measurement	Nominal		
	Role	Input		
Valid Values	0	I do not have an income	57	14.1%
	1	Under $40K	162	40.2%
	2	$40K - $59,999	88	21.8%
	3	$60K - $79,999	46	11.4%
	4	$80K - $99,999	16	4.0%
	5	$100K and greater	21	5.2%
	88	Prefer not to answer	13	3.2%

EMPLOYMENT

		Value	Count	Percent
Standard Attributes	Position	19		
	Label	What is your current employment status?		
	Type	Numeric		
	Format	F5		
	Measurement	Nominal		
	Role	Input		
Valid Values	1	Not employed	64	15.9%
	2	Employed part-time	203	50.4%
	3	Employed full-time	136	33.7%

HEALTH_INSURANCE

		Value	Count	Percent
Standard Attributes	Position	20		
	Label	Do you have health insurance?		
	Type	Numeric		
	Format	F5		
	Measurement	Nominal		
	Role	Input		
Valid Values	0	No	57	14.1%
	1	Yes	334	82.9%

	2	Not Sure	12	3.0%

HPV_VACC_DR_RECOMMEND

		Value	Count	Percent
Standard Attributes	Position	21		
	Label	Has a doctor or health care provider recommended that you get an HPV vaccination?		
	Type	Numeric		
	Format	F5		
	Measurement	Nominal		
	Role	Input		
Valid Values	0	No	154	38.2%
	1	Yes	207	51.4%
	2	Not Sure	42	10.4%

HPV_VACC_PARENT_RECOMMEND

		Value	Count	Percent
Standard Attributes	Position	22		
	Label	Has one or both of your parents/guardians recommended that you get an HPV vaccination?		
	Type	Numeric		
	Format	F5		
	Measurement	Nominal		
	Role	Input		
Valid Values	0	No	181	44.9%
	1	Yes	176	43.7%
	2	Not Sure	46	11.4%

HPV_VACC_OTHER_RECOMMEND

		Value	Count	Percent
Standard Attributes	Position	23		
	Label	Has anyone other than a health care practitioner or parent/guardian recommended that you get an HPV vaccination (friend, counselor, community leader, teacher, etc.)?		
	Type	Numeric		
	Format	F5		
	Measurement	Nominal		
	Role	Input		
Valid Values	0	No	185	45.9%
	1	Yes	173	42.9%
	2	Not Sure	45	11.2%

REGULAR_HCP

		Value	Count	Percent
Standard Attributes	Position	24		
	Label	Do you have a regular healthcare provider?		
	Type	Numeric		
	Format	F5		
	Measurement	Nominal		
	Role	Input		
Valid Values	0	No	79	19.6%
	1	Yes	324	80.4%

CONFIDENCE_HCP

		Value	Count	Percent
Standard Attributes	Position	25		

	Label	Do you have confidence that you can schedule an appointment with a healthcare provider?		
	Type	Numeric		
	Format	F5		
	Measurement	Nominal		
	Role	Input		
Valid Values	1	Completely confident	249	61.8%
	2	Moderately confident	143	35.5%
	3	Not confident	11	2.7%

HPV_VACC_IMPORTANT

		Value	Count	Percent
Standard Attributes	Position	26		
	Label	Most people that are important to me think that I should get the HPV vaccination series.		
	Type	Numeric		
	Format	F5		
	Measurement	Nominal		
	Role	Input		
Valid Values	1	Completely agree	167	41.4%
	2	Somewhat agree	162	40.2%
	3	Completely disagree	74	18.4%

CURRENT_HEALTH

		Value	Count	Percent
Standard Attributes	Position	27		
	Label	How do you describe your current health status?		
	Type	Numeric		
	Format	F5		
	Measurement	Nominal		
	Role	Input		

Valid Values	1	Very good/good	210	52.1%
	2	Fair/moderate	178	44.2%
	3	Not very good/poor	15	3.7%

HPV_RISK

		Value	Count	Percent
Standard Attributes	Position	28		
	Label	I believe that my risk of getting HPV infection is:		
	Type	Numeric		
	Format	F5		
	Measurement	Nominal		
	Role	Input		
Valid Values	1	Very high/high	89	22.1%
	2	Moderate	147	36.5%
	3	Low/very low	167	41.4%

HPV_WORRY

		Value	Count	Percent
Standard Attributes	Position	29		
	Label	My worry about getting genital warts and/or HPV cancers is:		
	Type	Numeric		
	Format	F5		
	Measurement	Nominal		
	Role	Input		
Valid Values	1	Very high/high	115	28.5%
	2	Moderate	134	33.3%
	3	Low/very low	154	38.2%

HEALTH_CLINIC

		Value	Count	Percent
Standard Attributes	Position	30		

	Label	Have you been to the student health clinic on campus?		
	Type	Numeric		
	Format	F5		
	Measurement	Nominal		
	Role	Input		
Valid Values	0	No	175	43.4%
	1	Yes	162	40.2%
	2	Do not know	20	5.0%
	3	No health clinic on campus	46	11.4%

CAMPUS_UTI

		Value	Count	Percent
Standard Attributes	Position	31		
	Label	Have you had a diagnosis and treatment of a urinary tract infection since being in college?		
	Type	Numeric		
	Format	F5		
	Measurement	Nominal		
	Role	Input		
Valid Values	0	No	253	62.8%
	1	Yes	114	28.3%
	2	Do not know	36	8.9%

DIAG_STI

		Value	Count	Percent
Standard Attributes	Position	32		
	Label	Have you ever been diagnosed with a sexually transmitted infection?		
	Type	Numeric		
	Format	F5		
	Measurement	Nominal		
	Role	Input		
Valid Values	0	No	289	71.7%

	1	Yes	84	20.8%
	2	Do not know	30	7.4%

SEXUALLY_ACTIVE

		Value	Count	Percent
Standard Attributes	Position	33		
	Label	Have you ever been sexually active (vaginal, oral, or anal sex)?		
	Type	Numeric		
	Format	F5		
	Measurement	Nominal		
	Role	Input		
Valid Values	0	No	139	34.5%
	1	Yes	264	65.5%

SEXUALLY_ACTIVE_12MO

		Value	Count	Percent
Standard Attributes	Position	34		
	Label	In the past 12 months have you had vaginal, anal, or oral sex?		
	Type	Numeric		
	Format	F5		
	Measurement	Nominal		
	Role	Input		
Valid Values	0	No	161	40.0%
	1	Yes	242	60.0%

SEXUAL_PARTNERS

		Value	Count	Percent
Standard Attributes	Position	35		
	Label	How many sexual partners have you had in your lifetime?		
	Type	Numeric		
	Format	F5		

	Measurement Role	Nominal Input		
Valid Values	1	0	114	28.3%
	2	1-3	233	57.8%
	3	≥4	56	13.9%

HEP_B_VACC

		Value	Count	Percent
Standard Attributes	Position	36		
	Label	Have you received a hepatitis B vaccination?		
	Type	Numeric		
	Format	F5		
	Measurement	Nominal		
	Role	Input		
Valid Values	0	No	199	49.4%
	1	Yes	157	39.0%
	2	Do not know	47	11.7%

FLU_SHOT

		Value	Count	Percent
Standard Attributes	Position	37		
	Label	Do you receive an annual flu shot?		
	Type	Numeric		
	Format	F5		
	Measurement	Nominal		
	Role	Input		
Valid Values	0	No	167	41.4%
	1	Yes	205	50.9%
	2	Sometimes	31	7.7%

HPV_STI

		Value	Count	Percent

Standard Attributes	Position	38		
	Label	Is HPV a sexually transmitted infection?		
	Type	Numeric		
	Format	F8		
	Measurement	Nominal		
	Role	Input		
Valid Values	0	Lack Knowledge	181	44.9%
	1	Knowledgeable	222	55.1%

HPV_SKIN_CONTACT

		Value	Count	Percent
Standard Attributes	Position	39		
	Label	Can a person get HPV from skin-to-skin contact with a person infected with HPV?		
	Type	Numeric		
	Format	F8		
	Measurement	Nominal		
	Role	Input		
Valid Values	0	Lack Knowledge	248	61.5%
	1	Knowledgeable	155	38.5%

HPV_CANCER

		Value	Count	Percent
Standard Attributes	Position	40		
	Label	Can HPV cause cancer?		
	Type	Numeric		
	Format	F8		
	Measurement	Nominal		
	Role	Input		
Valid Values	0	Lack Knowledge	259	64.3%
	1	Knowledgeable	144	35.7%

HPV_BOTH_GENDERS

		Value	Count	Percent
Standard Attributes	Position	41		
	Label	Does HPV affect both women and men?		
	Type	Numeric		
	Format	F8		
	Measurement	Nominal		
	Role	Input		
Valid Values	0	Lack Knowledge	98	24.3%
	1	Knowledgeable	305	75.7%

HPV_PREVENTED

		Value	Count	Percent
Standard Attributes	Position	42		
	Label	Can HPV infection be prevented?		
	Type	Numeric		
	Format	F8		
	Measurement	Nominal		
	Role	Input		
Valid Values	0	Lack Knowledge	118	29.3%
	1	Knowledgeable	285	70.7%

HPV_KNOW_VACC

		Value	Count	Percent
Standard Attributes	Position	43		
	Label	Before starting this survey, did you know that there is a vaccine for HPV?		
	Type	Numeric		
	Format	F8		
	Measurement	Nominal		

	Role	Input		
Valid Values	0	Lack Knowledge	119	29.5%
	1	Knowledgeable	284	70.5%

HPV_VACC_45

		Value	Count	Percent
Standard Attributes	Position	44		
	Label	If you were aware that there is a vaccine for HPV, did you know it can be given until ag 45?		
	Type	Numeric		
	Format	F8		
	Measurement	Nominal		
	Role	Input		
Valid Values	0	Lack Knowledge	256	63.5%
	1	Knowledgeable	147	36.5%

HPV_VACC_SAFE

		Value	Count	Percent
Standard Attributes	Position	45		
	Label	Is the HPV vaccine safe?		
	Type	Numeric		
	Format	F8		
	Measurement	Nominal		
	Role	Input		
Valid Values	0	Lack Knowledge	172	42.7%
	1	Knowledgeable	231	57.3%

HPV_VACC_PREVENT

		Value	Count	Percent
Standard Attributes	Position	46		
	Label	Is the HPV vaccine effective at preventing HPV infection?		
	Type	Numeric		

	Format	F8		
	Measurement	Nominal		
	Role	Input		
Valid Values	0	Lack Knowledge	179	44.4%
	1	Knowledgeable	224	55.6%

HPV_VACC_SAFE_NEED

		Value	Count	Percent
Standard Attributes	Position	47		
	Label	If someone is vaccinated for HPV are safe sex practices (i.e., condoms, contraceptives) still needed?		
	Type	Numeric		
	Format	F8		
	Measurement	Nominal		
	Role	Input		
Valid Values	0	Lack Knowledge	118	29.3%
	1	Knowledgeable	285	70.7%

HPV_CANCER_WOMEN

		Value	Count	Percent
Standard Attributes	Position	48		
	Label	Does HPV cause cancer only in women?		
	Type	Numeric		
	Format	F8		
	Measurement	Nominal		
	Role	Input		
Valid Values	0	Lack Knowledge	228	56.6%
	1	Knowledgeable	175	43.4%

HPV_CONDOMS

		Value	Count	Percent
Standard Attributes	Position	49		
	Label	Is the HPV vaccination only needed if you have multiple sexual partners?		
	Type	Numeric		
	Format	F8		
	Measurement	Nominal		
	Role	Input		
Valid Values	0	Lack Knowledge	227	56.3%
	1	Knowledgeable	176	43.7%

HPV_CURE

		Value	Count	Percent
Standard Attributes	Position	50		
	Label	Is there a cure for HPV?		
	Type	Numeric		
	Format	F8		
	Measurement	Nominal		
	Role	Input		
Valid Values	0	Lack Knowledge	245	60.8%
	1	Knowledgeable	158	39.2%

HPV_MULTIPLE_PARTNERS

		Value	Count	Percent
Standard Attributes	Position	51		
	Label	Is the HPV vaccination only needed if you have multiple sexual partners?		
	Type	Numeric		
	Format	F8		
	Measurement	Nominal		
	Role	Input		
Valid Values	0	Lack Knowledge	219	54.3%
	1	Knowledgeable	184	45.7%

HPV_VACC_SIDE_EFFECTS

		Value	Count	Percent
Standard Attributes	Position	52		
	Label	Does the HPV vaccination have significant side effects?		
	Type	Numeric		
	Format	F8		
	Measurement	Nominal		
	Role	Input		
Valid Values	0	Lack Knowledge	327	81.1%
	1	Knowledgeable	76	18.9%

HPV_VACC_GET

		Value	Count	Percent
Standard Attributes	Position	53		
	Label	Can you get HPV from receiving the HPV vaccination?		
	Type	Numeric		
	Format	F8		
	Measurement	Nominal		
	Role	Input		
Valid Values	0	Lack Knowledge	232	57.6%
	1	Knowledgeable	171	42.4%

Re_GENDER

		Value	Count	Percent
Standard Attributes	Position	54		
	Label	Re What is your gender?		
	Type	Numeric		
	Format	F8		
	Measurement	Nominal		
	Role	Input		
Valid Values	1	Male	141	35.0%
	2	Female	251	62.3%

	3	Transgender/Other	11	2.7%

Re_RACE

		Value	Count	Percent
Standard Attributes	Position	55		
	Label	Re What race best describes you?		
	Type	Numeric		
	Format	F8		
	Measurement	Nominal		
	Role	Input		
Valid Values	1	White/Caucasian	215	53.3%
	2	Black or African American	109	27.0%
	3	Indigenous Americans	13	3.2%
	4	Asian	27	6.7%
	5	Some other race	39	9.7%

Re_YEARS_IN_US

		Value	Count	Percent
Standard Attributes	Position	56		
	Label	If yes, how long have you been in the US?		
	Type	Numeric		
	Format	F8		
	Measurement	Nominal		
	Role	Input		
Valid Values	0	0 to 5 years	36	8.9%
	1	6 to >11 years	36	8.9%
Missing Values	88	Missing	331	82.1%